European Commission

JRC TECHNICAL REPORTS

Status of local soil contamination in Europe

Infographic showing the most frequent words in national/regional laws and strategies addressing soil contamination and non-related to EU policies.

Revision of the indicator 'Progress in the management contaminated sites in Europe'

A report by the JRC in collaboration with the European Information and Observation Network (Eionet) national reference centres for soil

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2018

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JRC107508

EUR 29124 EN

PDF	ISBN 978-92-79-80072-6	ISSN 1831-9424	doi:10.2760/093804
Print	ISBN 978-92-79-80073-3	ISSN 1018-5593	doi:10.2760/503827

Luxembourg: Publications Office of the European Union, 2018

How to cite this report: Ana Payá Pérez and Natalia Rodríguez Eugenio, *Status of local soil contamination in Europe: Revision of the indicator "Progress in the management Contaminated Sites in Europe*, EUR 29124EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-80072-6, doi:10.2760/093804, JRC107508

Content

Glossary

The key purpose of this report is to provide factual data on the management of contaminated sites in Europe, necessary to implement the 7th Environment Action Programme (EAP), based on replies to the questionnaire by countries in a voluntary basis. It also aims to increase awareness on soil contamination and identify knowledge gaps to enable effective decision and policymaking within the European Union, nationally and locally.

This glossary of terms is intended to help readers understand and use this report and to try to minimise the misinterpretation and inappropriate use of key findings. The terminology section explains some of the important elements of the report and highlights some of the most significant differences in terminology founded between countries.

Surveyed: the 39 ([1]) the questionnaire was sent to.

Respondents: the 31 that sent back the questionnaire providing information about the management of contaminated sites.

Europe: refers here to the 39 surveyed countries.

Artificial surface: the surface holding industrial, commercial and transport activities, urban areas and mine, dump and construction sites, where contamination is more likely to occur, under the coordination of information on the environment (Corine) land cover project ([2])

Site: a particular area of land related to a specific ownership or activity (Van-Camp et al., 2004).

Site status: refers to the management step in which a potentially contaminated site (PCS) is. Management steps range from the identification and preliminary investigation to the in-depth investigation and remediation if needed. The site-status categories are detailed in Table 1.

Site where polluting activities took/are taking place: a PCS, where an activity is (or was) carried out that may have caused soil contamination.

Risk-reduction measures (RRM): risk-based actions that ensure contaminated sites no longer pose an unacceptable risk (below the thresholds established in each case and for each land use), meaning that the RRM must remediate or take action for risk reduction (not necessarily including the reduction of concentration or the removal of every toxic molecule).

Historical contamination: refers to those sites where contamination has occurred before the entrance into force of the national and EU legislation (industrial emissions directive (IED), water framework directive (WFD)) regulations. It is, hence, different for each country.

New contamination: refers to contamination that has occurred as a result of accidents since the entrance into force of national and EU legislation (IED, WFD) or caused by activities not covered by such legislation.

Orphan sites: are those sites that have been contaminated (historical or new) and where the polluter-pays principle (PPP) cannot be applied. Either the polluter has gone or is not financially able to support the intervention cost, e.g. due to bankruptcy.

Risk assessment: is a process of collecting, organising and analysing environmental data to estimate the risk or probability of undesired effects on organisms, populations or

([1]) 33 EEA member countries (28 European Union Member States together with Iceland, Liechtenstein, Norway, Switzerland and Turkey) and the six EEA cooperating countries in the western Balkans: Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Montenegro, Serbia and Kosovo (Kosovo: This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence).

([2]) https://www.eea.europa.eu/publications/COR0-landcover

ecosystems caused by various stressors associated with human activities. It is used to set action-based priorities in an objective and scientific manner.

Screening value: the level of exposure below which there is no significant risk of adverse effects to the environment or human health. It varies among countries, soil types, land use and other factors.

Key messages

Soil contamination refers to reduced soil quality due to the presence of harmful substances resulting from human activity. This may harm human health or the environment, or otherwise violate private or public interests. It is often difficult to observe because its effects are frequently limited or mitigated by the natural functions of soils, in particular: storing, degrading or immobilising pollutants.

Of the 31 respondents to the questionnaire, the information provided is not complete for every country, the percentage of responses varies from 77 % for registered sites where polluting activities took/are taking place (site status 1) to 49 % for sites that may need remediation (status 4).

Data on the extent of local soil contamination in Europe in 2016 is available for 29 of the 39 surveyed, of which 25 European Union Member States. In most countries this inventory process starts with the establishment of a register of sites where potentially polluting activities have taken or might have taken place.

An average of **3.6 sites** are registered in country inventories per km^2 of artificial surface in all 28 EU Member States (EU-28). In the EU-28, an estimate based on artificial surfaces reveals the possible existence of around **2.8 million sites** where polluting activities took/are taking place. The extrapolation of this to all those surveyed in Europe is not possible because the available data mainly comes from the EU-28, and would therefore lead to an underestimate by dividing this data by the total artificial area of the 39 countries.

Nowadays, there are more than **650 000 registered sites** where polluting activities took/are taking place in national and regional inventories of respondents. More than **76 000 new sites** have been registered since the last exercise *Progress in the management of contaminated sites in Europe, 2014*, according to the data provided by the 16 which provided responses for both exercises. However, in **Germany, Spain, France**, **Hungary,** the **Netherlands** and **Slovakia,** a reduction in the number of registered sites where polluting activities took/are taking place has been observed. This may be due to changes in the specifications of polluting activities and/or the existence of dynamic inventories in some countries, as it is the case in **France**, where once a site has been investigated and remediated (if needed), it is removed from the inventory.

A significant effort is being made to remediate these contaminated sites with more than **5 000 new sites under remediation** or RRM (site status 5) across respondents since 2011. **Of respondents, 44 % have made significant progress** since the last report. However, since 2011, a reduction in the number of sites under remediation has been reported by **Belgium (Flanders)**, **Estonia**, **Italy, Latvia, Norway** and **Slovakia**.

Nowadays, **more than 65 500 sites have been already remediated** or are under aftercare measures, what represent an increment of more than **8 500 new remediated sites in the last 5 years**. **Belgium (Wallonia)** and **Portugal** have provided data for the first time and report that 1 593 and 83 sites have been remediated, respectively. **Bulgaria**, **Czech Republic, Denmark, Estonia, Finland, Hungary, the Netherlands, Norway, Slovakia** and **Spain** have reported fewer sites remediated than in previous exercises. That reduction could be due to the fact that these sites have been removed from national inventories once pollutant levels are confirmed below established screening values or levels do not pose a risk for the environment and human health.

There are many differences between the management efforts of the respondents. Those that have been tackling the problem of soil contamination for 3 decades are now focusing their efforts on remediating those sites previously identified, where polluting activities took/are taking place, while countries that are addressing soil contamination more recently are investing in the identification of contaminated sites. A clear relationship has been observed between political support (understood as the existence of legislation directly addressing soil contamination and remediation) and the completion of the registers of contaminated sites.

Of the 39 surveyed, 28 maintain **comprehensive inventories for contaminated sites** at different levels. Among them, 68 % of the inventories are managed at national level, frequently by environmental agencies. **Poland** and **Portugal** are preparing their inventories, which will be managed by regional authorities in Poland and at national level in Portugal. Since the last analysis of the management of contaminated sites in Europe, **Cyprus** has developed its national register of contaminated sites. **Malta** is currently collecting information on contaminated sites but there is not yet a comprehensive inventory.

Combined approaches to encourage staged assessment processes, considering screening values but allowing the flexibility to use comprehensive assessment tools for **site-specific risk assessment** are nowadays the most extended practice to deal with soil contamination across Europe. Due to the existence of a wide variety of soil types, land uses, depths of groundwater tables and site and building characteristics, the use of screening values alone might not be appropriate to assess the problem in an efficient and economically viable manner.

The average of the overall expenditures for the management of contaminated sites varies in a significant way across Europe. The industrial past, the number of sites where polluting activities took/are taking place, the existence of a legal framework on soil contamination, the availability of technologies and techniques for remediation, and the existence of well-defined procedures to investigate and remediate contaminated sites are aspects that determine the total budget needed for a complete risk management. The PPP is applied in every country in a systematic way for new contamination. However, on average more than **42 % of the total expenses comes from public budgets** in respondents to the questionnaire. This is mostly linked to the fact that PPP is rarely applicable to historical contamination. In those countries that use European funds for remediation, the percentage of private investment drops to 30 % of the overall cost.

Of the respondents, 86 % have a **national programme to deal with orphan sites**. The responsibility for identification and remediation of those sites that have been contaminated but where it is not possible to identify the polluter varies within and among countries, as does the funding regime.

The present report highlights the **remaining uncertainties** and differences among countries, despite the efforts made by the ad hoc working group on contaminated sites and brownfields in order to achieve harmonisation in data collection and management procedures.

Acknowledgements

This report has been possible thanks to the commitment of the ad hoc working group on contaminated sites and brownfields, which is composed by members of national reference centres (NRCs) with the mandate of the Eionet NRC Soil.

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NRCs are nominated by EU Member States and cooperating countries within Eionet and funded by the Member State to work with the European Environment Agency (EEA) and relevant European topic centres (ETCs) in specific thematic areas related to the EEA work programme. The NRC Soil composes nationally funded experts, or groups of experts, in organisations which are regular collectors or suppliers of soil data at the national level and/or possess relevant knowledge of specific environmental issues, monitoring or modelling.

NRC Soil plays a role in the technical coordination of these topics and work with the EEA, and the ETC on urban, land and soil systems (ETC/ULS), the European Commission's Joint Research Centre (JRC) and the Directorate-General for the Environment.

Preface

This report presents the results of the questionnaire for the revision of the indicator LSI003 'progress in the management of contaminated sites in Europe', with the status until the end of year 2016.

At the European Environment Information and Observation Network national reference centres on soil (Eionet NRC Soil) meeting on 23 May 2014, the European Commission indicated that despite the relatively successful 2011 data collection on 'the progress in the management of contaminated sites' indicator where 29 out of the 39 surveyed reported information, the data-collection programme would be discontinued if stronger support from those surveyed was not forthcoming. Countries agreed that there is room for improving the format and content of the questionnaire in order to receive more reliable and comparable data across Europe. Participants reacted favourably to the JRC's proposal to establish an Eionet-based expert group to discuss the follow-up for the contaminated-sites indicator, including the revision of the method.

The ad hoc working group on contaminated sites and brownfields discussed the contents, form and methodology for a revised indicator on the progress in the management of contaminated sites, which aims to allow a comparison of data between countries. After two meetings in 2015 (10-11 March 2015 at JRC Ispra (Varese, Italy) and 15 October at EEA Copenhagen (Denmark)), on 1 April 2016 a draft proposal for the revision of the 'progress in the management of contaminated sites' Indicator LSI003 was circulated by JRC to NRCs Soil for comments.

Version 1 of the questionnaire was submitted to Eionet NRC Soil Forum for discussion at the EEA meeting (4 October 2016, Copenhagen). Comments from the participants of the ad hoc working group on contaminated sites and brownfields to the Ferrara meeting arrived 17 October 2016. Version 2 of the questionnaire (11 November 2016) included comments from the NRC Soil meeting (4 October 2016). The NRC Soil representatives were invited to comment the questionnaire until 25 November 2016. Following this date, the JRC sent the revised questionnaire to NRCs Soil (22 December 2016), with the request to reply with the status on the progress in the management of contaminated sites before the end of 2016. Eionet NRC Soil representatives were invited to reply to the questionnaire until 3 April 2017.

The compilation of the questionnaire should achieve the objective of reporting for the deadlines of the 7th EAP that 'by 2020 (…) (e) land is managed sustainably in the Union, soil is adequately protected and the remediation of contaminated sites is well underway'.

This publication is a technical report by the JRC, the European Commission's science and knowledge service. It aims to provide evidence-based scientific support to the European policymaking process, using the information available from the reactions by NRC Soil representatives to the questionnaire, the information extracted from the Soil wiki platform, which collected an overview of European and national soil-related policy instruments, and the answers to the common forum questionnaires (publicly available on the website www.commonforum.eu). The scientific output expressed does not imply a policy position of the European Commission or the participant countries. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use that might be made of this publication.

1 Introduction

1.1 Context of the assessment

Soil is specified as the top layer of the Earth's crust, formed by mineral particles, organic matter, water, air and living organisms. It is the interface between earth, air and water, and hosts most of the biosphere (European Commission, 2006).

Soils must be understood as the base for life and for supporting livelihoods. It is essentially a non-renewable resource, which performs many functions and delivers services vital to human activities and to ecosystem survival. Seven main soil functions were identified in the *Proposal for a European soil framework directive* (EU, 2006), and are listed in the plan of action for pillar three of the global soil partnership adopted by the GSP plenary assembly in 2015, named:

- biomass production, including in agriculture and forestry,
- storing, filtering and transforming nutrients and water,
- hosting the biodiversity pool, such as habitats, species and genes,
- acting as a physical and cultural platform for most humans activities,
- providing raw materials,
- acting as a carbon pool,
- storing the geological and archaeological heritage.

However, soils are under increasing environmental pressure across the globe, and the associated soil degradation is raising extreme values in Europe due to a high population density and its related activities, such as industrial activity, inappropriate agricultural and forestry practices, tourism or urban development.

In the European thematic strategy for soil protection ([SEC(2006)620], [SEC(2006)1165]), the Commission identified the main eight threats which confront soils in the EU. These are:

- erosion,
- organic matter decline,
- contamination,
- salinisation,
- compaction,
- soil biodiversity loss,
- sealing,
- landslides and flooding.

The Intergovernmental Technical Panel of Soil (ITPS) identified soil pollution as the third threat to soil functions in Europe (FAO and ITPS, 2015).

Contamination is the chemical degradation of soils which affects human health and the environment and reduces the ability of soils to provide the ecosystems services mentioned above. Soil contamination can be understood as the trigger for other degradation processes, because it affects the ecosystem and causes toxicity to organisms, reducing the biodiversity, which is associated with the loss of organic soil matter, with nutrient imbalance and consequent soil erosion. Depending on which pollutants are present in the soil, salinisation problems can also be associated with soil contamination, for example the effects of bad agricultural practices such us excessive use of rich sulfates and nitrate pesticides and fertilisers on untreated wastewater for irrigation (Andreu and Picó, 2004; Sirguey and Ouvrard, 2013).

Soil contamination can be local (point source) or diffuse. Local soil contamination occurs where intensive industrial activities, inadequate waste disposal, mining, military activities or accidents introduce excessive amounts of contaminants into the soil. The local contamination pathways may involve heavy metals in land-based applications of waste, as well as those derived from mining and other extractive activities, nuclear and military

operations, point-source oil and chemical releases and spills (accidental or not) or during transport (FAO and ITPS, 2015). Pesticides and fertilisers are also a source of local soil contamination in the area they are applied or when storing and waste disposal of empty recipients are not well managed.

Frequently, associated water bodies are also affected by soil contamination. When poisonous chemicals percolate into groundwater, or if contaminated overflow reaches streams, lakes or oceans, those bodies of water then act as a source of contamination, transporting contaminants through different compartments in the environment; diffuse contamination. In those cases, technical and political efforts focus on water remediation but take into account the primary source and include source removal and/or remediation. Diffuse contamination means that it is not possible to apply the PPP because the origin of the contamination cannot be identified, due to several possible origins of the contaminants (e.g. a fertiliser or pesticide used by several farmers) in the groundwater or non-agricultural soil.

Soil contamination is often difficult to detect because its effects are frequently limited or mitigated by natural functions of soils, in particular storing, degrading or immobilising pollutants. The diversity of soil types and soil properties also influences the identification of soil contamination. In light of the wealth of soil types in Europe and the wide spatial variability of soil properties (Jones, Montanarella and Jones, 2005), it has not yet been possible to generalise soil-contamination-assessment procedures, as the background levels, the accumulation or the availability and mobility of contaminants depend on soil type and soil properties and must be addressed on a site-by-site basis. Furthermore, the diversity of contaminants and their different bioavailability, persistence and toxicity depending on their chemical properties makes the risk assessment and, hence, the decision on the need for remediation, difficult. Soil (in contrast to air and water) is closely related to land ownership and private property, increasing the complexity of soil-contamination assessment. On these matters many national legislations and regulations have existed for a long time and they are different in different countries and regions.

Soil can enter our bodies via three main routes:

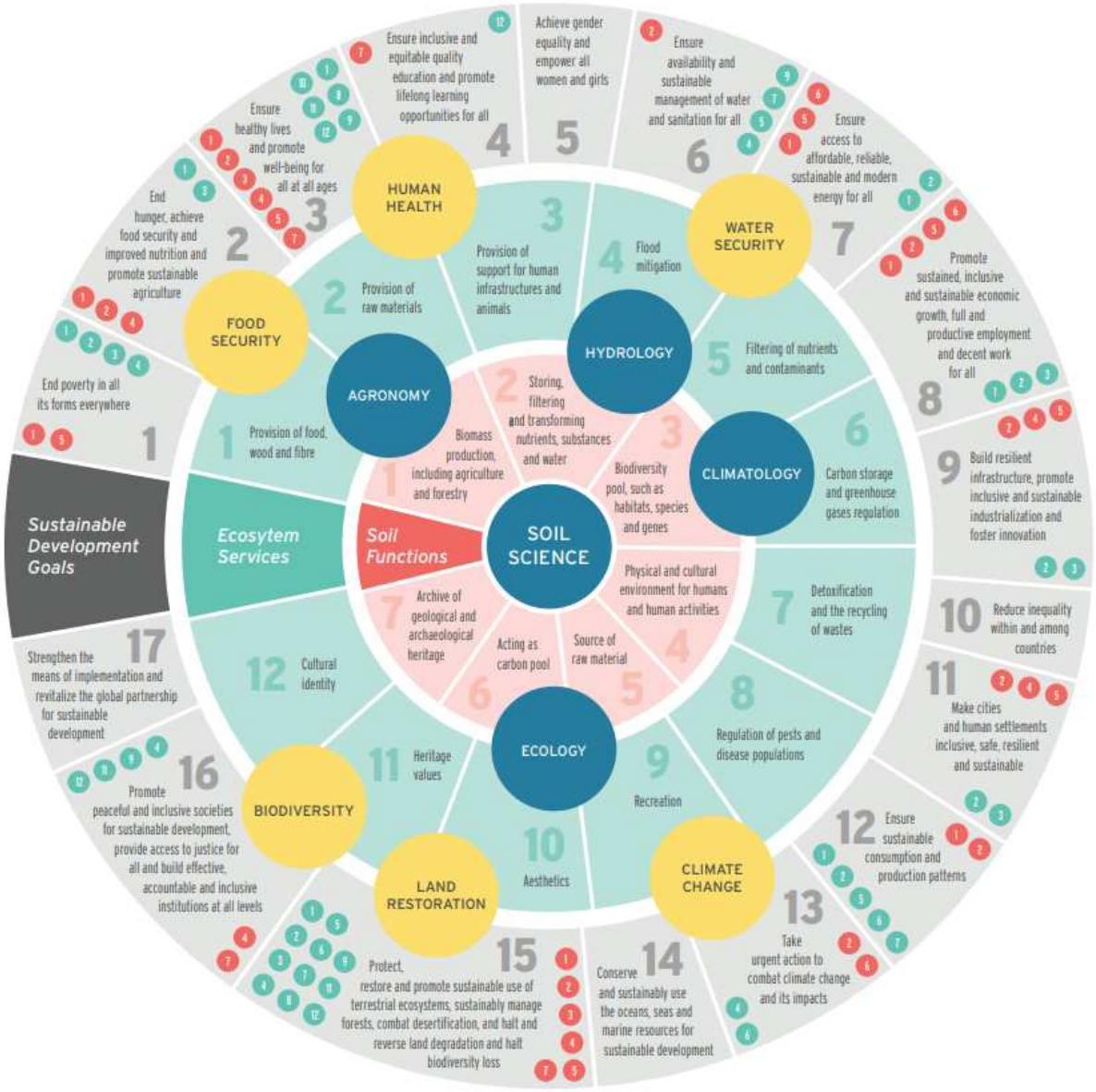
1. Eating soil (geophagy), which mainly affects young children who may be in contact with contaminated soils while playing outdoors.
2. Inhalation of very small soil particles mobilised during soil works, for example during agricultural practices.
3. Skin, by dermal absorption.

Another pathway soil contamination can affect human health and other compartments in the environment are through mobilisation to water bodies.

In the European context, the health impacts of long-term low-level (or 'chronic') exposure to soil contaminants is of particular interest, and decision-makers and researchers have noted the lack of information in this area (Science Communication Unit, University of the West of England, 2013).

Considering the important role soils play on human health and environmental preservation, putting their protection on the policy arena is fundamental in order to guarantee the future availability of this resource. A sample of the efforts the scientific community, civil-society organisations and policymakers have made is the inclusion of soil protection in one of the most important legal frameworks for development in the coming decades, the proposal of sustainable-development goals (SDGs), approved by the United Nations General Assembly in September 2015. The 17 SDGs present a major challenge for societies and governments, as they comprise significant changes in human development and activities to be achieved by 2030. The importance of soils in succeeding SDGs is summarised in **Error! Reference source not found.** and

Figure 2. Graphical abstract modified from (Keesstra et al., 2016), see details here.



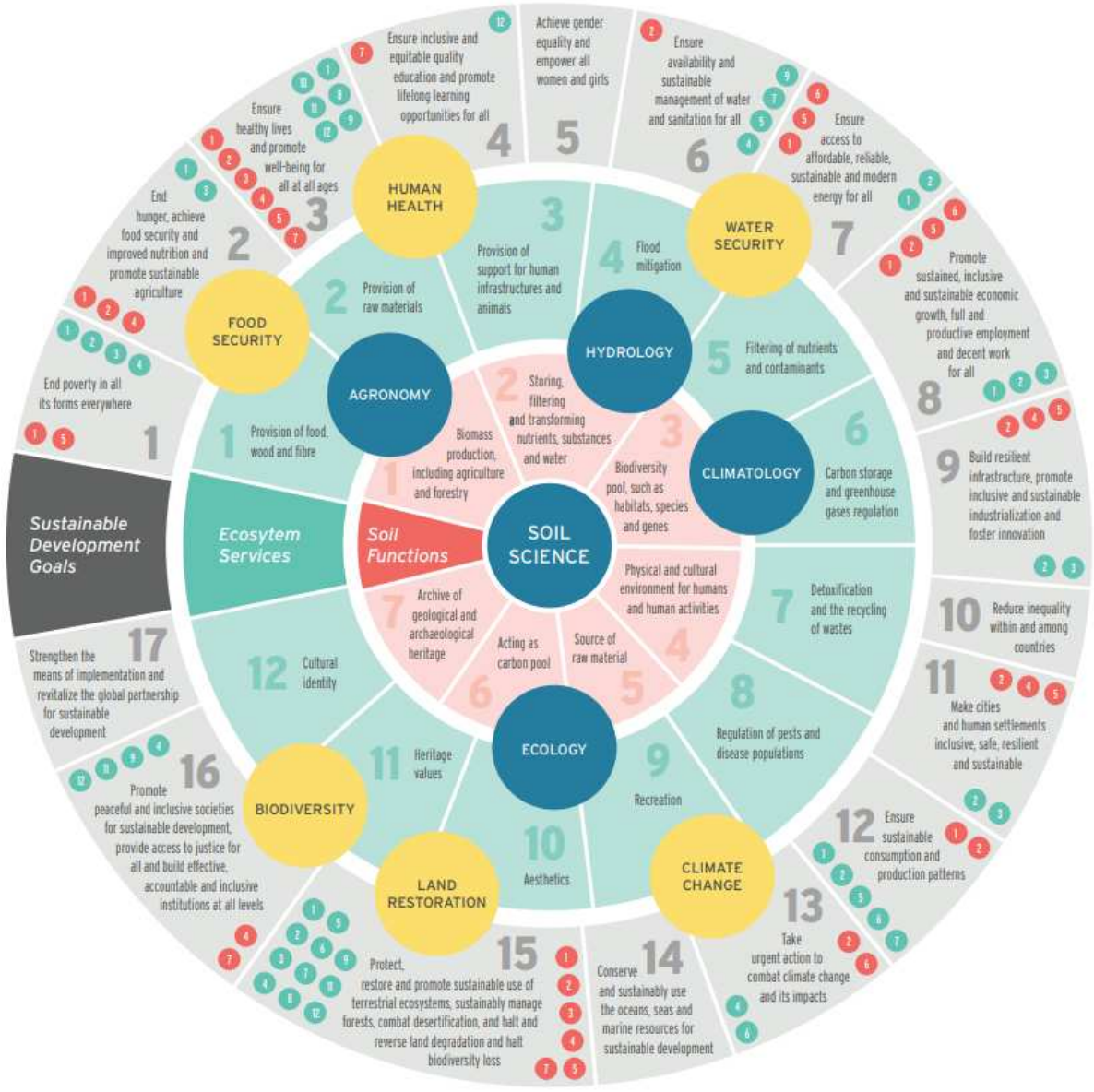
Error! Reference source not found.. In particular, SDG 15 aims to achieve the protection of soil functions by 2030, more specifically SDG Target 15.3 has the objective of combating desertification, restore degraded land and soil (including land affected by desertification, drought and floods) and strive to achieve a land degradation-neutral world. There are two references to soil contamination in that document: Target 3.9 proposes to reduce the effect of hazardous substances present in air, water and soils human health and Target 12.4 promotes better management of chemical and waste, reducing their release to air, water and soils to minimise their adverse impacts on human health and the environment.

Figure 1. Selection of sustainable-development goals targets addressing soil.

Ecosystems services (ES) provided by soils and the significance of soil functions for achieving the SDGs show the need for considering soil a key environmental issue and raising awareness of the crucial importance of soil protection (Keesstra et al., 2016; Montanarella and Alva, 2015). Moreover, to understand the need for an interdisciplinary assessment of the role of soil functions in order to guarantee these, ES can help to develop a broader but more accurate strategy for soil protection (

Figure 2).

Figure 2. Graphical abstract modified from (Keesstra et al., 2016), see details here.



The ambiguity in soil-contamination terms and the lack of agreement on the basic concepts have made it difficult to draft a corresponding common legal framework. Many efforts have been made in recent years to clarify the main concepts. In the Water Framework Directive (EU, 2000) and the IED (European Commission, 2010), pollution refers to the direct or indirect introduction, as a result of human activity, of substances, vibrations, heat or noise into air, water or land which may be harmful to human health or the quality of the environment, which result in damage to material property, or which impair or interfere with amenities and other legitimate uses of the environment. Chapman (Chapman, 2012) stated that contamination is the presence of a substance where it is not expected to be or above its background levels, while he defined pollution as the contamination that produces biological effects. The ITPS under the Global Soil Partnership has achieved a global agreement on these two terms (FAO and ITPS, 2015). There, soil pollution refers to the presence of a chemical or substance out of place and/or present at a higher-than-normal concentration that has adverse effects on any non-targeted organism. This definition includes the concept of soil contamination, which occurs when the concentration of a chemical or substance is higher than normal but is not necessarily causing harm. However, the origins for these definitions come from agronomy and agricultural perspectives and the continued lack of agreement results in

them being used as synonyms. For the scope of this report, only the term contamination is used and it refers to soil pollution linked to an anthropogenic source, which implies concentrations exceeding the screening or natural concentrations.

In spite of the complexity of identification, investigation and ultimate remediation of contaminated soils, increased technical and legal efforts are essential to reach the ecosystem conservation and human-health protection that EU has set out to achieve in the next decades. A common framework to support actions and progress in environmental protection, and specifically in soil-contamination prevention and remediation, would contribute to achieve this goal. The science-policy interface must be strengthened to raise awareness and engagement for soil protection. To this end, it is essential that there is firm support by the Commission and Member States for institutions or bodies specialising in adapting scientific knowledge for public policy, such as national environment agencies, the EEA with its European Environment Information and Observation Network (Eionet) and the JRC.

1.2 Type of indicator

The EEA has designed a series of indicators to answer key policy questions and give support and scientific backup to policymakers on environmental issues, as they are normally reported in the *State of the environment in Europe* (SOER). The indicators are classified as follows.

- Descriptive indicators (Type A): What is happening?
- Performance indicators (Type B): Does it matter? Are we reaching targets?
- Efficiency indicators (Type C): Are we improving?
- Policy-effectiveness indicators (Type D): Are the measures working?
- Total welfare indicators (Type E): Are we, on the whole, better off?

The report *EEA indicators* (EEA, 2015) shows that the EEA's indicator management system (IMS) currently contains 120 indicators covering 22 environmental topics. The core set of indicators (CSI) (currently under revision) aims to prioritise improvements in the quality and coverage of data flows, streamline contributions to other international indicator initiatives, and provide a manageable and stable basis for indicator-based assessments of progress against environmental-policy priorities.

Land and soil indicators (LSI) were launched to emphasise the importance of soil and land resources and attract policy attention. They are as follows:

- land take
- soil moisture
- imperviousness and imperviousness change
- organic soil carbon
- progress in the management of contaminated sites

The previously called CSI015 (progress in the management of contaminated sites), and now designated LSI003, intends to figure out how much progress in the management of contaminated sites has been achieved in Europe.

The present document aims to provide scientific support to the revision of the contaminated-sites indicator LSI003. Despite the success of previous data collection on indicator 'progress of the management of contaminated sites', there is an agreement among the experts of national reference centres (NRCs) member countries that the available data are not sufficiently precise to evaluate certain parameters, such as the total surface area contaminated per class of contaminant, the percentage of population exposed to the contamination or the environmental damage caused by contaminated sites. This is mainly because the data collected by each country are not totally comparable yet due to the lack of commonly accepted guidelines (Sivakumar and Stefanski, 2007).

1.3 Evolution of concepts for an indicator on the progress in the management of contaminated sites

The status of indicator CSI015 'progress in management of contaminated sites' is published on a regular basis (6 data-collection exercises were completed 2001-2006) and aims to show whether the European countries are making progress in managing local soil contamination. Progress is identified by assessing whether the identification of contaminated sites and the individual steps in the management process are being taken forward. The data-collection exercises focused parameters on four management steps:

1. preliminary study/site identification
2. preliminary investigation
3. main site investigation
4. implementation of risk-reduction measures.

In the 2011 data-collection period three new parameters were introduced, specifically: 'potentially contaminated sites' (PCS), 'contaminated sites' (CS) and 'sites under remediation', in order to minimise the differences in interpretation by countries. These parameters aimed to provide an insight into the level of management of contaminated sites. As opposed to parameters referring to the management steps, these parameters did not refer to cumulative total numbers but to the number of sites currently undergoing each management step.

- A CS is a well-defined area where the presence of soil contamination has been confirmed and this presents a potential risk to humans, water, ecosystems or other receptors (living organisms).
- A PCS is a site where soil contamination is suspected but not verified, and where detailed investigations need to be carried out to verify whether there is a risk of adverse impacts on receptors.

However, differences between countries remained considerable because of the differences in defining potentially polluting activities and the national approaches to registering sites. Frequently, the absences of political support and of budget overextend the development of systematic analysis and inventories. In 2015 the ad hoc working group on contaminated sites and brownfields under Eionet NRCs Soil initiated a revision of indicator CSI015. Thus, a new land and soil indicator (LSI003) was proposed and refers to a thematic cluster of indicators that provides scientific information on the status of land and soil resources (under development). LSI003 is based on site status, depending on its management step. The following 6 site statuses are considered in this process.

- Status 1: sites where polluting activities took/are taking place.
- Status 2: sites in need of investigation/still to be investigated or under investigation where there is a clear suspicion of contamination.
- Status 3: sites that have been investigated but no remediation is needed.

- Status 4: sites that need or might need remediation or risk-reduction measures (RRM), including natural attenuation.
- Status 5: sites under/with ongoing remediation or RRMs.
- Status 6: site remediation or RRMs completed or sites under aftercare measures.

The main goal of this report is to analyse progress made in the management of CSs, including policy support, by each Member State and cooperating countries. To achieve this, it is necessary to compare data from previous years in order to obtain trends. The concepts and methodologies for defining CSs have been revised after each data-collection process in an attempt to achieve harmonisation between countries, and a new classification is now used to define sites status.

Site statuses 5 and 6 are the most stable and reliable indices to understand the progress made by countries.

A baseline has been laid down for this purpose, it has been agreed to establish the year 2001 as the starting line for the management of CSs (or a different baseline if a country reports that has initiated a national programme to manage CSs before or after 2001), as it was the year when the data collection to develop the indicator started. Some countries have not started a national programme as such yet, but even without a specific programme targeting CS remediation, remediation can be ongoing in those countries. When temporal comparisons are presented in this report, baseline data refers to the first time each country replied to the Eionet questionnaires, reporting numbers and status of soil-contamination management.

Table 1 presents a correspondence table between the current LSI003 classes (2016) and the classes used in previous indicator CSI015 (2001-2006 and 2011). However, it must be taken into account that these correspondences are only used as guidance and for some countries these matches are not totally realistic.

Table 1. Matching the 2001-2006, 2011 and 2016 Eionet data collection.

CSI015 (from 2001-2006)	CSI015 (2011)	LSI003 (2016)
Preliminary study/site identification	Potentially contaminated sites (PCS): estimated	Status 1a: sites where polluting activities took/are taking place (estimated)
Preliminary investigation	PCS: already identified	Status 1b: sites where polluting activities took/are taking place (registered)
Main site investigation (estimated total number)	Contaminated sites (CS): estimated number (basis: estimated PCS)	Status 2a: sites in need of investigation/still to be investigated sites where there is a clear suspicion of contamination
Main site investigation (under progress or already completed)	CS: estimated number (basis: identified PCS)	Status 2b: sites under investigation where there is a clear suspicion of contamination
Implementation of risk-reduction measures (RRM)	CS: with need for remediation	Status 4: sites that need or might need remediation or RRM, including natural

(estimated total number)		attenuation
Implementation of RRM (under progress)	CS: under further investigation	Status 5: sites under/with ongoing remediation or RRM
Measures completed	CS: measures completed	Status 3: sites that have been investigated, but no remediation needed
		Status 6: site remediation or RRM completed or sites under aftercare measures

1.4 Terminology

The term **contaminated site** refers to that site where hazardous substances, as defined in Article 3 of Regulation (EC) No 1272/2008 ([3]), are present in a level that pose a significant risk to the environment and human health. When there is a suspicion of contamination, either because there is/has been an activity considered to be potentially polluting, or because an accident or spill has occurred, an investigation must be carried out to confirm such contamination. In many national policies, human activities are considered as the trigger of this presence, for example in **Belgium**, **Croatia**, **Lithuania**, **Luxembourg**, **Serbia**, **Slovakia**, **Sweden** and **Switzerland**, among others.

The concept of **polluting activities** refers to certain installations ([4]) and industrial activities ([5]) that are damaging the capacity of soil to continue to perform in full its broad variety of crucial functions. They were set out in the *Proposal of a soil framework directive*, with details in Annex II (European Commission, 2006b), which included those installations covered by the Integrated Pollution Prevention and Control (IPPC) Directive, the IED or the Seveso II directive. However, the list of polluting activities varies among countries, depending on their industrial past and the national legislation. For example, in **Latvia**, polluting activities are considered all those activities included the utilisation of; soil, subterranean depths ([6]), water, air, installations or buildings and any other stationary facilities that may result in environmental contamination or risk of accidents, as well as the activities that are performed in polluted sites and that may cause the spreading of contamination, which corresponds to a wider concept in this country in comparison to others. The same is valid for Belgium (**Flanders**), where there is an extensive list of potentially contaminating activities.

The following expressions represent the **site status** to report the progress in the CS management, understanding the progress as the increase in the number of sites under each management step.

Site status 1: sites where polluting activities took/are taking place: a) estimated and b) registered — (rather than 'sites registered').

Site status 2: sites in need of investigation/still to be investigated or under investigation where there is a clear suspicion of contamination (NB: it may not be relevant to all countries, in some countries there is a transition from status 1 to status 2 following risk assessments).

Site status 3: sites that have been investigated, but no remediation is needed (unless land-use changes, i.e. in application of the principle of fit for current use).

Site status 4: sites that need or might need remediation or risk-reduction measures (RRM), including natural attenuation (monitoring to be part of the preparative investigations how to remediate).

Site status 5: sites under/with ongoing remediation or RRM (probably common to all countries).

Site status 6: site remediated or RRM completed or sites under aftercare measures (i.e. sites that are monitored after remediation). Monitoring to be performed to confirm that remediation or RRM goals are achieved.

([3]) Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.

([4]) Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control), p.23.

([5]) Annex II of the proposal Directive of the European Parliament and of The Council establishing a framework for the protection of soil and amending Directive 2004/35/EC.

([6]) Subterranean depths are the part of the Earth's crust which is located under the soil and surface water to the limit of the depths to which it is economically and technically possible to perform geological research, extraction of mineral resources or use thereof. Law on subterranean depth.

In Europe, the legal background to address soil contamination dates back 30 years but varies considerably from one country to the other. Many European countries have already adopted national legislation at different moments (Frelih-Larsen *et al.*, 2016). These national regulations generally include procedures to avoid new contamination but for those sites where contamination occurred before the entrance into force of the regulation, a different procedure has been set out. The definition of **historical contamination** is, hence, different for each country, as it is based on the date the law entered into force.

The IED ([7]), the WFD ([8]) and the Environmental Liability Directive (ELD) ([9]) are based on preventive approaches and provide liability in case of accidents or unexpected contamination for certain activities and heavy industry, thus, new CSs are not expected to occur in Europe from a legal point of view. However, not every polluting activity is included under these legislations and accidents may occur, even in IED and WFD sites. In those cases, CSs are managed under specific national legislations on soil contamination or environmental protection. Under indicator LSI003 where contamination has occurred after the entrance into force of these regulations those sites are **new contaminated sites.** For some countries, however, the procedure to address historical and new contamination is the same and there is no distinction for liability or screening values (e.g. **Hungary**, **Italy**, **Malta**, **Norway**, **Romania** and **Slovenia**).

PPP is the commonly accepted practice that those who produce contamination should bear the costs of managing it to prevent damage to human health or the environment (OECD, 1992). The Organisation for Economic Cooperation and Development (OECD) adopted this term in 1972 as an economic principle for allocating the costs of contamination control. The PPP, enshrined in Article 191 of the Treaty on the Functioning of the European Union (TFEU), means that the public should not pay if an industrial operation causes significant environmental damage. The ELD establishes a framework of environmental liability, based on the PPP, to prevent and remedy environmental damage. The ELD applies only to damage occurring after 30 April 2007; it has no retrospective effect.

There are three categories of environmental damage under the ELD: (1) damage to protected species and natural habitats, (2) water damage, and (3) land damage, which is 'any land contamination that creates a significant risk of human health being adversely affected as a result of the direct or indirect introduction, in, on or under land, of substances, preparations, organisms or microorganisms'. Soil contamination is not explicitly mentioned in the ELD but is covered under the category 'land damage'. Some activities are excluded from the ELD. The operators carrying out dangerous occupational activities as listed in Annex III of the ELD (see Section 2 below) are strictly liable for the environmental damage they cause, i.e. there is no need to prove fault (intent or negligence). Operators carrying out occupational activities other than those listed as dangerous are liable on the basis of fault. According to the EU *Guidelines on state aid for environmental protection and energy 2014-2020* ([10]), aid for CSs can be granted only when the polluter (i.e. the person liable under the law applicable in each Member State, subject to the ELD and other relevant EU rules in this matter) is not identified or cannot be held legally liable for financing the remediation in accordance with the PPP, and that eligible costs are equal to the cost of the remediation work less the increase in the value of the land.

Orphan sites are those sites that have been contaminated and where it is not possible to identify the polluter. Either the polluter is gone or is not financially able to support the

([7]) Directive 2010/75/EU of The European Parliament and of The Council of 24 November 2010 on Industrial Emissions (Integrated pollution prevention and control).
([8]) Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives.
([9]) Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage.
([10]) Communication from the Commission. Guidelines on state aid for environmental protection and energy 2014-2020. (2014/C 200/01).

intervention cost, e.g. due to bankruptcy. The responsibility for identification and remediation varies within countries, as well as between states, as does the funding regime. There are countries that do not consider orphan sites in their legislations, as it is the case in **Belgium (Flanders)**, **Bulgaria**, **Cyprus**, **Ireland, the former Yugoslav Republic of Macedonia**, and **Slovenia**.

This report focuses on the status and the management of those sites where local or point-source contamination has occurred. Therefore, the surface holding industrial, commercial and transport activities, urban areas and mine, dump and construction sites has been considered for calculating the density of CSs per country because a positive correlation has been confirmed between artificial surfaces and the number of CSs in previous studies (Prokop, 2002). Furthermore, artificial surface has been chosen because of the availability and reliability of this data. In the Corine land cover project ([11]), **artificial surfaces** encompasses as following.

a. Urban fabric
    i. Continuous urban fabric. Most of the land is covered by structures. Buildings, roads and artificially surfaced area cover almost all the ground. Nonlinear areas of vegetation and bare soil are exceptional.
    ii. Discontinuous urban fabric. Most of the land is covered by structures. Buildings, roads and artificially surfaced areas associated with vegetated areas and bare soil, which occupy discontinuous but significant surfaces.
b. Industrial, commercial and transport
    i. Industrial or commercial units. Artificially surfaced areas (with concrete, asphalt, tarmacadam or stabilised, e.g. beaten earth) devoid of vegetation, occupy most of the area in question, which also contains buildings and/or vegetated areas.
    ii. Road and rail networks and associated land. Motorways, railways, including associated installations (stations, platforms, embankments). Minimum width to include: 100 m.
    iii. Port areas. Infrastructure of port areas, including quays, dockyards and marinas.
    iv. Airports. Airport installations: runways, buildings and associated land.
c. Mine, dump and construction sites
    i. Mineral extraction sites. Areas with open-pit extraction of industrial minerals (sandpits, quarries) or other minerals (opencast mines). Includes flooded gravel pits, except for river-bed extraction.
    ii. Dump sites. Landfill or mine-dump sites, industrial or public.
    iii. Construction sites. Spaces under construction development, soil or bedrock excavations, earthworks.
d. Artificial, non-agricultural vegetated areas
    i. Green urban areas. Areas with vegetation within urban fabric. Includes parks and cemeteries with vegetation.
    ii. Sport and leisure facilities. Camping grounds, sports grounds, leisure parks, golf courses, racecourses, etc. Includes formal parks not surrounded by urban zones.

In addition, the use of artificial surfaces to make estimates may lead over- or underestimates, either because many potentially polluting activities are considered, or because some CSs may fall into 'non-artificial' CLC classes (e.g. soil contamination may

([11]) https://www.eea.europa.eu/publications/COR0-landcover

be found also below green areas). However, as it has been exposed before, the artificial surfaces and the number of CSs have shown a positive correlation in previous studies (Prokop, 2002).

Remediation of contaminated soils refers to reducing the harmful effects to the environment and human health from the exposure to hazardous substances. Returning a CS to its original state is often neither necessary nor economically and technically feasible. Remediation aims to reduce the exposure to people and the environment, but taking into account the present and future use of the remediated site. To achieve this, there are many techniques available for soil cleaning. The definition of what clean means will depend on national regulations, which set out in detail the requirements that will need to be met in each given situation; the level of site characterisation to be accepted before and after the remediation works; and the acceptable end state of the site. Clean-up programmes to establish the nature and extent of contamination begin with sampling and analysis of field data to determine the nature and extent of threats to human health and the environment. Field data obtained is then compared with numerical values that have been considered in the legislation to be acceptable or under those values the risk is assumable. However, those values differ significantly from one country to another, including the nomenclature used for calling them (Fergusson, 1999). Frequently, these reference values are named as **background values, screening values, threshold values, remediation levels**, etc. In addition, each state differs in its approaches to setting background values, including the sampling strategies deployed and the statistical treatment of the results from those samples. Given the diversity in terminology, to simplify the reading and comprehension of this report, the term **screening value** has been chosen, considering it as a synonym of all the others mentioned before. Only when referring national policies or methodologies, the term used there is mentioned.

The two main types of remediation are **ex situ** and ***in situ***. **Ex situ** involves physically extracting media from a CS and moving it to another location for treatment. At an **ex situ** site, if the pollutant exists only in soil, the soil is excavated. If contamination has reached the groundwater, it is then pumped and both the polluted soil and water are removed. ***In situ* remediation** involves treating contaminants on-site (Kuppusamy et al., 2016). There are multiple techniques for *in situ* treatments that can be categorised in three main groups (United States environmental protection agency (US EPA), 1996):

- physical/chemical treatment technologies
- biological treatment technologies
- thermal treatment technologies.

The comparison between concepts presented above arises from a deep analysis of those national policies that address soil contamination. There are many other differences in relevant concepts that must be agreed in future meetings and panel of experts, for example by the ad hoc working group on contaminated sites and brownfields under Eionet NRCs Soil, in order to produce comprehensive and harmonised concepts. The comparativeness can be ensured and the development of a common framework on soil protection in Europe made more achievable only once the basic definitions and homogenised information capture are agreed.

1.5 Units

The main values used in this report are the following.

— Percentage of respondents replying to each question over the total surveyed (39).

— Number of sites managed or requiring management, with different site status, reported by respondents.

— Density of contaminated sites, expressed as the number of sites where polluting activities took/are taking place per km2 of artificial surface per country (12).

— Estimated number of sites where polluting activities took/are taking place per km2 of artificial surface, obtained by extrapolation of respondent data.

— Status of completed risk-reduction measures. [Number of remediated sites (site statuses 6 and 3)]/[Number of registered sites where polluting activities took/are taking place]*100.

— Trends of the progress in the management of contaminated sites calculated as the difference between the number of sites for each management step in 2016 and the same number reported in the previous data-collection process and the baseline (data from 2001-2005).

— Overall expenditure is provided in million EUR. This information is directly provided by respondents.

— Expenditures on remediation of contaminated sites in million EUR. This information is directly provided by respondents.

— Cost of assessment and remediation per site. The overall expenditure provided by respondents is divided by the number of registered sites in status 1 (registered sites where polluting activities took/are taking place).

— Percentage of allocation of public, private and EU expenditures to finance the remediation of contaminated sites per country. This information is directly provided by countries or calculated from the data provided.

1.6 Data sources and gap filling

A questionnaire was launched in autumn of 2016 to assess the current situation in the management of CSs of Member States and collaborating countries. The information provided by respondents has been the main data source for the elaboration of Section 3 *Progress in the management of contaminated sites in Europe*. However, other sources have been also used to prepare and complete this report. Information collected by EEA/Eionet to write previous assessment reports on indicator CSI015 in 2005, 2007 and 2014 has been used as a historic reference to establish the progress in the management of contaminated sites. These reports are available as shown below.

— https://www.eea.europa.eu/data-and-maps/indicators/progress-in-management-of-contaminated-sites ([13]).

— https://www.eea.europa.eu/data-and-maps/indicators/progress-in-management-of-contaminated-sites/progress-in-management-of-contaminated-1

— https://www.eea.europa.eu/data-and-maps/indicators/progress-in-management-of-contaminated-sites-3/assessment

Generally, to fill the gaps in questions on targets, inventories and policy-related criteria, data from previous questionnaires and reports presented by the common forum on contaminated land in Europe have been added. Whenever this was the case, it is explicitly mentioned in the table or graph. It must be taken into account that information from the common forum questionnaires is not updated. Brussels-Capital has provided updated information using the common forum questionnaire. If no data sources other than Eionet 2016 are indicated, only the data provided by the respondent has been taken into account.

([12]) Note that the EU has 28 Member States, but these comprise more than 28 countries (notably, the United Kingdom is one Member State but consists of four countries. Calculations are done by country, considering this situation.

([13]) Warning: This is an old version, kept for reference only.

Other sources of information include studies and information collected by Directorate-General for Environment, in particular the following.

— *Evaluation of expenditure and jobs for addressing soil contamination in Member States* (Ernst & Young, 2013).

— The updated inventory of soil-related policy instruments at EU and national level (Ecologic Institute, 2017).

— Soil wiki platform ([14]) containing information used for the aforementioned *Inventory and assessment of soil-protection policy instruments in EU Member States* (accessible only with European Commission account).

— Data on the total surface area of each country was obtained from Eurostat and from the World Bank (The World Bank Group, 2017). Population information was obtained from Eurostat (EU, 2016). Updated information was used when available; otherwise, data from years 2013, 2014 or 2015 was used.

— Statistical data for Belgian regions was acquired from Belgian federal government, 2013 and Belgian federal government, 2017.

([14]) https://webgate.ec.europa.eu/fpfis/wikis/display/SOIL/Home

2 Policy context

2.1 Context description

The European Parliament stated at the beginning of the millennium 'the urgent need to regulate its (soil) use and assess and mitigate the impact of external actions'. Some steps have been taken in this regard with the approval of several legal approaches in Europe in the last decade.

Since 2001, when the 6th EAP of the European Union established that soil protection against adverse impacts be a priority for Europe, social and political awareness of soil has risen. After a nearly decade-long attempt to implement a governance framework in Europe to ensure the protection and sustainable use of soils, the thematic strategy for soil protection (STS) was launched on 2006 (European Commission, 2006), which explicitly recognised the necessity of preventing soil degradation. The STS established a start-point for a common framework on soil protection, encouraged those Member States which did not have a national legislation to increase the efforts to preserve their soil resources, and set out the next steps that must be taken in order to achieve a common insight into the status of soil contamination in Europe. Three sets of measures were set out under the proposal of the soil framework directive addressing soil contamination (EU, 2006).

- Precautionary and preventing measures, to minimise the adverse effects on soil functions.
- Identification of risk areas and contaminated sites. Every Member State had to prepare an inventory of contaminated sites.
- Operative measures for risk areas and contaminated sites. Remediation strategies must be prepared and soil remediation has to be assured.

The 7th EAP recognises that varying levels of progress have been made at Member State level to ensure soil protection, including CS identification, awareness-raising, and research and development of monitoring systems. Progress made with risk-based and other remediation efforts is uneven, and results and EU-level reporting are limited (European Commission, 2011a). This report aims to give response to the objectives proposed in the 7th EAP of the European Union, which make reference to soil-contamination management.

Priority objective 2: 'To turn the Union into a resource-efficient, green and competitive low-carbon economy' (Article 39) sets waste prevention and better management as opportunities for improvement.

Priority objective 3: 'To safeguard the Union's citizens from environment-related pressures and risks to health and well-being', in Article 48, promotes the need for implementing the IED to significantly reduce industrial emissions.

Priority objective 8: 'To enhance the sustainability of the Union's cities', Article 90, states the importance of the status of urban and peri-urban areas (outskirts) in human health. Since most industrial polluting activities are located in these areas, contamination prevention and remediation is essential to protect our well-being. Furthermore, Article 91 makes reference to environmental problems, among them soil contamination and focuses on the necessity of taking them in account to design urban sustainable-development strategies.

The recently adopted resolution of the UN Environment Assembly (UNEA 3) calls for global action on soil-pollution prevention and control and the remediation of contaminated soils (United Nations Environment Programme, 2017). This action, adopted by 170 countries, represents a definitive commitment to further strengthen and improve

the science-policy interface and to raise civil and political awareness and engagement for soil protection.

2.2 European legal tools addressing soil contamination

Prevention of soil contamination in the European Union has strong links with policies on industrial activities and chemical substances use, e.g. the IED ([15]), registration, evaluation, authorisation and restriction of chemicals (REACH) ([16]), plant-protection products ([17]), fertilisers ([18]) and biocides ([19]) regulations, and with environmental-protection policies for water and air (e.g. the ELD ([20])). It has also strong links with policies concerning certain land uses, for instance agriculture. However, none of these regulations include guidelines to identify and deal with soil contamination (Ecologic Institute, 2017). Also, the commitments to which the European Union has signed up are fragmentary: it is essential to develop a generic framework that encompasses the uses and functions of the soil-(ground)water-sediment system in order to achieve effective protection of soil resources. Below is a detailed analysis of the EU policies and instruments, as well as the national policies, addressing soil contamination.

In 2015 the European Commission, DG Environment contracted a study for an updated inventory of soil-related policy instruments at EU and national level, which was published in February 2017 (Ecologic Institute, 2017). In total 35 EU-level policies and 671 instruments across the EU-28 were recorded in a wiki (the Soil wiki) and then analysed. This updated inventory has permitted the identification of the different policy instruments addressing soil protection in place in the EU and its Member States, as well as their level of implementation. For the scope of this report, a deeper evaluation of EU policies related to industrial and point-source contamination was carried out.

The Soil wiki includes 37 EU-level regulatory and non-regulatory documents related to soil protection. The non-regulatory instruments account for 41 % of legal instruments in the EU related to soil and they include monitoring, funding and awareness-raising schemes. The high percentage of non-legally binding tools indicates that great efforts have been made to protect soils but there is no consistent agreement allowing for the development of a legal framework that guarantees soil protection. Regarding regulatory instruments, 13 EU directives have a direct influence on the development of national policies related to soil-contamination prevention and management. None of them addresses soil contamination as a priority regulation objective but somehow remediation of CSs or protection of soil against contamination is noted (Table 2).

([15]) Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control).
([16]) Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).
([17]) Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant-protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC.
([18]) Regulation (EC) No 2003/2003 of the European Parliament and of the Council of 13 October 2003 on fertilisers.
([19]) Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocide products.
([20]) Directive 2004/35/CE on environmental liability with regard to the prevention and remedying of environmental damage.

Table 2. EU policies, strategies and funding instruments addressing soil contamination and the principal goal related to soil.

Policy instrument	Objectives
Binding measures — directives, regulations, decisions	
Water framework directive ([21])	It aims to prevent and reduce pollution, main pollutants are listed and thresholds established. Member States to carry out an inventory of surface systems, including terrestrial ecosystems.
Nitrates directive ([22])	It aims to protect surface water and groundwater against pollution by nitrates from agricultural sources.
Habitats ([23]) and birds directives ([24])	It aims to ensure that the species and habitat types they protect are maintained or restored. The main goal is to achieve a favourable conservation status throughout the natural range within the EU, and to reduce the pollution of habitats, which in turn might reduce soil contamination.
Environmental impact assessment directive ([25])	It aims to assess the environmental effects of public and private projects that are likely to have significant effects on the environment.
Industrial emissions directive ([26])	It aims to prevent, reduce and eliminate (when possible) pollution arising from industrial activities. Member States are to establish inventories of sulfur dioxide (SO_2), nitrogen oxides (NO_x) and dust emissions. Operators are also to produce a baseline report to establish the state of soil and groundwater contamination.
Sewage sludge directive ([27])	It aims to regulate the use of sewage sludge in agriculture in such a way as to prevent harmful effects on soil and it establishes limit values of heavy metals in soils.
Strategic environmental assessment directive ([28])	It aims to reduce environmental impacts from plans and programmes in the environment, including soils.
Waste framework directive ([29])	It provides the basis for remediation of historical contaminated waste-disposal sites. Unexcavated contaminated soils are not considered as waste.
Floods directive ([30])	It aims to reduce and manage the risk that floods pose to human health, the environment, cultural heritage and economic activity.
Environmental liability directive ([31])	It aims to establish a framework based on the polluter-pays principle (PPP) to prevent and remedy environmental damage to soil, ecosystems and water resources, if human health is affected.

[21] Directive 2000/60/EC establishing a framework for Community action in the field of water policy.
[22] Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources
[23] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora
[24] Directive 2009/147/EC on the conservation of wild birds
[25] Directive 2004/35/CE on environmental liability with regard to the prevention and remedying of environmental damage
[26] Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control)
[27] Council Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture
[28] Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment
[29] Directive 2008/98/EC on waste and repealing certain Directives
[30] Directive 2007/60/EC on the assessment and management of flood risks
[31] Directive 2004/35/CE on environmental liability with regard to the prevention and remedying of environmental damage

Pesticides framework directive ([32])	It aims to prevent contamination of the environment by pesticides.
Landfill directive ([33])	It aims to prevent or reduce the negative effects of landfilling of waste on the environment during the whole life cycle of the landfill.
Fertiliser regulation ([34])	It aims to guarantee that fertiliser does not have negative effects on human health, animals, plants or the environment (including soils) when applied under normal conditions.
Mercury regulation (*) ([35])	It aims to identify and evaluate sites contaminated with mercury, including an inventory of contaminated sites (Article 15). It includes a list of the main mercury compounds.
Groundwater directive (**) ([36])	It aims to prevent the entrance of pollutants (from diffuse sources) into groundwater and to identify contaminated land that can pose a risk in the quality of groundwater. Member States to keep an inventory of pollution sources. It includes threshold values for groundwater pollutants.
National emission ceiling directive (**) ([37])	It aims to regulate contaminant emissions in the atmosphere and reduce the eutrophication and acidification on soils. Member States to prepare emission inventories for the pollutants listed and large point-source inventories.
Renewable energy directive (**) ([38])	It aims to control the impact of production of biofuels on soil quality. Furthermore, it aims to reuse heavily contaminated soil for producing biofuels. Member States to carry out inventories of land carbon stocks.
Strategic initiatives	
Thematic strategy for soil protection (STS) ([39])	It aims to protect soils by preventing soil degradation and restoring degraded soils, included those contaminated.
7th environmental action programme ([40])	One of the priority objectives includes the sustainable management of land, adequate soil protection and remediation of contaminated sites.
Resource efficiency road map ([41])	Provides an overarching framework for policy transformation towards a European Union where resources, including soil, are sustainably managed.
Soil sealing guidelines	It aims to limit soil sealing or mitigate its effects. Some definitions are given such as brownfield and soil quality.

[32] Directive 2009/128/EC establishing a framework for Community action to achieve the sustainable use of pesticides
[33] Council Directive 1999/31/EC on the landfill of waste
[34] Regulation (EC) No 2003/2003 relating to fertilisers
[35] Regulation (EU) 2017/852 on mercury, and repealing Regulation (EC) No 1102/2008
[36] Directive 2006/118/EC on the protection of groundwater against pollution and deterioration
[37] Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC
[38] Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC
[39] Thematic Strategy for Soil Protection [SEC(2006)620] [SEC(2006)1165]
[40] Decision No 1386/2013/EU on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet'
[41] Communication from the Commission {COM/2011/571 final} Roadmap to a Resource Efficient Europe

Biodiversity strategy (**) ([42])	It aims to halt the loss of biodiversity and ecosystem services in the EU as well as to contribute to stop global biodiversity decline by 2020. Promotes healthy soils.
EU Forest strategy (**) ([43])	It aims to support and enhance sustainable forest management and the multifunctional role of forests.
Adaptation strategy (**) ([44])	It aims to increase adaptation through different mechanisms, which enhance the readiness and capacity to respond at different levels to climate change effects, develop a consistent approach and improve coordination.
LULUCF Regulation (**) ([45])	It aims to protect the soil carbon-sequestration function.
Funding instruments	
European Regional Development Fund (ERDF)	It is for the sustainable development and structural adjustment of regional economies.
Cohesion Fund (CF)	It aims to decrease the differences between the EU's regional economic development, focusing on improving the urban environment, decontaminating brownfield sites and reducing air pollution.
LIFE+ programme	It is the EU's funding instrument for environment and climate actions.
Horizon 2020 (H2020) actions	It is a comprehensive funding mechanism of pan-European projects.
Common agricultural policy (CAP)	It is the set of legislation and practices adopted to provide a common, unified policy on agriculture.
European Social Fund (ESF) (**)	It is the European Union's main financial instrument for supporting employment in the EU Member States.

(*) Recently adopted by EU and still not implemented by Member States, (**) EU instruments with less impact on national policies related to soil contamination.

However, few standards have been established related to the types of pollutants or screening values at EU level, being present only in 25 % of the EU directives analysed. When screening values are included, they are mainly related to bodies of water. An exception is the sewage-sludge directive, which includes threshold values for the input quality and the soil content.

Six of the European directives discuss the creation of national inventories: the WFD, the IED, the mercury regulation, the groundwater directive, the national emission ceiling directive and the renewable energy directive. The inventories proposed by the mercury regulation, the groundwater directive, and the national emission ceiling directive are related to soil contamination and can act as the basis for the CS inventory suggested in the STS.

The STS is the most relevant and wide strategic instrument at EU level related to soil. Soil contamination is set out here as one of the main threats to soils in Europe and presents an extensive analysis of contamination consequences, risk identification and measures to reduce the risk, and possible costs of investigation and remediation (EU, 2006). The 7th EAP to 2020 'Living well, within the limits of our planet' (**Error! Reference source not found.**) alludes to remediation of CSs (EU, 2013d).

[42] Communication from the Commission {COM/2011/244 final} Our life insurance, our natural capital: an EU biodiversity strategy to 2020

[43] Communication from the Commission {COM/2013/0659 final} A new EU Forest Strategy: for forests and the forest-based sector

[44] Communication from the Commission {COM/2013/216 final} An EU Strategy on adaptation to climate change

[45] Decision No 529/2013/EU on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities

- By 2020: 'land is managed sustainably in the Union, soil is adequately protected and the remediation of contaminated sites is well underway'.
- This requires, in particular: 'increasing efforts to reduce soil erosion and increase soil organic matter, to remediate contaminated sites and to enhance the integration of land-use aspects into coordinated decision-making involving all relevant levels of government, supported by the adoption of targets on soil and on land as a resource, and land planning objectives'.

The biodiversity strategy marks the importance of having a framework directive to protect soil to ensure biodiversity conservation (European Commission, 2011a).

By addressing the use and release of chemicals in the environment, the road map for resource efficiency acts on the protection of soils, mainly focuses on the negative effects of SO_2 and NO_x emissions (European Commission, 2011b). It includes the mandate for Member States to set up a CS inventory by 2015 and have remedial works in place by 2020.

The importance of land coverage to avoid soil degradation is one of the lead points in the EU forest strategy. Soil protection is also a main issue for the strategy on adaptation to climate change and the LULUCF regulation, as the role of soil in the uptake of carbon dioxide (CO_2) from the atmosphere has been widely recognised (EU, 2013a).

Brownfield and industrial CSs are frequently located in urban and peri-urban areas, hence these sites are considered under the soil-sealing strategy to be eligible to reuse them for redevelopment instead of sealing green areas (European Commission, 2012).

By using the funding mechanisms available in the EU, CS remediation and risk reduction can be held independently of the national budget, even though PPP has to be taken into consideration as the first funding option in all cases. The regeneration of contaminated brownfield sites is a priority of the ERDF (EU, 2013e), and of the cohesion fund for the improvement of the urban environment (EU, 2013f).

Figure 3. The 7th EAP

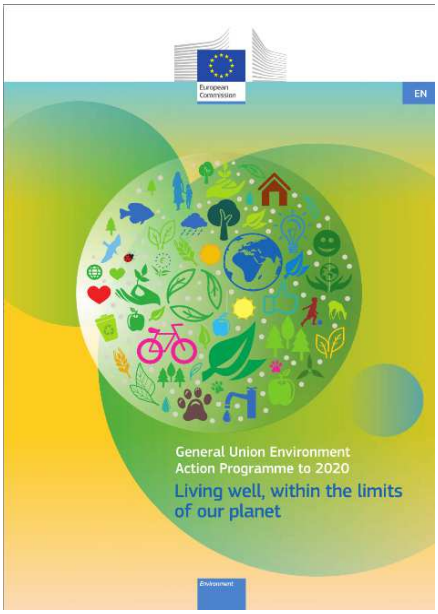
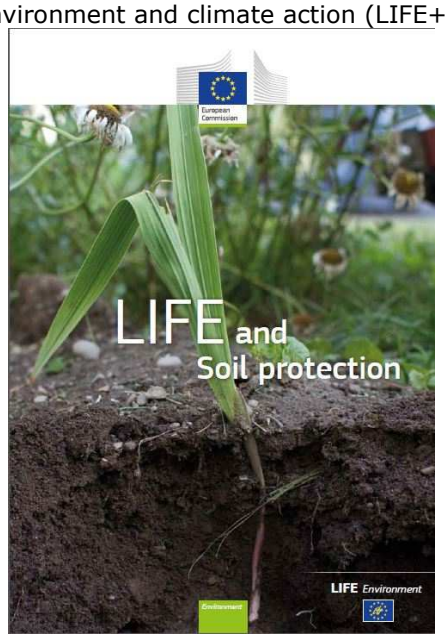


Figure 4. The programme for the environment and climate action (LIFE+).



The LIFE+ programme (**Error! Reference source not found.**) relates to research actions focused on the environment and climate action, therefore including the essential role of soils in helping to regulate the climate by taking up CO_2 from the atmosphere and storing extremely large amounts of carbon. Within this programme those activities

framed in the STS are funded (EU, 2013b) and they can also be financed through H2020 actions (EU, 2013c).

Some other EU policies also address soil contamination, for example the current common agricultural policy (CAP) discusses standards of 'good agricultural and environmental conditions' (GAEC), which propose guidelines for land management that can contribute to preventing soil degradation, and by extension to controlling soil pollution, even if this is more related to 'diffuse contamination' linked to agricultural practices; in particular excess of nutrients or fertilisers and pesticides. Financial support for monitoring soil health is included in Pillar 2: rural development. A deeper analysis of this EU instrument is not considered in this study but more details on the CAP and the existence of specific regulations focused on auditing dangerous substances in agricultural systems can be found in the inventory study (Ecologic Institute, 2017).

Some pollutants with significance for agricultural systems have been specifically regulated (in particular the nitrates directive and the fertilisers regulations) e.g. pesticide-derived sub-products accumulated in soils, causing toxicity in non-targeted organisms and the transport of pollutants to the human food chain (regulated by the pesticide framework directive and by the regulation on plant-protection products (EU, 2009)).

Nevertheless, the effectiveness of all these instruments depends on the implementation and enforcement at national level. It depends also on the willingness of the Member States to implement non-binding instruments. This generates significant differences in implementation between and within Member States, which are analysed in the section below.

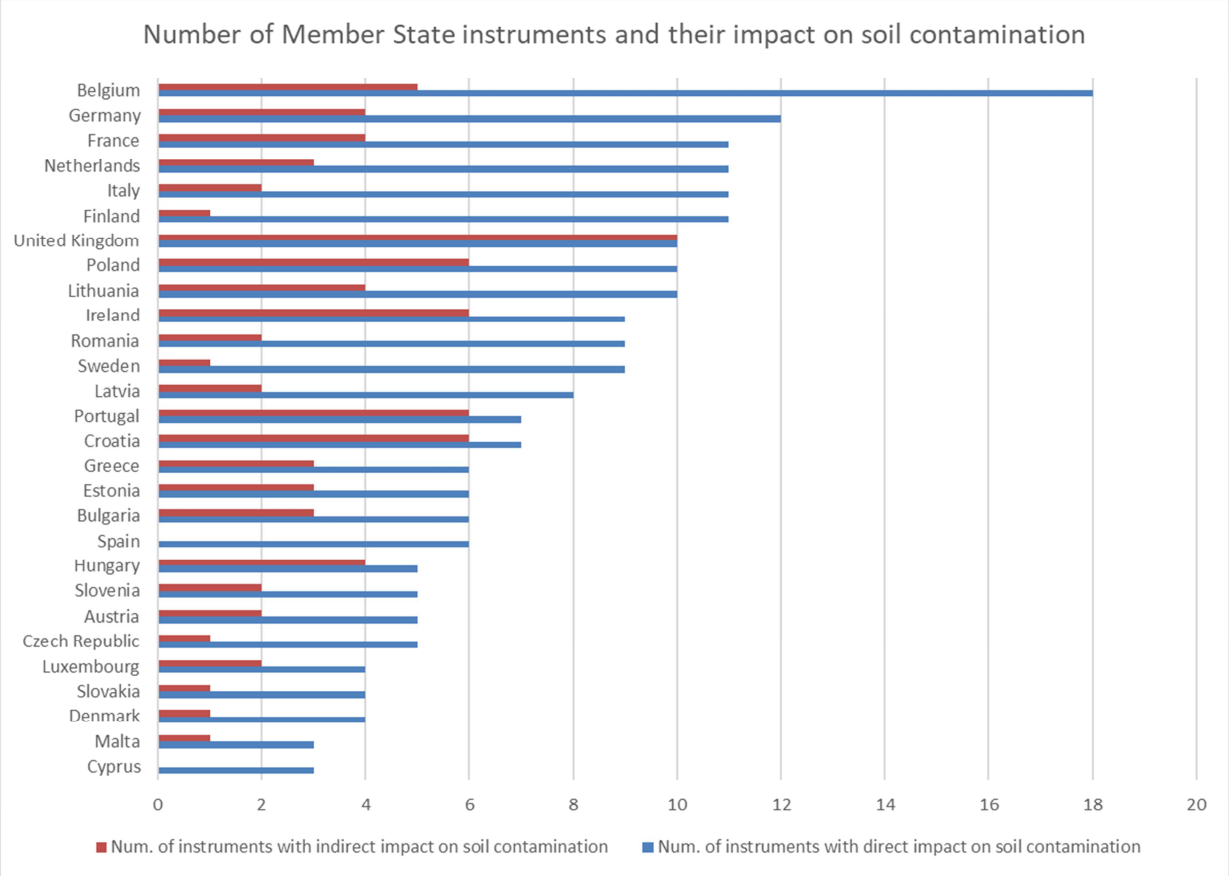
2.3 National legal tools addressing soil contamination

The aforementioned inventory identifies 671 instruments across the EU-28 (sometimes at regional level), of which nearly half are directly linked to EU policies (45 %), where implementation is mandated by EU law (the *acquis*). Another 21 % are linked partly to EU binding instruments, which means that they implement the EU binding legislation but also go beyond the *acquis* in either the degree of ambition that they set for EU requirements or they regulate additional areas that do not derive from the EU *acquis*. This means that a total of 225 identified instruments (35.5 %) are 'nationally initiated' policies, i.e. policies partly linked to EU non-binding policies or not linked to any EU requirements (Ecologic Institute, 2017).

A significant proportion of national instruments (44 %) explicitly address either directly (215 instruments) or indirectly (85 instruments) industrial and point-source soil contamination (Figure 5). Of the 215 instruments explicitly addressing soil contamination, 143 are linked to EU policy and 72 are national legislation not related to EU policies, which demonstrate the importance of this issue at national level for most Member States and indicates to some extent the legal vacuum of EU policy (Figure 5). However the distribution of nationally initiated instrument is uneven with a large concentration in some which have a very strong national legislation on soil contamination and on the other side, a lack of specific national legislation in others.

The general approach for discussion of soil contamination makes a distinction between source-oriented soil protection and contaminated-land management. Source-oriented soil protection aims to prevent (further) contamination of the soil, whilst contaminated-land management deals with the clean-up, remediation and reuse of soil which is already contaminated, often as a result of past activities. For the analysis presented here, the contaminated-land-management legal tools are considered to address soil contamination explicitly or with a direct impact on soil contamination, while the soil-protection legal tools are considered to address soil contamination indirectly.

Figure 5. Number of national policies that explicitly (directly) or indirectly address contamination of industrial and point sources (CIPS) (based on information provided in DG Environment Soil wiki platform) ([46]).



Nowadays, every EU Member State has a national policy that includes the PPP in compliance with EU treaties (either a specific policy or regulations included in a more generalist environmental code). They also include contamination-related definitions, screening values, RRM and guidelines for site identification.

In the European Union, 24 national policies explicitly address soil contamination and its remediation in specific legislation. Generally, all these regulations aim to prevent harmful changes in the soil and the rehabilitation of contaminated soils and groundwater (considered in many cases to be part of the soil system or to be intimately related to it). In some cases preventing air contamination by emissions is also included under specific legislation on soil contamination.

Many Member States have developed overarching instruments such as national plans or codes that implement at the same time multiple EU directives in order to facilitate the applications of these laws. The most relevant examples are the environmental code of **France**, which implements 17 EU instruments, the **Swedish** environmental code that implements 12 EU directives, or the proposal of a **Dutch** environmental and planning act, that, when approved, adopts 20 EU legal instruments.

The adoption by the European Parliament of the water framework and landfill directives represents a crucial point in the development of many of the national legal instruments addressing soil contamination specifically (Table 3). These two directives are implemented by 24 % of the 215 national policies explicitly addressing soil contamination included in the Soil wiki.

([46]) https://webgate.ec.europa.eu/fpfis/wikis/display/SOIL/Home

Despite the non-binding character of the thematic strategy for soil protection (STS), up to 40 national legal tools are adopting its goals and directives.

Norway was the first of the 39 countries considered in this report to enact a pollution control act, in force since 1981. It was the first reference in Europe aiming to protect the environment against contamination.

The **Dutch** soil protection act was adopted in 1987 with the main objective of setting out the accountability of individuals: for each case of soil contamination, which parties are fully liable. This national instrument was the first one adopting the liability for environmental damage in Europe. The **Austrian** CS-remediation law (entered into force 2 years later, in 1989) aims to ensure the availability of funds for remediation of historical CSs.

However, there are some examples where, in spite of not having specific legislation, many efforts have been carried out for CS protection and remediation. In **Finland**, the efforts for CS identification and management began in 1989 with the Samase project (Saastuneiden maa-alueiden selvitys- ja kunnostusprojekti) (Jarva, 2016). Soil pollution has been prohibited by the waste legislation since 1994 and the obligation to inform, investigate and remediate polluted areas is provided for in that legislation. Nowadays, soil contamination falls under the EPA, which came into force in 2000.

EFTA member, **Switzerland**, has two different ordinances to regulate soil contamination: the soil ordinance for diffuse soil contamination and the contaminated-sites ordinance for point-source soil contamination (with a limited extent).

In EU Member States **France**, **Italy**, **Malta** and **the United Kingdom** provision on CS identification, definition, management and remediation are comprised in national environmental codes.

Italy approved its first regulation on soil contamination in 1999 (Decreto Ministeriale 471/99). This regulation was revised and included under the environmental code in 2006 (Decreto Legislativo 152/06), currently in force. This specific regulation includes five technical annexes on risk assessment, characterisation, remediation techniques, soil and groundwater screening values.

Belgium (Flanders) adopted its first decree on soil remediation and soil protection in 1995. Its main goal was to deal with past soil contamination, over a period of 40 years, starting in 1996. It includes the provision of CS registering and establishes the figure of soil certificates as an information tool to establish the quality and the status of the soil. This decree was revised in 2006, entering into force in 2008, and its main improvements are the simplification of the administrative procedures and the regulation on excavated soils.

The federal soil-protection act adopted by the **German** government in 1998 aims to protect and restore the functions of the soil. This legislation has a strong preventive basis but also specifies the risk-assessment procedures and steps to be followed for investigation and remediation.

Four Member States have proposed legislation on soil contamination under adoption procedure, namely **Greece**, **Poland**, **Portugal** and **Slovenia**. However, the inexistence of a specific regulation does not mean that no assessment has been made until now. In **Poland**, since 2001, soil protection (and in particular, soil contamination) has been included within the EPA.

Slovenia has, since 1996, a decree on limit values, alert thresholds and critical levels of dangerous substances in soil, which established the threshold values above which further investigation or RRM must be applied. The decree on the status of soil together with the rules on soil-status monitoring aim to establish harmonised rules to soil sampling and site-status characterisation. However, some CSs with high relevance to Slovenia have been managed since 2006, when the resolution on the national environmental action plan entered into force.

The law adopted by the **Luxembourg** government on 1999 on classified establishment determines the need for investigation after cessation of certain activities and regulates the permits for remediation works. However, this legislation does not leave legal room for risk-based land management.

In candidate country, **Turkey**, the law on soil-pollution control and point-sourced polluted fields, published 8.6.2010, entered into force 8.6.2015. The by-law provides a methodology for CS identification, recording and cleaning. The inventory is populated with information on point-sourced polluted fields from the polluted-areas information system.

Table 3. Overview of national policies and EU directives addressing specifically soil contamination and the dates of entrance into force.

EU directives	Year	National Laws addressing soil contamination
Sewage-sludge directive	1986	
	1987	Netherlands — Soil-protection Act
	1988	
	1989	Austria — Law on the remediation of contaminated sites
	1990	
Nitrates directive	1991	
Habitats directive	1992	
	1993	
	1994	Finland — Waste Act
	1995	Estonia — Contaminated-site management Belgium (Flanders) — Decree on soil remediation and soil protection Switzerland — Environmental Protection Act (EPA)
	1996	Hungary — Decision No 2205/1996 (VII.24) adopted the national environmental remediation programme (before being part of EU) Slovenia — Decree on limit values, alert thresholds and critical levels of dangerous substances into the soil
	1997	
	1998	Germany — Federal soil-protection Act
The landfill directive	1999	Denmark — Act on soil contamination Italy — Regulation laying down criteria, procedures and methods for the safety, reclamation and restoration of polluted sites Luxembourg — Law on classified establishment
Water framework directive	2000	France — Environmental Code United Kingdom — Contaminated-land Regime (Part 2A of environmental-protection act, 1990) Finland — Environmental Protection Act
Strategic environmental assessment directive	2001	Latvia — Law on pollution
	2002	Cyprus — Water- and soil-pollution control Law
	2003	
Environmental liability directive (ELD)	2004	Belgium (Brussels-Capital) — Ordinance on the management and clean-up of soils Belgium (Wallonia) — Decree on the management of soils Slovakia — Soil-protection Act Sweden — Regulation on compensation for contamination damage and state aid for remedial (implementing Swedish environmental code of 1999)
	2005	Hungary — Decree on rules concerning the screening surveys of remedial site investigation Spain — Decree on defining soil polluting Activities and criteria
Thematic strategy for soil protection Waste-management extractive industries directive	2006	Ireland — Energy Act. Historic mine sites — inventory and risk classification Italy — Environmental Code Lithuania — Regulations on contaminated-sites treatment procedures
	2007	Bulgaria — Soil Act Finland — Government Decree on the assessment of soil contamination and remediation needs Romania — Decree on remediation Slovakia — Act on the prevention and remedying of environmental damage
Waste framework directive	2008	Czech Republic — Act concerning the prevention of environmental harm and its rectification
Pesticides directive	2009	Belgium (Brussels-Capital) — Decree on soil remediation and soil management of 5 March 2009 amended 23 June 2017
Industrial emissions directive	2010	Serbia — Regulation on the programme for systematic monitoring of the soil quality, indicators for evaluation of soil degradation and methodology for preparation of remediation program
Environmental-impact-assessment directive Biodiversity strategy	2011	Spain – Law on waste and contaminated soils
	2012	Malta — National Environment Policy
	2013	
	2014	Croatia — Ordinance on the protection of agricultural land against pollution
	2015	Serbia — Law on soil protection
	2016	
Mercury regulation	2017	Greece — Law for the protection and sustainable use of soil (under preparation) Poland — Assessment of the land surface contamination (under preparation) Portugal — Contamination prevention and soil-remediation legal regime (under preparation) Slovenia — Decree on status of soil and rules on soil status (under preparation)

3 Progress in the management of contaminated sites in Europe

Progress in the management of soil contamination, and the knowledge base, is very different between national legislations and different also even at the regional level. This is mainly caused by the different starting dates of relevant policies: some introduced the relevant legislation one or two decades earlier than others. At a regional/provincial level, larger variability is due to non-homogeneous administrative procedures in place that may be highlighted whenever planning/remediation/and licensing relies on local authorities' responsibilities. There are also some examples of there still being no specific national legislation to address soil contamination. There is a general commitment to harmonisation in order to increase the quality of the information provided by the indicators. This can be achieved by using standardised definitions, specifying the data that are required and the standardised methods of sampling and analysis to be used for acquiring them (European Commission, 2006).

3.1 Extent of local soil contamination in Europe

A questionnaire with the request for data was sent to the 33 EEA member countries (EU-28 together with Iceland, Liechtenstein, Norway, Switzerland and Turkey) and the six EEA cooperating countries in the western Balkans: Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Montenegro, Serbia as well as Kosovo ([47]).

There were 31 respondents to the questionnaire (Figure 6), which represents more than 80 % of total population and about 91 % of total artificial surface in Europe (Table 4). Of the EU-28, 27 have answered the questionnaire. **Poland** replied the questionnaire but did not provide number of sites under different site statuses because there is no registry of such data available yet. **Turkey** and **Greece** have provided limited information (Annex3-Table 10).

The number that did not respond to the questionnaire means that caution is needed in interpreting the results and reaching overall conclusions. It should also be noted that those that did reply to the questionnaire did not all respond to every question. Furthermore, Belgium, Italy, Spain and the United Kingdom keep regional management systems and it has not been possible to collect data for all their regions. The data provided by **Italy** covers 17 regions and one autonomous province out of 19 regions and two autonomous provinces, whereas the information submitted by the **United Kingdom** encompasses data for 197 of 326 local councils (60 %) of England; the information on Scotland, Wales or Northern Ireland was not available at the time of replying to the questionnaire. For **Belgium**, the three regions (Flanders, Brussels-Capital and Wallonia) replied to the questionnaire, but only Flanders and Wallonia provided complete information on the number of sites in each management status. Only the artificial surface area of Flanders and Wallonia has been taken into consideration for the calculations. In **Spain**, only 50 % of the 19 autonomous regions provided updated information, the rest was estimated by the Spanish ministry of agriculture and fisheries, food and environment.

Estimates were provided by 14 respondents for the extent of local soil contamination, representing about one third of the number surveyed. All those respondents are from the European Union.

([47]) This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

Figure 6. 31 replying out of 39 surveyed, with their membership (EU, EEA, EEA cooperating countries in the western Balkans).

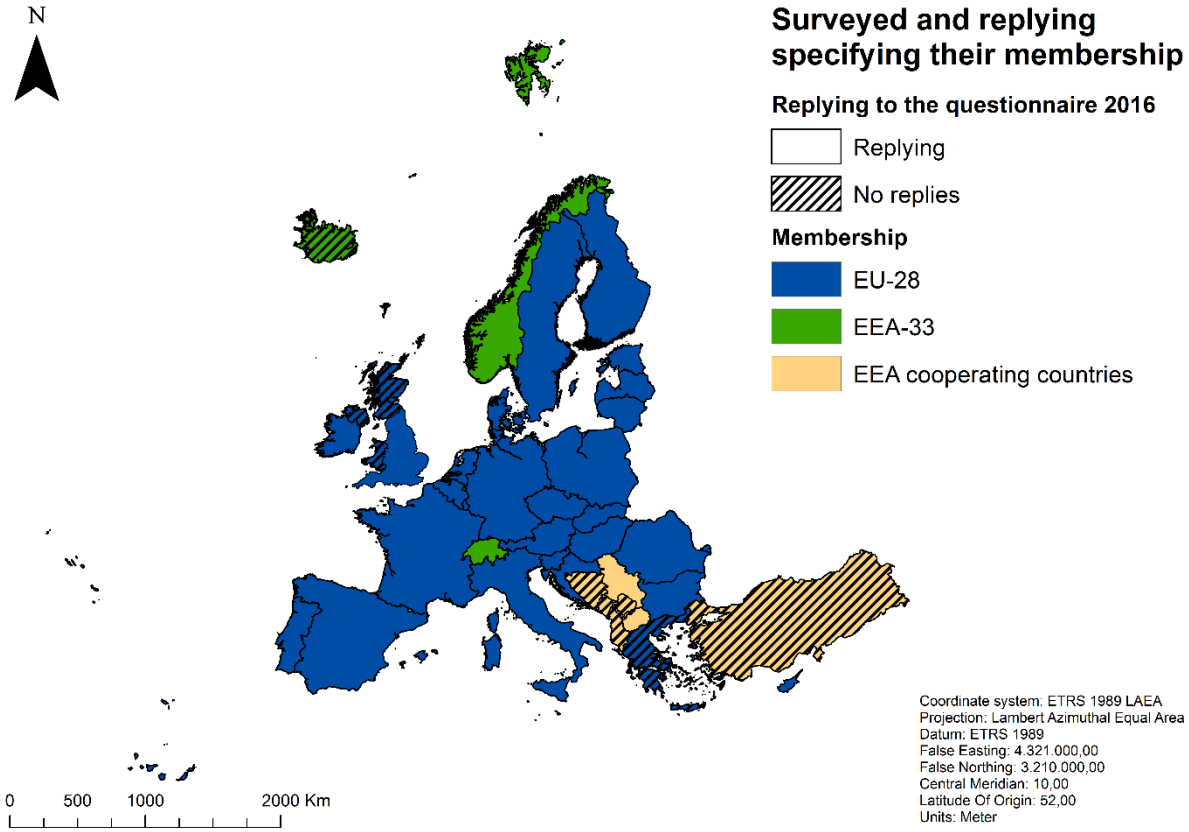


Table 4. Population and area data for those surveyed.

	Replying	Surveyed
Countries	31	39
Population (million inhabitants)	513.4	621.2
Total surface area (thousands of km^2)	4 869.6	5 994.9
Artificial surface (thousands of km^2)	217.7	239.1
Surveyed of total population (%)	83	100
Surveyed of total artificial surface (%)	91	100

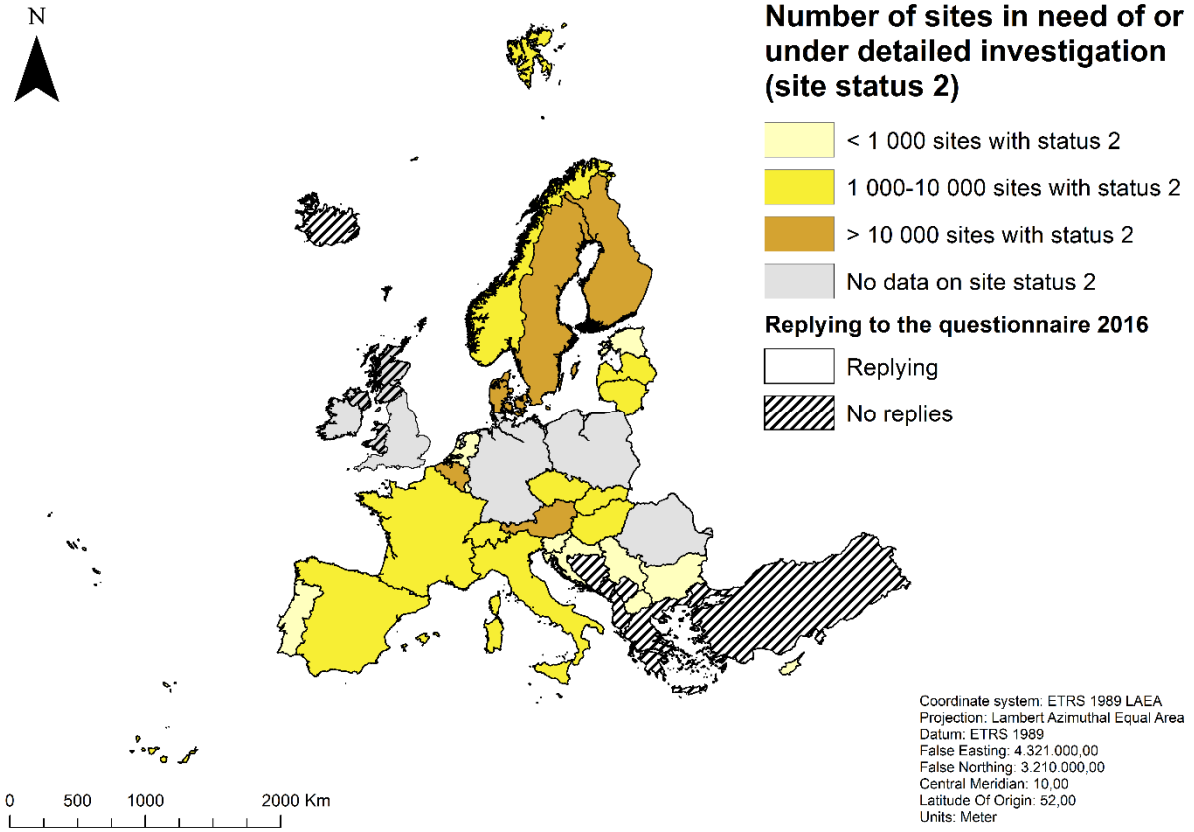
No information is available for the non-EU-28 respondents related to the estimated number of PCSs, for that reason, an extrapolation to the whole of Europe (39 countries), would underestimate the potential number of CSs.

For the EU-28, an **estimate** of around **2.8 million sites where polluting activities took/are taking place** is obtained.

In Europe, 29 respondents provided the number of registered sites where polluting activities took/are taking place, representing an average density of 3.6 registered sites/km^2 of artificial surface in their inventories (Table 5, Annex3 - Table 11). Significant progress has been achieved on the **identification of sites** where polluting activities took/are taking place (Table 5, Annex3 - Table 11), with 694 000 sites already identified

and registered in national and/or regional inventories (see section 2.4). Of them, more than 240 000 sites are in need of or under detailed investigation in order to identify whether contamination is creating a significant risk to human health and the environment (site status 2). Of the 26 respondents to this question, 10 have 1 000 or more sites still requiring detailed inspection and five (**Belgium** (Flanders and Wallonia), **Denmark**, **Austria**, **Finland** and **Sweden)** have more than 10 000 sites that need further investigation (Figure 7).

Figure 7. Number of sites that need or are undergoing detailed investigation (site status 2).



Around 19 % of **registered sites** in Europe need, or might need, remediation or risk-reduction measures, including natural attenuation (site status 4).

However, a significant effort is being made to reduce or remediate these polluted sites with more than 14 400 sites under remediation or RRM (site status 5) as reported by respondents.

There are **85 000 sites** where soil contamination was suspected, but after detailed investigation it has been determined that there is no need for RRM or remediation, as reported by 20 respondents, but an estimate of about 122 000 sites in EU-28 might be in this situation (site status 3) based on extrapolation by artificial surface.

Currently, respondents have reported around **65 500 sites that have already been remediated** or are under aftercare measures.

However, this number could be higher because in some countries these sites are removed from national inventories once it has been confirmed that pollutant levels are below established screening values or they do not pose a risk to the environment and human health, as is the case in **France**.

Table 5. Site-status data in Europe.

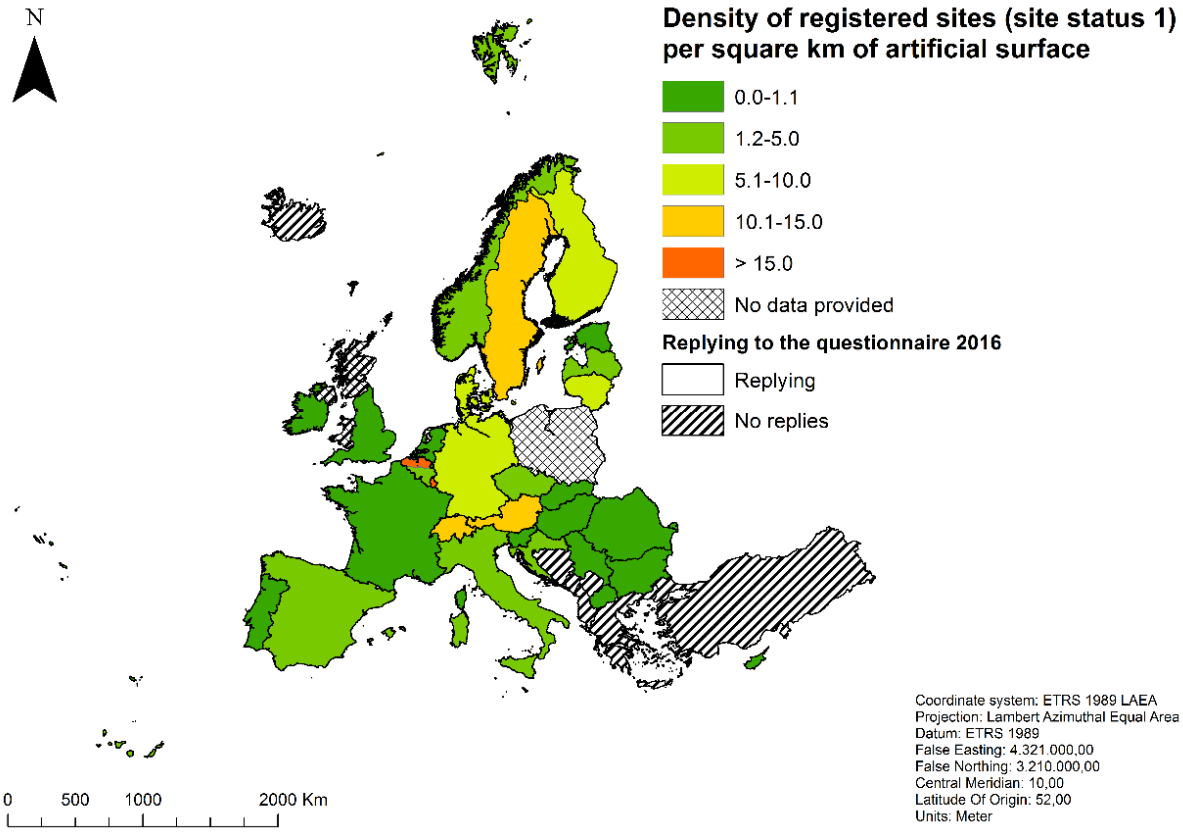
Site status	Europe (39 surveyed)			EU-28		
	Respondents	Reported sites	Total estimates	Respondents	Reported sites	Total estimates
1 — Sites where polluting activities took/are taking place						
Sites where polluting activities took/are taking place per km² of artificial surface: estimated				13	10.4	
Sites where polluting activities took/are taking place per km² of artificial surface: registered	29			25	4.0	
Sites where polluting activities took/are taking place: estimated				13	1 539 661	2 800 000 (*)
Sites where polluting activities took/are taking place: registered	29	694 243		25	648 964	
2 — Sites in need of investigation/still to be investigated or under investigation where there is a clear suspicion of contamination						
2a — Sites in need of investigation	24	178 617		20	170 215	362 360 (*)
2b — Sites under investigation	20	68 042		17	67 839	
3 — Sites that have been investigated, but no remediation needed						
3 — Investigated sites but no remediation needed	20	85 093		19	78 193	122 250 (*)
4 — Sites that need or might need remediation or risk-reduction measures (RRM), including natural attenuation						
4a — Sites where remediation is needed	26	48 737		22	45 420	
4b — Sites where remediation might be needed	19	82 530		16	80 304	148 301 (*)
5 — Sites under/with ongoing remediation or RRMs						
5 — Sites under remediation	26	14 446		23	14 155	
6 — Site remediation or RRMs completed or sites under aftercare measures						
6 — Remediated sites (RS)	27	65 546		23	63 089	

(*) Based on extrapolated data for total artificial surface of EU-28.

When the artificial-surface information from each respondent is analysed in detail (see Annex 3-Table 10) it becomes clear that respondents that have been systematically addressing soil contamination and that have inventories, have a higher density of registered sites than those that have only recently begun to identify and record CSs (Figure 8). **Luxembourg** presents a high density of registered sites, but not all should be considered as CSs, since in there a wide range of potentially polluting activities are considered in the inventory, e.g. every oil tank above 300 l is registered. However, its administration is working on new criteria to be applied within the scope of a future soil-protection law and so the high number of sites will be reduced. **Austria**, **Sweden** and **Switzerland** show high densities of registered sites where polluting activities took/are taking, which can be explained by the nationwide surveys carried out in the past and the fact that they have already completed the inventories of sites where polluting activities took/are taking place.

Figure 8 shows a low number of sites for certain respondents where it would be expected to be higher due to their industrial past. For example, in the **United Kingdom**, where coal mining dates back to Roman times, the low number of registered sites (600 sites, Annex 3-Table 10) may be explained by the relatively recent legislation, which dates from 2000, while the estimated number of sites where polluting activities took/are taking place is considerably higher (325 000 estimated sites). It must be taken into account that only the artificial surface of England has been considered for obtaining the density, as information is only available for England. Estimations are not provided for Northern Ireland, Scotland and Wales.

Figure 8. Density of registered contaminated sites per km^2 of artificial surface in Europe.



NB: The density of contaminated sites per km^2 of artificial surface in Ireland was calculated using the number of sites in site status 4 (in need of remediation) instead of the total number of registered sites, as there is no national register.

In the **Netherlands**, despite legislation on soil remediation dating back to 1983 and a list of over a thousand potential-polluting activities, there is no formal national record of the sites where such potentially polluting activities took/are taking place. Local and regional authorities keep records of classified sites based on their past and present activities (uniform source classification of potential-polluting activities/*Uniforme Bron Indeling potentieel bodemvervuilende activiteiten* (UBI system)), indicating the likelihood of encountering soil and groundwater contamination. The present inventory of sites in need of remediation or risk management is a result of past exercises of site investigation.

On the other side, those without a national CS programme have a low density of identified sites where polluting activities took/are taking place due to lack of legal regulation promoting data collection, for example, this is the case of **the former Yugoslav Republic of Macedonia**. In **Portugal**, those sites under the scope of Seveso and IPPC directives have been identified, but there are also other potentially contaminating activities not considered within the scope of these two directives. In **Croatia,** reliable information is only available related to hot spots, though the information contained in the database on potentially contaminated and contaminated localities (GEOL) has not been updated or verified since 2007.

In **Ireland**, due to the absence of heavy industry in the past, the number of CSs is very low. **Ireland** reported not having a comprehensive CS register, but did report the number of sites requiring further investigation, taking into account historical landfills that may require further investigation. For reference, the ratio of CSs per artificial area there has been calculated using the number of sites that need investigation or remediation (site status 4), although they are not officially registered.

In **Italy**, potentially polluting activities are not set out in existing legislation and there is no legal obligation to collect information on the sites where polluting activities took/are taking place. For the scope of this report, the number of sites where management procedures have been initiated included in regional registers (17 regions and one autonomous province out of a possible 19 regions and two autonomous provinces) has been used, which implies an underestimate of the total number of sites at the national level.

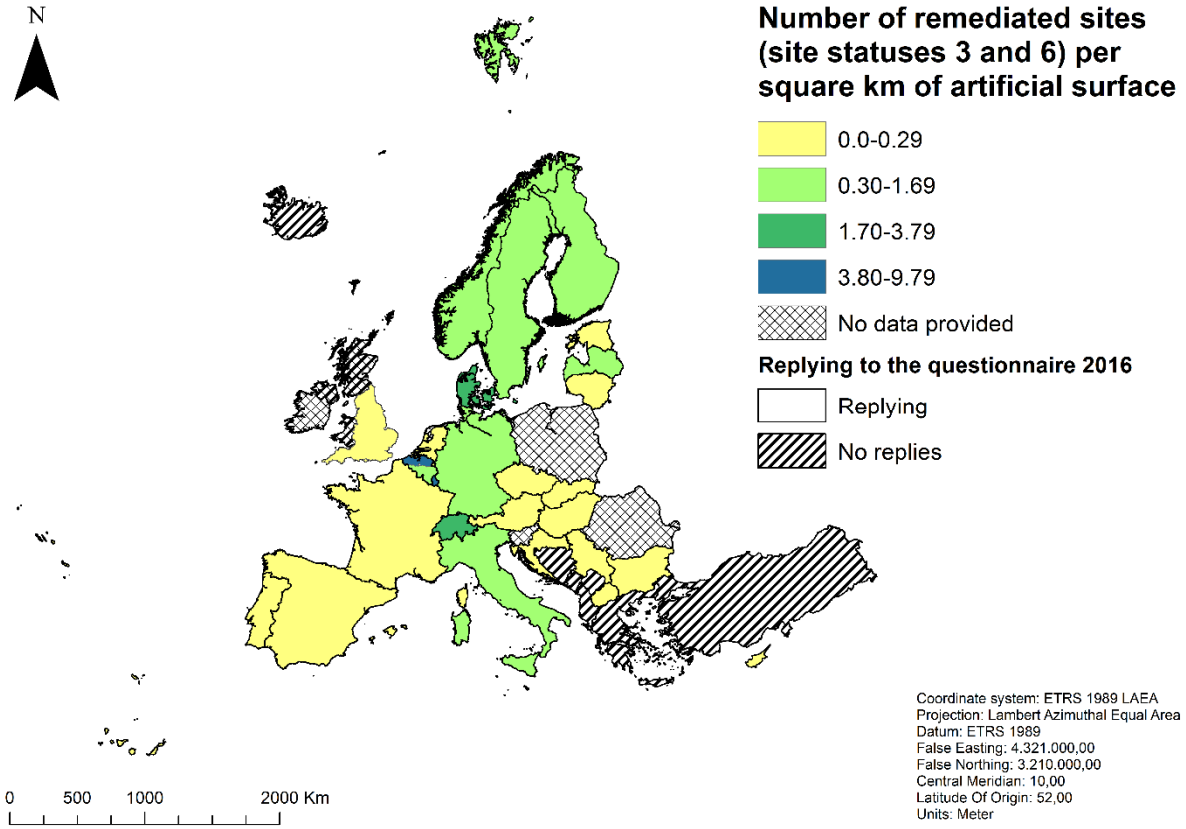
Significant differences can be observed between the regions of **Belgium** when analysing the density of sites where polluting activities took/are taking place in relation to the artificial surface (Figure 8). Despite the fact that **Belgium (Wallonia)** started to assess soil contamination in the late 1960s with the development of several inventories, the higher density of artificial surfaces in **Belgium (Flanders)** and the existence of a Flemish soil decree (approved more than 20 years ago) requiring the investigation of all sites where there are justified indications of soil contamination, have led to a higher number of registered CSs. However, it has been determined, after a preliminary investigation, that there is no need to remedy many of the sites included in the register.

It is important to highlight that **Sweden** and **Switzerland** have already completed the identification of all sites where polluting activities took/are taking place in all their territory.

Belgium (Flanders) and **Luxembourg** reported the highest density of sites in statuses 3 and 6, followed by **Denmark** and **Switzerland** (

Figure 9). **Germany** and **Finland** adopted their national legislation on soil contamination at the end of 20th century and they have made significant progress in CS investigation and remediation, as shown in the high number of remediated sites (RDs), with more than one remediated site per km^2 of artificial surface (see Annex3-Table 12).

Figure 9. Number of remediated sites (site status 6) or sites that have been investigated but no remediation is needed (site status 3) per km^2 of artificial surface.

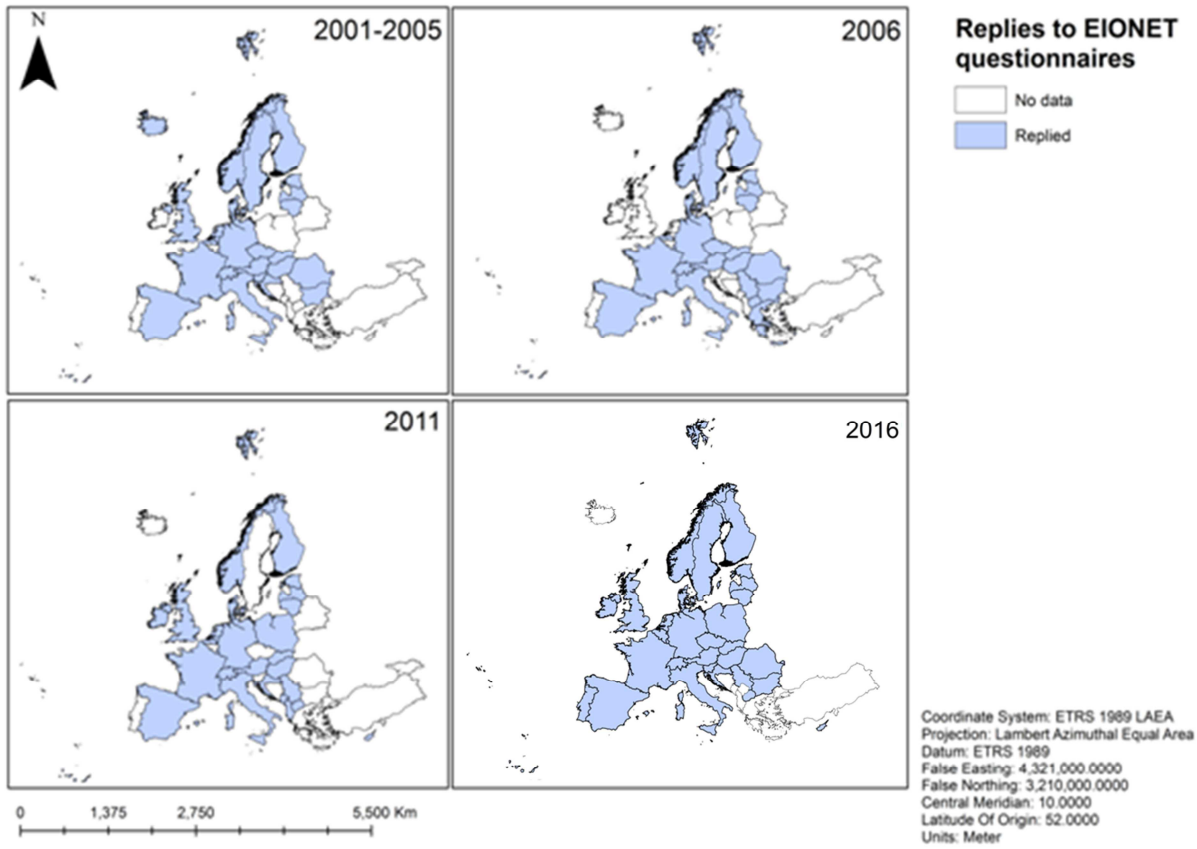


3.2 Progress in the management of local soil contamination

According to the agreement reached by the NRCs Soil (2016) on the *Proposal for the revision of the indicator of progress in the management of contaminated sites*, 2001 is considered as the baseline or starting year. However, not all countries reported the first data that year, but in consecutive years (2002 to 2005), therefore the baseline is presented as 'Eionet data-collection period 2001-2005'. For countries that participated for the first time in the Eionet data collection in subsequent years (2006 or 2011) that year should be considered as the baseline (

Figure 10**Error! Reference source not found.**).

Figure 10. Participation of countries in each of the Eionet data-collection exercises.



This report aims to analyse progress in the management of sites where polluting activities took/are taking place. To achieve this objective, the new data (2016 questionnaire) and the data available from the last questionnaire (2011) have been compared for each country, following the correspondence between management steps and site status, as described in Table 1.

Progress is analysed on a respondent basis and, because of the remaining uncertainties, cross-country comparisons should be avoided.

Error! Reference source not found. represents the progress of each management step or site status by respondent since 2011. Progress in the management of local contamination is highly heterogeneous, with some respondents very advanced in

identifying and registering the problem and others only at very early stages. However, there is a clear positive trend in Europe.

Since 2011, more than 76 000 new sites have been registered in 12 respondents, namely **Austria**, **Belgium (Flanders)**, **Croatia**, **Estonia**, **Finland**, the **former Yugoslav Republic of Macedonia**, **Italy**, **Lithuania**, **Malta**, **Norway**, **Serbia**, and **Switzerland** (see Annex 3-Table 13).

A reduction in the number of registered sites where polluting activities took/are taking place (site status 1) can be observed for several respondents, such as **Cyprus**, **France**, **Germany**, the **Netherlands**, **Hungary**, **Slovakia** and **Spain**. This difference can be explained because over the past decade there have been changes in the criteria for defining an activity as potentially polluting to include a site in the national inventory. For example, certain industrial activities are now covered under the umbrella of other legal instruments, such as the IED or the waste directive, and are no longer considered polluting activities in national soil-contamination regulations. This is the case of **Slovakia**, where the management of small landfills has been included under the waste act, therefore, after 2012, those sites were removed from the CS inventory. **France** has reported that ports and former military sites are no longer counted as polluting activities. The same happens in **Austria,** where airports, ports and military sites are not considered as polluting activities either. These differences between respondents in the industrial activities that are considered polluting make the comparison between them impossible, and the progress made since the start of data collection can only be set by respondent.

Furthermore, the reduction in the number of sites where polluting activities took/are taking place may also be due to the existence of dynamic inventories. For example, in **France**, when a site has been remediated it is removed from the national inventory (Basol: see §2.3) and it is then transferred to the historical regional inventory (Basias) to keep track of it.

Belgium (Flanders), **Denmark, France, the former Yugoslav Republic of Macedonia, Lithuania, Malta, Serbia, Slovakia, Spain** and **Switzerland** have reported a significant increase in those sites that are in need or under detailed investigation, accounting for 97 000 new sites under Status 2 (Annex 3-Table 13).

Since 2011, around 27 000 new sites have been identified to be in need of remediation. Most of these sites have been reported by **Finland**, but progress has also been made in **France**, the **former Yugoslav Republic** of **Macedonia**, **Ireland**, **Latvia**, **Malta**, **Serbia** and **Spain.**

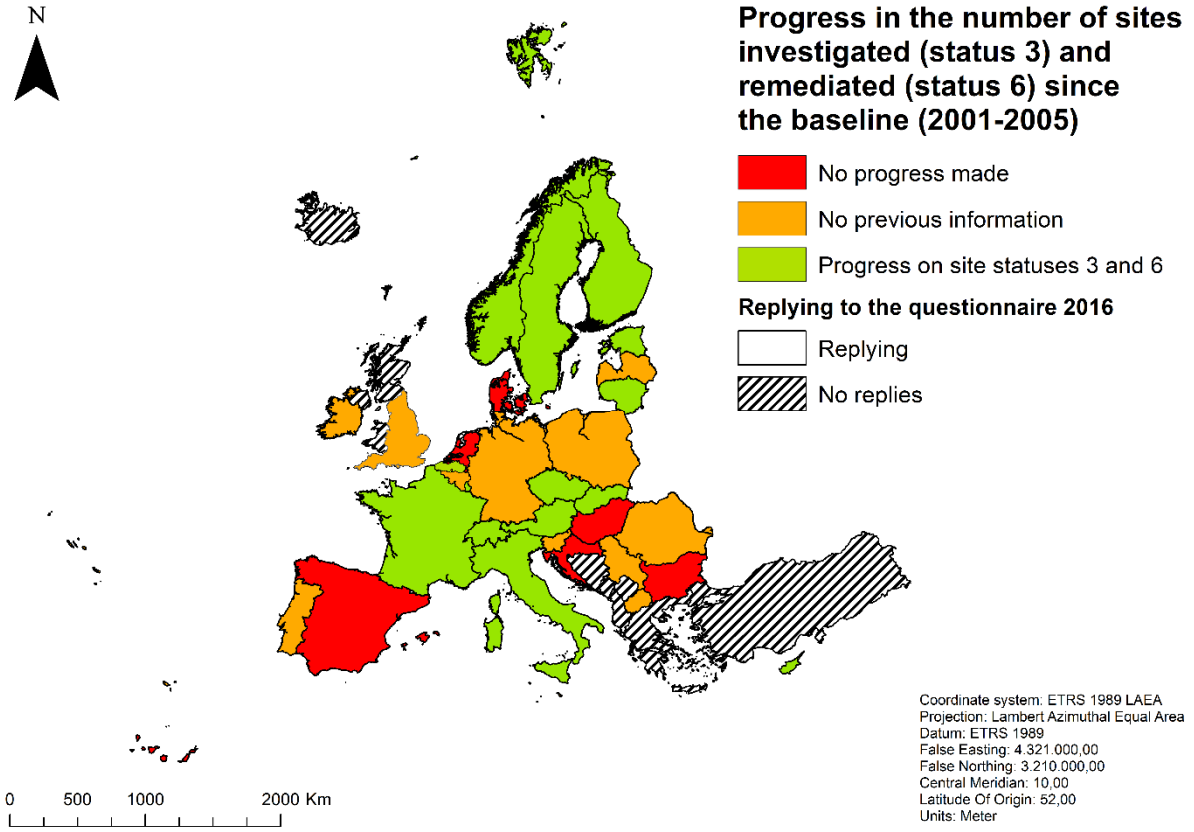
Error! Reference source not found. shows that significant progress has been made in the final management steps, as the number of sites under remediation or with ongoing risk-reduction measures (site status 5) and those already remediated (site status 6) or investigated, but where remediation is not required (site status 3), have increased since 2011.

2 200 new sites undergoing remediation (site status 5) have been reported since the last process in 2011, for the nine respondents that provided information in both exercises. However, **Belgium (Flanders)**, **Estonia**, **Italy** and **Slovakia** reported a reduction in the number of sites under remediation**.**

Over the past 5 years, 12 respondents have shown an increase of more than 17 800 new RS (**Error! Reference source not found.**). **Belgium (Wallonia)** and **Portugal** have provided data for the first time and therefore no progress can be estimated, but 1 593 and 83 sites have been reported as remediated respectively. **Bulgaria**, the **Czech Republic, Denmark, Estonia, Finland, Hungary,** the **Netherlands, Norway, Slovakia, Spain** and the **United Kingdom (England)** have reported that they have remediated fewer sites than in previous exercises.

Error! Reference source not found. The number of sites that have already been remediated (site status 6) or that have been investigated and do not need to be remediated (site status 3) should always increase. However, when comparing the number of sites with completed measures (site statuses 3 and 6) reported in the baseline with the number of sites reported under site statuses 3 and 6 in 2016, six of the 19 respondents with available information for these site statuses (site statuses 3 and 6) for both exercises (2001-2005 and 2016) have reported a decrease in the number of RS, namely **Hungary**, **Bulgaria**, **Croatia, Denmark**, the **Netherlands** and **Spain** (Figure 11). Caution should be taken in this case, as explained above, due to changes in the concepts of site status since the first data compilation, which could lead to significant differences in numbers. In **Hungary** the lack of a long-term and continuously available budget and the existence of an unstable structural system have been identified as the main obstacles to progress in CS management.

Figure 11. Progress in the remediation of contaminated sites comparing new data (2016) with the data provided in the baseline.



As the Table 3 shows, legislation to address soil contamination is adopted at different times, and sometimes no specific legislation exists yet. The existence of legal instruments has proved to be a determining factor in making progress in CS management. Thus, Figure 11 shows that where soil contamination has been addressed for more than two decades, significant progress in CS remediation has been made, thanks to comprehensive inventories.

There is also a clear influence of the availability of funds to initiate and continue remediation projects. As indicated in Section 2, some European funding mechanisms, such as the ERDF, have been used to remediate heavily contaminated sites in **Bulgaria**, **Croatia**, **Cyprus**, **the former Yugoslav Republic of Macedonia**, **Slovenia** and **Serbia**.

3.3 Inventories

Ten years after the adoption of the STS, in which the Member States committed to draw up an inventory of CSs (European Commission 2006, Art. 10), some progress has been achieved, but significant gaps remain to be addressed in the coming years.

The STS sets out the steps to be taken to develop CS inventories, beginning with the definition of what constitutes a CS and the identification of potentially polluting activities.

Many countries started national strategies in the 1980s and 1990s and have already developed their CS inventories, based on their own consideration of potentially polluting activities, taking into account their major industrial activities. There are still considerable differences between countries in the scope, CS definition and the list of potentially polluting activities.

According to previously available information and new data provided by respondents, 28 of the 39 surveyed maintain comprehensive inventories of contaminated sites, of which 19 have centralised national inventories (Figure 12) (JRC, 2014).

Seven collect and manage their inventories at regional and/or local level, namely the **Czech Republic**, **Denmark**, **France**, **Spain**, **Switzerland**, **Latvia** and **Romania**. Seven others, namely **Belgium**, **Bosnia**-**Herzegovina**, **Germany**, **Hungary**, **Italy**, **Sweden** and the **Netherlands**, manage their inventories at the regional level, although in many cases they are compiled according to national guidelines and final information is often collected by national agencies. In **Belgium**, each region has its own legislation and is responsible for specifying the methodology and managing the inventory, but recent progress has been made in harmonising the country´s legislation. In the **Czech Republic**, regional inventories are carried out in regions with specific requirements and do not maintain a common structure.

With a few exceptions, all inventories include polluting activities, sites where polluting activities took/are taking place, sites where there are justified indications of contamination, and CSs. Since the last analysis of the CS situation in Europe, **Cyprus** has developed its national CS register. It is important to note that in some countries, although the responsibility for collecting CS information lies with regional authorities, national coordination makes harmonised data available, for example in **France**, the **Czech Republic**, **Hungary**, the **Netherlands**, **Norway**, **Sweden** and **Switzerland**.

Ireland does not maintain a CS inventory, but there is a register of historical waste-disposal sites, managed by the environmental protection agency and recorded by local authorities in accordance with the waste-management legislation ([48]). In addition, an inventory of Ireland's historic mine sites was set up in 2009 (EPA, 2009). Other inventories of certain activities are also maintained.

Slovenia and the **former Yugoslav Republic of Macedonia** have reported that they do not have a comprehensive inventory or register of sites where polluting activities took/are taking place. However, both countries have included CS data in other registers under different directives and national legislation. In **the former Yugoslav Republic of Macedonia**, most of the activities related to the identification and financial analysis of CS remediation were based on research on soil degradation and protection, as was undertaken in the *Case study on industrial contaminated hot spots* and the *Study on closure/reclamation of non-compliant municipal landfills in the* [former Yugoslav] *Republic of Macedonia* (Ministry of environment and physical planning, the former Yugoslav Republic of Macedonia and Swedish environmental protection agency, 2012). These two studies were developed under the national project 'Waste-management plan and feasibility study' financed by the European Union and executed through the European Agency for Reconstruction in 2005.

In **Italy**, although there is no list of potentially polluting activities in the current legislation used for CS identification, the identification procedure is associated with refineries, chemical plants, steelworks and asbestos production or extraction sites. In addition, a preliminary investigation begins when an event occurs that may cause contamination of soil and/or groundwater or when historical contamination is discovered. It is important to highlight that the regional inventories in **Italy** include sites in need of investigation and remediation, where management procedures have already been initiated, but do not take into account sites where polluting activities took/are taking place, since there it is not legally required to register sites where polluting activities took place, but only sites under management.

Poland and **Portugal** have indicated that regional and national authorities are preparing comprehensive inventories respectively. In **Portugal**, the forthcoming legislation on contamination prevention and soil remediation, if adopted as proposed, provides for a national CS inventory. Nevertheless, an inventory of former mining sites, which have

([48]) Waste-management regulations S. I. No 267/2001.

been environmentally rehabilitated by a state-owned company, was made in 2003/2004 and an inventory of industrial orphan sites was made in 2008. In **Poland**, the county government is obliged to submit to the regional directorate for environmental protection the list of potential historical soil surface contamination by October 2018.

Croatia does not yet have an inventory of sites where polluting activities took/are taking place: some inventories or databases have been developed for specific projects (waste-management strategy of the Republic of Croatia (Official Gazette (OG) No 130/05)), but they cannot be considered official because they were not regularly updated nor legally established.

In the **United Kingdom**, local councils are required to have a written inspection strategy describing their approach to CS identification in their areas. Their inspection strategy is reviewed every 5 years on average, but they do not routinely record CS information.

Malta has been compiling a CS list since 2012. This list is constantly being updated, but the information is not yet publicly available. This process is managed at national level.

The **Spanish** Soil Decree (2005) and the set up a national inventory of contaminated soils, establishing the obligation to declare all CSs. The Law 22/2011, of 28 July, on waste and contaminated soils contains a requirement for the establishment of a register of remediated sites, for which regional authorities are responsible. In addition, it states that the Autonomous Communities shall declare and delimit the contaminated soils and establish an inventory of the soils declared as contaminated. However, the legislative initiative to develop such a register has not yet happened. Therefore, the national CS inventory has become inoperative. CS management is the responsibility of the regional authorities, except in the autonomous region of Andalusia, where the local authorities are responsible for risk assessment and remediation.

A CS register, managed by the national environmental agency, exists within the framework of the **Romanian** national strategy and the national plan for CS management, but the available data need to be updated.

The **Greek** inventory for contaminated soils and remediation is under preparation. However, some information has been already collected. As regards CSs due to industrial activity, in 2009 a study was completed for the investigation, evaluation and remediation of uncontrolled (illegal) polluted sites with industrial and hazardous wastes. In 2013 another study was initiated for recording and evaluation of the polluted sites by industrial-hazardous wastes in the region of Attica and the prefecture of Thessaloniki, Viotia, Evia, Kozani, Achaia, Heraklion, Magnisia, Kavala and Chalkidiki (the areas that account for most of the country's industrial activity). The goal of this study was the detection, recording and the initial characterisation of potentially polluted sites focusing on areas with heavy industrial activity, storage areas of industrial and hazardous waste, waste-management areas, mining activities, shipyards etc. The study comprises the following 6 deliverables:

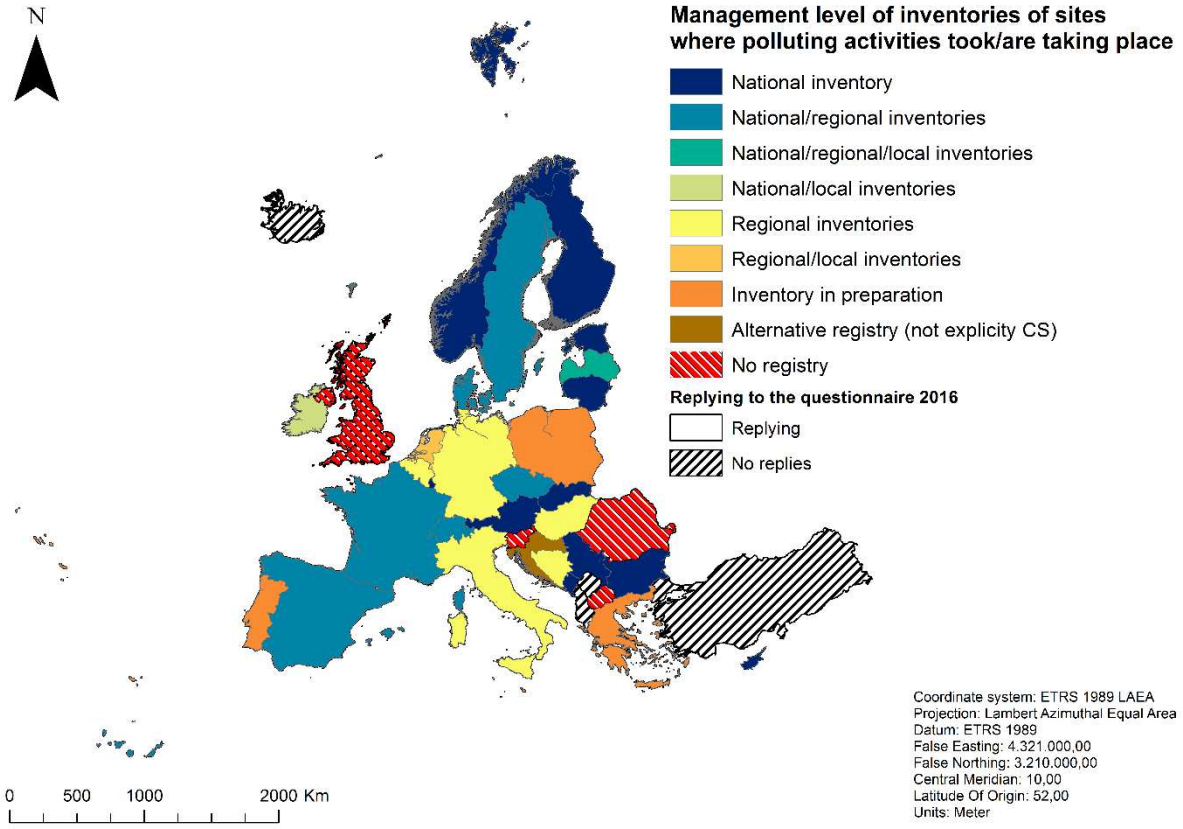
1. methodology followed
2. recording and initial characterisation
3. final characterisation
4. effect of the contaminated site on the catchment water reservoirs
5. guide for locating, recording and risk assessment of polluted sites
6. database-development conclusions.

All sites are classified as controlled (legal) and uncontrolled (illegal) sites. Currently, 2 029 potential CSs are identified. The 300 most likely CSs were selected for further investigation through questionnaires and on-site assessment. Of these, 135 are legal sites and 165 uncontrolled (illegal) sites, which were further investigated through field research, soil, sediment and water sampling, and analytical examination. These sites were classified into three groups: 1. High priority group (urgent action) (HP); 2. Medium

priority group (MP); 3. Low priority group (LP). After the investigation, the controlled sites were classified as 69 HP, 64 MP, 2 LP; and the illegal sites were classified as 82 HP, 82 MP and 1 LP. This project is the first approach and indicates that more research is needed, including ecotoxicological studies, a setting out of polluting parameters and thresholds, clarification of reference sampling and robust site sampling and monitoring.

With regard to sites contaminated by illegal landfills, **Greece** has an analytical database. According to official data reported to the European Commission in the context of the relevant decision of the European Court of Justice imposing fines on Greece for the case of illegal landfills, there were 293 illegal landfills in December 2014. By December 2017 the number had dropped to 44. The rest (149) have been rehabilitated. It should be noted that the number of illegal landfills exceeded 3 000 landfills in 2010 but, in the meantime, most of them have been rehabilitated.

Figure 12. Inventories of sites where polluting activities took/are taking place in Europe and their management level.



Since the last report, *Progress in the management of contaminated sites in Europe* (JRC, 2014), progress has been made in Europe. The most important is the development of a national register of PCSs in **Cyprus**, which has been maintained by the geological survey department since 2006. This includes historical contamination such as mining and industrial abandonment. Along with registration, a well-defined environmental-impact-assessment process is followed for new developments that may incorporate polluting activities. Furthermore, **France**, **Switzerland**, **Denmark** and the **Czech Republic** have reported that regional registers are kept as additional information to nationals. **Latvia** updated its inventory with information provided by the regional environmental boards (REBs) and CS management is the responsibility of the owners, municipalities and the state.

In the **Netherlands**, under the Dutch soil-protection Act, 42 competent authorities (12 provinces and 30 cities/bigger municipalities) have been designated for contaminated land. The management of the register is a shared responsibility of all partners who

signed the convention on soil and underground: the national government, the municipalities, the provinces and the water boards. It should be noted that in the **Netherlands** there is no formal CS registration, but the local and regional competent authorities maintain registers of sites according to a formalised and harmonised system for classifying sites based on past and present activities using the UBI system (Uniform Source Classification of potential polluting activities; *in Dutch (Uniforme Bron Indeling potentieel bodemvervuilende activiteiten*). In the past, site investigations have been conducted on a large scale based on UBI scores. The current inventory of sites that require remediation or risk management is the result of this previous process. Currently, only CSs in need of urgent remediation are registered in the national database.

Each of **Switzerland's** 26 cantons (and three of the federal authorities) is responsible for the implementation of the CS ordinance and has set up its own register of contaminated sites, which is publicly available. The 29 regional registers are consistent and based on a common structure, specified in Articles 5 and 6 of the contaminated-sites ordinance (CSO) ([49]). At the national level, in 2019, the cadastre of public-law restrictions on landownership (PLR-cadastre) will be published. It will be a reliable official system that will provide information on the most important restrictions of public-land-ownership law. The CSs are also part of this register.

Soil contamination is considered one of the major threats to soil, at the local scale (CSs); at the large scale (diffuse soil contamination, usually low-level and dispersed by deposition from the air, groundwater or agricultural practices) and at the brownfields level (regions with many CSs and usually combined with diffuse contamination) (European Commission, 2006). However, there are no explicit guidelines for creating a homogeneous dataset in Europe. In 2013, an attempt was made to include a generic approach to some soil aspects in the Inspire Directive, including aspects related to soil contamination (Inspire working group, 2013). These rules apply to geospatial data and metadata.

As regards the application of the Inspire Directive to spatial data on sites where polluting activities took/are taking place, 11 respondents ensure that Inspire standards are applied to spatial data on contaminated and remediated sites. **Austria ([50])**, the **Czech Republic ([51])**, **Norway ([52])** and the **Netherlands ([53])** have developed their inventories and databases under the Inspire Directive, while **Estonia**, **Germany**, **Italy**, **Latvia**, **Portugal**, **Slovakia** and **Slovenia** have already started to implement the standards. **Hungary** has a national decree regulating the implementation of the Inspire Directive (government Decree No 241/2009), but it has not yet been implemented.

Malta is applying the Inspire standards to the new information collected and its future inventory is intended to be Inspire compliantly.

Belgium (Flanders and Wallonia), **Croatia**, **Denmark**, **Finland** and **Serbia** have applied the Inspire standards to soil data, but not yet to data related to soil contamination, polluting activities and management process.

Inventories were set up for **Bulgaria**, **Cyprus**, **France**, **Lithuania**, **Luxembourg**, **the former Yugoslav Republic of Macedonia, Spain** and **Switzerland** before the specifications for soil-contamination data were agreed and therefore do not comply with the Inspire format. **Sweden** has a model for gathering information on contaminated land and making it available. However, this model has not been adopted or developed on the basis of the Inspire Directive.

([49]) https://www.admin.ch/opc/en/classified-compilation/19983151/index.html
([50]) http://gis.bmlfuw.gv.at/wmsgw/gs103603/?&service=wms&version=1.3.0&request=GetCapabilities
([51]) http://www.sekm.cz/
([52]) http://grunn.miljodirektoratet.no/
([53]) http://www.bodemloket.nl/

3.4 Site assessment

3.4.1 Procedures for assessing the status of the sites under investigation

Once contamination has been confirmed at a site suspected of being contaminated, it is necessary to assess the contamination and determine whether it poses a risk to the environment and human health.

Europe has thousands of CSs. They are the result of past industrialisation and poor environmental-management practices (World Health Organisation (WHO), 2013). Soil contamination is perceived as a widespread infrastructural problem of varying intensity and importance.

There are several approached to assessing the potential hazardous effects of contamination on soils and groundwater, but the most widely used in Europe is risk assessment. These risk-assessment tools are typically used for CS prioritisation, to quantify harmful effects on human health or the environment, and to address soil contamination on an objective and scientific basis (Ferguson et al., 1998). However, since corrective actions require the investment of large amounts of money, it is worth investing in a thorough investigation of the risk involved.

Risk-assessment tools used in soil-quality assessment are based on scientific and technical judgement and expertise. Nevertheless, in rare cases, intervention values have been set at higher levels by policymakers for socioeconomic reasons (Swartjes et al., 2012). The intervention values for hazardous substances, set in those risk assessments, are considered as those levels above which there exists risk of damage to the environment or human health. Setting screening levels for each single polluting substance present in the environment is not possible because new contaminants are being released continuously from new industries and materials and because normally more than one pollutant is found in the soil at the same time and interactions occur between them. Furthermore, exposures differ between different land uses, exposure patterns, site characteristics and soil types. Countries and policymakers tend to adopt integrated risk assessments that consider ecotoxicologic effects and effects to human health of mixtures of pollutants, but scientific evidence in this matter is still scarce.

According to the terminology used in much of the scientific literature, the considerations used in this report are the same as the ones used by Carlon (JRC, 2007). When risk assessment takes into account the specific conditions of a particular site, it is referred to as site-specific risk assessment, and generic environmental quality standards are referred to as screening values.

Setting **generic soil-quality criteria** and considering them as a guide for risk assessment could be useful for prior analysis of the country's land status and political and technical decisions, but a great deal of information is also required to obtain accurate guidance values. However, more and more citizens are concerned about the increasing presence of various types of chemicals and contaminants in the environment and food and their potential impact on health. In this context, generic soil-quality criteria or soil-quality standards would ensure greater transparency.

Considering total elimination of pollutants from soil is not technically or economically feasible. Consequently, although the need for policies to protect soil and groundwater is recognised, strategies for managing contaminated land have moved towards fitness for use (Fergusson, 1999). As a result, many countries have additionally considered as a more suitable option to develop a **site-specific risk assessment**. Furthermore, in many cases land-use change or property transaction has been adopted as a driver for further investigation.

The existence of diverse legislations that regulate the use of certain chemical substances, e.g. REACH ([54]), POPs regulation ([55]), PPP regulation ([56]), or the ones that regulate only certain industrial activities, e.g. IED, make the process of establishing harmonised risk-assessment tools to evaluate the status of sites suspected of posing a potential risk to the environment and to human health complex (JRC, 2007). However, improvements in harmonisation have been achieved due to several FP6-FP7 concerted actions and networks between European countries, namely the Concerted action on risk assessment for contaminated sites in the European Union (Caracas) (1996-1998); Contaminated-land-rehabilitation network for environmental technologies in Europe (Clarinet) (1998-2000); the Network for industrially contaminated land in Europe (NICOLE) (1996); and the Human and ecological risk assessment for contaminated land in European Member States (HERACLES) (Swartjes et al., 2009). In 2015, the project Remediate ([57]) was launched between five Member States and 15 partner organisations to improve the decision-making in contaminated-land site investigation and risk assessment.

Those with specific CS legislation, namely **Austria**, **Belgium (3 regions)**, **Bulgaria**, the **Czech Republic**, **Estonia**, **Germany**, **Hungary**, **Latvia**, **Serbia**, **Slovakia**, **Slovenia** and **Norway**, if the activity carried out at a site is classified as potentially polluting, a preliminary investigation should be carried out to ensure that the levels of contaminants are below the screening values set out in the national-legislation guidelines.

For industrial sites, these screening values are often higher than those of other land uses and in many cases, despite the existence of such screening values, risk assessment is carried out for each site (site-specific risk assessment) (Table 6). Some signs of harmonisation have been identified, as most countries are currently conducting risk assessments to identify adverse effects on human health and several also include the effects on the environment (Swartjes, Carlon and de Wit, 2008).

Further analysis of the quality standards set by various countries/regions is needed but it is beyond the scope of this report. Detailed information can be found in the report *Derivation methods of soil screening values in Europe. A review and evaluation of national procedures towards harmonisation* (JRC, 2007).

In the **Walloon Region (Belgium),** the preliminary investigation is site specific and carried out by a certified soil expert; the result is that the site is classified as contaminated (and needs further investigation) or not.

France has made it compulsory to clean up industrial sites after operations and, for other sites, has differentiated between sites already developed and sites to be urbanised. For the first situation, a comparative approach to the state of the environment has been set up, while for the areas to be urbanised there is a management plan that sets out remediation measures if necessary. The French methodology does not propose screening values due to the specificities of each situation.

([54]) Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

([55]) Commission Regulation (EU) No 757/2010 of 24 August 2010.

([56]) Council Directive of 15 July 1991 concerning the placing of plant-protection products on the market (91/414/EEC).

([57]) https://cordis.europa.eu/project/rcn/193990_en.html

Table 6. Main approaches and legal documents framing site assessment.

Country	Approach for assessing contaminated sites	Guidance and legal instruments framing site assessment
Austria	Environmental quality standards and site-specific risk assessment.	ALSAG ([58]); water act ([59]); waste-management act ([60]). Austrian Standard ÖNORM S 2088 (part 1: groundwater; part 2: soil; part 3: air) ([61]).
Belgium (Buxelles-Capitale)	For single pollution and mixed pollution: exceeding soil-remediation standards. For orphan pollution: site-specific risk assessment.	Decree on soil remediation and soil management ([62]). S-Risk model.
Belgium (Flanders)	Historical contamination is evaluated using site-specific risk assessment. New contamination is addressed comparing values with soil-quality standards approach.	S-Risk model ([63]).
Belgium (Wallonia)	Screening values laid down in soil decree and site-specific risk assessment.	Soil decree ([64]). S-Risk model.
Bulgaria	Site-specific risk assessment for historical and new pollution.	Liability for preventing and remedying environmental damage act (Lpreda) ([65]).
Cyprus	Soil-quality standards and site-specific risk assessment are used indistinctly depending on each situation.	No formal procedure.
Czech Republic	Thresholds and site-specific risk assessment.	*Methodological guidelines* (Svoboda, 1997).
Denmark	Threshold values for contact risk and site-specific risk assessment for groundwater contamination.	JAGG 2.1 tool ([66]).
Estonia	Site-specific risk assessment to prioritise intervention and screening values to consider remediation completed.	Water Base Management plans ([67]). Water act ([68]).
Finland	Site-specific risk assessment, but guideline values can also be applied to	Decree on the assessment of soil contamination and remediation needs ([69])

([58]) Federal Act of 7 June 1989 on the Financing and Implementation of the Remediation of Contaminated Sites
(Contaminated Site Remediation Act) Federal Law Gazette No. 299/1989
([59]) Water Law Act 1959 - WRG 1959. Federal Law Gazette 1959/215 (Wv)
([60]) Federal Act on Sustainable Waste Management, Waste Management Act (AWG), BGBl. I No. 102, 2002
([61]) http://austrianstandardsinstitute.com/
([62]) The Ordinance of 05/03/2009 on the management and remediation of polluted soils entered into force on 1 January 2010, amended by the Ordinance of 23/06/2017 (MB. 13/07/2017).
([63]) www.s-risk.be
([64]) Decree (statutory instrument) on ground management (http://environnement.wallonie.be/legis/solsoussol/sol003.htm)
([65]) Liability for Prevention and Remedying of Environmental Damage Act (https://moew.government.bg/static/media/ups/tiny/file/Legislation/Zakoni/ZOPOESHt_EN.pdf)
([66]) http://mst.dk/virksomhed-myndighed/jord/it-vaerktoejer-til-vurdering-af-jord/jagg-21-programmet/
([67]) http://ec.europa.eu/environment/water/participation/map_mc/countries/estonia_en.htm
([68]) https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/510102017003/consolide

	determine soil contamination and remediation needs.	
France	Site-specific risk assessment.	Interpretation of the state of the environments ([70]).
Germany	Risk-based soil screening values (trigger values) and site-specific risk assessment.	Federal soil-protection act ([71]).
Hungary	Site-specific risk assessment to determine remediation limits.	Ministerial decree No 6/2009 (IV. 14.) on the contamination-limit values and measurements necessary for the protection of geological formations and groundwater ([72]).
Ireland	Site-specific risk assessment with a prioritisation in three phases	*Code of practice for environment risk assessment for unregulated waste-disposal sites* ([73]).
Italy	Screening values for assessing the need for investigation and on-site-specific risk assessment for assessing the need for intervention.	Legislative Decree n. 152/2006 approving the Code on the Environment ([74]).
Latvia	Soil-quality standards.	Regulations on soil and subsoil Quality standards (2005) ([75]).
Lithuania	Soil- and groundwater-quality standards.	Requirements on treatment of contaminated sites with chemical substances ([76]) and requirements on cleaning and pollution limitation for soil and groundwater contamination with oil products ([77]).
Luxembourg	Investigations are driven voluntarily by construction projects or legally by cessation of potentially polluting activities.	German trigger values of Rhineland-Palatinate.
Malta	Soil screening values and groundwater thresholds, are different for industrial and residential sites. Site-specific risk assessment.	
Netherlands	Screening values and site-specific risk assessment depending on the tier.	Dutch soil-protection act/soil ministerial circular ([78]). Sanscrit risk-assessment decision tool, including the CSOIL exposure model soil-protection act ([79]).

([69]) http://www.finlex.fi/en/laki/kaannokset/2007/en20070214.pdf
([70]) https://www.legifrance.gouv.fr/affichCode.do?cidTexte=LEGITEXT000006074220&dateTexte=20160913
([71]) https://www.umweltbundesamt.de/sites/default/files/medien/publikation/short/k2158.pdf
([72]) http://net.jogtar.hu/jr/gen/hjegy_doc.cgi?docid=A0900006.KVV
([73]) https://www.epa.ie/pubs/advice/waste/waste/EPA_CoP_waste_disposal_sites.pdf
([74]) http://extwprlegs1.fao.org/docs/pdf/ita64213.pdf
([75]) https://likumi.lv/doc.php?id=120072
([76]) Environmental protection requirements for treatment of contaminated sites polluted with chemical substances (the Official Gazette 2008, No 53-1987).
([77]) Environmental protection requirements for treatment of contaminated sites polluted with oil products (LAND 9-2009), (the Official Gazette 2009, No 140-6174).
([78]) http://rwsenvironment.eu/subjects/soil/legislation-and/soil-remediation/
([79]) http://www.rivm.nl/bibliotheek/rapporten/711701054.html

Norway	Soil-quality standards for different land uses and site-specific risk assessment depending on contamination type.	*Guidelines for the risk assessment of contaminated sites* ([80]).
Poland	Permissible levels depending on land use. Site-specific risk-assessment approach used to plan remediation.	Environment-protection act ([81]).
Portugal	Threshold values and site-specific risk assessment.	Under development.
Romania	Alert and intervention thresholds for soil pollutants for sensitive and less sensitive land use.	Procedure for the realisation of the environmental balances ([82]). Regulation on the environment pollution evaluation ([83]).
Serbia	Threshold values.	Regulation with the indicators for evaluation of soil degradation and methodology for preparation of remediation programme ([84]).
Slovakia	Threshold values and site-specific risk assessment.	Guideline of the Ministry of Environment of the Slovak Republic No 1/2015-7 on Risk assessment of contaminated sites ([85]).
Slovenia	Soil-quality standards, limit values, alert thresholds and critical levels of dangerous substances.	New decree under preparation.
Spain	Soil-quality standards and site-specific risk assessment.	Soil decree ([86]).
Sweden	Soil-quality standards for screening purposes and site-specific risk assessment to perform remediation.	Guidelines on management of contaminated areas in the environment-protection act ([87]).
Switzerland	Threshold values and site-specific risk assessment.	
United Kingdom	Site-specific risk assessment.	Contaminated-land statutory guidance ([88]).

([80]) http://www.miljodirektoratet.no/old/klif/publikasjoner/andre/1691/ta1691.pdf
([81]) http://extwprlegs1.fao.org/docs/pdf/pol60001.pdf
([82]) Order of the minister of waters, forests and environmental protection no. 184/1997 for the approval of the procedure for the realisation of the environmental balances.
([83]) Order of the minister of waters, forests and environmental protection no. 756/1997 for the approval of the regulation on the environment pollution evaluation.
([84]) *Official Gazette of the Republic of Serbia*, No 88/2010
([85]) Guideline of the ministry of environment of the Slovak Republic no. 1/2015 -7. on risk assessment of contaminated sites.
([86]) Real Decreto [royal decree] 9/2005 suelos contaminados.
([87]) http://www.naturvardsverket.se/Documents/publikationer/978-91-620-5976-7.pdf?pid=3574
([88]) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223705/pb13735cont-land-guidance.pdf

Finland has guidelines values for 52 substances or groups of substances which are useful for identifying and assessing the risks to the environment and human health included in its legislation. Risk assessment should be done on a case-by-case basis, but the guideline values may be used as part of the assessment.

Three different soil-quality standards are described in the **Slovenian** decree.

- Limit values: the effects or impact on human health or the environment are acceptable.
- Warning values: there is the likelihood of adverse effects or impact on human health or the environment on certain types of land use.
- Critical values: due to adverse effects or impact on people and the environment, contaminated soil is not suitable for the cultivation of crops intended for human or animal consumption nor for retaining or filtering water.

In this case, the risk assessment is not based on land use but on the likelihood of adverse effects on human health or the environment. In **Slovenia**, the new decree ([89]) on the status of soil and the rules on soil-status monitoring are under preparation.

In **Cyprus**, impact assessment is carried out on-site when a contamination problem arises or when there is a clear suspicion of soil contamination due to the disposal of hazardous waste, an accident, a leak in a storage tank, or any other situation involving hazardous substances, mixtures or waste in the soil. Although no legislation has been passed on soil screening values, the natural geochemical background and the current state of the soil are well known. The same approach is used in **Croatia**.

The **Polish** environmental-protection agency has recently determined the permissible levels of hazardous substances for different types of land uses, considering permissible levels to be those below which none of soil functions are significantly impaired.

There are no legally binding screening values, guideline values or soil-quality values in **Swedish** legislation. However, there are non-legally binding guideline values or screening values that can assist in the investigation of potential risks associated with contamination, when there is known contamination or if there is suspicion of contaminated soil.

In **Denmark**, the priorities are the protection of groundwater and dealing with the contamination of residential sites. The assessment of harmful effects in these two environments is carried out immediately when there is a suspicion of soil contamination.

In **Lithuania**, cleaning is compulsory depending on the intended future activity and land use.

Germany has guidelines and handbooks for each of the *Laenders* that must to be followed by formal procedures to assess the status of suspect sites. These guidelines are also used as a reference in **Luxembourg**.

In the **Netherlands** the soil-protection act, which provided for the prohibition of soil pollution, came into force in 1987. If a soil becomes polluted, the procedure for assessing and appraising soil- and groundwater-quality is based on a combination of soil- and groundwater-quality standards (screening values) and site-specific risk assessment.

In **Ireland**, the main sites where contamination occurs are landfills, which are regulated by the waste-management act. It includes a *Code of practice for environment risk assessment for unregulated waste-disposal sites* to assist local authorities in the risk assessment and in the identification of remedial action to be taken. This code includes a classification system with three phases: Stage 1: site characterisation & assessment; Stage 2: corrective action feasibility and design; Stage 3: corrective action implementation and aftercare.

([89]) Rules on monitoring of the status of Soil (Draft in Preparation by Ministry of the Environment and spatial Planning). National Name: Pravilnik [rules] o monitoringu stanja tal (Osnutek v pripravi).

There are two ministerial orders that regulate the assessment soil contamination in **Romania**: one that regulates the realisation of the environmental balances; and the other that establishes the basis for the assessment of environment pollution.

The former Yugoslav Republic of Macedonia and **Portugal** have stated that they do not have a formal procedure to assess the status of the sites under investigation. However, Portugal is preparing an act on contamination prevention and soil remediation which will set out the guidelines and measures to be taken when there is suspicion of soil contamination. Currently, the initial state, soil background values (if available) or international standards, screening or reference values are used as reference levels.

3.4.2 Procedures to evaluate hazardous substances found on-site (soil, groundwater, sediment, land), but not occurring in the list of quality standards.

Despite significant scientific and technical advances, there are still hazardous substances that have entered in the soil/groundwater system, but whose effects on the environment and human health are not well known, and there are no legally established screening values for them yet.

Twelve respondents reported having developed **derivation processes** (e.g. describing a relevant generic exposure scenario, exposure parameters, and the algorithm/equation to derive a trigger value) based on technical and scientific expertise for substances that are not laid down in their guidelines or decrees.

In **Austria**, technical standards set environmental quality standards (EQS) for soils, soil vapours and groundwater. Aiming at transparency, these technical standards usually provide references to the origin of EQS (e.g. the drinking water ordinance) or describe the derivation process (e.g. describing a relevant generic exposure scenario, exposure parameters and the algorithm/equation to derive a trigger value).

In **Belgium**, soil-remediation experts and experts from the Société Publique d'Aide a la Qualité de l'Environnement (SPAQuE) and the Institut Scientifique de Service Public (ISSeP) in **Belgium (Wallonia)** are responsible for developing a test and making decisions on risk assessment on a case-by-case basis. In **Belgium (Flanders)**, technical guidelines are available including information on exposure scenarios, parameters and model equations, databases, etc.

The United States environmental protection agency (US EPA) or the World Health Organisation (WHO) guidelines are used in the **Czech Republic** to address contaminants not covered by its legislation.

The **Finnish** environment report (23/2007) *Derivation basis of threshold and guideline values for soil* presents the derivation process of threshold and guideline values. Threshold values and guidance values are based on a general risk assessment, in which various reference values for soil concentrations have been obtained, describing negligible and maximum-acceptable risks to the environment and human health. When necessary, experts from the Finnish environment institute also assist in risk assessment, determining site-specific target values or reference values for substances that are not listed in the government decree. The national investigation-and-remediation programme, launched in 2016, is based on the systematic and risk-based prioritisation and management of potentially contaminated areas, and will implement new guidelines on sustainable risk management (Reinikainen, Sorvari and Tikkanen, 2016).

In the late 1990s, **Germany** published the standard methods and values used to derive trigger values and action values. It states that these methods and standards should be taken into account when deriving trigger values or action values for additional pollutants not included in Annex 2 of the *Assessment principles for contaminants in contaminated sites* ([90]).

([90]) Federal Gazette No 161(a) of 28 August 1999.Bundesanzeiger No 161(a) of 28 August 1999.

Similarly, **Hungary** has regulated the rules for screening tests in the investigation of hazardous substances in geological environment and groundwater (Ministerial Decree No 14/2005). When a pollutant exceeds the limits values, or its presence is assumed on the basis of historical research but has not been identified before, it is to be investigated by a separate procedure.

Sweden considers the generic exposure scenario, the exposure parameters, and the algorithm/equation for obtaining a trigger value. This scenario has been used when deriving screening values for substances that have been prioritised. However, the scenario could also be used for other substances if sufficient substance-specific data are available for the calculations and risk assessment. It is common to use screening values from other countries for substances without Swedish values. The Swedish environmental protection agency continuously updates and develops screening values for substances of emerging concern. However, this is dependent on reliable substance-specific data that are not always available.

Poland´s regulation of 1 September 2016 on the assessment of contamination of land surface of the minister of the environment lays down detailed requirements for the determination of permissible levels of hazardous substances in soil and groundwater for pollutants not listed in that regulation.

In **Slovakia**, the procedure for dealing with hazardous substances not listed in the act concerning integrated prevention and pollution control includes three possibilities. The first concerns the use of international standards for these pollutants when available; the second refers to the assessment and approval of CS risk-assessment reports by the national commission responsible for CSs (established under the ministry of environment); or, the last option if necessary, refers to the consultation with the regional institutes of health of Slovakia.

The **Dutch** soil-quality decree (2008) stipulates the obligation to care for the environment, including soils and sediments, even if the pollutant is not included in the list of quality standards. When there is a lack of soil or groundwater-quality standards, the national institute for public health and environment is authorised to derive these standards for local application only.

The national health institute of **Italy** may set out the screening values in soil and/or groundwater for substances not included in the list of contamination threshold concentrations (CTCs). This list specifies CTCs for 92 contaminants in soil according to two different land uses (residential and industrial/commercial) and for 94 chemicals in groundwater.

In **Switzerland**, the risks and need for remediation must be assessed on a case-by-case basis.

In **Malta**, when planning a site investigation, the applicant/operator must follow the list of EPA, EN, ISO or equivalent standards for the analysis of the various contaminants and the associated detection limits, which must be submitted to and approved by the competent authority for each site investigation. The analyses must be carried out by laboratories accredited to at least EN ISO 17025:2005/Cor 1:2006 and preferably accredited for each and every analysis. In cases where soil must be managed as waste after excavation, the presence of hazardous substances contained in the waste is assessed in accordance with Annex III of the Waste Framework Directive (2008/98/EC), as transposed by S.L. 549.63.

The regulation on the assessment of environmental pollution in **Romania** includes reference values for traces of chemicals and hazardous substances in soils. There is no special regulation for other dangerous substances.

The **Spanish** decree sets screening values for a total of 54 substances but at the same time sets out a clear methodology for calculating these levels for substances other than those mentioned in the decree.

3.5 Main remediation techniques and their extent in Europe.

Remediation to consist of actions on or in the soil aimed at the removal, control, containment or reduction of contaminants so that the CS, taking into account its current use and approved future use, no longer poses any significant risk to human health or the environment (Clarinet, 2002a). Any approach of RRM should be faced in a sustainable manner (Nicole, 2010).

Contaminated soils and sediments can only improve in a reasonable time if an active cleaning operation is carried out; otherwise, they act as sinks for pollutants. However, remediation actions are very costly, especially if the area to be remediated is large and the contamination is persistent (European Commission, 2006).

Despite the associated expenses, CS remediation should be understood as a win-win process, with the double benefit to reduce the negative effects on human health and the environment, and to regenerate the environmental functions of the soil. Contamination significantly reduces many of fundamental functions of soils, for example the ability to act as a carbon sink, making it difficult to achieve the 1.5/2 °C target of the Paris Agreement (Service de l'observation et des statistiques, 2015), or endangering food safety and security and the possibility of meeting the SDGs (UN, 2017).

To achieve sustainable management of contaminated soils in Europe, the best available techniques must be incorporated into the whole process of RRM, not only during remediation, as promoted in the IED (2010/75/EU). Early incorporation of conservation into the remediation process produces the best results for the ecosystem, community and local business. For example, during investigation or the selection and permitting of remedies, conservation objectives can drive the development and selection of solutions, address stakeholder concerns and priorities, motivate the inclusion of best and sustainable management practices and, in some cases, reduce costs (Wildlife Habitat Council, 2017). Environmental restoration approaches to creating wildlife habitats or building green spaces within an urban area are advantageous measures to prevent industrial areas from becoming brownfields after they are dismantled.

Although many technologies have been developed to remediate contaminated soils, the selection depends on what contaminants are suspected at the site, what technologies are available in the country, what the estimated expenditure is, the public/private budget to deal with contamination, and the potential limitations of the site (Mulligan, Yong and Gibbs, 2001).

Remediation operations can be carried out outside the CS: what soil must be excavated or water extracted and transported to a suitable disposal facility where treatment is carried out. The original site is then filled with uncontaminated material. This is known as off-site remediation (when soil recovery takes place) or dig and dump if the soil is disposed of in landfill. This practice is used for small CSs or 'hot spots' throughout Europe, or when the exploitation pressure at the site is high (Kuppusamy et al., 2016; Suer and Andersson-Sköld, 2011).

In many situations, treatment of contaminated soil at the same site is more feasible due to the extent of contamination or special site conditions, and the cost and environmental impacts could be lower if *in situ* techniques are used (Sorvari et al., 2009). ***In situ* treatment** leaves the soil structure intact, but reduces the potential migration of contaminants through soil and water systems, for example *in situ* bioremediation, phytoremediation or natural attenuation (Boopathy, 2000). In this case, the site is not dramatically transformed and there are no limitations for its future use, as these techniques aim to reduce the total quantity of contaminants in the site. However, these techniques are often time-consuming and many uncertainties are involved during the process, and they may not be acceptable for application at certain sites depending on the land use and the risk they may pose to the environment or human health (Cunningham and Berti, 1993; Reinikainen, Sorvari and Tikkanen, 2016).

Ex situ techniques involve the excavation or removal of contaminated soil, which may be buried or disposed of in landfills, involving the transport of soil **(off-site techniques)**, or treated on-site by physical, chemical, electrical, thermal or biological mechanisms. There are different techniques for cleaning up ex situ soils, for example, land farming, where contaminated soils are spread over a prepared bed and tilled periodically until the contaminants degrade; composting, where high microbial activity is able to reduce concentration of contaminants. The use of bioreactors, which involves the processing of contaminated solid material (soil, sediment, sludge) or water through an engineered containment system that accelerates the biodegradation of contaminants by indigenous microorganisms (Mulligan, Yong and Gibbs, 2001). Due to the complex nature of many contaminated soils and the fact that contamination is often caused by the presence of a mixture of contaminants, the application of more than one remediation technique becomes essential to reduce the concentrations of contaminants to acceptable levels (Eugris, 2017).

Assuming that there is no perfect or unique technique applicable for every situation because many factors are conditioning the selection between best available practices, there is a clear willingness to reduce the use of landfills and strengthen on-site techniques (Clarinet, 2002b).

Regarding the area that has been remediated since the last data request, only four respondents have been able to extract this information from their registries and inventories (Table 7).

Table 7. Total remediated surface and area treated with different remediation techniques.

Country	Total area remediated (ha)	Area remediated off-site (million tonnes)	Area remediated on-site (million tonnes)	Area remediated *in situ* (ha)
Denmark	—	2.5	—	—
Estonia	53	—	—	3.5
Finland	—	1.5 ([1])	—	1 015 ([2])
France	14 500	1.1	—	—
Hungary	97 ([3])	1.0	1.5	8.8
Luxembourg	—	0.2	—	—
Portugal	27.21	0.7	—	—
Switzerland	600	2	0.1	70

([1]) area remediated per year, ([2]) number of sites under *in situ* remediation, ([3]) RS per year (-) data not provided

In **Estonia**, the remediated area accounts for 53 hectares (ha), including 166 orphan sites. Among them, at least 3.5 hectares have been treated *in situ*, representing more than 17 870 tonnes (50 600 m^3) of soil remediated.

In **Hungary**, 97 orphan sites underwent remediation between 2011 and 2016, but there is no a clear registry of the extension occupied by these sites. However, 972 370 tonnes of soils have been excavated and treated off-site, according the data reported by the regional environmental authorities in March of 2017.

Data are available exclusively for industrial sites in **Portugal**, where 27.21 ha of contaminated industrial lands have been remediated. Given the lack of legislation in Portugal, the guidelines for dealing with CSs have been derived in the application of Dutch and Canadian reference values for decontaminant the soils (JRC, 2015), where the main technique is excavation and either treat or bury off-site. The last interventions carried out in industrial sites account for 646 911 tonnes following this procedure.

Denmark is one of the countries with the largest experience, technical and legally speaking, for dealing with soil contamination. Some well-documented heavily contaminated sites are being used as laboratories to develop more-efficient and less-expensive remediation techniques (Danish Soil Partnership, 2017; JRC, 2015). However,

treatment off-site is still the main technique used for remediation, accounting for 2.5 million tonnes of soil.

Remediation of contaminated land is usually carried out by removing soil and depositing it off-site (ex situ) in **Finland**. Each year, 1-1.5 million tonnes of contaminated extractable soil resources are excavated to then be processed or disposed of at one of over 70 landfill sites or other processing plants. However, less invasive techniques, such as soil vapour extraction, biological methods or chemical oxidation, are also used for *in situ* remediation. Each year, 10-15 sites are treated with these techniques.

In **France**, ca. 650 CSs were excavated and soil was treated off-site or buried in landfills (data from March 2015). Of these sites, the available information on volume only refers to 150 sites that represents 1 132 million tonnes.

The deposit of industrial waste in landfills in **Switzerland**, as in many other countries in Europe, has resulted in many heavily contaminated sites. The most significant CSs are Bonfol and Kölliken, where activities of pre-treatment were carried out on-site before the complete removal of waste and soil for thermal-soil treatment abroad (Chiresa AG, 2017; JRC, 2015). Globally in Switzerland, an estimate of 600 ha has already been remediated. In total, waste and soil excavated and treated off-site in Switzerland represents 2 million tonnes, of which 860 000 tonnes correspond to these two megasites. In other sites, on-site treatments have been applied after excavating the soil. Once the extracted mass is decontaminated, it is used for refilling the area. Roughly estimated, it represents 80 000 tonnes of contaminated soil. In addition, a total area of 70 ha is treated *in situ*.

In **Brussels-Capital**, the main remediation techniques used are excavation and ex situ remediation, which account for the 75 % of the remediation techniques; venting, which is applied in 10 % of contaminated soils; pump and treat, that represents another 10 % and other techniques, such as bioremediation, oxidation and air sparing or *in situ* volatilisation, which together represent 5 % of the remediation techniques applied. However, there is a shift towards *in situ* techniques as soil heating, natural attenuation, phytoremediation, etc.

In **Malta**, remediation involves dig and dump of contaminated soil. Data for one remediated site has been provided, accounting for 24 tonnes (68 m^3) of soil removed from its location.

3.6 Funding mechanisms and liability for contamination management.

Due to the lack of specific European legislation, that would ensure CS investigation and remediation, other national, regional and local policy strategies have been designed for management of contaminated land.

3.6.1 Overall management costs

One of Europe´s priority is to improve the knowledge and evidence base for the European Union's environmental policy, as stated in Objective 5 of the 7th EAP. Its objective for 2020 is to provided policymakers and stakeholders with a better-informed basis for developing and implementing environment and climate policies, including understanding the environmental impacts of human activities and measuring the costs and benefits of action and the costs of inaction (European Commission, 2017).

CS remediation may result in complete removal or reduction of impacts. In Europe, the costs of investigation-and-remediation projects typically range from EUR 5 000 to EUR 50 million, and some macrosite-remediation projects exceed EUR 100 million. Normally, remediation projects require between EUR 50 000 to EUR 500 000 (40 % of the reported cases). Large remediation projects, that represent the 8 % of the cases reported for Europe in 2012, usually require investments that exceed EUR 5 million (JRC, 2014). Despite the notable amount of money needed to manage a CS, it should be demonstrated that striving to halt land degradation does not imply loss of income, but, even possibly, increasing incomes in the short, medium and long term, besides the evident benefit for the environment and human health (Beccarello and Molinaro, 2017; Keesstra et al., 2016).

An overall estimate of the annual cost for contaminated-soil remediation was made in the proposal for a soil framework directive. The investment needed by each Member State accounted for EUR 290 million per year for the first 25 Member States of the EU (EU-25) in the first 5 years and up to EUR 240 million per year in the following 20 years. The total costs for CS remediation were estimated at EUR 119 billion, considering the average costs of remediation related to the size of the CSs (EU, 2006).

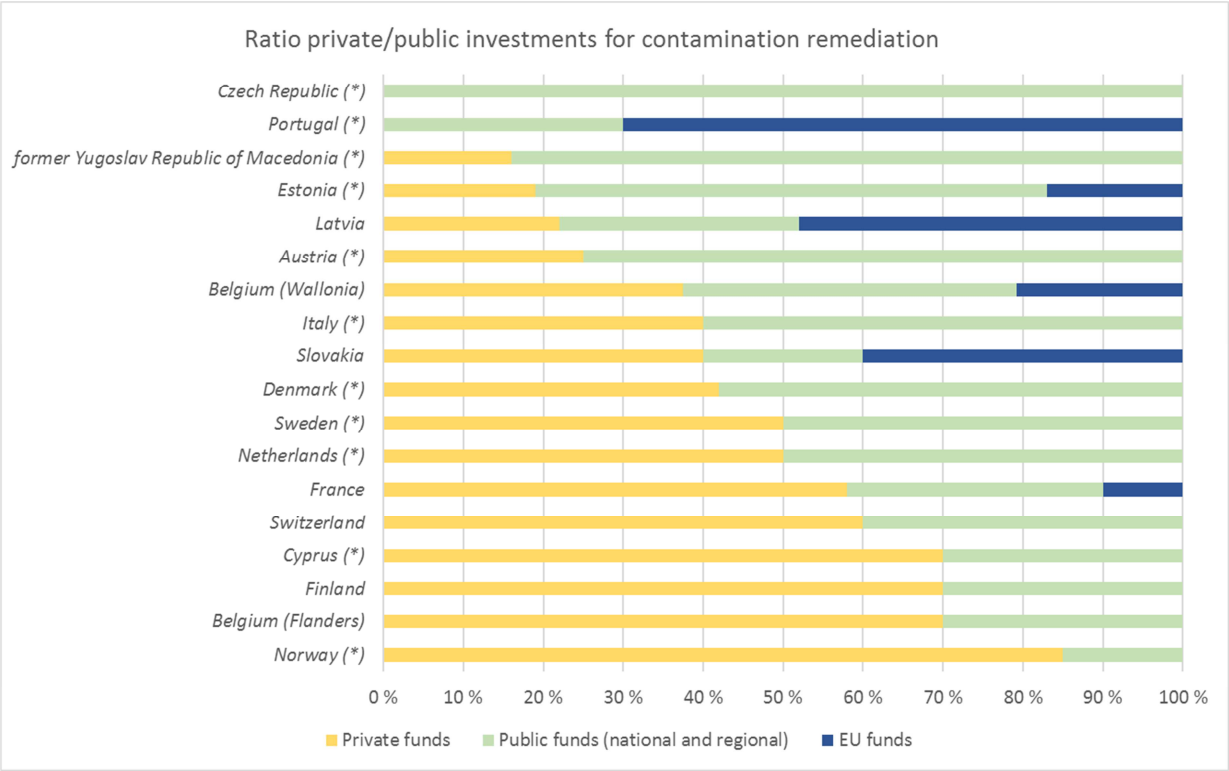
The broad study on soil-contamination expenditures in Europe undertaken by Ernst & Young (2013) has shown a disparity across Member States in contaminated-soil management. In this study, the expenditures on remediation were calculated as EUR 2.75 billion per year to EUR 4.6 billion per year, and an estimate of the overall expenditures of EUR 46 billion over 25 years.

The last report on *The progress in the management of contaminated sites in Europe* (JRC, 2014) showed that average expenditures on the management of contaminated sites was approximately of EUR 10.7 per capita per year, which suppose a decrease in overall expenditures in Europe since 2006, when the investment was calculated on EUR 12 per capita per year, of which 81 % was spent on remediation measures while only 15 % was spent on site investigation.

Figure 13 shows the relationship between investments made by the private and public subsidy sectors, and European subsidies where they are present, in different countries to investigate, manage and remediate CSs.

Some countries have made special efforts to estimate the overall costs that contaminated-soil management (investigation and remediation when necessary) has represented so far and how much it will represent for their national budget in the future. Countries were asked to provide estimates of total expenditures and to comment on whether they have been incorporated in their national budget and development strategy for the coming decades.

Figure 13. Investment of public, private and EU funds to finance the remediation of contaminated sites in some countries of Europe.



Source: information provided in the questionnaire 2016, (*) information extracted from (van Liedekerke M., 2014)

For example, in **Austria,** two scenarios have been set up for estimating the costs of CS management. First, considering that no legal improvements at national level have been achieved since 2007 the overall costs were estimated between EUR 10 000 and EUR 12 000 million. Where legal amendments were adopted or new national legislation was approved, including guidelines on risk management as binding statutes, the estimated expenditures decrease by EUR 5 000-6 000 million, as it has been reported in the Austrian questionnaire (2016).

The public budget for remediation measures of 21 large-scale projects in lignite and uranium mining in **Germany** have gone upwards to EUR 19.5 billion. Information about *Laender* and private expenditures is not available at this moment.

The responsibility for the technical and economic management of CSs in **Belgium** has been transferred to regional governments. Thus, in **Flanders**, the total remediation cost is estimated to be EUR 7 000 million, of which, circa 70 % is expected to come from private investment. However, in **Wallonia** a great effort to identify every CS is been carried out, making it difficult to predict the overall cost. Estimates of EUR 31 000 to EUR 145 000 per site, including orientation and characterisation study, development of the remediation plan and the remediation works for those CSs are managed with private funds. For those biggest polluted sites, the estimates provided by SPAQuE (Wallonia) vary from EUR 207 000 per site for soil investigations to EUR 108/m^2 of remediated soil. In **Brussels-Capital**, the annual budget allocated to soil-contamination management account for EUR 2 million coming from public funds and EUR 28 million provided by the private sector. The ratio public/private in Brussels-Capital is 6/94. Of the investment, 85 % goes to remediation while the other 15 % is utilised in the investigation process.

The overall estimated costs for CS management in **Switzerland** is roughly EUR 4.7 billion (approximately CHF 5 000 million). The estimated ratio public/private is about 60 % public and 40 % private (Figure 13**Error! Reference source not found.**).

When the national environmental remediation programme (OKKP) was initiated in 1996 by the **Hungarian** government, experts estimated the total cost at EUR 3 330 million. New estimates have not been made since then.

The total cost of orphan sites in **Denmark** was estimated at EUR 1 800 million in 2012. There is no estimate of the expected private sector equivalent total, as liability and management of orphan sites is entirely public in Denmark. It has been estimated (data from 2013) that the total turnover of the soil-remediation sector (including public spending, which is roughly half) was EUR 1 200-1 400 million per year.

In 2008, when systematic CS identification started in **Slovakia** the first estimate on the overall CS management cost was EUR 1 716-2 553 million. In 2015, EUR 78 million was spent within the framework of the operational programme environment (public). This investment included detailed investigation of 138 sites (105 PCSs and 33 CSs), remediation of 19 sites and monitoring of 161 sites (all from European Union funds under the operational programme environment), as well as public awareness, education and publicity on CSs. At the present time, 950 sites are in need of detailed investigation and 956 sites need (or might need) remediation or RRM in Slovakia. Estimate of the overall management cost in 2015 was ca. EUR 2 580 million (public + private). The latest estimate of the cost of addressing CSs according to the state CS remediation program for period 2016-2021 is EUR 210 million, which refers only to public funds, which represent the 20 % of the investment. 50 % of these expenditures are expected to come from European Programmes and the remaining 30 % must be provided by private companies.

The overall management cost from **Czech** state budget (including EU funds) is estimated to be EUR 2 000 million, but there is no information available on private funds.

France does not have information about the overall expenses for CS remediation. However, when analysing available information from years 2012 and 2013, the tendency appears to be positive. In 2013, the cost of cleaning up soil and aquatic environments (groundwater and surface water) increased by 4 % compared to the previous year. Expenditures related to the protection and cleaning of soil, groundwater and surface waters amounted to EUR 1.6 billion in 2013. According to the European Cepa nomenclature, the expenditure breaks down as follows: EUR 807 million for soil- and water-contamination audit and remediation, EUR 616 million for water and soil-contamination prevention, EUR 89 million for financing the measurement and monitoring network, and EUR 75 million for erosion control and other physical degradation. In 2013, the private and public sectors financed 58 % and 32 % of the expenditure on prevention and protection of soil and water, respectively. The rest is financed by European funds (Service de l'observation et des statistiques, 2015).

The **Dutch** national inventory has been updated in 2016 with more detailed questions on costs (both public and private). Considering most of CSs in the **Netherlands** have been remediated during the last 30 years, accounting for EUR 300 million per year (EUR 100 million per year from public budget and EUR 200 million per year from private investments), and further CS management will be carried out during next years, an overall estimate of national (public and private) investment in CS management may account for EUR 10 billion.

The overall management costs in **Finland** vary considerably each year. The overall management cost has not been assessed, but a rough estimate is EUR 50-100 million per year. The remediation costs are mainly borne by companies and others from the private sector, whose investment is approximately 70 % of the costs, the remaining expenses come from municipalities and the state.

In **Portugal**, due to a lack of a comprehensive CS inventory, solely information about public investment to remediate orphan sites is available. The estimated cost of remediation of old mining areas amounts to EUR 90 million, from which ca. EUR 88 million has already been invested since 2001.

Latvian legislation does not embrace the obligation to report private expenditures on CS remediation. Information about public investment for remediation of four megasites has been reported (namely Incukalns acid-tar ponds, Olaine hazardous-waste storage, Jelgava hazardous-waste storage and Sarkandaugava oil-polluted site), which account to circa EUR 71 million. In these projects, the Latvian state is financing 30 % of the total cost, 22 % is provided by Switzerland finances and 48 % comes from the European Regional Development Fund (ERDF).

Lithuania has provided a rough estimate about the overall CS management cost at high and very high risk, which account to circa EUR 1 300 million. EUR 19 million from the EU CF has been designated for the treatment of the 36 historically contaminated sites on state land for the period 2013-2020. Information about contribution of private and public sector is not available.

Estonia plans for an overall management expenditure of EUR 53 million to investigate and remediate 78 sites where polluting activities took/are taking place and are in need of RRM.

In **Bulgaria** two different budgets are planned to deal with soil contamination in coming years. Firstly, EUR 263 376 (BGN 515 119) of public budget is planned to be spent for ensuring the remediation of one site with historic contamination in the period between 2018 and 2020. For the same period, EUR 30 693 (BGN 60 000) is planned to be spent for the preparation of the reports on a determination of remedial measures for cases where the operator is unknown and a factual complexity exists and/or the need for additional analyses, according to the liability for preventing and remedying environmental damage act (Lepreda).

The estimate of remediation costs for former landfills in **Ireland** are dependent on the sites status set out following the guides provided by the Irish environmental protection agency ([91]). These oscillate between EUR 200 000-350 000 per hectare for those sites with high risk (Class A) to EUR 10 000-140 000 per hectare to remediate those sites with low risk (Class C) (see explanation of the classes in the Annex 1, question 4).

In **Sweden**, there is no estimate of the overall costs for CS remediation; however, the budget for 2017 was approximately EUR 87 million, including a special section of EUR 30 million for the remediation of residential construction. According to the government budget not yet approved, the annual budget for remediation of contaminated land is approximately EUR 87 million per year 2018, in which the budget for remediation for residential construction has been reduced to EUR 20 million and a new special section for sediment remediation has been added (EUR 8 million). In 2019 the budget is expected to increase to a total of approximately EUR 98 million. For investigations, the budget for 2018 is EUR 22 million. About EUR 230 000 is spent annually on maintaining the national CS register.

On the basis of the available data provided by seven respondents, the median overall expenditure for assessing and remediating soil contamination amounts to EUR 4.5 billion (

[91] *Guidance on the management of contaminated land and groundwater at EPA licensed sites*, 2013. ISBN: 978-1-84095-511-8.

Table 8).

The median cost of remediation per site varies from country to country, representing a cost of **EUR 124 000 per site**. The average investment for investigation and remediation of contaminated sites for the seven respondents is EUR 618 per capita.

Table 8. Estimated cost for site investigations and remediation measures.

Country	Overall management costs (EUR million)	Site Status 1 (registered)	Cost per site (EUR)	Cost per capita (EUR)
Austria	12 000	68 569	175 006.2	1 373.1
Belgium (Flanders)	7 000	68 000	102 941.2	1 081.6
Switzerland	4 700	38 000	123 684.2	564.4
Hungary	3 330	5 375	619 534.9	338.7
Slovakia	2 790	1 906	1 463 798.5	514.2
Estonia	8.75	300	29 166.7	6.6
Lithuania	1 300	12 341	105 339.9	450.1
Average	4 447	27 784	124 000 ([1])	618.4

([1]) The median is more representative in this case than the average due to the existence of significant outliers.

All seven confirmed that the PPP is been applied. For those sites where this principle cannot be applied, public and EU funds cover the expenses of the investigation-and-remediation works. In some countries, private funds contribute to investigating and remediating those sites where the liability chain cannot be applied.

In the **Czech Republic,** 100 % of the expenses are covered by public funds, while in **Norway** public investment accounts only for 15 % of the total cost (Figure 13).

In some cases, EU-funding mechanisms (such as Interreg or the European Regional Development Fund (ERDF)) are used for financing soil remediation, varying from 17 % in **Estonia** to 70 % of the total expenditure, as it is the case in **Portugal**. However, these funding mechanisms are limited to certain regions. **Romania** has also reported the use of Structural and Cohesion Funds for financing the remediation of orphan sites, but information on the percentage is not available.

3.6.2 Liability for contaminated sites

One of the most widely accepted principles on environmental policies is the PPP. However, establishing accountability for soil contamination is not always easy, thus, some countries have adopted a more detailed liability chain to ensure the availability of funds for remediation and so ensuring that sites do not enter into a state of abandonment. Frequently, to assure funds availability there are several agreements, previously stipulated, for the financing of contamination remediation.

In Belgium, the **Walloon** soil decree differentiates between the liability of the polluter and the responsibility which forms part of the land owners' obligation to undertake soil studies and remediation works. There is a legally defined chain of responsibility that goes from voluntary study, polluter (presumed or not), occupier and in the last instance, landowner. **Hungary** has applied the same approach. Also in the decree on soil remediation from **Brussels-Capital** Region in Belgium, this difference is made. Thus, the decree designates clearly the person whose obligation it is to remediate the soil contamination according to a fixed chain of designation: the operator of the installations present on the land where the soil contamination originated; the owner of the land where the soil contamination originated; and thirdly the person who caused an accident.

German legislation provides that the liability of the polluter to be transferred to the universal successor, the relevant landowner and the occupant of the property. **Latvia**, **Luxembourg** and **Sweden** have the same approach and only where there is total abandonment and a high risk for human health and the environment does the site become an orphan site and the legislative mechanisms to deal with contamination activated.

In accordance with the PPP, following the cessation of activities of an environmentally protected installation (ICPE), the **French** state is to initiate administrative actions towards those responsible for the execution of studies and remediation works required by the condition of the industrial site. In the event of non-execution of the prescriptions or insolvency of the person in charge, the administration can then instruct ADEME to implement the interventions necessary for the safety of the site.

Another commonly adopted approach to assign liability for CS management range from the polluter to the landowner and in the last instance, the liability is on local municipalities or the state. **Austria, Finland, the Czech Republic, the Netherlands, Serbia** and **Slovakia** have set out this hierarchy in their legislation.

In **Switzerland**, in accordance with the PPP, the polluter has to bear the cost of remediation. If there is more than one polluter in a remediation case, each bears the cost in proportion to their share of responsibility. Thus, in remediation cases where the polluter(s) cannot be called upon to bear the costs, the remediation cost cannot simply be passed on to the owner or the other parties involved (no 'deep-pocket-principle'). Any shortfalls that arise in such cases must be borne by the community. Though, the canton can request partial repayment of remediation cost from the federal remediation fund.

A more complex hierarchy is applied in **Norway**, where the primary polluter is the entity responsible. Where the polluter is difficult to identify or no longer exists, the landowner (or the person who benefits most) can be held responsible for paying for remediation as the value of the land will increase substantially. Where the polluting industry is taken over by a different person, the liability for remediating current and past negative effects devolves upon that person or to the mother company if there is not a legal person figure. Ultimately, the developer or entrepreneur starting the polluting activity must assume responsibility.

In **Romania**, liability for CS remediation falls on the owners or the users of a CS.

3.6.3 Historical contamination and orphan sites

More than 200 years of industrialisation have left their trace on the status of soil. Europe has a problem of historical contamination of soil due to the use and presence of dangerous substances in many production processes while there was no legal framework to control emissions or deal with the problem once it had appeared. An example of historical contamination can be clearly identified in Eastern Europe; countries that belonged to the former Soviet Union have many military and industrial sites that were abandoned after the dissolution.

Historic contamination represents a widespread problem attributable, in many cases, to a polluter who is unknown or no longer present in the area. Governments often have difficulties in obtaining funding to address the remediation of such sites. This is one of the most common constrains the countries are confronted with when dealing with CSs.

Generally, soil remediation is analysed on the basis of fitness for use, and only when a land-use change is planned, some actions are taken to reduce the risk for the new use. Otherwise, actions are carried out when there is possible damage to the environment and people living close to the contaminated areas.

In general, on the basis of the information obtained from the respondents, it is considered that **historical contamination** is that which occurred before the introduction of a specific law on soil contamination. The criteria for addressing historical contamination are often laxer and risk-based approaches are applied. In addition, often some provisions are included in legislation to assure that funds are available for the remediation of historically contaminated sites. Some EU-funding mechanisms (such as Interreg or the ERDF) also have the potential to finance soil remediation, although they are limited to certain regions. The ERDF action aims to reduce economic, environmental and social problems in urban areas, with particular emphasis on sustainable urban development. At least 5 % of ERDF resources are allocated to this area, through

'integrated actions' managed by cities. Naturally disadvantaged geographical areas (remote, mountainous, sparsely populated and the outermost areas) benefit from special treatment under this funding mechanism.

The first legislative intervention for the management of sites with historical contamination occurred in the late 1960s in **Belgium**, where legislation to deal with the cleaning of abandoned coal sites entered into force in 1967. After the regionalisation of the administration in Belgium, the regions adopted different approaches to deal with historic contamination. In **Wallonia**, historical contamination is specified as that occurring before 30 April 2007 and a risk-based approach is used to remove serious threats. However, for new contamination, remediation objectives go back to reference values. On the other hand, the **Flemish** soil decree legally establishes historical contamination as soil contamination caused before 29 October 1995; new soil contamination is anything caused after this date. The approach for new contamination is stricter in order to stimulate prevention: immediate remediation is necessary when soil-remediation standards are exceeded. For historical contamination, a priority of intervention is set out and only those sites where there is a serious risk to human health and the environment or risk of contamination dispersion, clean-up is carried out. In the **Brussels-Capital** legislation, a difference is made regarding liability only. Thus, when contamination has been generated by several persons in distinctly unidentifiable proportions, including an operator, a holder of real rights in the land concerned or, if the pollution was generated after 20 January 2005 by a clearly identified person; soil remediation aims at avoiding that soil quality presents (either effectively or potentially) a risk for people and for the environment.

In 1969, the first **Swedish** environmental law entered into force, and it allowed the government to fund cleaning and required investigations in cases where no liable stakeholder could be identified, or where it was not reasonable for the liable stakeholder to fund parts or all of the clean-up. Based on the legal frameworks in place at the time of contamination, a legal practice for evaluation of reasonable legal liability has been developed. This practice brings that there is no reasonable legal liability for soil and groundwater contamination dating from before 1960, since there were no applicable legal framework regulating contaminating activities and operations. Between 1960 and 1969, the reasonable liability for soil and groundwater contamination was considered at 50 %, national authorities being responsible for the rest. After 1969, when a new environmental framework was introduced, reasonable liability was considered at 100 %. This means that there are clean-ups which are fully funded by the government. For orphan sites, a yearly budget for their remediation is settled and managed by the municipalities where those sites are located.

The **Netherlands** adopted a soil-protection act in 1987 which establishes historical contamination as that occurring before its entry into force. For soil contamination occurring after this date, the polluter has full liability. A risk assessment for addressing historical contamination was also followed here. Due to the early entry into force of the Dutch soil legislation, orphan sites affected by historical contamination are not very common, but when it occurs, the competent authorities are subsidised for remediation by the national government.

The law on CS remediation in **Austria** (1989) provides for the need to have a fund to remediate historically contaminated soils. This funding comes from a levy on certain activities in relation to the disposing of and temporary storage of waste and in relation to the mass of waste. Site owners or operators able to prove not being liable for historical contamination may apply for funding of remediation measures. Polluters identified as being liable, which means not meeting the agreed technical state of the art and legal obligation before 1 July 1989, are not allowed to apply for funding. If neither a polluter nor a third party conducts investigation or remediation measures, the federal government may finance measures completely, depending on available revenues raised by the levy. For managing orphan sites, a state-owned company (Bundesaltlastensanierungsgesellschaft mbH (BALSA GmbH)) was established in 2004,

which uses a public budget coming from waste-taxation system to implement remediation projects.

In **Hungary**, the national environmental remediation programme (United States Federal Register, 1993) proposed identical approaches as in Austria on historically contaminated sites in comparison to sites contaminated by polluting activities. However, historical sites are typically under state liability and are funded through the governmental budget or financed through the EU CF. This is because most of the land and industrial activities causing contamination were state owned.

Since the **Estonian** chemical act entered into force (1998) there are different approaches to historical residual contamination in comparison to new contamination. The **PPP ([92])** is applied only in those cases of new contamination. Remediation activities at orphan sites have been funded through the governmental budget and the environmental investment centre of Estonia. Separate programmes using funding from national environmental taxes and financing through the EU CF have been used by the state.

In **Denmark**, the polluter's full liability was introduced for contamination that occurs on or after 1 January 2001, as set out in the act on soil contamination. For public remediation there is no difference between new and historic contamination, but public budgets to deal with orphan sites are allocated to the regions every year.

In **Croatia**, the main strategic document that regards management of landfills and historical contaminated sites is the waste-management plan (2005). Those sites in the environment that have become highly burdened through long-term inappropriate management of industrial (technological) waste are known as 'hot spots' and represent the priority for remediation for the Croatian government. Some of them are orphan sites and they are managed under the environmental protection and energy-efficiency fund ([93]).

In **Bulgarian** legislation, a different concept for historical contamination is set out and it does not depend on the entrance into force of the legislation. Only past environmental damage caused prior to the privatisation of enterprises is considered as historical contamination. There is no information about funding mechanisms to deal with orphan sites.

Poland has a more recent approach to dealing with historic contamination. In the Polish EPA, Title II, Section IV, referring to 'land surface protection', some provisions are stated to deal with contamination that occurred before 30 April 2007, and it also includes clear rules on abandoned sites where potential or confirmed soil contamination occurs.

Once the ELD (2004/35/CE) was implemented in **Slovakia**, two new concepts were introduced in Slovak legislation. Thus, environmental burden is specified as historical contamination when it is caused by human activities before 1 September 2007, while new contamination is that caused by human activities after this date.

In **Luxembourg,** every CS, regardless of whether it is a site with historical or recent contamination, is considered under the waste law. The same is the case of **Italy**, where new and historical contamination are addressed equally, following the same procedure to identify, investigate and remediate CSs.

For historic contamination or orphan sites located in **Czech Republic**, investigation and remediation can be financed by the state, the army or through environmental operational programmes (EU funds). New contamination is managed in a regime of an emergency event (according to the water act) and/or according to the act on environmental derogation (polluter pays) due to the lack of specific legislation.

([92]) OECD Glossary 2001: Definition: The polluter-pays principle is the principle according to which the polluter should bear the cost of measures to reduce pollution according to the extent of either the damage done to society or the exceeding of an acceptable level (standard) of pollution.

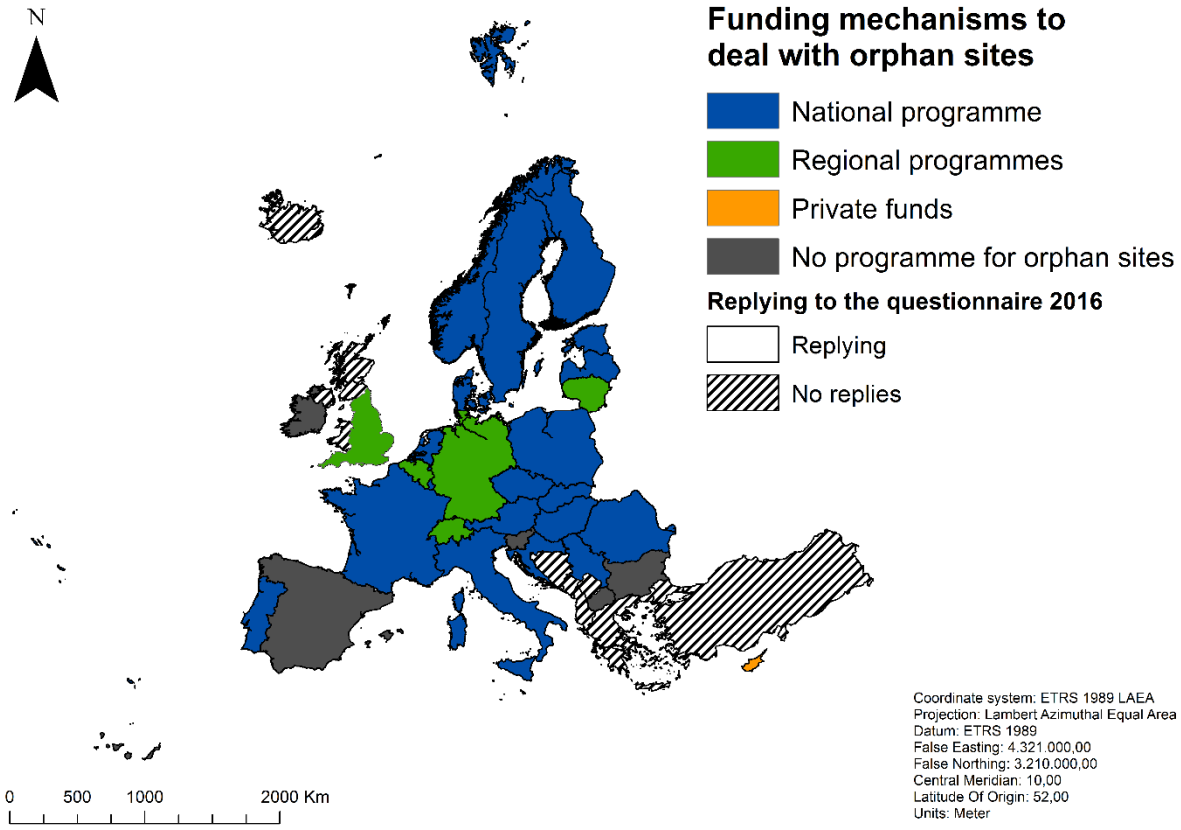
([93]) Act on the environmental protection and energy efficiency fund (OG No 107/03 and 144/12).

For the last historically contaminated-site-remediation programme (2007-2013), **Latvia** achieved remediation of six megasites. Funds from the state, the EU and Swiss foundation made the implementation of this program possible.

In the last three decades, a number of European countries have introduced national policies to deal with historical contamination problems and to assure the availability of funds to remediate orphan sites (

Figure 14).

Figure 14. Funding mechanisms for orphan sites in Europe.



In **Luxembourg**, when orphan sites are identified, it is possible to apply for public funding through 'Fonds pour la protection de l'environnement', but the budget is allocated on a case-by-case basis.

Significant differences exist in Belgium among its regions regarding orphan sites. Whereas in **Flanders**, the concept of orphan sites is not legally recognised but they do have 'blackfields', which are those sites where the remediation cost are higher than the selling value. In Belgium (Wallonia) 'orphan sites' are described in the soil decree. In those situations, the public waste agency of Flanders (OVAM) has the responsibility of carrying out the soil investigation, the soil remediation and all other expenses related to the land using public budget. SPAQuE is in charge of the ex officio rehabilitation of 'orphan sites' in **Wallonia**. In this case, the public authority supports the cost in absence of other solution, unless court proceedings can establish the holder of liability.

German legislation on soil protection does not specifically provide for orphan status. However, in every case someone can be drawn to fulfil the remediation duties. If those mentioned as responsible for different reasons are not able to remediate, or if it is (e.g. politically) unwise to insist on remediation through the landowner, who did not pollute, then the competent authority has to remediate it and the federal soil-protection act

allows a public encumbrance to support remediation. In this case, remediation programmes are managed at regional level (*Laenders*).

Neither **Slovenia** nor **Norway** has a different approach when the contamination is historical and those sites are managed under the legal framework. Norway has specific funds to remediate sediments where the identification of parties responsible is difficult, while Slovenia does not have a specific programme or budget to deal with orphan sites.

A different approach has been adopted in **Lithuania** for orphan and historically contaminated sites. If a contaminated orphan site is on state land, the municipality is responsible for investigation and remediation. If 'historical' contamination is observed on private land, the state does not have a specific budget to deal with it or other solutions.

Portugal has not yet approved national legislation on contamination prevention and soil remediation. Nevertheless, old orphan mining sites have been environmentally rehabilitated by a state-owned company and an inventory of these old mining sites was made in 2003/2004 and an inventory of orphan industrial sites was made in 2008. On the other hand, Portugal has a budget, supported by private funds, public/national environmental funds and EU funds to deal with orphan sites, showing a great political will for protecting its soils.

Cyprus has not legally set out the differences between historical and new contamination. Orphan sites have been remediated according to ownership of the site. Private land was remediated using private funds and state-owned land was remediated using public funds.

Ireland has recently started to work on the development of a multi-agency protocol for dealing with orphan sites and securing financial provision for their remediation.

In **Switzerland** there is no difference in the obligation for investigating, monitoring or remediating between historical and new polluted sites. However, there is a difference in the funding: if the contamination originated after 1 February 1996 it is not paid by the federal remediation fund. Exceptions are shooting ranges: if there are still deposit of projectiles in the soil after 31 December 2012 (or after 31 December 2020 in all other areas) the remediation works are not paid by the federal remediation fund.

Finland has three legislative mechanisms that allow it to ensure the availability of funds in case of accidents which can pose a risk to the environment or human health. Through the state waste-management system, the state has supported the remediation of unmanaged sites. The Finnish oil pollution compensation fund guarantees the investigation and remediation of those areas contaminated with oil. The last funding mechanism is the environmental impairment liability insurance, which is compulsory for every company whose activities involve a potential risk of environmental damage.

A similar system of financial guarantees of certain installations likely to pollute the soil was initiated in **France** in 2012. The French agency for the environment and energy management (ADEME) can intervene to ensure the safety of polluted sites and soil where the entity responsible is failing to do so.

For contaminated orphan and abandoned sites belonging to the public domain in **Romania**, the responsibility for investigation and pollution assessment are financed from the state budget or the Structural and Cohesion Funds, through projects approved for funding in accordance with the rules of implementation of these funds. There is no legal differentiation between historical and new contamination in this country.

Polluter-pays and legal-successor liability principles are strictly applied in **Serbia.** The polluter or the legal successor is legally bound to eliminate the cause of contamination and the consequences of direct or indirect environmental contamination even where there is liquidation or bankruptcy of the company or other legal entities. Furthermore, when changes in the ownership of companies or other legal entities or other changes in the ownership structure occur, an assessment and allocation of liability for environmental contamination and settlement of debts (charges) of the ex-owner on account of contamination or damage to the environment is also to happen. It is also

possible that the liability be passed, contractually, from the polluter to a CS purchaser. However, when the polluter is unknown or when contamination originates from sources outside the territory of the country, the principle of subsidiary liability is applicable and the state authorities, within their financial abilities, are to eliminate the consequences of environmental contamination and reduce damages. In cases of accidents and new contamination, the state can manage them via an emergency regime.

Liability when the PPP cannot be applied is not clearly set out in **Spain**. However, in particular cases when the site is posing a significant risk to the environment or human health, regional administrations and, occasionally, the ministry of the environment can assume the costs of remediation. At national level, the soil decree makes no difference between historical and current contamination. It should be noted, however, that Basque legislation does introduce this concept.

In **Malta** and **the former Yugoslav Republic of Macedonia**, there is no specific national funding mechanism for remediation of orphan sites.

3.7 Targets

The roadmap to a resource-efficient Europe (COM/2011/0571 final) ([94]) proposed (Section 4.6 Land and soils) a milestone for soil protection and remediation of contaminated soils: 'By 2020, EU policies take into account their direct and indirect impact on land use in the EU and globally, and the rate of land take is on track with an aim to achieve no net land take by 2050; soil erosion is reduced and the soil organic matter increased, with remedial work on contaminated sites well underway'. And countries were requested to set up a CS inventory and a schedule for remedial work by 2015.

The 7th EAP has continued promoting the sustainable use of soil: 'land shall be managed sustainably in the Union, soil shall be adequately protected and the remediation of contaminated sites will be well underway' (EU, 2013b). One of the leading efforts that are required to achieve the goals is CS remediation and the enhancement of the integration of land-use aspects into policies (paragraph 28vi). However, no more referencing has been done on inventories.

New targets on soil contamination have been set out under the 2030 *Agenda for sustainable development* (UN, 2015). The SDG 3 'Ensure healthy lives and promote well-being for all at all ages', in Target 3.9, includes the decision of members to 'by 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination'. SDG 6 'Ensure availability and sustainable management of water and sanitation for all' refers to the use and release of untreated wastewater, which is a significant source of soil pollution and SDG 12 'Ensure sustainable consumption and production patterns' reiterated 'by 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimise their adverse impacts on human health and the environment'.

Whereas targets are mainly related to technical achievements, political willingness is essential to guarantee the availability of funds to accomplish these goals.

Significant progress has been made during the last years in most European countries in dealing with historical site contamination, setting targets for the management or the complete remediation of these sites.

Since the last two data requests, in 2006 and 2011, 17 EEA members and cooperating countries have set new policy targets or have improved the ones that they set out in previous years.

([94]) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Roadmap to a Resource-Efficient Europe.

Policy targets for CS management were reported in 17 Member States and four cooperating countries: by 2050 (**Austria** and **Hungary**) or earlier for 15 respondents (Table 9). Another nine Member States report not having any political or technical targets for remediating historical contamination, but do have a strategy to immediately manage new contamination, namely **Cyprus**, **France**, **Germany**, **Italy**, **Luxembourg**, **Malta**, **Poland, Spain** and **United Kingdom (England)**. **Portugal** does not have a deadline for the remediation of contaminated orphan sites, but 2022 is has been set as the expected finish date for most of the remediation works on orphan mining sites. Frequently, these remediation goals have political and legal support.

In 2009 the **Austrian** Ministry for the environment set out the national schedule for remedial works, and an inventory of CSs and sites where polluting activities took place was to be completed by 2015. The goal proposed for 2050 refers to the establishment of risk management (covering remediation, RRM and monitoring measures like monitored natural attenuation (MNA)).

In **Belgium** there are different targets depending of the region. In **Brussels-Capital,** the main objective of soil policy is to prevent or to immediately remedy new soil contamination and to deal with orphan soil contamination that has taken place in the past by 2029. In **Flanders**, 2036 is the deadline set for remediating all sites with historical soil contamination, and in **Wallonia**, remediation of all priority sites identified in the Marshal Plans. Green (since 2005, see Annex I for reference) is expected to be completed by 2022. In **Denmark** and **Estonia**, the targets reported do not refer specifically to CS remediation but to the management of contamination affecting bodies of water.

In **Serbia**, the national environment protection programme and the waste management strategy for the period 2010-2019, have set the goals to achieve in relation to contaminated soils.

In some countries, the specific legislation on soil contamination specifies a deadline to address soil contamination. The national risk management strategy for contaminated land supports **Finnish** soil-contamination goals. **Lithuania** deals with remediation of historical contamination under the national CS management plan. In **Slovakia**, the operational programme quality of the environment (2014 -2020), which has adopted the objectives of the 7th EAP to 2020, includes the second state CS-remediation programme 2016-2021. Sweden has also included CS remediation in the accomplishment of the 7th EAP's goal of 'a non-toxic environment'.

In **Hungary**, political and technical targets are not consistent. While 2030 is considered the deadline for the national environmental remediation programme, on a technical level, CS remediation can be extended until 2050.

The adoption of long-term objectives (2030-2050 timeframe) by the 27 % of those surveyed demonstrates the growing awareness in the political and social spheres, going beyond the electoral horizon (4-year timeframe) or the objectives of the EU for this decade.

Malta is currently collecting the data required to compile a national implementation plan for CS remediation while addressing contamination issues using site-specific risk assessments and applicable legal requirements for specific sites, but there is no technical or political date to finish this collecting period. The same situation is present in **Spain**, where no targets are set out but soil contamination is addressed when detected, following the steps set out in the national CS policy.

Table 9. Overview of existing policy/technical targets for addressing soil contamination. Targets from previous questionnaires are presented in those cases when there is an improvement on the target proposed.

Country	Questionnaire	Year	Political or technical target to be reached
Austria	2006	**2050**	Remediation and re-integration of identified contaminated sites into economic and natural cycle
	2016	**2050**	Complete risk management
Belgium (Brussels-Capital)	2016	**2029**	Deal with orphan soil contamination that has taken place in the past by 2029
Belgium (Flanders)	2011	**2036**	Remediation started on sites with potentially contaminating activities and which are considered as contaminated
	2016	**2036**	Remediation of all sites with historical soil contamination
Belgium (Wallonia)	2016	**2022**	Complete remediation of all priority sites identified in the Marshall Plans (since 2005)
Bulgaria	2016	**2020**	Every programme that has not been started and/or have incomplete performance should be finished
Croatia	2016	**2025**	Management of landfills and historical contaminated sites (hot spots)
Cyprus	2016	**——**	No specific date is set: depends on the technical development
Czech Republic	2016	**2016** (achieved)	Remedial work of old environmental burdens caused by the Armed Forces of the Union of Soviet Socialist Republics army completed in 2016.
		2018	The Environmental Liability Act (ELA) provides for mandatory financial security for operators of the operational activities listed in Annex I of the ELA
Denmark	2016	**2025**	80 % of groundwater resources cleaned
		2027	Contamination threatening surface water bodies must be solved by 2027
Estonia	2011	**2030**	All contaminated areas have to be remediated or sustained.
	2016	**2021**	All sites with serious risk for polluting groundwater have to be remediated before 2021.

		2030	All identified currently disused hazardous sites will be cleaned up by 2030.
Finland	2016	**2040**	To have the significant risk posed to health and the environment by contaminated land under control in a sustainable way
France	2005	**2007** (no information on achievement)	Main objectives for 2007 are to continue to put in place an efficient information system on polluted soils. Basias would be probably completed in 2008 and will give a more accurate view on the polluted soils and sites at the national level.
	2016	**——**	There is no political or technical target for historical local contamination. New contamination is taken care of immediately.
the former Yugoslav Republic of Macedonia	2006	**2008-2012** (achieved)	Implementation of the closure/remediation measures for the top 3 hotspots in Annex 1 of the National Waste Management Plan.
	2016	**——**	No target.
Germany	2016	**2030**	Target only at federal level and not binding.
Hungary	2016	**2050**	To achieve remediation of identified polluted sites on a technical level.
Latvia	2006	**2008** (no information on achievement)	Development of financial, technical and human resources in municipalities; to work on projects for management of contaminated sites and to perform recovery (remediation) of sites.
Lithuania	2006	**2009** (no information on achievement)	Waste disposal to all landfills not fulfilling special requirements should be stopped.
	2016	**2023**	Remediation of the most contaminated sites.
Luxembourg	2006	**2006** (no information on achievement)	Finish inventory Caddech.
	2016	**——**	No target.
Malta	2016	**——**	No targets for remediation are in place at present.
Netherlands	2011	**2015** (no information on achievement)	Handling of sites with actual risks with current land use.
	2016	**2020**	To manage risks for human-health and ecological risks and risk due to groundwater migration for the 1 383

			locations that require urgent remediation or risk management.
Norway	2016	**2020**	The national target is for releases and use of mercury and other substances that pose a serious threat to health or the environment to be continuously reduced with a view to eliminating them by 2020 ([95]).
Poland	2016	**——**	There are no political or technical targets for historical local contamination. New contamination is taken care of immediately.
Portugal	2016	**2022**	Major remediation works for the environmental remediation of old mining orphan areas are expected to be completed by this year, but there is not a deadline for the remediation of contaminated sites.
Romania	2006	**2020**	Environmental remediation of the majority polluted areas.
	2016	**——**	No target.
Serbia	2011	**2019**	20 % of priority sites should be remediated.
	2016	**2019**	Remediation of contaminated sites from the list of priorities, rehabilitation of existing dumpsites and performing remediation of those that pose the biggest risk to the environment, as well as remediation of contaminated soil. To make an inventory of locations contaminated with hazardous waste, to set out the risks for rehabilitation and remediation and to decide on priorities for rehabilitation and remediation.
Slovakia	2011	**2015** (no information on achievement)	Remediation of the contaminated sites with the highest risk to human health and environment (to reach 'good status of water' with respect to the Water Framework Directive)
	2016	**2021**	Risk assessment of all contaminated sites, remediation of contaminated sites with the highest risk
Slovenia	2016	**2022**	Remediation of the Upper Meža Valley has been ongoing since 2007 and is expected to be completed in the year 2022.
Spain	2006	**2007** (achieved)	Preliminary reports on potentially polluting activities sent to regional environmental authorities. These reports are tools to identify contaminated soils.
	2016	**——**	There are no political or technical targets for historical local contamination. New contamination is taken care immediately when detected.
Sweden	2013	**2025**	The interim target for the remediation of contaminated sites means the following (SEPA, 2016).

[95] http://www.miljodirektoratet.no/no/Publikasjoner/Publikasjoner/2010/Juni/Reducing_and_eliminating_mercury_pollution_in_Norway__The_mercury_problem/

			• At least 25% of sites with very large risk (Risk Class 1) to human health or the environment are remediated by year 2025. • At least 15% of sites with large risk (Risk Class 2) to human health or the environment are remediated by year 2025. • The use of other remediation techniques than excavation and disposal, without pre-treatment of masses, increased by year 2020.
	2016	**2020**	Contaminated sites should have been corrected, to the extent that they do not pose any threat to human health or the environment, within one generation (or by 2025).
Switzerland	2006	**2007** (achieved)	The registration of all polluted sites in the registers should be completed.
	2016	**2025**	All investigations of potentially contaminated sites (PCS) should be finished by 2025 at the latest
		2040	All contaminated sites should be remediated by 2040 at the latest
United Kingdom (England)	2003	**2007** (no information on achievement)	At a political level, the environment agency aims to substantially remediate and/or investigate 80 special sites identified under the Part 2A Regime (environmental protection act (EPA), 1990) in England.
	2016	**——**	No target

4 Future and political objectives

After the analysis of all the information provided by respondents and the comprehensive examination of existing national and EU policies, some gaps and future directions on soil contamination have been identified.

The lack of agreement on the triggers for initiating an investigation at a site suspected of being contaminated remains evident. It is clear that differences in soil types between countries, with heterogeneous pedogenic processes such as selective dissolution and weathering, volatilisation, vertical and lateral transport, pedoturbation and soil accretion by dust and organic matter, make it difficult to decide on a single procedure. In addition, the complexity of soil governance complicates standard setting (de Vries, Römkens and Bonten, 2008). Furthermore, background levels are different and the main polluting activities are not the same for each country. However, soil contamination is posing real risk to human health and the environment in Europe and it is everyone's responsibility to deal with it and to ensure a safe environment for future generations.

The scarcity of data on interactions between different contaminants and between them and soil constituents also highlights the need for continued investment in research and technical development. Due to the transboundary nature of soil contamination, guidelines and screening values for all pollutants need to be agreed among all countries. The development of a common language for discussing contaminated-soil issues is of crucial interest. Furthermore, as many countries have reported, the lack of a common and binding framework is a bottleneck for them to develop a national strategy because of the limited political will to address soil protection. Implementation in accordance with these guidelines and procedures will require each country to provide the same information, with the same level of detail, to resolve the differences and lack of information found to date. All these arguments underline the need for harmonisation and the implementation of a common soil policy. In addition, a common framework can help to channel EU efforts towards more efficient, economically viable and environmentally friendly ways of remedying soil and site contamination.

The new European regulation on mercury, adopted in May 2017, includes an article on sites contaminated by mercury and mercury compounds. This regulation states that an inventory of sites contaminated by mercury and mercury compounds must be available to the public by 1 January 2021. Taking into account that 11 respondents have reported to have political and technical goals in relation to CS remediation by 2021, the implementation of this regulation could contribute to conducting surveys, investigations and remediation if the risk is high.

Some respondents have reported information on megasites and the complex feasibility of regional and national governments investigating and remediating such sites due to the high costs involved. Detailed information on these sites at EU level, their extent and characteristics would also be interesting for assessing the high risks to the environment and human health and for seeking collaborative remediation.

A number of networks worldwide (the Sustainable Remediation Framework (SuRF) in different countries - SuRF-UK, SuRF-Canada, SuRF-United States, the Contaminated land rehabilitation network for environmental technologies (Clarinet), the Network for Industrially Co-ordinated Sustainable Land Management in Europe (NICOLE) Road Map for Sustainable Remediation, Common Forum), have been discussing over the past 10 years how to find consensus on the best available techniques to remediate soil contamination. The environmental friendliness and the cost-effectiveness are aspects to be considered when a technique is chosen to assess site-specific risk. However, the extent of a technique's application is limited where it is not commercially available: in many cases techniques are restricted to research. The urgency and the magnitude of the risk will conduct the decision-making process, and the availability of funds will determine which methodology is chosen to address the problem (Bardos, 2014). The most common remediation method used so far is the off-site technique of 'dig and dump', which has a negative impact on the soil ecosystem and is a waste of resources, since the excavated

soil is normally buried in landfill. Although it has been reported as the most common technique, the extent of its application is not yet well known in Europe. A survey of ex situ practices in Europe to estimate soil resources being lost each year in each country would provide sufficient technical support to develop a legal framework to regulate the future applications. Future efforts should focus on more efficient, economically suitable and environmentally friendly manners to deal with soil contamination.

In addition, it is not only a European objective to apply more-efficient techniques to remediate contaminated soils, but also a global commitment that the EU has assumed. Priority objective 9 of the 7th EAP states that 'the Union will engage proactively in international efforts to develop the solutions needed to ensure sustainable development globally'. It is through sharing the know-how and the technologies together with financial support that the EU will be able to promote sustainable contamination management in third countries.

At the global level, the importance of sustainable-soil and land management is increasingly recognised on the international political agenda, particularly in the SDGs, the Global Soil Partnership initiative and United Nations Environment Programme (UNEP). Soil is a cross-cutting theme for several UN conventions, agencies and initiatives that should work together to set out harmonised concepts, soil-quality criteria and procedures. Soil contamination as an issue is gaining momentum worldwide; in particular with the adoption of the 'Towards a pollution-free planet' agenda by the United Nations Environment Assembly (UNEA-3) in Nairobi in December 2017. In addition, the Global Soil Partnership, the Food and Agriculture Organisation of the United Nations (FAO), and other UN agencies (UN Environment, WHO and Basel, Rotterdam and Stockholm Conventions Secretariat) jointly organised a Global Symposium on Soil Pollution in May 2018. The EU has the opportunity to work together with other countries and agencies around the world to achieve the prevention, management and remediation of soil pollution.

5 Summary

An overview of this report and the findings of the questionnaire commissioned by JRC in 2016 about CS management in Europe are presented in this section.

5.1 Response rate

A total of 31 out of 39 countries (79 %) responded to the questionnaire. However, not all were able to answer all the questions; therefore, for some questions related to the determination of site status, the response rate is reduced to 33 % (13 countries), while the response rate is 10 % for those questions related to the area of contaminated soil being addressed under different remediation techniques. Due to these response rates, caution is required when interpreting the results and drawing conclusions, as the figures sometimes represent a very low response rate and, in such cases, the analysis provided in the report cannot be extrapolated to the overall situation in Europe.

Despite the intensive efforts of the ad hoc working group on contaminated sites and brownfields and the Observation Network of National Reference Centres on Soil (Eionet NRC Soil) to set a better indicator and harmonise the CS information available in Europe, many differences and uncertainties remain.

5.2 Progress in the management of contaminated sites

In the EU-28, the extent of soil contamination has been estimated at 2.8 million sites where polluting activities took/are taking place. There is not enough information to extrapolate the number of polluted sites for the 39 countries surveyed.

The actual extent of soil contamination from industrial activities and point sources is 690 000 identified sites where polluting activities took/are taking place located in 74 % of the countries surveyed. Estimates of the number of sites where polluting activities may have taken place refer to more than 1.5 million sites, but only 36 % of countries have conducted this estimation exercise.

To date, the measures have been completed at more than 150 000 sites, which have either been remediated or, following an investigation, it has been declared that the remediation was not necessary (site statuses 3 and 6). There has been a general improvement in CS management; efforts are mainly focused on the investigation and remediation of sites where polluting activities took/are taking place, due to the fact that many countries already have an accurate inventory.

5.3 Inventories

More than 70 % of the countries surveyed have comprehensive CS inventories. The competence to manage the CS register depends on the country. It can be managed centrally, regionally or locally. Almost 40 % of countries surveyed maintain a national inventory, while 21 % of countries manage inventories on a regional basis. Five countries combine national and regional inventories. Portugal and Poland are developing their CS inventories.

Slovenia, Romania, Malta, the United Kingdom (England) and the former Yugoslav Republic of Macedonia have declared not to have an official CS inventory.

5.4 Remediation techniques

The main priority of national inspection strategies is to assess risks to human health and the environment. About half of the countries use site-specific risk assessment for their inspection strategies, while 15 % of countries decide to conduct further investigation and corrective actions based on screening values previously set out in the national guidelines.

Only eight countries provided information on the area recovered using different techniques. The most commonly used remediation procedure among them appears to be

the ex situ 'dig-and-dump' technique, which involves the excavation and off-site disposal of contaminated soil.

5.5 Costs and liabilities

On the basis of the available data provided by respondents, the overall average expenditure for assessing soil contamination amounts to EUR 4.5 billion. The cost of site-based remediation varies from EUR 30 000 per site in Estonia to EUR 620 000 per site in Hungary, although the size and level of contamination are not the same in all cases.

All respondents have confirmed that the PPP is applied; however, on average more than 43 % of total expenditure comes from the public budget. In some cases, EU-funding mechanisms (such as Interreg or the ERDF) are used to finance soil remediation.

The liability for CS management generally has the following hierarchy: 1. the polluter, 2. the landowner and, ultimately, the liability lies with the local municipalities or state. There are some countries with a more complex system for ensuring the availability of funds for remediation.

5.6 Historical contamination and orphan sites

Historical contamination is considered to be that which occurred prior to the application of the specific soil-contamination law. Most EU Member States have adopted their own legal instruments to deal with soil contamination, which have entered into force at different times since the 1980s. The criteria for addressing historical contamination vary (from one country to another and even within a country) and are often laxer than those used for new contamination; risk-based approaches are often applied.

In the case of CSs where the polluter either has gone or cannot be held (partly or totally) liable for the contamination, it is the responsibility of national, regional or local authorities to manage the remediation of such orphan sites in order to reduce the risk they pose to human health and the environment.

5.7 Legal instruments and targets

Despite the lack of a specific EU instrument that ensures soil protection, including the prevention of soil contamination, other EU policies have contributed significantly to soil protection. In spite of this, soil is still subject to many pressures that lead to its degradation. The European Union has recently recognised the importance of soil protection as fundamental to achieving other environmental objectives in the coming decades, but there is as yet no agreement to regulate land use, including soil protection against contamination.

Due to this lack of specific common framework to prevent soil degradation, several Member States have developed their own legislation to protect their soils, prevent further contamination and regulate the procedure for the assessment and treatment of soil contamination. Each European Member State has a national policy that includes the PPP principle, whether it is a specific policy on soil contamination or regulations included in a more general environmental code. They also include definitions related to contamination, screening values, RRM and guidelines for site identification.

Of the EU Member States, 17 report official policy targets for CS management. The adoption of long-term objectives (2030-2050 timeframe) demonstrates the growing awareness in the political and social spheres.

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List of abbreviations and definitions

ADEME	French agency for the environment and energy management/Agence de l'Environnement et de la Maîtrise de l'Énergie
AMR	Antimicrobial resistance
ASI	Austrian Standards Institute
BD	Basin directorates
CAP	common agricultural policy
Caracas	Concerted action on risk assessment for contaminated sites in European Union
CF	Cohesion Fund
CIPS	Contamination of industrial and point sources
Clarinet	Contaminated land rehabilitation network for environmental technologies in Europe
CLC	Corine land cover
Corine	coordination of information on the environment
CPCS	Contaminated and potentially contaminated sites
ChS	Characterisation study
CS	contaminated sites
CSI	core set of indicators
CSO	Contaminated-sites ordinance
CTC	contamination threshold concentrations
EAA	Environment Agency Austria
EAP	EU Environment Action Programme
EEA	European Environment Agency
EC	European Commission
Eionet	European environment information and observation network
ELD	environmental liability directive
EP	European Parliament
EPA	environmental protection act
EPEEF	environmental protection and energy-efficiency fund
EQS	environmental-quality standards
ERDF	European Regional Development Fund
ES	ecosystems services
ESBN	European soil-bureau network
ESF	European Social Fund
ETC	European topic centre
ETC/ULS	European topic centre on urban, land and soil systems
EU	European Union

Eugris	portal for soil and water management in Europe
FAO	Food and Agriculture Organisation (of the United Nations)
FE	final-evaluation
FOEN	federal office for the environment
FP6-FP7	research framework programmes financed by the European Commission
GAEC	good agricultural and environmental conditions
GDP	gross domestic product
GSP	global soil partnership
HERACLES	human and ecological risk assessment for contaminated land in European Member States
ICPE	environmentally protected installation in France/*installation classée pour la protection de l'environnement*
IED	industrial emissions directive
IMS	indicator management system (EEA)
Inspire	infrastructure for spatial information in Europe
IPPC	integrated pollution prevention and control
ISCS	information system of contaminated sites
ITPS	intergovernmental technical panel on soils
JRC	Joint Research Centre
LCA	Life cycle assessment
LEGMC	Latvian environment, geology and meteorology centre
Lepreda	liability for prevention and remedying of environmental damage act
LGS	Lithuanian geological survey
LIR	land information register
LP	Low priority
LSI	land and soil indicators
LULUCF	land use/land- use change and forestry
MNA	monitored natural attenuation
MOEW	ministry of environment and water
NEAP	National environment protection action programme
Nicole	network for industrially contaminated land in Europe
NRC	national reference centres
NSDI	National spatial data infrastructure
OKKP	national environmental remediation programme of Hungary
OS	orientation study
OVAM	waste agency of Belgium (Flanders)/Openbare Afvalstoffenmaatschappij voor het Vlaams Gewest
PCS	potentially contaminated sites
PPA	prospective purchaser agreements

PPP	polluter-pays principle
RDEP	regional director for environmental protection
REACH	registration, evaluation, authorisation and restriction of chemicals
REBs	regional environmental boards
RP	Remediation plan
RRM	risk-reduction measures
RS	remediated sites
SAED	Sites d’activité économique désaffectés
SAR	Sites a réaménager
SCAHT	Swiss centre for applied human toxicology
SDG	United Nations sustainable development goals
SEPA	soil to the environmental protection agency
SFD	soil framework directive
SOER	state of the environment in Europe
SPAQuE	Société Publique d''Aide a la Qualité de l''Environnement
STS	thematic strategy for soil protection
SUI	sites under investigation
TFP	transitional and final provisions
UN	United Nations
UNEP	United Nations Environment Programme
US EPA	United States Environmental Protection Agency
WBM	water base management
WFD	waste framework directive
WHO	World Health Organisation

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Annexes

Annex 1. Eionet NRC Soil — Countries' replies to the questionnaire on the establishment of the indicator LSI003 'Progress in the management of contaminated sites in Europe'

European Commission

Joint Research Centre

Sustainable Resources Directorate D

Land Resources Unit D.3

Ispra, 22/12/2016

ARES/APP/app/…./2016

NB: Assumption is that sites reported in Questions Q3, Q4, Q5, Q6 and Q7 are subsets of the sites reported in Question Q2.

Question 1: Which year did your country initiate a national programme to deal with contaminated sites?

Explanation: It may happen that your country has not a 'programme' but other ways to deal with contaminated sites. This 'way' may consist of a process with various steps. With this question, we would like to know when the country started to address 'contaminated sites' in a systematic way and to identify the date (the year) considered as starting point. It likely will be also crucial to understand the general objective, context and the scope of national 'programmes' (approaches) such as the following.

The legal background and references at national level.

The polluting activities considered (in particular as national programmes starting before 2006 likely considered activities different from that which had been discussed during the negotiation on the withdrawn European Commission proposal on a soil framework directive).

Whether there are different approaches to historically contaminated sites in comparison to sites contaminated by polluting activities nowadays.

Reply Q1 (Austria): The national programme on historically contaminated sites has been started by 1.7.1989.

A first and major legal framing has been set by the Austrian water act (WRG, 1959) enacted in 1959. WRG sets out a general objective to keep groundwater in natural quality and as a drinking-water resource.

Awareness on contaminated sites grew since the early 1980s primarily on landfill causing groundwater pollution or risks due to landfill gas migration. At several of those public well-known contaminated sites liable parties did not start remediation projects or lodged appeals against orders of competent authorities. Accordingly, hardly any remediation projects progressed. Analysing the situation it was concluded that the major obstacle hindering necessary actions were that extraordinary high costs had been to be expected. In correspondence, it was obvious that small and medium enterprises hardly would be able to cover the costs to remediate historical contamination.

In 1989, the law on the remediation of contaminated sites (ALSAG) was enacted. The objective is to ensure that funding is available for remediation of contaminated sites. Its scope covers historically contaminated sites (soil and groundwater) that pose a significant risk to human health or the environment. The law sets a levy on certain activities in relation to the disposing of and temporary storage of waste. Owners of

installations carrying out such activities have to pay the levy calculated in relation to the mass of waste. The revenue is earmarked for funding remediation as well as identifying, assessing and maintaining registers of potentially contaminated sites and polluted sites (causing significant risk to human health or the environment).

In terms of possibly contaminating activities, ALSAG considers commercial or industrial activities having stored or handled significant amounts of hazardous substances (before 1 July 1989) as well as old unmanaged landfills. Compared with the list of potentially soil polluting activities of the former draft on a European soil framework directive the following differences need to be recognised.

Airports, ports and military sites are not considered as polluting activities in general. Only areas having been used for specific activities (e.g. fuel storage; shooting ranges) are recognised and registered when soil or groundwater contamination is evident by investigation and sampling.

Wastewater treatment installations and pipelines are not considered or registered.

ALSAG (1989) also requires a prioritisation of polluted sites with respect to a classification of the severity of risks. Priority classes indicate the urgency of implementing and a possible funding of remediation measures, as well as a limiting maximum rate of funding. Site owners or operators able to prove not being liable for historical contamination may apply for funding of remediation measures. Polluters identified being liable, which means not meeting the agreed technical state of the art and legal obligation before 1 July 1989, are not allowed to apply for funding. If neither a polluter nor a third party conducts investigation or remediation measures, the federal government may finance measures completely depending on available revenues raised by the levy.

As a complementary piece of environmental legislation, a waste management act (AWG) was raised in 1990 and amended in 2002. The main aim of the waste management act (AWG, 2002) is to secure an environmentally sound management of waste. The objectives and principles of the waste management act 2002 require arranging the waste management in accordance with the precautionary and sustainability principle in order to preserve inter alia resources, e.g. raw materials and land. AWG (2002) includes provisions for remediating contaminated soil.

More detailed information on legal background and references at national level can be found at the Soil wiki set up on behalf of the European Commission (DG Environment) in 2016 (see also report: Updated inventory and assessment of soil protection policy instruments in EU Member States; Ecologic; Berlin, February 2017).

Reply Q1 (Belgium (Flanders)): Flanders has [had] a waste decree since 1981, which initially primarily focused on waste management and prevention, but one article allowed OVAM [waste agency of Belgium (Flanders)] to remediate contaminated sites 'ex officio' (in discharge of one's duty) when the responsible party would not take appropriate action. Because this single article was not sufficient to provide urgent and comprehensive solutions for complicated contamination problems, the Flemish parliament adopted a soil remediation decree (22 February 1995) to tackle contamination in a more holistic and coordinated way. The decree came into full effect in October 1996, which in Flanders is the starting point for 'addressing contaminated sites in a systematic way'. Potentially contaminated sites were already preliminary inventoried for the first time in 1992.

The soil remediation decree introduced a legal obligation for users, operators or owners to conduct an exploratory soil investigation on land on which certain risk activities were carried out. The list of these industrial activities with an increased risk of soil contamination that were executed before 1 June 2015 is part of the executive order Flemish regulations on soil remediation and soil protection (Vlarebo, appendix I). You can find a link to the list of the activities currently listed as potentially contaminating in the annex, unfortunately only in Dutch.

The legislation makes a distinction between historical and new soil contamination. Historical soil contamination is legally defined by the Flemish soil decree as soil

contamination caused before 29 October 1995, new soil contamination is caused after this date. The approach for new contamination is stricter to stimulate prevention: immediate remediation is necessary when soil-remediation standards are exceeded. For historical contamination, a risk-based approach is applied, taking into account the risks on human health, ecology and dispersion.

Reply Q1 (Belgium (Wallonia)): The initiation of a programme to deal with contaminated sites is closely linked to the history of polluting activities that took place in Wallonia (see the publication The Remediated sites and brownfields-Success stories in Europe).

In the early 19th century, the industrialisation process of the Walloon area was concentrating around four coalfields — Borinage, Centre, Charleroi and Liège — located along the rivers Haine, Sambre and Meuse. At the end of the 1950s Belgian industry was affected by the 1958 European coal crisis. The European Coal and Steel Community — established by the Treaty of Rome, which came into force in July 1952 — reacted by a programme of industrial conversion which accelerated the closure of several Belgian coalmines and which contributed to the multiplication of wasteland. After the golden sixties, the phenomenon of industrial restructuring was accelerated by the oil shock of the early 1970s. It spread gradually to manufacturing industries (mainly the textile industry) and, at the end of the 1970s, to the steel industry, very active in the region of Liège and Charleroi. During the 1980s, the tertiary sector was affected in turn. The development of brownfield sites in Wallonia raised a series of issues not only with respect to urban planning but also on environmental protection. Therefore, different tools and practices were deployed to tackle this issue.

The first legislative intervention for the management of brownfield sites occurred in the late 1960s. Two pieces of legislation from 1967 regulated the clean-up of coal sites and involved some charges for their owners (Royal decision of 18 of April 1967 on derelict coal-producing sites remediation and its subsequent amendment by the Royal decision of 11 of November 1967). A first inventory listing and describing the derelict coal mines was produced (the first inventory, only dedicated to the abandoned coal mines, counted 550 sites (1960s and 1970s)). After this first experience, other inventories were created in order to list all the abandoned industrial sites (the second inventory was produced at the end of the 1970s, it listed 1 250 sites). This type of directory was designed as a management tool for public authorities and as an information resource for public and private operators.

In 1978, general legislation [was] dedicated to the renovation of economic wasteland i.e. the 'sites d'activité économique désaffectés (SAED)' (law of 27 of June 1978 on the renovation of Walloon economical wasteland). The term refers to disused sites that hosted a large variety of activities (particularly industrial ones) and that hamper the local land planning. The main objective of the abovementioned piece of legislation was to foster the renovation of brownfield sites and the demolition of existing infrastructure. After the regionalisation of Belgium, spatial landing and environmental policies, among other matters, were transferred to the three regions.

Regarding the spatial planning policies, the 1978 legislation on economic waste land was followed by the Walloon decree from 4 May 1995 (Decree of 4 May 1995 modifying Articles 79 to 93 of the Walloon code of land planning, urbanism, and cultural heritage on the renovation of Walloon economical wasteland), which introduced as a new priority the notion of environmental remediation — all the work required for the elimination of the causes preventing the reuse of a site besides the concept of renovation. However, those policies ignored the environmental and health concerns. In order to mobilise relevant information in terms of pollution risks during the renovation and remediation process of the SAED, the Walloon administration collaborated with a range of partners, including academic-research centres. At the beginning of the 1990s, all 2 700 sites of the new SAED inventory were classified in categories based on the level of pollution risk (the sites were classified into four categories: no risk expected, possible risk of limited importance, possibility of a high risk, requiring additional investigation). After this experience, each

SAED inventory integrated information about former activities and environmental risk. A new acronym replaced SAED and extended its scope following the Walloon decree of 23 February 2006 setting out priority actions for the Walloon future (Decree of 23 February 2006 on priority actions for Walloon future). The new term is 'Sites a réaménager (SAR)' and applies now to all activities (economic or not) except housing. The latest version of the SAR inventory conducted in 2014-2015 identified 3 796 sites and their classification based on Annex 3 of the soil decree is currently under finalisation. Annex 3 of the soil decree offers a typology of potentially polluting activities/installations (http://environnement.wallonie.be/legis/solsoussol/sol003.htm).

Regarding the environmental policies, previous to the development of a specific soil-contamination regional legislation applying to all types of contaminated sites in 2008, Wallonia based its contaminated sites management on the waste legislation framework considering contaminated sites as waste (Decree of the Walloon Region of 5 July 1985 on waste) (to tackle mainly landfills), on water protection (Decree of 30 April 1990 on protection and operation of groundwater and drinkable water) and, in the case of service stations, on a specific decision linked to the general protection at work legislation framework (Decision of the Walloon government of 4 March 1999 modifying general protection at work regulation inserting special measures applicable to settlement and operation of service stations). Besides, big activities/installations were handled through the environmental code (Decree of 11 of September 1985 organising environmental impact assessment in the Walloon Region) and afterwards through permit delivery (Decree of 11 on March 1999 on environmental permit). In 2004, an attempt to join spatial-planning procedures to environmental ones on soil issues was undertaken (adoption of the Decree of 1 April 2004 on remediation of polluted sites and on economic rehabilitation of sites — Site d'activité économique a Réhabiliter (SAER)), however the decree was only partially applied (the part on polluted sites was finally not implemented). Despite this situation, the decree laid down the conceptual basis further used by the 2008 soil decree, and proposed the following principle.

3-level system of screening values calculated for soil and groundwater and depending on the land use: reference value + 2-levels of risk-based values (risks for human health, groundwater and ecosystems)

3-step management of potentially polluted soils (2 levels of investigation studies and one level of remediation)

Distinction between historical pollution (risk-based management, best available techniques not entailing excessive costs (Batneec) remediation) and new pollution (back to reference values)

Finally, in 2008, the soil decree was adopted by the Walloon parliament (Decree of the Walloon Region), and contains the following principles.

- Soil protection has a larger aim than soil-pollution management.
- Identification of potentially polluting activities/installations (233, identified in Annex III).
- Establishment of a soil status database (this inventory was conceived as a tool dedicated to the management of potentially polluted soils and provides information at the scale of the cadastral plot).
- Establishment of a map for background-concentration levels of pollutants.
- Specification of triggers for soil-pollution investigations (voluntary procedure, administrative police procedure, mandatory triggers of Article 21: purchase of a site listed as potentially contaminated by the soil status database, permit demand for an activity of Annex III, bankruptcy for an activity of Annex III, end of an activity of Annex III, environmental damage).
- Same screening values and management steps as those set out in the 2004 decree.
- Distinction between historical contamination (before 30.4.2007: risk-based approach and deletion of serious threat, and, when remediation is needed,

objectives are function of Batneec) and new contamination (remediation objectives back to reference value but function of Batneec).

Use of a 3-step approach in order to deliver a soil control certification.

1. Orientation study (OS) (preliminary study and, if appropriate, site investigation with analyses, reporting) for which the decision of a site being polluted or not depends on threshold values and takes into account the background level of pollutants.

2. Characterisation study (ChS) (more-detailed investigations and risk assessment) for which the decision of a site needed to be remediated or not (serious threat or not) depends on threshold values and takes into account the background level of pollutants.

3. Remediation plan (RP) depending on the CS [characterisation-study] results, and setting a cleaning target given the situation (old or new contamination, risk assessment, Batneec, etc.) and final-evaluation (FE) assessing remediation works and associated aftercare measures if needed, delivery of a soil control certificate for each cadastral plot.

Polluter-pays principle, and the distinction between liability of the polluter and the responsibility of land owner' obligation to undertake soil studies and remediation works (voluntary > polluter (presumed or not) > occupier > landowner).

This soil decree provides therefore the legal framework of reference for the management of soil pollution. The decree came into force on 18 May 2009, except from Article 21 (no activation of triggers other than voluntary approach and administrative enforcement). More information is available in the questionnaire of Wallonia on the Common Forum on contaminated land in Europe website (https://www.commonforum.eu/Questionnaires/LF/LF_BEW.asp)

Reply Q1 (Bulgaria):

Legislation

Regarding contaminated sites by certain economic activities.

Liability for preventing and remedying environmental damage act (Lpreda) promulgated SG 43/2008, last amended and supplemented SG 101/2015.

Ordinance No 1/29.10.2008 on the types of preventive and remedial measures in cases provided by the Liability for preventing and remedying environmental damage act and the minimum cost of their removal (SG 96/2008).

Regarding 'historically' contaminated sites.

§ 9 of the transitional and final provisions (TFP) of the environmental protection act (EPA), SG 1991, 1997, 2002.

Ordinance on the conditions and procedures for determining the responsibility of the state and to eliminate damages to the environment resulting from past actions or omissions prior privatisation (SG 1999, 2004, last amended and supplemented SG 96/2011).

• Polluting activities considered

Regarding a contaminated sites by certain economic activities.

Activities listed in Annex 1 of Lpreda.

Regarding 'historically' contaminated sites.

Activities of the privatised enterprises prior privatisation causing past environmental damages ('historical pollution').

In 2016, the Methodology for preliminary and detailed surveys of sites with contaminated soil was approved by order of the Minister of Environment and Waters. In accordance with national legislation, this methodology is mandatory for the development of the inventory and studies of areas with contaminated soil, as well as the necessary remedial

measures and maintenance of the realised recreational events.

Reply Q1 (Croatia): Croatia does not have national programme for dealing with contaminated sites. There is no legal definition of what constitutes a contaminated and/or potentially contaminated site in the national legislation that would allow inventory or categorisation of such sites. Environmental protection act (Official Gazette of the Republic of Croatia (OG) No 80/13, 78/15) only provisionally addresses overall contamination and contaminating substances.

Historically contaminated sites are set out in the Waste management strategy of the Republic of Croatia (OG No 130/05): 2.6.2 'Hot spots' (old burdens). The 'hot spots' are those areas in the environment that have become highly burdened through long-term inappropriate management of industrial (technological) waste (e.g. waste from leather and textile industries, waste generated during petroleum extraction and processing, drilling mud, oily soil and sludge remaining around deep boreholes, substances deposited in tanks, waste from inorganic technological processes: acids, leakages, heavy-metal salts, waste generated during production of fertilisers, waste from organic chemical processes, waste from residues of paints and varnishes, packaging waste, pesticides, waste from photo industry, waste from inorganic thermal processes, waste oils of mineral origin and waste organic solvents, vehicles tyres, waste from asbestos production and waste batteries and lead accumulators). Most industrial (technological) waste (inert and hazardous) has been deposited at municipal waste landfills, within industrial areas and installations, where the so-called high-risk points can be differentiated, and also in depressions, excavation holes and pits, and elsewhere. The data on waste relating to types, volumes, production sites and handling methods are incomplete and unreliable.

The main strategic document that regards management of landfills and historical contaminated sites: The hot spots waste management plan for the Republic of Croatia for the period 2017-2022 (OG 3/2017).

There are 13 'hot spots', defined by the mentioned strategy and plan, as areas in the environment that have become highly burdened through long-term inappropriate management of industrial (technological) waste. Five sites are remediated, five sites are undergoing remediation and three sites are pending.

Croatia does not have specific legal regulations that refer to soil (or land) protection, and (potentially) contaminated sites. There are some regulations that refer indirectly or/and generally.

There are no threshold or limit values for contaminants/pollutants in soil depending on land use, except for agricultural land (Ordinance on the protection of agricultural land against the Pollution, OG No 9/14).

There is no official inventory of (potentially) contaminated sites. Some inventories/databases were developed for specific projects, but cannot be considered official since they were not regularly updated and legally set out.

Reply Q1 (Cyprus): Cyprus has no national programme for dealing with contaminated sites as such. This is usually done on a per site basis when a contamination problem arises depending on various factors first and foremost when concerns of adverse effects on public health exist. Cyprus did start addressing contaminated sides about 30 years ago.

Reply Q1 (Czech Republic): There is no official national programme to solve contaminated sites systematically for the time being. There is a provisional unfinished 'system for evidence of contaminated sites' (SEKM) (see also Reply Q2). There are general legislative measures to be applied in cases of potential or proved soil pollution.

Act No 167/2008 Collection about prevention of ecological damage and its remediation.

Decree No 17/2009 Coll. on investigation and remediation of ecological damage on soil.

Government order No 295/2011 Coll. setting the methodology for risk assessment of

ecological damage.

Methodical guidelines of the ministry of environment (see Q11).

Reply Q1 (Denmark): 1983 (96)

Reply Q1 (Estonia): [The] Republic of Estonia was re-established in 1991. After the departure of [the] Soviet army in 1992, [the] ministry of the environment started the investigation and inventory programme of polluted military and industrial areas.

Different approaches with regard to historical residual pollution in comparison to nowadays pollution [have been] applied since 1998 by [the] chemical act. Polluter-pays principle (PPP) is applied in cases of nowadays pollution.

Reply Q1 (Finland): In its environmental report submitted to parliament in 1988, the government of Finland promised that the extent of contaminated sites would be assessed and remedial measures taken where necessary. The Samase project, the internal programme set up for that purpose by the environmental authorities at the end of 1989, is part of the effort to keep this promise.

In Finland, the environmental administration (governmental and municipal administrations cooperate) had the Samase project [of] which one [of] the aims was to identify potentially contaminated sites. This project took place 1990-1993. During the project, information was gathered from 10 400 potentially contaminated sites. An extensive amount of information sources such as permits, protocols, announcements, chemical- and oil-combating incident reports and other documents on polluting activities or events was screened. This information was collected from waste management, water, public health, construction and regional-planning authorities. Also other-than-official sources (such as old catalogues of industrial associations, registers, maps) were used. Altogether more than 20 different sources of information were utilised. Based on this information a list of potentially polluting activities was made. Listed activities handle and store hazardous substances that may enter the environment. The main criteria to identify potentially contaminated site is the earlier or ongoing activity on the site. After this project, regional environmental centres have maintained regional registers. Nationwide regional environmental centres (nowadays the centres for economic development, transport and the environment) updated and completed their registers in years 1998-1999. A national database system (MATTI) on the state of soils has been created and taken into full-scale operation in July 2007.

The ministry of the environment set up a working group to draw up the national risk-management strategy for contaminated land during 2014-2015. The objective was to create a national viewpoint and target state for risk management of contaminated land and to draw up a strategy to have the significant risks posed to health and the environment by contaminated land under control in a sustainable way by 2040. In order to achieve the objective, the national investigation-and-remediation programme for contaminated land is to be drawn up and carried out and a state secondary financing system created to support its realisation, by renewing the state waste-management work system. The programme will promote the investigation of the most urgent sites from an environmental- and health-protection perspective, as well as the realisation of any necessary risk-management measures. The sites within [the] national investigation-and-remediation programme account for approximately 15 % of all remediation sites.

The national database system MATTI contains information about 26 200 sites where harmful substances may have been able to reach the soil from current or previous operations in the area. The activities carried out in the site are known to have generally caused soil contamination at comparable sites. The actual condition of each site is investigated using data about the history of operations there and field research. Some of the sites included in the data system have been included due to observed problems. Some have already been investigated or remediated. One third of the areas are active

([96]) LOV nr 262 af 08/06/1983 — Lov om kemikalieaffaldsdepoter — Historisk.

sites (approximately 9 000 sites), where usually the soil condition should be investigated at the latest when operations there conclude.

Reply Q1 (France): The French ministry for environment and energy has been compiling an inventory of contaminated sites and soils since the early 1990s and has produced the Basol database of contaminated or potentially contaminated sites and soils, calling for administrative action for prevention or remediation. At the start of 2017, Basol contain[ed] 6 478 contaminated sites and soils. Basol is a living and evolving database updated regularly at the regional level by the regional authorities for environment, spatial planning and housing.

To fulfil this role, new contaminated sites and soils are included in Basol when there is a suspicion of pollution requiring action on the part of the public authorities. The information contained in the historical regional inventories of former sites of industrial and service activities likely to be contaminated (Basias, since 1998) (issuing mainly from departmental and prefectural administrative archives) can provide useful indication of former and successive activities on a site, and on the types of substances and pollutants likely to have been used there. Conversely, sites are deleted from the Basol inventory as soon as they are treated and cleared of any restriction. They are then transferred to the Basias database in order to keep a trace of them. Therefore, the eldest polluted site addressed in the Basol database goes back to 1994 and not to 1990.

The main categories of polluting activities considered in the Basol database include:

- mechanical, electrical, electronic, surfaces treatments,
- iron and steel industry, metallurgy, coking,
- waste and wastewater collection, treatment,
- chemical, pharmaceutical, rubber, plastics,
- petroleum industry, natural gas,
- warehousing, transport, trade (including petrol stations),
- textile, leather and hides,
- wood, paper and cardboard,
- mineral industries,
- non-hydrocarbon extractive industries,
- energy,
- agri-food and beverages,
- other industries, services and miscellaneous.

The main categories of polluting activities considered in the Basias database include:

- agriculture, hunting, forestry and fishing,
- mining and quarrying,
- manufacturing industry,
- production and distribution of electricity, gas, steam and air-conditioning,
- water production and distribution; sanitation, waste management and decontamination,
- construction,
- transportation and warehousing,
- real estate activities,
- specialised, scientific and technical activities,
- human health and social work,
- other collective or private activities and services; storage of products.

Reply Q1 (Germany): In the federal system of Germany, the legal competence for the handling of contaminated sites is forwarded to the 'Laender' [local government]. They are setting priorities and implementing remediation programmes. The federal government is responsible for sites in their ownership only.

The initial action came from the federal soil protection act (since 1999). In the existing soil protection act, a legal[ly] defined remediation plan or programme does not exist.

Reply Q1 (Hungary): Before the implementation of the national environmental

remediation programme (OKKP) in 1996, there were already some signs of hidden or uncontrolled abandoned pollution sources. The short- and long-term governmental action plan of 1991 included the tasks of survey, exploration and elimination of these accumulated contaminations. This can be considered as the period of the preparation of the OKKP.

In 1996, the Hungarian government adopted the national environmental remediation programme in Decision No 2205/1996 (VII.24), followed by a Parliamentary Decision No 83/1997. (IX. 26.).

Main objectives of the OKKP were:

a. develop legal and technical regulations,

b. carry out a countrywide assessment of potentially polluted sites and sources,

c. develop a national register,

d. develop a decision-making system and prioritisation method,

e. training and capacity building,

f. research and development,

g. undertake urgent actions required to eliminate pollution posing the highest risks to the environment: typically, the industrial sites, the former heavy-industry objects, evacuated Soviet barracks and mines.

Although the countrywide assessments of potentially contaminated sites are ongoing, results indicate that more previously unknown sites exist and need to be dealt with.

The OKKP was divided into three stages and is expected to run for several decades.

1. Short-term stage (1996-1997) (regulated by government Decision No 2205/1996 (VII.24));

2. Medium-term stage (1998-2002) (regulated by government Decision No 2304/1997);

3. Long-term stage (2003-2030) in alignment with the OKKP, with 6 year schedules.

The first legal framework was adapted in 2000 as government Decree No 33 (rules regarding remediation) and joint Ministerial Decree No 10 (groundwater and geological medium-limit values).

Approaches regarding historically contaminated sites in comparison to sites contaminated by polluting activities nowadays are identical. However, the historical sites are typically under state liability and are funded through the governmental budget. This is because most of the land and industrial activities causing contamination were state owned.

Reply Q1 (Ireland): Ireland does not have a significant problem with contaminated land and brownfield sites and as such does not have a national contaminated-land programme or a register of the number of contaminated sites.

Brownfield or contaminated-land sites are dealt with through a range of legislation including the water-pollution act, environmental-protection-agency act (which deals with integrated pollution control and industrial-emissions licensing), waste-management act, environmental-liabilities regulations, and also through planning legislation.

The EPA is responsible for overseeing the remediation of polluted soil and groundwater at facilities licensed by the EPA. The EPA prioritises its enforcement efforts at sites which pose a high risk of environmental pollution or which pose a risk of failure to meet water framework directive objectives. Because there is no legal definition of what constitutes 'contaminated' the EPA does not maintain a public register of these sites.

Reply Q1 (Italy): Italy started to deal with contaminated sites in a systematic way at national level with Legislative Decree no 2 of 5 February 1997, with subsequent

Ministerial Decree no 471 of 25 October 1999 providing specific administrative and technical procedures for identification and management. Before 1997, some regions had their specific regional legislation.

In 2006, a relevant change in legislation has been provided by the Legislative Decree n. 152, with a risk-based approach for the assessment and management of contaminated sites.

According to current legislation, the administrative procedure for contaminated sites identification and management is under the responsibility of municipalities and regions with the help of provinces.

The national remediation program started in 1998, with the creation of Contaminated sites of national interest (SIN). For their management complexity (e.g. many contaminants, many site owners), SINs are under the direct responsibility of the Ministry of Environment. The first SINs were not originally selected according to their polluting activities, but on proposals from regions. Then Ministerial Decree no 471/99 and Legislative Decree no 152/06 established criteria for SINs identification. In 2007, SINs reached the number of 57 and in 2013, according to new identification criteria set out by ministerial decree of 11 January 2013, they were reduced to 40. SINs are now associated to the following activities: refineries, chemical plants, steel plants, and asbestos production or extraction sites.

According to current legislation, there is no list of potentially polluting activities used for the identification of contaminated sites. The identification procedure starts with a preliminary investigation when an event occurs that may cause soil and/or groundwater contamination or when an historical contamination is discovered.

A list of potentially polluting activities was created in 1989 for the definition of the 'regional remediation plans' before the national legislation on contaminated sites management. This list is no longer applied.

The management approach is the same for historical and new contamination and site-specific risk-assessment procedure is used for the identification of contaminated sites.

Reply Q1 (Latvia): [The] law of pollution (Articles 33, 34, 35) set requirements for contaminated-sites identification and registration. Responsible institutions are municipalities together with regional environmental boards (REBs). [The] ministry of defence is responsible for sites identification and registration under [its] responsibility. In 2001 regulation of cabinet of ministers No 483 was accepted. This regulation describes contaminated and potentially contaminated sites (CPCS) identification-and-registration order. Identification and registration of CPCS were done in years 2003 and 2004. Register of CPCS was set up. The Latvian environment, geology and meteorology centre (LEGMC) is responsible for register development and maintenance.

Reply Q1 (Lithuania):

1997. The main references:

Geologinės aplinkos taršos židinių informacinės sistemos sukūrimas (programa) = programme: Creation of information system on contamination sources of geological environment. Juodkazis V., Kanopienė R., Šugalskienė J., Belickas J.; Lietuvos geologijos tarnyba. Vilnius, 1997. 56 p. (Lithuanian geological survey (LGS) report Nr.4585).

Taršos židinių inventorizavimo metodikos įdiegimas = Implementation of inventory methods of contamination sources. Šugalskienė J.; Lietuvos geologijos tarnyba. Vilnius, 1998. 40 p. + CD. (LGS report Nr.5017).

Kadūnas K., Radienė R., Šugalskienė J. Užterštų teritorijų tyrimo raida Lietuvoje = Development of investigations of contaminated sites in Lithuania // Baltica. 2011. Vol. 24, Special Issue. p. 61-64: iliustr. Santr. angl. Bibliogr.: p. 64. (Geosciences in Lithuania: Challenges and Perspectives = Geomokslai Lietuvoje: iššūkiai ir perspektyvos)

Radienė R., Šugalskienė J. Užterštų teritorijų inventorizavimo, tyrimų ir tvarkymo

apžvalga = Overview of inventory, investigation and treatment of contaminated sites. In: Požeminio vandens monitoringas Lietuvoje 2011-2015 metais ir kiti hidrogeologiniai darbai: straipsnių rinkinys. Vilnius: LGT, 2016. P. 150-155: iliustr.

The legal background:

Ekogeologinių tyrimų reglamentas = Regulations of eco-geological investigations (Žin., 2008, Nr.71-2759, Žin., 2010, No 130-6679, Žin., 2013, Nr. 84-4248) https://www.e-tar.lt/portal/lt/legalAct/TAR.D7048734A661

Cheminėmis medžiagomis užterštų teritorijų tvarkymo aplinkos apsaugos reikalavimai=Requirements on treatment of contaminated sites with chemical substances (Žin., 2008, Nr. 53-1987, Žin., 2013, Nr. 86-4325) https://www.e-tar.lt/portal/lt/legalAct/TAR.554EE563D95B

LAND 9-2009 Grunto ir požeminio vandens užteršimo naftos produktais valymo bei taršos apribojimo reikalavimai=Requirements on cleaning and pollution limitation for soil and groundwater contamination with oil products (Žin., 2009, Nr. 140-6174) https://www.e-tar.lt/portal/lt/legalAct/TAR.A4CDFBAF4A79

Aplinkos atkūrimo priemonių parinkimo bei išankstinio pritarimo gavimo tvarkos aprašas=Description of procedure for selecting environmental rehabilitation measures and obtaining prior-approval (Žin., 2006, Nr. 59-2099) https://www.e-tar.lt/portal/lt/legalAct/TAR.91488566B8B2

Priemonė „Praeityje užterštų teritorijų tvarkymas"=Measure „Treatment of historically contaminated sites' (Žin., 2008, Nr. 136-5352, Žin., 2011, Nr. 135-6427, TAR 2015, i.k. 2015-03400) https://www.e-tar.lt/portal/lt/legalActEditions/TAR.8EA06D74F444

Priemonė „Užterštų teritorijų tvarkymo 2013-2020 m. planas"=Measure „Managament plan of contaminated sites for 2013-2020' (Žin., 2012, Nr. 115-5842) https://www.e-tar.lt/portal/lt/legalAct/TAR.ACB96E4E6DA3

Reply Q1 (Luxembourg): Contaminated sites are not addressed in a systematic way in Luxembourg. However, since 1990, the law on classified installations requires taking in charge any soil pollution due to activities at site closure. According to the law on classified installations, all these activities are considered as posing a risk for soil contamination.

There is however no law helping to tackle the question of historically contaminated sites. A contaminated site is considered under waste law.

Reply Q1 (The former Yugoslav Republic of Macedonia): In the [former Yugoslav] Republic of Macedonia we do not have legislation pertaining to contaminated sites, neither a programme that will deal with contaminated sites. Most of the activities regarding identification and financial analysis of remediation of contaminated sites were based of the activity and investigation in the area of soil degradation and protection, as done in the Case study on industrial contaminated hot spots and in Study on closure/reclamation of non-compliant municipal landfills in the [former Yugoslav] Republic of Macedonia. These two studies were developed in the framework of the project national waste-management plan and feasibility study, financed by the European Union and implemented through European Agency for Reconstruction in 2005.

Reply Q1 (Malta): A Land and groundwater monitoring guidance document was drafted for Malta in 2013 with the cooperation of various international consultant companies. This guidance document was originally designed to provide the technical background for baseline surveys carried out for IPPC sites.

Another interim document was also prepared to assist applicants/operators in preparing a land and groundwater baseline report, which may be required as part of integrated pollution prevention and control (IPPC) or environmental permitting obligations. It is intended to guide operators and their consultants:

(1) to determine whether land and groundwater monitoring needs to be carried out

(unless this is already required by the permit); and

(2) to provide guidance on the monitoring strategy.

The latter report was based on the AMEC (Environment and Infraestructure UK Limited) report to the European Commission on Guidance on the content of the baseline report. Following the communication from the Commission that the European Commission guidance concerning baseline reports under Article 22(2) of the industrial emissions directive was adopted, this was also utilised so as direct operators falling within the scope of the IED (IPPC) regulations as a basis for providing the required risk-assessment and baseline-monitoring report.

For IED facilities requirements for land-monitoring data and an outline decommissioning plan arise from Regulation 7 of industrial emissions (integrated pollution prevention and control) regulations (LN 10 of 2013), which transpose the EU industrial emissions (IPPC) Directive (2010/75/EU) into Maltese law (IED). Soil-screening values and groundwater threshold values for Malta were determined based on relevant EU regulations and international-guidance documents. Later on this document also provided a scientific base for the drafting of general terms of reference for land- and groundwater-contamination investigations to be carried out for potentially contaminated sites either before their redevelopment or after decommissioning.

In cases which do not fall within the scope of the IED, the provisions of Subsidiary Legislation 549.97 on prevention and remedying of environmental damage regulations (21 August 2015), Legal Notice 280 of 2015 may be applied. These cases would include the requirements for land and groundwater monitoring along similar lines as quoted in the paragraph above.

Reply Q1 (Norway): In 1989 Norwegian authorities started mapping contaminated soil in Norway. The goal was to find sites where there was a confirmed or suspicion of dumping, storage or leakage of hazardous waste and chemicals. After this, several white papers have addressed the issue of contaminated sites. The latest is from 2005 prioritising assessment and remediation of sites in close proximity to fjords and coastal areas and where there is a risk for human health. It also focuses on contaminated soil in day-care centres and kindergartens.

More info: http://www.environment.no/topics/hazardous-chemicals/contaminated-soil/

Norway's chemical policy:

https://www.regjeringen.no/en/dokumenter/report-no.-14-to-the-storting-2006-2007/id441267/?q=chemical%20policy

Reply Q1 (Poland): There is no 'programme' dedicated to contaminated sites in Poland. All threats of soil are somehow (in [a] more or less detailed way) covered by the legislation. Other types of instruments (non-legislative) are only additional and complementary to the legislation.

In Poland there is no overarching soil-protection act. Article 101 in the environmental protection act of 27 April 2001 (hereinafter referred to as EPA) includes general provisions on land-surface (soil and ground) protection: land-surface protection consists in prevention of contamination and remediation of contaminated land surface, prevention of: erosion, depletion of organic matter, biodiversity, compaction, salinisation, acidification, mass wasting (i.e. landslides), soil sealing, adverse transformation of the natural lie of the land.

Different types of threats to soils are regulated in separate acts of law. Land-surface protection from contamination and the remedying of its condition (the removal of contaminants) are now regulated by the following legal acts.

1. EPA title II, Section IV 'Land surface protection', which was introduced in 2001, includes:

- EPA general provisions (Article 101 mentioned above),
- an authorisation to issue the regulation of the minister of the environment on the assessment of the land-surface contamination (at present: regulation of the minister of the environment of 1 September 2016 on the assessment of the land surface contamination),
- Provisions on historical contamination of the land surface (contamination which occurred before 30 April 2007).

2. EPA Title III, Section IV 'Integrated permit' (transposition of Directive 2010/75/EU) refers to:

- a baseline report and a closure report on state of soil, ground and groundwater (provision introduced in 2014).

3. The act of 13 April 2007 on the prevention and remedying of environmental damage (2004/35/EC directive transposition), hereinafter referred to as the Damage act.

- Provisions on environmental damage to the land surface (contamination which occurred after 30 April 2007).

Reply Q1 (Portugal): Portugal [has] not yet approve[d] the national legislation on contamination prevention and soil remediation and therefore does not have a programme to deal [with] contaminated sites in a systematic way.

Concerning the old mining sites (mining orphan sites), as a result of the concession contract for the environmental rehabilitation of those, granted by the Portuguese government to a state-owned company, an inventory of old mining sites was elaborated by 2003/2004.

Furthermore, some contaminated industrial orphan sites were identified in 2008, inventory that has been updated in 2011.

Apart from these mining and industrial orphan sites, when a site is identified as being contaminated, a case-by-case approach is adopted in order to remediate it or to reach an acceptable level of risk to human health and to the environment.

Reply Q1 (Romania): The legal instrument are: government Decision No 1408/2007 on means to investigate and evaluate soil and subsoil pollution; government Decision No 1403/2007 on the recovery of areas where the soil, subsoil and terrestrial ecosystems were adversely affected; government Decision No 683/2015 on the national strategy and national plan for managing contaminated sites from Romania.

The polluting activities are considered in national strategy and national plan for managing contaminated sites from Romania and are:

- mining and metallurgy activities,

- chemical industry,

- oil industry,

- ancient deposits of pesticides,

- other large-scale activities such as industry, metal processing, waste landfill compliant, military sites, wood processing industry, power plants coal, transport, service activities, etc.

No differences between historical and current contamination.

Reply Q1 (Serbia): The Republic of Serbia does not have a national programme specifically developed for dealing with contaminated sites.

In 2005, [the] Serbian environmental-protection agency started creation of the national inventory of contaminated sites. In the law on soil protection (Official Gazette of the

Republic of Serbia, No 112/15), Article 34 describes the basis for developing the methodology for the creation of 'The cadastre of contaminated sites' which is an integral part of the environmental protection information system administered by the environmental-protection agency.

The law on environmental protection (Official Gazette of the Republic of Serbia, No 135/2004, 36/2009, 36/2009: other law, 72/2009: other law, 43/2011: decision of constitutional court and 14/2016) is the basic law which establishes the system of environment protection in the Republic of Serbia. This law defined that rehabilitation, i.e. remediation is the process of undertaking measures in order to halt pollution and further degradation of environment up to the safe level for future use of the location, including also the arrangement of the area, revitalisation and re-cultivation thereof. According to Article 16 of this law, any person who degrades the environment is obliged to perform re-cultivation or to rehabilitate in any possible way the degraded environment in accordance with this and special laws. According to Article 43 of this law, the status of the endangered environment and the regime for rehabilitation and remediation in an area of importance for the Republic of Serbia shall be determined by the ministry which is responsible for the environment, and for an area of local relevance by the local self-governance unit.

National environment protection programme (adopted in 2010) establishes requirements for better and best practices for rehabilitation and remediation. Among the long-term goals of this programme (2010-2019) are remediation of contaminated sites from the list of priorities, rehabilitation of existing dumpsites, and perform remediation thereof that pose the biggest risk to the environment, as well as remediation of contaminated soil. Additionally, the waste-management strategy for the period 2010-2019 is predicted to make an inventory of locations contaminated with hazardous waste, to define the risks for rehabilitation and remediation and to define priorities for rehabilitation and remediation.

Two by-laws, which were adopted in 2010, deal with contaminated sites.

The regulation on the programme for systematic monitoring of the soil quality, indicators for evaluation of soil degradation and methodology for preparation of remediation programme (Official Gazette of the Republic of Serbia, No 88/2010). The regulation is harmonised with the recommendations given in the Proposal for a soil framework directive — COM(2006)232. The adoption of this regulation has provided to ensure the soil protection based on prevention of degradation through identification of risk area for soil degradation, whether such degradation is natural or human-induced. The regulation provides the basis for identification and management of contaminated sites on the territory of the Republic of Serbia. The level of chemical contamination of soil is assessed on the basis of the values of contaminants listed in the regulation's annex. For the purpose of designing programmes for the remediation of contaminated soil, additional research is carried out in the identified contaminated sites to assess the level of soil contamination.

The regulation on the criteria for determining the status of the vulnerable environment and priorities for rehabilitation and remediation (Official Gazette of the Republic of Serbia, No 22/2010).

Reply Q1 (Slovakia): [The] Slovak Republic initiated the national programme to deal with contaminated sites in 2006. In this year the project systematic identification of contaminated sites was started. On the base of the project the information system of contaminated sites (ISCS) was established. The first state remediation programme of contaminated sites (2010-2015) was approved by government in March 2010 and the second state remediation programme of contaminated sites (2016-2021) in January 2016.

Reply Q1 (Slovenia): In 1999 Slovenia adopted the national environment protection action programme (NEAP) and in 2006 the resolution on [the] national environmental action plan which were the basis for implementation of systematic research of soil

pollution in Slovenia (ROTS). The NEAP set out the goals, guidelines and strategy for environmental protection and the use of natural resources. The main goals were to prevent further chemical and physical contamination of soil and to perform remedial actions where necessary and feasible. Therefore, the starting point when Slovenia first started to address soil contamination and to identify contaminated sites is 1999. However, in the framework of ROTS the polluting activities were not especially considered and there are no different approaches with regard to historically contaminated sites in comparison to sites contaminated by polluting activities nowadays.

In 2016, Slovenia adopted the operational plan for waste management, where disposal of waste on landfills was specified.

Reply Q1 (Spain): After the completion of a pilot study between the years 1992-1994 and a preliminary inventory for contaminated sites was available, [the] ministry of environment launched in 1995 a national plan for contaminated sites endowed with an amount of EUR 410 million. This plan was aiming to: a) refine and expand the already-existing inventory, b) carry out specific remediation projects to tackle those site[s] that were considered more urgent and c) expanding the inventory by more detailed characterisation of sites which were considered priority at that time. It must be pointed out, however, that this plan was not relying on clear legal basis since waste law did not provide [a] specific mandate to address soil contamination. The approval of a new waste law in 1998 represents a substantial change in the legal framework in which management of contaminated soils in Spain was taking place since it contained a chapter specifically devoted to contaminated sites. In this chapter, a mandate was given to the national authorities to develop rules for contaminated-soil management including:

- a definition of potentially contaminating soil activity;

- the setting of criteria and standards for the declaration of contaminated soils, taking into account the risks that soil contamination means for human health and the environment;

- the establishment of the polluter-pays principle.

Under this umbrella, in 2005, a decree for potentially soil-polluting activities and contaminated sites was approved: henceforth 'soil decree'. This regulation contains a set of elements for the management of contaminated sites in Spain. A number of elements must be highlighted among others.

1) A definition of what are considered as potentially polluting activities for soil and its relationship with the national census of economic activities.

2) The obligation to the owners in which the abovementioned potentially polluting activities of the soil take place in the present or have been developed in the past to report information on soil contamination under several circumstances (on [a] regular basis, when change on soil use is planned or when cessation of potentially contaminating activity take place, among others).

3) The establishment of allowable and not allowable risk levels.

4) The establishment of 'safe' concentration levels of pollutants in soils that for a generic scenario of exposure to soil contamination.

5) A conceptual framework for the risk assessment in contaminated (or suspicious) sites.

6) The obligation to the owners to carry out remediation/risk-reduction tasks once a soil is formally declared as contaminated, by environmental authorities.

[The] soil decree, still valid, has been recently amended (November 2017) to refine and update potentially contaminating soil activities. Regional authorities have also set specific rules to deal with contaminated sites.

At national level the aforementioned decree makes no difference between historical and current contaminations. It should be noted, however, that Basque legislation does

introduce this concept.

Reply Q1 (Sweden): In 1990, the Swedish environmental protection agency was assigned the task of planning for the remediation of the nation's contaminated sites. A nationwide inventory of industrial branches was carried out during 1992-1994 for the purpose of identifying industry branches most urgently in need of attention. The inventory was complemented with a method for identification of sites and uniform risk classification of these in 1999. Since then guidance on handling contaminated sites has been continuously updated, and there is also government funding for clean-up of orphan sites.

Historically contaminated sites and currently active contaminated sites are dealt with differently. The overarching principle in our environmental code, however, is the polluter-pays principle.

Modern and ongoing, environmentally hazardous operations are subject to continuous supervision by the applicable regulatory authority, in accordance with our environmental code, which entered into force in 1999 (in its current form). For ongoing operations the polluter-pays principle is prevalent.

For historically contaminated sites and orphan sites the polluters-pay principle is not applicable in all cases. Our environmental code allows for the government to fund clean-ups and required investigations in cases where no liable stakeholder can be identified, or where it is not reasonable for the liable stakeholder to fund parts or all of the clean-up. Based on the legal frameworks in place at the time of contamination a legal practice for evaluation of reasonable legal liability has been developed. This practice brings that there is no reasonable legal liability for soil and groundwater contamination dating from before 1960, since there w[as] no applicable legal framework regulating contaminating activities and operations. Between 1960 and 1969, the reasonable liability for soil and groundwater contamination is considered to be 50 %. After 1969, when a new environmental framework was introduced, the reasonable liability is considered to be 100 %. This means that there are clean-ups which are fully funded by the government. And clean-ups where a stakeholder (with partially reasonable liability) funds parts of it. If there is a partially liable stakeholder, the legal practice is that the stakeholder funds all required investigations, and to the extent reasonable also parts of the clean-up.

When assessing reasonable liability, the total period of active operational activities is evaluated against the practice of liability in order to assess the precise fraction. In this considerations other things than those mentioned above are also taken into account. Such as the stipulation of the operating permits and to what extent the operations have followed the operating permits. For sites where no reasonable legal liability can be attributed to the operating company, it is possible to get public financing for remedial actions. This is also possible in those cases where parts of the remedial costs are paid for by the operator, but where this stakeholder does not have reasonable liability for all clean-up costs.

Reply Q1 (Switzerland): Starting point of the national programme in Switzerland is 1995: The basic legal background for contaminated sites management on national level was set with the revision (of 21.12.1995) of the environmental protection act (EPA).

1998 the national programme was set out in detail with the implementation of the contaminated sites ordinance (CSO) of 26 August 1998.

Reply Q1 (The Netherlands): In 1983, the Dutch government published the interim soil remediation act. This act included the first generation of soil quality standards (the A, B and C Values), based on background concentrations and expert judgement. In 1987, the soil protection act was introduced. A main purpose of this act was to establish the accountability of individuals, which means that parties are fully liable for each case of soil contamination created since 1987. To assess historical contamination (from before 1987), a risk-based approach has to be followed. The first series of risk-based soil and groundwater quality standards and the methodology to determine the urgency of

remediation were formalised in a ministerial circular in 1994. The legislation was extended in subsequent years based on scientific evaluations and policy discussions.

In the Netherlands, a lot of effort was put in making an appropriate inventory of potential polluted activities. Over a thousand different activities with potential pollution were identified. These activities were already ongoing before in the EU a proposal for a soil directive was initiated.

Reply Q1 (United Kingdom (England)): The contaminated land regime under Part 2A of the environmental protection act 1990 is one of the main policy measures used to deal with contaminated land.

Part 2A of the Environmental Protection Act 1990 came into force in 2000 and takes a strategic and risk-based approach to identifying and cleaning up contaminated land in England. The legislation is supported by statutory guidance that expands on certain aspects of the legislation, such as risk assessment, remediation and liability.

Land is defined as contaminated under Part 2A if there is a significant possibility of causing significant harm to human health or property, pollution of controlled waters or the wider environment.

Question 2 (site status 1): In your country how many sites have been recorded [(a) registered (b) estimated] where polluting activities took/are taking place?

Explanation: 'Polluting' activities' are those activities that have been identified in the country as potential sources of contamination (e.g. such activities were listed in the Annex II of the 'withdrawn proposal' soil framework directive). It may be the case that not all 'polluting activities' have been registered and the country has made an 'estimation' of them. Here countries may provide 1 or 2 values, in case they have '(a) counted sites' and '(b) estimated sites'.

Reply Q2 (Austria): Sites recorded by EAA [Environment Agency Austria] database: 68 569 (1.1.2017)

Total (estimate): 72 000

Reply Q2 (Belgium (Flanders)): Number of locations with potentially polluting risk activities recorded end 2016: 68 000

Estimated number of locations with risk activities: 85 000

Reply Q2 (Belgium (Wallonia)): The list of potentially polluting activities identified in Wallonia is defined in Annex 3 of the soil decree (currently 233 at total) and can be applied to the following different databases available in Wallonia: historical inventory (part related to 1850s Vandermaelen maps), environmental permit register (including IPPC/IED and Seveso), and service stations. Other databases such as economic wasteland, dumps and files instructed within the soil decree cannot be directly linked as such to a 'potentially polluting activity' list as they include illegal waste deposits and sites were soil studies have been conducted regardless of the occurrence of a potentially polluting activity (triggers linked to voluntary process or pollution accidents). Such data are however shown hereunder under the terminology 'potentially polluted sites' as they are part of the overall soil status database (SSDB) defined by the soil decree. Note that hereunder some data are from 2014 as the current update process for some databases and automatic computerised requests is not yet finalised (these data were published for the Environmental Outlook of Wallonia in 2014, the next environmental outlook is foreseen later in 2017). http://environnement.wallonie.be/cgi/dgrne/plateforme_dgrne/visiteur/v2/frameset.cfm?page=http://environnement.wallonie.be/cgi/dgrne/aerw/ied/ied_index.htm.

Note also that the total of potentially polluted sites cannot be considered as the sum between each line as there is spatial redundancy for some sites. This will be corrected progressively with the improvement of the databases gathered under the SSDB.

Potentially polluted sites (03/5/2016) [2014]	
Historical inventory (1850s Vandermaelen maps)	[5 694] (a)
Sites in environmental permit register (including IPPC/IED and Seveso)	[422 to 7 391] (a)
Brownfields (minor and major estimates)	[1 342 to 3 592](b)
Service stations (minor and major estimates)	527 to 664 (b)
Dumps/landfill sites	184 (a)
Sites investigated within the context of the soil decree 5/12/2008	213 (a)

[] Environmental Outlook for Wallonia. Digest 2014. SPW Editions. State of the environment directorate. SPW — DGO3 — DEMNA — DEE

Reply Q2 (Bulgaria): Regarding contaminated sites by certain economic activities: at present the competent authorities (CAs) according to Lpreda ha[ve] not reported any cases of environmental damage, but have registered four sites where an imminent threat of environmental damage has occurred. Regarding the sites with historic pollution: During the period 2000-2008 there have been approved 22 programmes for remediation of past environmental damages caused prior privatisation (of 22 privatised companies). Among them, 11 include remediation measures for sites with contaminated soils (respectively. 11 sites have been recorded).

Reply Q2 (Croatia): During 2005/2006, the Croatian environment agency (now: Croatian agency for the environment and nature) a dynamic georeferenced digital database on potentially contaminated and contaminated localities (GEOL) which contained data on recognised contaminated and potentially contaminated locations; general data on the legal entity which disposes with the location, present pollutants, the status of contaminated location and other.

During 2007, within the implementation of the project development of the Croatian soil monitoring programme with a pilot project, co-financed by European Commission, LIFE third countries programme, existing GEOL data have been verified and supplemented in accordance with recommendations of the European point-source assessment system (EPSAS) (industrial plants which are subject to IPPC and Severso II directive) and European pollutant release and transfer registers — EPRTR (Attachment 1) EC/166/2006.

The verified and supplemented GEOL base in 2007 contained data on 2 264 potentially polluted sites at the territory of the Republic of Croatia owned by 1 080 legal entities. For 247 sites (128 legal entities), Project recommended to establish soil monitoring considering the type of registered activity at location, production capacities, high potential of contamination and the type of pollutants that these activities may generate.

Unfortunately, the project results were never implemented, and GEOL database has not been updated since 2007, due to no legal obligation for data delivery and no resources.

The conclusion is that the GEOL database cannot be considered reliable source of information on potentially contaminated and contaminated sites.

Reply Q2 (Cyprus): Based on the latest estimation done in 2011 there were 84 sites identified where polluting activities took/are taking place. These included municipals waste sites, abandoned copper mines, industrial waste disposal sites, storage sites, abandoned activities etc.

Reply Q2 (Czech Republic): General statistic can be derived from the project system for evidence of contaminated sites (SEKM) (www.sekm.cz):

recorded (in SEKM) 4 916 sites

registered 9 300

estimated 20 000.

Polluting activities (only SEKM data)

Main types of local source	Contribution to local soil contamination [%]
Municipal waste disposal	52 360
Industrial waste disposal	3 295
Industrial and commercial activities	11 839
Mining	3 173
Oil extraction and production	4 577
Power plants	-
Military sites	3 438
War affected zones	-
Oil storage	3 438
Obsolete chemicals storage	0.122
Other storage (i.e. manure storage)	1 241
Oil spills sites	0.244
Other hazardous substance spill sites	0.366
Nuclear operations	-
Others	17 148
Total	4 916

Industrial/Commercial activities	Contribution to local soil contamination [%]
Energy production	10.82
Oil industry	2.89
Chemical industry	2.07
Metal working industry	1.12
Electronic industry	0.63
Glass, ceramics, stone, soil industry	0.98
Textile, leather industry	0.65
Wood & paper industry	0.75
Food industry, processing of organic products	3.68
Others (production sector)	2.32
Gasoline stations	1.38
Car service stations	0
Dry cleaning	5 /01
Printers	0
Others (service sector)	3 436/69.89
mining sites	133/2.71

Reply Q2 (Denmark): a) 16 865 ([97])

Reply Q2 (Estonia): We have 300 objects registered in our database of historical polluted sites where polluting activities took/are taking place.

Reply Q2 (Finland):

a) counted sites

We have compiled data in the national database system (MATTI), concerning sites which are known or suspected to be polluted. In the end of year 2016 there were almost 26 200 MATTI- sites. Approximately 6 400 sites are classified as 'No need for treatment'. In those sites there are not significant amounts of harmful substances or sites which have been remediated to a level compatible with the current use of the land. Thus in the national database system [there] are 19 800 contaminated or potentially contaminated sites, most of them are historical pollution.

b) estimated sites

In Finland we have not estimated the total number of sites any more. Each year the number of sites in the national database system (MATTI) increases with 500-1 000 new sites, mainly caused by accidents or are discovered in contact with land-use changes.

Reply Q2 (France): In January 2017, the Basias inventory (French historical regional inventories of former sites of industrial and service activities likely to be contaminated) registers 275 800 sites where polluting activities took/are taking place. However, it should be noted that several activities may have succeeded over time on a same site.

([97]) Regionernes arbejde med jordforurening i 2015, Danske Regioner.

List of potentially polluting activities for soils listed in the Annex II of the 'withdrawn proposal' soil framework directive:

1. Establishments in which dangerous substances are present or have been present quantities equal to or greater than the quantities set out in Parts 1 and 2 of Annex I, Column 2 of Council Directive 96/82/EC (Seveso) 16.

2. Activities listed in Annex I to Council Directive 96/61/EC.

3. Airports.

4. Ports.

5. Former military sites.

6. Service stations.

7. Dry cleaning.

8. Mining installations not covered by Directive 96/82/EC of the European Council, including waste management facilities in the extractive industry as defined in Directive 2006/21/EC of the European Parliament and of the Council17.

9. Landfills as defined by Council Directive 1999/31/EC18.

10. Wastewater treatment plants.

11. Pipelines for the transport of hazardous substances.

Reply Q2 (Germany): We do have on the Laender-level cadastres with suspected contaminated sites. All sites under suspicion are counted. In fact, Germany registered 2016 more than 260 883 suspected sites.

Reply Q2 (Hungary): Recorded:

(a1): 5 375 (*) ((*) according to our most recent survey (22.3.2017) sent out to the regional environmental authorities)

(a2): 5 926 (registered in FAVI-ENG (database of authorised activities regarding groundwater protection))

Estimated (b): 778 (*) ((*) including petrol stations, large livestock holdings/breeding facilities, landfills, valid IPPC permit etc.)

Reply Q2 (Ireland): As stated above Ireland does not have a register of contaminated sites at present as Ireland does not have a significant problem with contaminated sites or legacy brownfield sites.

Reply Q2 (Italy): It is impossible to answer for the time being. Data on potential polluting activities are not collected so far because it is not legal binding. Only [a] few regions collected some data using different methodologies: total number of registered sites is 22 100 and this information cover[s] 17 regions and one autonomous province over 19 regions and two autonomous provinces.

Therefore, there is an underestimation of the total amount at national level.

Reply Q2 (Latvia): At this moment in Latvia CPCS register 3 574 sites are registered:

Contaminated sites: 245

Potentially contaminated: 2 637

Not potentially contaminated (identification is done): 692

Reply Q2 (Lithuania):

Inventoried (counted) 12 341 potentially contaminated sites.

Estimated about 50 000 (with local (in private households) sewage systems).

Reply Q2 (Luxembourg): Estimated number of sites where potentially polluting

activities took/are taking place is 12 000. Among the sites registered presently, not all should be considered as sites where polluting activities took/are taking place. The administration is working on new criteria to be applied in the scope of the future soil protection law.

Reply Q2 (The former Yugoslav Republic of Macedonia): In our country we have not identified all sites where polluting activities took/are taking place and which are potential sources of contamination. During the previously mentioned project, there have been identified 16 contaminated sites and 54 potentially contaminated sites.

Reply Q2 (Malta): The compilation of the list of contaminated and potentially contaminated sites in Malta is an ongoing process, as is the assessment of the likelihood, extent and significance of contamination. The compilation of the list takes into consideration various potentially polluting installations (e.g. petrol stations, slurry pits, scrapyards and historical military fuel storage sites) where there is a risk of seepage of contaminants and groundwater contamination.

a) Number of recorded contaminated sites: 135

b) Estimated number of contaminated sites: approximately 600. The sites included in this figure are primarily considered as likely to be contaminated in view of their site history. However, contamination is yet to be confirmed, and the level of contamination and significance determined through site investigations.

Reply Q2 (Norway):

a) 6 500 recorded sites.

b) we estimate a much higher number than the recorded sites (i.e. petrol stations are not recorded in today's register).

Reply Q2 (Poland): In Poland since September 2016 the general director for environmental protection has kept a register on historical contamination of the land surface. [The] regional director for environmental protection (competent authority in the field of historical contamination of land surface) updates and completes this register. Identification of sites where potential historical contamination of land surface occurs is a duty of the Starost (head of the local administration: powiat (county)). The Starost is obliged to submit to regional directorate for environmental protection the list of potential historical contamination of land surface to October 2018. [The] regional director for environmental protection has 6 months to supplement data from the list. Due to [this] the above data are incomplete. Useful information on contamination of the land surface will be available in 2019.

In Poland there is no register about potentially contamination of the land surface nowadays.

Reply Q2 (Portugal): There were 181 recorded sites where polluting activities took/are taking place: 8 industrial orphan sites and 173 mining orphan sites.

Reply Q2 (Romania): In national strategy and national plan for managing contaminated sites from Romania, are these sites:

1 183 potentially contaminated sites;

210 contaminates sites.

Reply Q2 (Serbia): Out of the total number of 709 sites recorded in the cadastre of contaminated sites, 557 sites are registered and 152 are estimated. According to the list of potentially soil polluting activities from Annex II of the Proposal for a directive of the European Parliament and of the Council establishing a framework for the protection of soil and amending Directive 2004/35/EC, sites such as former military sites, petrol and filling stations, dry cleaners, wastewater treatment installations and pipelines for the transport of dangerous substances are not included in [the] cadastre.

Reply Q2 (Slovakia): Information system of contaminated sites (ISCS) has been

created. ISCS consists of 1 982 (1 758 unique without duplicity, because 224 sites are in two parts of registers) sites and divides: 891 potentially contaminated sites, 299 contaminated sites and 792 remediated or under remediation sites.

Reply Q2 (Slovenia): Slovenia does not have an official comprehensive register of sites where 'polluting activities' took place in the sense of activities which were listed in the Annex II of the 'withdrawn proposal' soil framework directive. However, the information according to different inventories is as follows:

a) operators according to Seveso directive (estimated 61 sites),

b) operators according to IED (estimated 222 sites),

c) contaminated areas due to past industry (mostly mining, smelting and still production estimated 11 sites) and closed landfills of waste (26 sites of industrial and 58 sites of municipal waste).

It is planned to establish an official comprehensive inventory of sites were polluted activities took place.

Reply Q2 (Spain): According to the decree, soil holders in which potentially contaminant activity takes place (or took place) are obligated to submit to the environmental authorities enough information to evaluate the possibility that soil contamination may occur (preliminary soil reports). In accordance with this scheme, [The] total number of installations that are covered under the definition of potentially contaminating soil activity has been counted. Preliminary soil reports are mainly of [a] qualitative nature (it does not necessarily have to contain analytical information). Equally, an estimation of total number of potentially polluting activities is provided.

Counted sites: 43 092.

Estimated sites: 133 344.

Reply Q2 (Sweden): In Sweden we have approximately 83 000 registered sites that are potentially contaminated. Of these, approximately 24 000 have been classified according to risk.

Reply Q2 (Switzerland):

a) 38 000 polluted sites (counted sites).

b) The registration of all polluted sites in the registers is completed.

Reply Q2 (The Netherlands): There is no formal registration of potentially polluting activities (current or past) on the national level. There is, however, a formalised system to classify sites based on past and present activities, the so-called UBI system (Uniform Source Classification of potential polluting activities; in Dutch, Uniforme Bron Indeling potentieel bodemvervuilende activiteiten). Local and regional competent authorities keep records of sites and their respective UBI codes, indicating the likelihood of encountering soil and groundwater pollution. In the past, site investigations have been performed on a large scale based on UBI scores. The current remaining inventory of sites in need of remediation or risk management is a result of this past exercise.

Reply Q2 (United Kingdom (England)): Since the regime was introduced in 2000 more than 600 contaminated land sites have been identified and dealt with in England.

Question 3 (site status 2): How many sites are in need of (a) investigation/still to be investigated or (b) under investigation?

Explanation: We need to have trends on the progress of the overall process of soil remediation. Every country may have different criteria for deciding if a site needs or not to be investigated. Please explain which criteria your country is using in the decision-making.

Reply Q3a (Austria): 10 000 (estimate on sites to be investigated by the national

programme).

Decisions on the need of investigations are driven either (i) by reuse interests or (ii) a preliminary assessment within the national programme. Results of preliminary assessments indicate the likelihood of serious contamination at a site and provide for a ranking of sites within a simplified classification system.

Reply Q3b (Austria): 1 497 (1.1.2017).

Reply Q3 (Belgium (Flanders)): A site needs to be investigated when potentially contaminating risk activities were carried out on it. The list of these industrial activities with an increased risk of soil contamination is legally defined in appendix I of the executive order Vlarebo (activities started before 1 June 2015) and in column 8 of appendix I of the order of the Flemish government concerning environmental licences (activities started after 1 June 2015). A link to the Vlarebo list is given in [the] annex.

Reply Q3a (Belgium (Flanders)):

Number of sites in need of investigation (estimation): 85 000 (cipher from question 2).

Number of sites already investigated: 38 522.

Number of sites still to be investigated (estimation): 46 478.

Reply Q3b (Belgium (Flanders)): OVAM does not know the number of sites that are currently under investigation. The results and the report of an exploratory soil investigation are only communicated to OVAM when the investigation is finished.

Reply Q3a (Belgium (Wallonia)): In theory, the number of sites in need of investigation/still to be investigated can be considered to be all the potentially polluted sites (see answer to question 2). Concerning the criteria used in Wallonia, the dynamic for the management of potentially polluted sites is linked to triggers arising both from environmental policy (triggers from [the] soil decree: voluntary procedure and administrative police procedure currently implemented, and mandatory triggers of Article 21 not yet implemented: purchase of a site listed as potentially contaminated by the soil status database, permit demand for an activity of Annex III, bankruptcy for an activity of Annex III, end of an activity of Annexe III, environmental damage), and from land planning policy (identification, by successive 5-year regional plans called 'Marshall Plans' started in 2004, of priority sites to investigate within the brownfields database, based on the following criteria: environment, urbanism and economic approach, opportunities, accessibility to water/rail road networks, economical actors consultation). For the 2009-2014 'Marshall Plan 2. Green', the objective was to continue remediating 30 heav[il]y polluted sites identified in the first Marshall Plan and to add 30 new sites to the list of sites to remediate. The Marshall Plan 4.0 (2015-2019 with deadline in 2022) ensures the continuity of the work done previously, and a new program of sites to put in the list of priority will be defined in 2017.

Reply Q3b (Belgium (Wallonia)): As the current update process for some databases and automatic computerised requests is not yet finalised, the answer to the number of sites under investigation (but for which the presence of absence of risk has not been established yet) cannot be answered yet.

However, the number of sites for which an investigation has started and has identified areas for which soil analyses show higher values than screening values, with or without a risk assessment having being conducted on the sites, is shown in the table hereunder for 2016 (and 2014 when the update of the number of polluted sites is not finalised for some database). It therefore includes sites still in need of risk assessment to determine if remediation/risk-reduction measures are needed, sites with remediation works in progress, sites not needing remediation works but having either security or monitoring measures.

Polluted sites (03/05/2016) [2014]

Historical inventory (1850s Vandermaelen maps)	[?]
Sites in environmental permit register (including IPPC/IED and Seveso)	[?]
Brownfields	[203]
Service stations	572
Dumps/landfill sites	278
Sites investigated within the context of the soil decree 5/12/2008	436

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Reply Q3a (Bulgaria): Regarding contaminated sites by certain economic activities (according to Lpreda): 0; Regarding the sites with 'historic pollution': see reply Q2.

Reply Q3a (Croatia): No data.

Reply Q3b (Croatia): No data.

Reply Q3a (Cyprus): There is no specific roadmap as to which sides get investigated and when. The general rule for dealing with contamination is stated in Q1. Currently five sites need to be preliminary investigated.

Reply Q3b (Cyprus): —

Reply Q3a (Czech Republic): As a part of SEKM application, there is software for criteria categorisation. They include geological, hydrogeological, chemical, risk potential and other criteria. There is hardly any subjective impact of an assessor. Based on SEKM database, there are 828 sites in need of investigation.

Reply Q3b (Czech Republic): Based on SEKM database, there are 405 sites under investigation.

Reply Q3a (Denmark): 32 000 (Jordforurening: status 2012: Videncenter for Jordforurening)

Reply Q3b (Denmark): 16 985 (97) (Regionernes arbejde med jordforurening i 2015, Danske Regioner).

Reply Q3a (Estonia): 15 sites need to be investigated before remediation. These are sites where residual pollution is not removed at all, or some works have made to localise the pollution and reduce the pollution risk, but still further investigations and preliminary design are necessary for planning treatment activities at these sites.

55 sites have to be investigated to decide if there is need for further remediation. Most of the pollution has been removed from these sites earlier and these sites are maybe in better conditions now (natural attenuation etc.).

After remediation 78 sites need to be monitored to evaluate the success of remediation works.

Reply Q3b (Estonia): There are no sites under investigation right now.

Reply Q3a (Finland): At the end of the year 2016 investigation are needed in 17 700 sites.

Approximately 9 100 functional sites, where the soil condition should be investigated at the latest when operations there conclude and approximately 8 600 sites, where operations have concluded, but where the soil status has not yet been established.

Reply Q3b (Finland): Sites to be assessed or treated, where, on the basis of investigations carried out, there are known to be harmful substances in the soil. The next step for these areas is to assess their need for treatment, if the decision has not already

been made to start remediation, or remediation has not already been started, approx. 2 200 sites.

On average 250-300 remediation projects are initiated annually. This estimate has been made based on the remediation decisions issued by environmental authorities. Thus at least 250-300 sites are investigated every year. But actually, the number of investigated sites is much higher.

Reply Q3 (France): First of all, it should be noted that the French method used to address contaminated sites in a systematic way is not meant to define trends on the progress of the overall process of soil remediation. Indeed, the contaminated sites are removed from the Basol inventory and placed in the Basias one as soon as they are remediated.

At the start of 2017, Basol registers 6 478 contaminated sites and soils. It should be noted that among the potentially polluting activities for soils listed in the Annex II of the withdrawn proposal soil framework directive, some of the polluting activities have not been registered in the Basol database, namely: ports, former military sites. Thus, if the statistical use of the Basol database makes it possible to determine the characteristics of contaminated and potentially contaminated sites and soils at a time 't', contrariwise it is not possible to analyse the trends of the French remediation.

Moreover, risk management according to the use of the site, intangible principle of the French methodology, concerns only historical pollution. For existing installations, legislative and regulatory measures must prevent pollution. In the event of damage to the environment, the operator is responsible for repairing the damage caused.

Reply Q3a (France): In January 2017, among the 6 478 contaminated sites and soils registered currently in the Basol database, 514 (7.9 % %) sites are under safety step or subject to diagnosis.

Reply Q3b (France): In January 2017, among the 6 478 contaminated sites and soils registered in the Basol database, 1 194 sites (18.43 % %) are currently being evaluated.

Reply Q3a (Germany): Information you will find in the current statistics from August 2016.

http://www.umweltbundesamt.de/daten/bodenbelastung-land-oekosysteme/altlasten-ihre-sanierung

Reply Q3b (Germany): see above

Reply Q3a (Hungary): 71 (*) sites are in need of investigation/still to be investigated

Reply Q3b (Hungary): 87 (*) sites are under investigation

Decision-making is based on any factual data and/or measurements that confirm a suspected contamination. All potential contaminated sites are evaluated by the regional environmental authorities; they are also the authoring bodies in the different phases of remediation (preliminary inventory, detailed inventory, remediation actions, monitoring and follow-up monitoring).

(*) According to our most recent survey (22.3.2017) sent out to the regional environmental authorities. These cases are ongoing proceedings of the authorities.

Reply Q3a (Ireland): As stated the EPA is responsible for overseeing the remediation of polluted soil and groundwater at facilities licensed by the EPA. The EPA prioritises its enforcement efforts at sites which pose a high risk of environmental pollution or which pose a risk of failure to meet legislative requirements.

Reply Q3b (Ireland): There is an ongoing need for assessment and remediation of additional environmentally-degraded landfill sites. The department is working with the waste management planning lead authorities and the EPA on a long-term strategy for the remediation of impacted sites around the country. Kerdiffstown landfill remediation remains the single most significant project being supported at present.

Reply Q3a (Italy): Sites in need of investigation registered in regional inventories (excluding sites of national interest (SINs)) are 6 754. The data cover 14 regions and one autonomous province over 19 regions and two autonomous provinces. The total surface of the sites considered for this management step is 11 069 hectares and this information is available for 3 699 sites.

For both data, number of sites and surface, there is an underestimation of the total amount at national level.

Reply Q3b (Italy): Sites under investigation registered in regional inventories (excluding sites of national interest (SINs)) are 1 710. The data cover 15 regions and one autonomous province over 19 regions and two autonomous provinces. The total surface of sites considered for this management step is 20 952 hectares and this information is available for 1 034 sites.

For both data, number of sites and surface, there is an underestimation of the total amount at national level.

Reply Q3a (Latvia): Investigation still going on if there some new place is found during construction work or identified in other way. When new CPCS register will be developed, then municipalities will be asked to update information about CPCS in their territories.

Reply Q3b (Latvia): —

Reply Q3a (Lithuania): 1 270 (49 %) estimated to be at very high risk and 3 351 estimated to be at high risk after preliminary risk assessment

Reply Q3b (Lithuania): —

Reply Q3a (Luxembourg): Our list of potentially polluted sites is dynamic because it includes sites with historical activities as well as sites with ongoing activities. The measurement of progress is therefore not possible with the data of this list.

Reply Q3b (Luxembourg): Luxembourg does not know the exact number of sites that are currently under investigation. At any moment, there are always approximately 30 investigations ongoing.

Reply Q3a (The former Yugoslav Republic of Macedonia): 8 sites from identified 16 contaminated sites still have to be investigated, and all 54 potentially contaminated sites have to be further investigated.

Reply Q3b (The former Yugoslav Republic of Macedonia): —

Reply Q3a (Malta): the number of sites in need of investigation/still to be investigated: 121. The sites considered include industrial sites (such as Seveso and IPPC sites and port installations), waste management sites, shooting ranges, as well as sites with issues of historical contamination (such as post-war installations and dumpsites) as well.

Reply Q3b (Malta): the number of sites under investigation is 5.

Reply Q3a (Norway): 1 162 sites are registered with suspicion of contaminated soil, but no assessments done. This is based on assumptions of contamination due to historical or actual land use, illegal dumping of waste, known spills etc.

Reply Q3b (Norway): No number available.

Reply Q3a (Poland): The answer is the same as that in question Q2.

Reply Q3b (Poland): The answer is the same as that in question Q2.

Reply Q3a (Portugal): There are 21 recorded sites that are in need of investigation: 1 industrial orphan site needing preliminary investigation and 20 mining orphan sites needing a reinforcement of the initial investigation.

Reply Q3b (Portugal): There are three recorded industrial orphan sites still to be investigated.

Reply Q3a (Romania): For potentially contaminates sites there are information about previous activities carried out on-site, but there prepared report level II environmental assessment and/or risk-assessment report. Follow the following elaboration and on the basis of information obtained, will be establish if it declared contaminated or uncontaminated sites category.

Information on potentially contaminated sites are only descriptions of activities previously carried out without any on-site investigation.

For the category of contaminated sites are drawn report level II environmental audit and/or risk-assessment studies. They were developed based on existing environmental legislation and their developments were obtained and the information about link pollutant contamination factor soil and groundwater environment. Even if the investigation does not comply with international practice, this information cannot be ignored.

Reply Q3b (Romania): The answer is in Reply Q3a.

Reply Q3a (Serbia): Out of 709 sites listed in cadastre of contaminated sites, 478 are in need of investigation/still to be investigated.

Reply Q3b (Serbia): According to the cadastre of contaminated sites, 103 are currently under investigation. Criteria are described in a question Q11a.

Reply Q3a (Slovakia): Generally, approximately most of potentially contaminated sites (around 750) and part of contaminated sites (around 50) are in need of investigation. These 800 sites are without any actual detailed investigation or monitoring in [the] last 5 years. Besides of these sites there are other sites (around 150) which are in need of detailed investigation or additional investigation.

The state remediation programme of contaminated sites 2016-2021 contains the list of sites which are in need of management: detailed investigation, 93 sites; monitoring or investigation, eventually remediation, 161 sites; monitoring eventually remediation, 141 sites; monitoring after remediation, 19 sites; remediation, 26 sites.

Criteria for deciding if a site needs or not to be investigated are: 1. priority on the base of classification of locality in ISCS (so-called preliminary risk assessment (evaluation)) 2. detailed investigation with actual risk analysis was realised on the locality, whether or not? These criteria are taken into consideration in state remediation programme of contaminated sites 2016-2021.

Reply Q3b (Slovakia): In the last time (last 2 years) detailed investigation were realised on 138 sites (105 potentially contaminated sites and 33 contaminated sites) and additional investigation was realised on 19 sites closely before their remediation, monitoring was realised on 161 sites (all from European Union funds in the framework operational programme environment). Besides it investigation was realised approximately on 90 sites (paid by private companies) in last 5 years.

52 sites will be under investigation in very short time (bidding procedure is finished).

Reply Q3a (Slovenia): An official inventory of sites is not yet established.

Reply Q3b (Slovenia): In-depth investigation of one area is in progress.

The criterion in the decision-making is the severity of impacts on human health or on the environment due to soil contamination.

Reply Q3a (Spain): Once the environmental authorities assess the content of a preliminary soil report, [the] landowner may be required to make additional reports containing analytical information (quantitative). The scope of such as reports can be broad and ranging from an exploratory research data upon a limited number of samples to compare with the screening levels settled in the soil decree to a more complex repost such as formal risk analysis. The number of sites that already been investigated correspond to 4 924 (1 706 confirmed + 3 218 estimated).

Reply Q3b (Spain): those whose research is currently (31.12.2016) ongoing:

270.

Reply Q3a (Sweden): Approximately 25 000.

Reply Q3b (Sweden): 1 408. Criteria for evaluating the need of investigations are based on whether an area is suspected to be contaminated, or if the operations or actions taken by an operator, may cause negative effects on human health or the environment. Where there is a suspicion of potential negative effects on human health or the environment, the operator or person who is responsible for the actions, is liable to do undertake the investigations that are necessary for the regulatory authority to undertake its supervision.

The national programme for dealing with contaminated sites with government funding, prioritises sites classified in risk Class 1 and 2 (high or very high risk) for investigations and remedial actions.

Reply Q3a (Switzerland): Sites already investigated and evaluated: 9 600 sites still to be investigated: 6 700 sites (up to 59 % of all sites in need of investigation have been already investigated and evaluated).

Reply Q3b (Switzerland): 100 sites (estimated) are momentary under investigation decision, if a site needs or not to be investigated.

Depending on the type and quantity of waste, the location of the site and in particular on the exposure of the subjects of protection it has to be determined, if a polluted site:

- is a site from which no harmful effects or nuisances are to be expected; or

- is a site requiring an investigation as to whether it is in need of monitoring or remediation.

(-> From all of the 38 000 polluted sites in Switzerland, 21 700 (57 %) are not in need of investigation.)

Reply Q3a (The Netherlands): 0

Reply Q3b (The Netherlands): 10 (as per the end of 2016 of a total of 1 455 locations that are currently in the inventory of locations that are in need of urgent remediation or risk management)

Reply Q3a (United Kingdom (England)): The environment agency has estimated that there may be 325 000 potentially contaminated sites in England and Wales. However, a vast majority will either be dealt with through the planning regime or will not be contaminated in the legal sense.

Reply Q3b (United Kingdom): —

Question 4 (site status 3): How many sites have been investigated but no remediation is needed?

Explanation: An investigation is intended by means of soil sampling and testing studies.

Reply Q4 (Austria): 622 (1.1.2017)

Reply Q4 (Belgium (Flanders)):

Number of sites already investigated: 38 522 (cfr. question 3).

Number of these investigated sites where no remediation was needed: 32 431.

Reply Q4 (Belgium (Wallonia)): As the current update process for some databases and automatic computerised requests is not yet finalised, the answer to the number of sites that have been investigated but no remediation is needed cannot be answered yet.

However, the number of sites classified as 'non-polluted sites' that have been investigated and for which no soil analyses show higher values than screening values,

and therefore for which no remediation is needed, amounted in 2016 to:

Non-polluted sites (3.5.2016) [2014]	
Historical inventory (1850s Vandermaelen maps)	[?]
Sites in environmental permit register (including IPPC/IED and Seveso)	[?]
Brownfields	[?]
Service stations	873
Dumps/landfill sites	0
Sites investigated within the context of the soil decree 5/12/2008	54

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[?] information not available

Reply Q4 (Bulgaria): Regarding contaminated sites by certain economic activities (according [to] Lpreda), 0; Regarding the sites with historic pollution, 2 sites.

Reply Q4 (Croatia): No data.

Reply Q4 (Cyprus): None. Usually investigation in the form of a soil survey takes place after reasonable indication of past polluting activities.

Reply Q4 (Czech Republic): Based on SEKM database, there are 543 such sites.

Reply Q4 (Denmark): 10 191 (98) (question to the regions, March 2017).

Reply Q4 (Estonia): Not any sites have got the soil contamination under pollution limit by themselves (by natural solubility etc.). 1 site was registered into database earlier twice using two different names. The database was renewed in 2015 and the mistake was fixed.

Reply Q4 (Finland): In the national database system (MATTI) about 6 400 sites are classified as 'No need for treatment' and 5 700 of these sites have needed some remediation actions. Hence 660 sites in the database system have been investigated but no remediation is needed.

The authorities are not informed of all the investigations, thus amount of the above-mentioned, 'no remediation is needed' sites is much higher in reality.

Reply Q4 (France): In January 2017, among the 6 478 contaminated sites and soils registered currently in the Basol database, 796 sites (12.3 %) are free from any restrictions after having been remediated or evaluated.

Reply Q4 (Germany): We do not count this exactly but we assume only between 7-11 % (depending on industrial sectors) of suspected sites will cause measures in line with the options given by the soil protection act.

Reply Q4 (Hungary): 145 (*) sites have been investigated (soil and groundwater sampling and measurements), and no remediation was needed

(*) According to our most recent survey (22.3.2017) sent out to the regional environmental authorities.

Reply Q4 (Ireland): As stated earlier Ireland does not have a history of contaminated sites so the focus has been to address former landfill sites. Under Section 22 of the waste management act 1996 a waste plan is required to include an inventory of sites identified as previous disposal/recovery sites. A risk assessment of these sites is required as well as

([98]) Question to the regions, March 2017.

identifying remedial action to be taken. To assist the local authorities with risk assessments the EPA issued a Code of practice for environment risk assessment for unregulated waste disposal sites in April 2007. The code of practice was produced to ensure a consistent approach to environmental risk assessments by local authorities. The risk-assessment methodology is a structured, transparent and practical process that allows for the prioritisation of the sites as high, moderate and low risk known as Class A, B and C. The methodology has three phases as follows.

Tier 1: Qualitative risk assessment (risk screening and prioritisation).

Tier 2: Site investigations and refining risk screening.

Tier 3: Quantitative risk assessment (detailed site specific).

Legislation (certification of historic unlicensed waste disposal and recovery activity regulations, 2008) required all landfills closed between 1977 and 1997 to have a minimum Tier 1 assessment completed by 31 December 2009 and that Tier 2 and Tier 3 stages would follow on as soon as possible.

Reply Q4 (Italy): Sites not needing remediation (after investigation) registered in regional inventories (excluding sites of national interest (SINs)) are 5 521. The data cover 10 regions and one autonomous province over 19 regions and two autonomous provinces. The total surface of sites considered for this management step is 4 344 hectares and this information is available for 3 314 sites.

For both data, number of sites and surface, there is an underestimation of the total amount at national level.

Reply Q4 (Latvia): In CPCS no such kind of information. According to CPCS sites register soil analyses is done in 115 sites.

Reply Q4 (Lithuania): In 460 (about 40 % %) of investigated sites no remediation is needed.

Reply Q4 (Luxembourg): We have approximately 100 investigated or remediated sites where no remediation is needed even for the most sensitive land use. We have 1 506 investigated or remediated sites where no remediation is needed for the current land use. The database does make a distinction between sites where the conclusion that no remediation is needed comes from information of investigation or from information after remediation.

Reply Q4 (The former Yugoslav Republic of Macedonia): There are no such sites from the already investigated sites.

Reply Q4 (Malta): The number of sites where investigations have been carried out, but no remediation is deemed necessary is five. To note that certain sites are being monitored throughout their operations so as to periodically assess any potential impacts from such operations.

Reply Q4 (Norway): no number available.

Reply Q4 (Poland): The answer is the same as that in question Q2.

Reply Q4 (Portugal): There are 53 recorded mining orphan sites where indeed no environmental remediation is needed.

Reply Q4 (Romania): The answer is in Reply Q3a.

Reply Q4 (Serbia): We still cannot provide the answer to this question.

Reply Q4 (Slovakia): Generally, 63 of 247 sites have been investigated but no remediation is needed.

138 sites have been investigated within the framework operational programme environment (see previous answer). 49 sites of these 138 sites have been investigated but no remediation is needed, but seven sites of these 49 sites need only some relatively

simple measures like removal pesticides from storage. Additional investigations were realised on 19 sites before their remediation. Approximately 14 of 90 sites which have been investigated (paid by private companies) but no remediation is needed.

Approximately 40 of 161 monitored sites (within the framework operational programme environment) no remediation is needed.

Reply Q4 (Slovenia): Such sites were not found as primarily focus was on heavily polluted areas, which we [have] already known for a long time.

Reply Q4 (Spain): 2 203 (897 confirmed + 1 306 estimated).

Reply Q4 (Sweden): 1 775

Reply Q4 (Switzerland): Of the sites already investigated (9 600):

~ 6 900 sites (~ 72 %) have not been in need of remediation

~ 2 700 sites (~ 28 %) are (or have been) in need of remediation (about 1 000 of them have been already remediated).

Reply Q4 (The Netherlands): 13.

Reply Q4 (United Kingdom): Unknown.

Question 5 (site status 4): How many sites need (1) or might need (*) (2) remediation, including risk-reduction measures (RRM) and natural attenuation? (Monitoring shall be part of the preparative investigations on how to remediate); (*) it can be an estimate.

Explanation: The appraisal of risk may change depending on the actual land use and the remediation has to fit the purpose by considering adequate risk-reduction measures in view of the protection goals to be achieved like the protection of the groundwater/drinking water, human population, or of vulnerable ecosystems. The term 'need' (1) refers to the 'known' number of sites; the term might need (*) (2) refers to the 'estimated' number of sites.

Reply Q5-1 (Austria): 288 (1.1.2017).

Reply Q5-2 (Austria): 2 050 (estimate in a scenario with major legal amendments allowing for site-specific risk reduction as well as monitoring for seriously contaminated sites not causing environmental or human health risks).

5 000 (estimate in a scenario with major legal amendments) cross-reference see also answers Q16.

Reply Q5-1 (Belgium (Flanders)): Number of sites already investigated: 38 522 (cfr. question 3).

Number of these investigated sites that need remediation: 6 091.

Reply Q5-2 (Belgium (Flanders)): Number of sites in need of investigation (estimation): 85 000 (ciphers from questions 2 and 3) Number of these sites that might need remediation (estimation): 11 000-12 500.

Reply Q5 (Belgium (Wallonia)): As the current update process for some databases and automatic computerised requests is not yet finalised, the answer to the number of sites that need or might need remediation cannot be answered yet.

Reply Q5 (Bulgaria): Regarding contaminated sites by certain economic activities (according Lpreda), 0; Regarding the sites with historic pollution, 1 site.

Reply Q5 (Croatia): Three sites (hotspots) are waiting for remediation.

Reply Q5 (Cyprus): 3 sites

Reply Q5 (Czech Republic): It is not possible to give the exact number of sites. It can

be several hundreds.

Reply Q5 (Denmark): 531 ([98]); 8 500

Reply Q5 (Estonia): (1) 78 sites still definitely need remediation.

Reply Q5 (Finland): A very rough estimate has been made that half of the potential sites of the national database system (MATTI) will need remediation or other risk-reduction actions. Thus from 19 900 potentially contaminated in sites 9 950 need risk-reduction in the future.

Reply Q5 (France): Idem 3a + 3b.

Reply Q5 (Germany): We do not divide these cases in particular. The spectrum of measures or a combination among them is based on the existing law.

Reply Q5 (Hungary): No of sites that need remediation: 411 (*); No of sites that might need remediation: 238 (*).

(*) According to our most recent survey (22.3.2017) sent out to the regional environmental authorities. These cases are ongoing proceedings of the authorities.

Reply Q5 (Ireland): As stated above the focus has been on legacy disposal/recovery sites and using the risk-assessment methodology described above 66 high-risk sites have been identified.

Reply Q5 (Italy): Sites that need remediation or risk-reduction measures (RRM) registered in regional inventories (excluding sites of national interest (SINs)) are 2 600. The data cover 14 regions and one autonomous province over 19 regions and two autonomous provinces. The total surface of sites considered for this management step is 7 094 hectares and this information is available for 1 677 sites.

For both data, number of sites and surface, there is an underestimation of the total amount at national level.

Reply Q5 (Latvia): According to information from CPCS register, 245 are contaminated. These sites might be needed for remediation.

Reply Q5 (Lithuania): About 800 sites needed remediation measures after the testing studies.

Reply Q5 (Luxembourg): We have currently approximately 60 sites identified through investigation that need remediation.

Reply Q5 (The former Yugoslav Republic of Macedonia): All identified 16 contaminated sites need remediation measures.

Reply Q5 (Malta): The requirement for remediation may depend on the projected after use of the site. Soil-screening values and groundwater threshold values established are different in cases of 'industrial' and 'residential' after uses. In different cases, the authority may require specific techniques ranging from site sealing to full remediation activities.

1. Known: 14. Land and groundwater investigations previously confirmed that these sites are contaminated.

2. Estimated: 600.

The figure indicated includes sites that are considered as potentially contaminated (now or in future) in view of the activities carried out and/or substances handled, or in view of the site history. It should be noted that only a percentage of these sites are considered as likely to be contaminated.

The indicated figure is an approximate figure established through analysis of historical information on specific sites and the environmental risk associated with specific industrial sectors.

Reply Q5 (Norway): 508 sites registered that need remediation.

Reply Q5 (Poland): The answer is the same as that in question Q2.

Reply Q5 (Portugal): There are 16 recorded sites that still need remediation, 5 industrial orphan sites and 11 mining orphan sites.

There are 21 recorded sites that might need investigation, 1 industrial orphan site and 20 mining orphan sites.

Reply Q5 (Romania): --

Reply Q5 (Serbia): Need remediation: 93 sites. Might need remediation: 564 sites.

Reply Q5 (Slovakia): We know answer on this question on the base of analogy.

184 of 247 sites have been investigated and remediation is needed or was needed (see previous answers). 61 of them have been remediated (19 from European Union funds and 42 from private-company sources) in [the] last 5 years.

Approximately 120 of 161 monitored sites might need remediation (see previous answers).

On the base of this information approximately 75 % of identified sites need remediation or risk-reduction measures (RRM) including natural attenuation.

It means (on the analogy) that approximately 600 of 800 sites which are without any actual detailed investigation or monitoring and 113 of 150 sites which are in need of detailed investigation or additional investigation might need remediation or risk-reduction measures (RRM) including natural attenuation. It is 713 sites together.

Globally 123 sites need and 833 sites might need remediation or risk-reduction measures (RRM) including natural attenuation.

Reply Q5 (Slovenia): This data will be available after the establishment of the official inventory.

Reply Q5 (Spain): soil decree of appoints obligation to the owner of contaminated site to proceed to reduce the level of risk established in the decree.

1) 112 (counted)

2) 1037 (estimated).

Reply Q5 (Sweden): 1: 6 805 sites; 2: 9 311 sites.

Reply Q5 (Switzerland): Momentary 1 600 sites (4.2 % of all the sites) are in need of remediation; Estimated: overall 4 000 sites (10.5 % of all the sites) will have been in need of remediation.

Reply Q5 (The Netherlands): Currently, the most severe cases of historical contamination (that cause actual health risks) have been controlled or remediated in the Netherlands. Now the focus is on controlling the risks from contaminated groundwater. Currently, there are 466 sites with unacceptable risk due to migration of contaminated groundwater.

Reply Q5 (United Kingdom): Unknown.

Question 6 (site status 5): How many sites are under remediation, including RRM and natural attenuation?

Reply Q6 (Austria): 104 (57 decontamination/containment in progress + 47 monitoring sites).

Reply Q6 (Belgium (Flanders)): Number of sites under remediation, including RRM and natural attenuation: 1 584.

Reply Q6 (Belgium (Wallonia)): As the current update process for some databases

and automatic computerised requests is not yet finalised, the answer to the number of sites that need or might need remediation cannot be answered yet.

Reply Q6 (Bulgaria): Regarding contaminated sites by certain economic activities (according Lpreda), 0. Regarding the sites with historic pollution, 2 sites with natural attenuation.

Reply Q6 (Croatia): Five sites (hot spots) are under remediation.

Reply Q6 (Cyprus): the petroleum storage area in Larnaca which will be investigated after their dismantling as well as the Vasilico site where environmental investigation of the site will happen very soon before regeneration of the area.

Reply Q6 (Czech Republic): 106.

Reply Q6 (Denmark): 403 (97).

Reply Q6 (Estonia): Four sites are in starting phase. Preliminary designs are approved and construction works are in tendering negotiation.

Reply Q6 (Finland): On average 250-300 remediation projects are initiated annually. This estimate has been made based on the remediation decisions issued by environmental authorities. Because especially in situ and large-scale remediation are long-lasting (take several years), the number of sites under remediation is higher than [that mentioned above].

Reply Q6 (France): In January 2017, among the 6 478 contaminated sites and soils registered currently in the Basol database, 924 sites (14.3 %) are currently under treatment, remediation objectives and technical choices definition or implementation are defined or in progress.

Reply Q6 (Germany): See previous data.

Reply Q6 (Hungary): 398 (*) sites are under remediation, where the authorities have issued a legal decision.

(*) According to our most recent survey (22.3.2017) sent out to the regional environmental authorities.

Reply Q6 (Ireland): The focus is on high-risk sites and the three regional waste management planning regions have agreed a process for the investigation, authorisation and remediation of the remaining Class A high-risk sites over the lifetime of the plans (2015 — 2021). The process will rank the high-risk landfills according to a risk screening process and these sites will be dealt with in the following order.

Sites with a gas source-pathway-receptor linkage containing hazardous waste.

Sites with a gas source-pathway-receptor linkage.

Sites with a groundwater vulnerability source-pathway-receptor linkage.

Sites with a surface waste vulnerability source-pathway-receptor linkage.

Reply Q6 (Italy): Sites with ongoing remediation or RRM registered in regional inventories (excluding sites of national interest (SINs)) are 2 054. The data cover 14 regions and one autonomous province over 19 regions and two autonomous provinces. The total surface of sites considered for this management step is 5 262 hectares and this information is available for 1 519 sites.

For both data, number of sites and surface, there is an underestimation of the total amount at national level.

Reply Q6 (Latvia): According to information from REB (collected in March 2017) in 44 sites remediation took place since year 2003, and these remediation works had permissions from REBs. Information about RRM and natural attenuation requirements is not available for remediated sites. New register will collect such kind of information.

Reply Q6 (Lithuania): The 92 sites are under remediation, 40 of them left to controlled (monitoring) natural attenuation.

Reply Q6 (Luxembourg): We have currently 26 sites under remediation.

Reply Q6 (The former Yugoslav Republic of Macedonia): All contaminated and potentially contaminated sites are under natural attenuation.

Reply Q6 (Malta): Certain sites have commenced remediation actions, these are either still underway or surveys to determine the effectiveness of the remediation/the need for further remediation were pending at the time of compilation of this report. Number of sites under remediation, including RRM and natural attenuation: 9.

Reply Q6 (Norway): no number available.

Reply Q6 (Poland): The answer is the same as that in question Q2.

Reply Q6 (Portugal): There are 10 recorded sites that are under remediation, 2 industrial orphan sites and eight mining orphan sites.

Reply Q6 (Romania): There is no clear evidence.

Reply Q6 (Serbia): Based on the review of issued approvals for rehabilitation and remediation (re-cultivation) projects in the period of 2008-2017, 41 sites are in the process of rehabilitation.

Reply Q6 (Slovakia): 18 sites will be under remediation in very short time (bidding procedure is finished). Some sites (circa 4) are under remediation (from the sources of private companies). Some other projects of remediation are in progress.

Reply Q6 (Slovenia): Two sites: the Upper Meža Valley and the Celje Basin.

Reply Q6 (Spain): 198.

Reply Q6 (Sweden): 1 520 sites.

Reply Q6 (Switzerland): 180 contaminated sites (roughly estimated) are momentary. under remediation

Reply Q6 (The Netherlands): 807.

Reply Q6 (United Kingdom): Unknown.

Question 7 (site status 6): How many sites have been remediated, including those with RRM completed or natural attenuation or under aftercare measures (i.e. sites that are monitored after remediation)? (Monitoring shall be performed to confirm that remediation and RRM goals are achieved).

Reply Q7 (Austria): 203 (152 seriously contaminated sites + 51 contaminated sites).

Reply Q7 (Belgium (Flanders)): Total number of remediated sites: 3 509.

Reply Q7 (Belgium (Wallonia)): The number of sites that have been remediated in 2016 (and in 2014 when the update of the number of remediated sites is not finalised for some database) amounts to:

Remediated sites (3.5.2016) [2014]	
Historical inventory (1850s Vandermaelen maps)	[?]
Sites in environmental permit register (including IPPC/IED and Seveso)	[?]
Brownfields	[352]
Service stations	517

Dumps/landfill sites	694
Sites investigated within the context of the soil decree 5/12/2008	30

[] Environmental Outlook for Wallonia. Digest 2014. SPW Editions. State of the environment directorate. SPW — DGO3 — DEMNA — DEE

Reply Q7 (Bulgaria): Regarding contaminated sites by certain economic activities (according Lpreda) — 0. Regarding the sites with 'historic pollution'; for nine programmes 18 sites have been remediated; for 2 programmes 2 sites have been naturally attenuated.

Reply Q7 (Croatia): Five sites (hot spots) are remediated.

Reply Q7 (Cyprus): 4 sites: Limni mine Paphos, Amiandos mine Limassol, askarel site, chemical industries site at Moni Limassol.

Reply Q7 (Czech Republic): 257.

Reply Q7 (Denmark): 2 483 ([98]).

Reply Q7 (Estonia): 110 sites totally completed. 55 sites have to be investigated to decide if there is need for further remediation. Most of the pollution has been removed from these sites earlier and these sites are maybe in better conditions now (natural attenuation etc.).

Reply Q7 (Finland): In the national database system (MATTI) approximately 5 700 sites have been remediated either completely or partly.

Reply Q7 (France): In January 2017, among the 6 478 contaminated sites and soils registered currently in the Basol database, 3 054 sites (47 %) are treated and under aftercare measures and/or restriction of use.

Reply Q7 (Germany): See previous data.

Reply Q7 (Hungary): 347 (*) sites have been remediated since 2011.

Sites must be monitored for 4 years after successful remediation (government Decree No 219/2004 (VII. 21.)). Remediation is considered successful if concentrations of pollutants go below the permitted limit value.

(*) According to our most recent survey (22.03.2017) sent out to the regional environmental authorities.

Reply Q7 (Ireland): To date only small restoration works have taken place on landfills as a coordinated approach has only been recently agreed. There are currently several tenders out to seek contractors to conduct the landfill remediation work.

Reply Q7 (Italy): Remediated sites, including those with RRM completed or natural attenuation or under aftercare measures, registered in regional inventories (excluding sites of national interest (SINs)) are 2 904. The data refer to 14 regions and one autonomous province over 19 regions and two autonomous provinces. The total surface of sites considered for this management step is 4 130 hectares and this information is available for 2 180 sites.

For both data, number of sites and surface, there is an underestimation of the total amount at national level.

Reply Q7 (Latvia): In 44 sites remediation took place since year 2003. Registered remediation activities.

Reply Q7 (Lithuania): The 96 sites are remediated from some 1 200 sites studied, according of the Lithuanian geological survey (LGS) register data in the end of 2016.

Reply Q7 (Luxembourg): We have 100 investigated or remediated sites where no remediation is needed even for the most sensitive land use. We have 1 506 investigated

or remediated sites where no remediation is needed for the current land use.

Reply Q7 (The former Yugoslav Republic of Macedonia): Five contaminated sites have been remediated, but the measures are not completed.

Reply Q7 (Malta): Many of the IPPC sites which are subject to monitoring based on the original land and groundwater risk assessment are required to regularly carry out environmental monitoring activities. There are also specific conditions in all the IPPC permits obliging the site operators to carry out land and groundwater contamination investigations after the decommissioning of the IPPC facility. Number of sites that have been remediated: 1.

Reply Q7 (Norway): Approximately 1 400, but very unsure number.

Reply Q7 (Poland): The answer is the same as that in question Q2.

Reply Q7 (Portugal): There are 83 recorded sites that have been remediated, two industrial orphan sites and 81 mining orphan sites.

Reply Q7 (Romania): There is no clear evidence.

Reply Q7 (Serbia): Based on the abovementioned review of issued approvals for projects in the period of 2008-2017, rehabilitation and remediation (re-cultivation) are completed on 52 sites on which are currently applying aftercare measures (monitoring).

Reply Q7 (Slovakia): 792 remediated or rehabilitated sites have been recorded (up to date 16.3.2016) in information system of contaminated sites but 224 sites from them are recorded in two registers (unfinished or unsuccessful or aborted or without information about successful remediation or rehabilitation).

61 sites have been remediated (19 from European Union funds and approximately 42 from private companies' sources) in [the] last 5 years.

Besides 49 sites (waste disposal) were rehabilitated from 2008 to 2013.

Reply Q7 (Slovenia): This data will be available after the establishment of the official inventory.

Reply Q7 (Spain): 157.

Reply Q7 (Sweden): 1 930 (excluding old petrol and service stations managed by a private fund).

Reply Q7 (Switzerland): 1 000 sites have already been remediated.

Reply Q7 (The Netherlands): 176.

Reply Q7 (United Kingdom): N/A

Question 8: Is there any date envisaged (at political or technical level) when remediation, including RRM and natural attenuation is to be achieved and what objective is linked with this date (e.g. management of the biggest sites, management of all sites etc.)?

Reply Q8 (Austria): By 2050 risk management (covering remediation, RRM and monitoring measures like MNA) shall be in place.

Reply Q8 (Belgium (Flanders)): The remediation of all sites with a historical soil contamination has to be started by 2036, which is 40 years after the soil remediation decree came into force.

Reply Q8 (Belgium (Wallonia)): Concerning sites managed under environmental legislation, no date can be envisaged as triggers for soil investigations are continuous and as potentially polluted sites are progressively increasing due to historical studies initiated by public authorities. Only dumps/landfills identified by the administration should be close to the end of administrative procedures (depending on the human resources

available) as 70 % of them were finalised (54 % remediated and 16 % with a closed procedure) and 30 % were under investigation in 2014.

Concerning sites managed under land planning legislation, since 2005, the soil remediation is stimulated by a boost in available financial resources via the Marshall Plan and the Marshall Plan 2. Green plans: EUR 369 million have been allocated for remediating 60 priority contaminated sites (SARs: sites to be remediated, most of the SARs belonging to the brownfields category) and a further EUR 205 million for remediating 176 priority non- or slightly polluted SARs. The Marshall Plan 4.0 upholds the importance of completing this work with a view to hosting new business projects. The priority sites identified in the Marshall Plans should be remediated by 2022.

Reply Q8 (Bulgaria): Regarding contaminated sites by certain economic activities (according Lpreda) (any contaminated sites are reported by the competent authorities; Regarding the sites with 'historic pollution') According to the §9, par. 2 TFP of EPA (amendments and supplies SG. 42 of 2011, suppl., SG. 32 of 2012, effective 24.04.2012) Contracts for the implementation of programmes for remediation of damages to the environment resulting from past acts or omissions prior privatisation which are concluded until 15 December 2007 shall be implemented by the previous order. If necessary contracts can be amended or supplemented in order to enable implementation of the programmes. In this way programmes are implemented at the latest by 31 December 2020 and after that date all programmes that have not been started and/or have incomplete performance are terminated.

Reply Q8 (Croatia): No date or deadline.

Reply Q8 (Cyprus): N/A.

Reply Q8 (Czech Republic): No.

Reply Q8 (Denmark): For groundwater and area use there is no such national target. At regional level certain objectives have been set out — such as 80 % of the groundwater resource clean by 2025. For contaminations threatening surface water bodies they are included by the target in the water framework directive of good status for water bodies in 2027.

Reply Q8 (Estonia): There are deadlines in water base management plans (WBM) for sites that are polluting (or serious risk for) groundwater. Sites are scheduled in time table up to year 2021. WBM is approved in political level.

Reply Q8 (Finland): The goal of the national risk management strategy for contaminated land is to have the significant risks posed to health and the environment by contaminated land under control in a sustainable way by 2040.

Reply Q8 (France): There is no date envisaged at French national level when remediation, including RRM and natural attenuation is to be achieved. Indeed, for existing installations, legislative and regulatory measures must prevent pollution. In the event of damage to the environment, the operator is responsible for repairing the damage caused.

Reply Q8 (Germany): Some Laender announced specific dates, but they are not binding and more a political statement than seriously elaborated.

Reply Q8 (Hungary): On a political level (national environmental remediation programme in Decision No 2205/1996 (VII.24), followed by a parliamentary Decision No 83/1997. (IX. 26.)), the end year of the long-term stage of the programme is 2030. On a technical level the date to achieve remediation of the sites is defined as 'until 2050'.

Reply Q8 (Ireland): As stated above the regional waste plans aim to agree a process for the investigation, authorisation and remediation of the remaining Class A high-risk sites over the lifetime of the plans (2015-2021).

Reply Q8 (Italy): There is not a linkage with any date.

Reply Q8 (Latvia): No. In Latvia is not set the date

Reply Q8 (Lithuania): According Management plan of contaminated sites for 2013-2020 remediation of the most contaminated sites should be achieved in 2023.

Reply Q8 (Luxembourg): No.

Reply Q8 (The former Yugoslav Republic of Macedonia): No such data.

Reply Q8 (Malta): Malta is currently collecting data required to compile a national implementation plan for remediation of contaminated sites. Malta is also addressing contamination issues using site-specific risk assessments and applicable legal requirements for specific sites.

Reply Q8 (Norway): Several political dates have been given.

In 1999 sites where prioritised with the goal of assessing and remediating the most serious known contaminated sites by the year 2005 (93 sites), in the same project 510 sites where assessed and prioritised.

In 2005 a new strategy for dealing with contaminated sites was released. The goal was remediation of prioritised sites by the year 2012. This included approximately 130 sites.

Although there has been a substantial effort to deal with contaminated sites since the 1990s we have not finished assessing, registering and cleaning up contaminated sites. The prioritisations made are always done on today's knowledge and these changes with time. An example of new cases is airports that where remediated for oil contamination but now are assessed for per- and poly-fluoroalkyl substances (PFAS)-contamination.

Reply Q8 (Poland): No, there is no specific date envisaged. Every detected case of land-surface contamination is considered separately by [the] competent authority issuing an administrative decision, according to present legislation.

Reply Q8 (Portugal): There is no date envisaged to finish the remediation of the contaminated industrial orphan sites identified so far. The remediation is pending on the budget available for the purpose.

The concession contract for the environmental remediation of old mining areas granted by the Portuguese government to a state-owned company is valid until 2022. It is expected by that date that the major remediation [be] completed, although follow-up measures, [such] as monitoring and maintenance, shall continue after the referred date.

Reply Q8 (Romania): No.

Reply Q8 (Serbia): [The] national environment protection programme (adopted in 2010) establishes requirements for better and best practices for rehabilitation and remediation. Among the long-term goals of this programme (2010-2019) is remediation of contaminated sites from the list of priorities, rehabilitation of existing dumpsites, and perform remediation thereof that pose the biggest risk to the environment, as well as remediation of contaminated soil. Additionally, the waste management strategy for the period 2010-2019 is predicted to make an inventory of locations contaminated with hazardous waste, to define the risks for rehabilitation and remediation and to define priorities for rehabilitation and remediation.

Reply Q8 (Slovakia): Slovakia has a procedure of risk assessment (of all sites), relevant legislation, commission as an advisory organ of the Ministry of Environment of the Slovak Republic [Slovakia]. Slovakia has the second state remediation programme of contaminated sites 2016-2021 referring to the state remediation programme of contaminated sites 2010-2015.

Reply Q8 (Slovenia): There is no date envisaged at political or technical level.

Reply Q8 (Spain): [The] national contaminated-sites policy does not establish technical or doctrinal targets or a concrete time schedule. In this sense, Spanish soil policy is not aprioristic but incremental dealing out with contaminated sites as far as they are

detected. However, in some cases in which specific contaminated sites pose a special risk to human health and environment, regional governments have stated political mandates to reduce the risk.

Reply Q8 (Sweden): According to our environmental objective for 'a non-toxic environment', contaminated sites should have been corrected, to the extent that they do not pose any threat to human health or the environment, within one generation, i.e. by 2020.

Reply Q8 (Switzerland): There are no legally binding dates in this context existing in Switzerland.

Nevertheless, the Swiss federal office for the environment (FOEN) has formulated the goals that all investigations should be finished by 2025 at the latest while all contaminated sites should be remediated by 2040 at the latest.

Reply Q8 (The Netherlands): The minimum requirement for the 1 383 locations that require urgent remediation or risk management according to the inventory ending 2015 is that risks for human health and ecological risks and risk due to groundwater migration are managed by the year 2020.

Reply Q8 (United Kingdom): —

Question 9a: In case your country does not have a register, do you have an alternative way for dealing with sites as defined in one of the six site status described above (Q2, 3, 4, 5, 6, 7)?

Reply Q9a (Austria): N/A

Reply Q9a (Belgium (Flanders)): N/A.

Reply Q9a (Belgium (Wallonia)): N/A.

Reply Q9a (Bulgaria): Regarding contaminated sites by certain economic activities (according Lpreda) (there is no legal requirement to establish a register. Regarding the sites with historic pollution) there is no legal requirement to establish a register.

Reply Q9a (Croatia): Explained in Q1.

Reply Q9a (Cyprus): Cyprus has a register of potential contaminated sites kept by the geological survey department since 2006. This includes historic pollution such as mining and industrial abandonment. Along with the register a well-defined environmental impact assessment process is adhered for new developments that might incorporate polluting activities.

Reply Q9a (Czech Republic): The sites are dealt according to valid legislative measures as stated in Reply Q1.

Reply Q9a (Denmark): There is a register.

Reply Q9a (Estonia): N/A.

Reply Q9a (Finland): N/A.

Reply Q9a (France): N/A.

Reply Q9a (Germany): We do have registers on the Laender level.

Reply Q9a (Hungary): Ministerial decree No 18/2007 on data provision of the groundwater and geological formations information system (FAVI) entered into force on 1 July 2007, which contains the datasheets for inventories of pollution sources, contaminated sites and remediation according to the government Decree No 219/2004.

The FAVI database is part of the national environmental information system (OKIR). All environmental data (waste, air, surface water, groundwater, European pollutant release and transfer register (E-PRTR), nature conservation data) are entered to a centralised

computer database of the OKIR. Regional environmental authorities perform the measurements, process the reported data and transmit the data directly to a central database operated by the ministry of agriculture.

FAVI has three subsystems:

1. potential polluting activities
2. register for contaminated sites (Kárinfo)
3. monitoring.

Legal background of data provision (scope of obligates, deadlines) is detailed in the abovementioned decrees. Other information about the data provision can be found in the guides of the individual datasheets. Since 2015, environmental data provisions can be sent only electronically to the authorities.

Reply Q9a (Ireland): In terms of registers available, under waste management legislation each local authority is required to record historic waste-disposal sites within its boundary on a register. This register is hosted by the EPA (See waste management act S22 Register). In addition, an inventory of historic mine sites in Ireland was published in 2009 (see Historic Mine Sites).

Reply Q9a (Italy): —

Reply Q9a (Latvia): Information from REB could be obtained about permission for remediation works. That could be information only about remediation.

Reply Q9a (Lithuania): We have the state register 'contaminated sites' with data of inventoried potentially contaminated sites.

We have the state register 'investigations of underground resources' with data of investigated sites and its measurements. Both registers are linked with each other.

Reply Q9a (Luxembourg): We have a register but no appropriate legal framework to determine the need to address the question of the (potential) soil pollution.

Reply Q9a (The former Yugoslav Republic of Macedonia): The data and information regarding the contaminated sites and their management could be obtained through the distribution of questionnaires regarding investigation and remediation, sent out to the companies and contaminated sites facilities by the ministry of environment and physical planning.

Reply Q9a (Malta): Malta is currently compiling a list, which is constantly being updated.

Reply Q9a (Norway): N/A.

Reply Q9a (Poland): According to Polish law, landowner of the land surface, who confirmed the historical contamination of the land surface in the area which is his possession, shall be obliged immediately to report this fact to the regional director for environmental protection. After receiving notification regional director for environmental protection shall conduct proceedings on the remediation of such land.

Reply Q9a (Portugal): The upcoming legislation on contamination prevention and soil remediation, if approved as it was proposed, foresees a national inventory of contaminated sites.

While it is not adopted, the public entities that approve and monitor the remediation of orphan sites have their own registers/lists with the site status.

Reply Q9a (Romania): There is national evidence as we answer at Q2, but the data must be updated.

Reply Q9a (Serbia): N/A.

Reply Q9a (Slovakia): Slovakia has a register — information system of contaminated

sites (ISCS).

Reply Q9a (Slovenia): Slovenia carried out the rehabilitation of areas based on studies that have been made in order to detect environmental problems and problems of public health. For example: The Upper Meža Valley was declared as a contaminated site due to high levels of toxic metals (mostly lead, zinc and cadmium) in the environment. This led to [a] special remediation programme to protect human health, especially children's health, which is still ongoing. Different remediation measurements have been implemented and monitoring of selected metals in the air and soil and biomonitoring of lead in the blood of children is being carried out.

Slovenia adopted the operational programme for the management of waste oils for the 2003-2006 period. The programme also earmarked funds for the rehabilitation of the old burdens. [An] example of [the] results of this programme is a site in Maribor where [a] waste-oil refinery landfilled the acid tar into neighbouring dumps which resulted in soil contamination. Therefore, the site rehabilitation was carried out and the monitoring system for environmental impacts was established; an extensive study in the Celje Basin, where soil is polluted due to past smelting, was performed. In an effort to provide residents of the Celje Basin [with a] safe and clean environment and to solve the problem of long-term environmental burden, a group of experts from various fields (e.g. soils, water, health) made a joint project of environmental pollution and natural resources as the limiter of the Celje Basin development (modelling approach) remediation program. The project was carried out in the context of the target research programme Slovenian competitiveness 2006-2013 of 2010. The most important outcome of the project was a designed modelling approach for rehabilitation of degraded areas, which can be useful in similar degraded areas in Slovenia in terms of improving quality of life and sustainable development.

Reply Q9a (Spain): [The] soil decree established the creation of a national contaminated soil inventory to include information on soils [and] lands that had been formally declared as contaminated. Subsequently, the waste law currently in force (2011) introduced the concept of voluntary decontamination. Under this concept (voluntary remediation) a formal contaminated-soil declaration is no longer required to submit a decontamination project. This way, national inventory of contaminated sites has become inoperative. Although waste law (2011) contains a prescription to build a register of voluntary remediated sites, legislative initiative to develop this register is still to be initiated.

Reply Q9a (Sweden): N/A.

Reply Q9a (Switzerland): N/A.

Reply Q9a (The Netherlands): N/A.

Reply Q9a (United Kingdom): —

Question 9b: Since when?

Reply Q9b (Austria): — — -

Reply Q9b (Belgium (Flanders)): N/A.

Reply Q9b (Belgium (Wallonia)): N/A.

Reply Q9b (Bulgaria): N/A.

Reply Q9b (Croatia): Regarding hot spots since 2005.

Reply Q9b (Cyprus): N/A.

Reply Q9b (Czech Republic): N/A.

Reply Q9b (Denmark): The register was introduced in the soil-contamination act of 1999.

The current national register (www.miljoeportal.dk) was made the official register in 2013. It is based on real-time data from the five regions.

Reply Q9b (Estonia): We have the register from 2005 ([Microsoft] Excel datasheet), it was re-inventoried in 2015 and [a Microsoft] Access database was made to link more information with polluted sites. Also, investigation documents were gathered and organised for these sites. In last 2 months a central web platform of environmental data is connected with renewed data of polluted sites.

Reply Q9b (Finland): N/A.

Reply Q9b (France): N/A.

Reply Q9b (Germany): Some Laender already started since the end of the 1980s but at latest 1999.

Reply Q9b (Hungary): OKKP, and with it the first phase of data collection started in year 1996. FAVI started in year 2007.

Reply Q9b (Ireland): The register of historic mine sites was published in 2009. The Section 22 register of historic landfill sites has been a requirement since 30 June 2009.

Reply Q9b (Italy): —

Reply Q9b (Latvia): Since year 2003.

Reply Q9b (Lithuania): Since 1997.

Reply Q9b (Luxembourg): Our register of sites where potentially polluting activities might have taken place was first finished in 2006, but since it is a dynamic register, it is updated regularly.

Reply Q9b (The former Yugoslav Republic of Macedonia): N/A.

Reply Q9b (Malta): Malta began compiling a register in 2012.

Reply Q9b (Norway): N/A.

Reply Q9b (Poland): 5 September 2014.

Reply Q9b (Portugal): Since 2003/2004 for old mining sites and since 2008 for industrial orphan sites.

Reply Q9b (Romania): N/A.

Reply Q9b (Serbia): N/A.

Reply Q9b (Slovakia): ISCS has been established since 1.1.2009.

Reply Q9b (Slovenia): Remediation of the Upper Meža Valley has been going on since 2007 and is expected to be completed in the year 2022.

The operational programme for the management of waste oils for the 2003-2006 period was adopted in 2003. Rehabilitation of a contaminated site near Maribor (Pesniški Dvor) started in 2006 and was finished in 2008.

Remediation of one site in the Celje Basin started in 2014 (Stara Cinkarna).

Reply Q9b (Spain): 2005.

Reply Q9b (Sweden): N/A.

Reply Q9a (Switzerland): N/A.

Reply Q9b (The Netherlands): N/A.

Reply Q9b (United Kingdom): —

Question 10: Is the competence managed at national, at regional level or at municipal level?

10 (a): of the register

10 (b): of the management of contaminated sites

Explanation: The Country may have the situation that the competence of managing the register is different from the competence of managing the contaminated sites. We would like to understand in a brief explanation how the country is organised to deal with contaminated sites, for example some competences are centralised and others may be managed at regional or local level.

Reply Q10a (Austria): The register is established nationally and maintained by Environment Agency Austria (EAA).

Reply Q10a (Belgium (Flanders)): OVAM, a regional public environment agency, is legally obligated by the soil decree to manage a land information register (LIR) which contains all known data on soil contamination in Belgium (Flanders). The LIR is fed by the municipalities which provide the location of potentially contaminated sites and their risk activities, and by information that comes from the execution of soil investigations, remediation projects and remediation works.

Reply Q10a (Belgium (Wallonia)): The regional level is the competent authority for environment and spatial planning management in Belgium. Sublevels are involved in the continuous improvement of the register(s).

Reply Q10a (Bulgaria): See reply Q9a.

Reply Q10a (Croatia): Hot spots are defined (registered) by waste management strategy of the Republic of Croatia (Official Gazette 130/05) and in competence of ministry of environment and energy.

Reply Q10a (Cyprus): The competence is managed nationally for both the register and the contaminated sites.

Reply Q10a (Czech Republic): Serious and large contaminated sites that are in the SEKM database are to be remediated under the competence of the ministry of environment. The expenses are covered by several sources: A) national privatisation account, B) budget of the ministry of environment, C) Operational programmes for the environment, D) national programme for the environment and state fund for the environment. In some cases of small extent the remediation can be paid also from regional or municipal budgets.

Reply Q10a (Denmark): Regionally managed but compiled nationally in a real time GIS portal (www.miljoeportal.dk).

Reply Q10a (Estonia): Register is managed at national level. The web-based platform is managed by environment agency (EA). Renewing the data is managed by ministry of environment (MinE). Reporting about sites that are cleaned up is done by environmental board. The process in total is managed by ministry of the environment.

Reply Q10a (Finland): At national level Finnish environmental institute owns, upholds and develops the register or the data base system and makes national monitoring and summaries. At regional level the Centres for Economic Development, Transport and the Environment (ELY Centres) centres maintain and store site data and provide information on [a] single site. The municipalities have limited extent for the applying of site data.

The national database system (MATTI) is nationwide and uniform database. In the database there is a direct connection to other information systems of the environmental administration. For example, sampling data of surface waters, groundwaters and sediments and organisms are saved in their own databases. The database is available to all the workers in the governmental environment administration. Authorities in municipalities (environment, land-use planning and supervision of building) can see the information via [a] special user interface and the same concerns nominated users in other government institutions.

Reply Q10a (France): The competence of the registration as well as the management of contaminated sites is managed at regional level by the Dreal (regional authorities for environment, spatial planning and housing, formerly known as Drire, regional authorities for industry, research and environment). On the other side, the registration at regional level supplies the national Basol database in the scope of the regulation of the contaminated sites.

Reply Q10a (Germany): Laender level due to the federal system and the competences provided with the soil protection act.

Reply Q10a (Hungary): The register is managed at a regional level by the environmental authorities as per Ministerial Decree No 18/2007. (V. 10.).

Datasheets of contaminated sites before investigation, after detailed investigation and following remediation are recorded in the FAVI-Kárinfo system, at regional level, the data available at a national level.

Reply Q10a (Ireland): The register of historic landfill sites is hosted by the EPA under national legislation.

Reply Q10a (Italy): According to former legislation on contaminated sites management in Italy (Ministerial Decrees n.471/99 and n.185/89), regions were obliged to develop regional remediation plans, including a list of 'potentially contaminated sites' (defined as sites were potential polluting activities had taken place) together with a prioritisation of them for investigation needs. Even if after 2006, with Legislative Decree n.152/06, the definition of 'potentially contaminated sites' has changed and the list of 'potential polluting activities' no longer applied, some regional remediation plans still contain the original list of 'potential polluting activity sites'.

According to current legislation, registers of 'sites to be remediated' (i.e. 'contaminated sites') have been developed at the regional level. The contents of the registers are different among regions and some regions have not yet completed them. However, information on site location, type of polluting activity (where known), contamination nature (type of contaminants), current management step, risk-reduction measures adopted is included in all available registers. This information, and in particular the progress in management of contaminated sites, is periodically collected at national level from the regions.

Not all the information available at regional level is public, but collected national data are published in the Environmental data yearbook.

The definition of the national database for the systematic contaminated sites relevant data collection is under development.

As for SINs (sites of national interest), the registers are kept by the ministry of environment.

Reply Q10a (Latvia): In Latvia situation register is managed by LEGMC according to information what is received from REBs. Contaminated sites management is under owner, municipalities and state responsibility. Responsibilities are described in [the] law of pollution.

Reply Q10a (Lithuania): [The] Lithuanian geological survey under ministry of environment is owner of both registers and data holder at national level. LGS has competence in inventory of potentially contaminated sites, expertise of reports on the eco-geological investigations of contaminated sites and evaluation concerning demand of treatment of contaminated sites regarding protection of underground resources.

Reply Q10a (Luxembourg): National.

Reply Q10a (The former Yugoslav Republic of Macedonia): Historically contaminated sites are under the jurisdiction of the central government.

Reply Q10a (Malta): National level.

Reply Q10a (Norway): Registration of sites is done at all levels, but [the] Norwegian environment agency is responsible for maintaining the register and is the owner of the register.

Reply Q10a (Poland): [The] general director for environmental Protection keeps a register on historical contamination of the land surface. [The] regional director for environmental protection updates and completes this register.

Reply Q10a (Portugal): In the absence of legislation, there is no national register of contaminated sites. As answered in question 9a, public entities that deal with contaminated sites have their own registers/lists. If the legislation is approved as proposed, the register will flow in a single platform at national level despite some competences will be decentralised to regional authorities.

Reply Q10a (Romania): The register responsibility belongs to the national environmental agency.

Reply Q10a (Serbia): Article 34 in the law on soil protection (Official Gazette of the Republic of Serbia, No 112/2015), describes the basis for developing the methodology for creation of the 'Cadastre of contaminated sites' which is an integral part of the environmental protection information system administered by the environmental protection agency of the Republic of Serbia (SEPA). According to the same law, [the] 'cadastre of contaminated sites' is a database of polluted, endangered and degraded soils and it is an integral part of Soil information system which is maintained by the environmental protection agency (SEPA). In line with this and other laws, state organisations, local authorities, and polluters are obliged to provide information about the quality and state of the soil to the environmental protection agency (SEPA).

Reply Q10a (Slovakia): Competence is at national level. Slovak environment agency is administrator of information system of contaminated sites (ISCS) entrusted with ministry of environment of the Slovak Republic [Slovakia].

Reply Q10a (Slovenia): Slovenia does not have the register yet.

Reply Q10a (Spain): As indicated above, the national inventory of contaminated soil is kept by national authorities, although but in practice is no longer updated since there is no longer formal declaration of contaminated sites. Regional authorities are responsible to keep a record of voluntary remediation

Reply Q10a (Sweden): The register is managed at a regional level, with national coordination.

Reply Q10a (Switzerland): Creation and keeping of the register: at regional levels; the 26 cantons and the four federal authorities who are in charge to enforce the contaminated sites ordinance (CSO) for their sites.

The Swiss federal office for the environment (FOEN) at national level collects the data from the different registers, evaluates the information and informs the public regularly on the progress with the remediation of contaminated sites.

Reply Q10a (The Netherlands): In the Dutch soil protection act, 42 competent authorities (12 provinces and 30 cities/bigger municipalities) are designated for contaminated land. The management of the register is the shared responsibility of all partners that signed the 'Convention on soil and underground': national government, municipalities, provinces and the water boards.

Reply Q10a (United Kingdom (England)): Regional (Local authorities are solely responsible for contaminated land).

Reply Q10b (Austria): The competent authority is established at the regional level of nine provincial governments.

Reply Q10b (Belgium (Flanders)): Since Belgium is a federal state where most environmental matters are decentralised to the regions, the policy on soil contamination

and remediation, and the management of contaminated sites is a regional competence.

Reply Q10b (Belgium (Wallonia)): The regional level is the competent authority for environment and spatial planning management in Belgium.

Reply Q10b (Bulgaria): Regarding contaminated sites by certain economic activities (according Lpreda) (at national level) a competent authority is the minister of environment and water when the case of imminent threat/environmental damage (to the soil) is on the territory of two Regional Inspectorates of Environment and Water (RIEW) at regional level (the director of the regional inspectorate) when the case of imminent threat/environmental damage (to the soil) occurs on the territory of the regional inspectorate.

Regarding the sites with 'historic pollution': Based on the art.17 of the Ordinance (see Reply Q1) the control over the implementation of remediation programmes has been doing by the minister of environment and water, resp. by authorised persons. In practice — by the directors of the RIEWs and directors of river basin directorates (BD), according to the order of the minister of environment and water No RD-794 /22.10.2012.

Reply Q10b (Croatia): Hot spots are managed and co-financed by environmental protection and energy-efficiency fund (EPEEF).

Reply Q10b (Cyprus): The competence is at the national level.

Reply Q10b (Czech Republic): Basically, the same as Reply to Q10a.

Reply Q10b (Denmark): The law, threshold values and risk assessment procedure is made nationally, but the management and prioritisation is done regionally.

Reply Q10b (Estonia): We have prioritised top 75 sites of residual pollution that are in the concern of state. In this list sites that are situating on state land are to be cleaned up or are already cleaned up by national level (MinE, EB, EA).

Other sites are in the concern of local municipalities. It means that the interest to clean them up should come from local field. State has made rules for supporting them (funding and reporting rules, necessity of tenders etc.).

Reply Q10b (Finland): The ministry of environment directs by the strategic guidelines policy and is responsible for preparing the legislation. [The] Finnish environment institute SYKE is both a research institute and a centre for environmental expertise. Both, ME and SYKE affect at the general level to the management of the contaminated sites and use information of the national database system.

The liable party commissions the investigations, which are usually being done by an environmental consultant. Investigations are usually reported to the competent environmental authority (ELY-centre) together with the notification or permit application (permits are handled by the regional state administrative agency) of remediation. ELY-centre gives a decision on the notification (or permit) and is the supervisory authority. The decision may include the necessary regulations on how the activity must be organised and supervised. The liable party carries out the remediation and delivers the final report on remediation work to the supervision authority (ELY-centre), for verification. ELY-centre may also order the party responsible for remediation. Ely-centre saves the data from the application, the permit and the final report into the national database system (MATTI).

Reply Q10b (France): As well as the competence of the registration, the management of contaminated sites is managed at regional level by the Dreal.

Reply Q10b (Germany): Laender level/in some cases on the federal level, if there is a governmental ownership of the contaminated site.

Reply Q10b (Hungary): Management of contaminated sites is done according to the legal decision and under the supervision of the 20 regional environmental authorities based on government Decree No 219/2004. (VII. 21.). Regional water directorates of the

12 water basins are competent for the protection of groundwater. Assessment of human health risks and determination of the remediation target value is task of the regional public health authorities.

Reply Q10b (Ireland): The management of the contained sites is carried out on a case-by-case basis. For historic landfills the process is managed under the regional waste management plans.

Reply Q10b (Italy): The management of contaminated sites is administered at regional level, with the help of municipalities and provinces for regional sites.

For SIN, the management is under the responsibility of the ministry of environment.

Reply Q10b (Latvia): -

Reply Q10b (Lithuania): Regional environment protection departments (10) have a competence to approve with agreement of LGS the treatment plans/programmes of contaminated sites and can give the mandatory instructions concerning studies of suspected sites.

Reply Q10b (Luxembourg): National.

Reply Q10b (The former Yugoslav Republic of Macedonia): -

Reply Q10b (Malta): National level.

Reply Q10b (Norway): Managed at all levels, but with different responsibilities and legal framework.

Municipalities: responsible for remediation of contaminated soil where there is planned building activities (closely linked to the planning and building act, i.e. building houses on old industrial areas in a city).

Regional: responsible for contaminated sites at delegated industries such as airports and landfills and ship yards including baseline reports according to the IED-directive. In these cases, contaminated soil is regulated through the pollution control act which states that it is forbidden to pollute and that the person responsible for the pollution has to ensure that measures are taken to prevent pollution from occurring, repeating/spreading and cleaning up.

National: responsible for all contaminated sites not delegated to the regions, writes guidance material, develops legal framework including baseline reports according to the IED-directive (same legal framework as regional level, but other types of industries).

Reply Q10b (Poland): [The] regional director for environmental protection is competent authority in the field of historical contamination of land surface. [The] general director for environmental protection is the higher level authority in relation to the regional director for environmental protection.

Reply Q10b (Portugal): The old mining areas are managed at national level, as part of a concession contract granted to a state-owned company, but for the old contaminated industrial sites, management entities were designated on a case-by-case by the government.

Reply Q10b (Romania): To the owners or to the users. For orphans and abandoned sites, the responsibility in management belongs to the national public authority.

Reply Q10b (Serbia): A competency for the management of contaminated sites depends on ownership of property.

Reply Q10b (Slovakia): Competence is at national level managed by [the] ministry of environment of the Slovak Republic (directorate for geology and natural resources).

Reply Q10b (Slovenia): The competence of the management of the Upper Meža Valley is at national level in collaboration with the local level.

The competence of the management of site near Maribor and the Celje Basin is at

national level.

The competence of the management of contaminated site can also be at municipal level, for example contaminated site of kindergarten/nursery.

Reply Q10b (Spain): Regional authorities are responsible to manage contaminated sites all around the country except Andalusia in which local authorities manage them.

Reply Q10b (Sweden): The management of contaminated sites is coordinated at a national level through the environmental protection agency. However, the management (in terms of regulatory supervision) is decentralised to regional or municipal level depending on local/regional procedures and the operations that have caused the site contamination.

Reply Q10b (Switzerland): Management of polluted and contaminated sites: At regional levels: the 26 cantons and the four federal authorities who are in charge to enforce the contaminated sites ordinance (CSO) for their sites.

The Swiss federal office for the environment (FOEN) at national level harmonises and assists the cantons in enforcing the contaminated sites ordinance (CSO), it enforces the ordinance on the charge for the remediation of polluted sites (CSRCO) and evaluates subsidy applications (funding), it initiates and assists in research projects for the further development of technologies for contaminated site development and it enacts enforcement aids.

Reply Q10b (The Netherlands): In the Dutch practice the competent authority (see answer Q10a) (in collaboration with the local authorities), is responsible for the management of contaminated sites; for sediments, the water boards are primarily responsible.

Reply Q10b (United Kingdom): —

Question 11a: Does your country/region have or use a formal procedure for assessing the status (e.g. need for further investigation or need for remediation) of the sites under investigation?

Reply Q11a (Austria): The responsibility for site assessment, establishing the national list of 'seriously contaminated sites' and publishing the list by the journal of laws of the Republic of Austria is with the ministry of agriculture, forestry, environment and water management (BMLFUW). Within formal procedures site characterisation and assessments are provided by reports of Environment Agency Austria (EAA), which need approval by BMLFUW and finally undergo a public examination before getting introduced to the official national list.

Reply Q11a (Belgium (Flanders)): OVAM has developed standard procedures for the execution of the exploratory soil investigation (including the assessment of the need for further investigation) and the descriptive soil investigation (including the assessment of the need for remediation). Both standard procedures are only available in Dutch and a link is added in [the] annex 2.

Reply Q11a (Belgium (Wallonia)): Yes — see soil decree and SAR procedures described in question 1.

Reply Q11a (Bulgaria): Regarding contaminated sites by certain economic activities (according [to] Lpreda), Lpreda requires each operator involving the activity/ies listed in Annex 1 to prepare own risk assessment. The procedure is regulated by the Ordinance No1, mentioned in Reply Q1.

Regarding the sites with historic pollution: the appraisal of the liability of the state for implementing a remediation programme is based on the risk assessment and prepared for each enterprise under privatisation using the methodology designed especially for these cases and approved by the minister of environment and water.

Reply Q11a (Croatia): No data.

Reply Q11a (Cyprus): As explained in Q1 this is done site by site.

Reply Q11a (Czech Republic): There are detailed procedures for investigation, assessing and remediation of contaminated sites in methodical guidelines of the ministry of environment. The guidelines include e.g. geological survey, methods of sampling, evaluation procedure, risk assessment, feasibility study, remediation procedure, prioritisation etc. The methodical guidelines are publicly available. The decision-making is made by the ministry of environment, Czech environment inspection or other specific organisations (e.g. state office for nuclear safety).

Reply Q11a (Denmark): Danish EPA's guidelines for registration, no. 8, 2000

(http://www2.mst.dk/udgiv/publikationer/2000/87-7944-331-1/pdf/87-7944-331-1.pdf).

Danish EPA's guidelines for remediation and risk assessment, no. 6, 1998

(http://www2.mst.dk/udgiv/Publikationer/1998/87-7909-783-9/pdf/87-7909-783-9.PDF).

Reply Q11a (Estonia): Yes. If the contamination exceeds the limit of content of hazardous particles for that land type then it has to be remediated before using that land. We have two land types in that context (living area and industrial land). This is the formal part.

If previous studies about the site have given information enough to start remediation works, then we schedule this work depending on real risk and WBM plans. This is case-by-case, but we also make re-inventory of uncompleted sites and renew statuses in the database.

Reply Q11a (Finland): Finland has no exact definition for 'contaminated site' in our legislation. According to the soil pollution prohibition in the environmental protection act (EPA), the contamination of soil is related to the effects and not to the concentration of the harmful substances.

Soil-pollution prohibition (EPA 16 §): 'Waste or other substances shall not be left or discharged on the ground or in the soil so as to result in such deterioration of soil quality as may harm health or the environment, substantially impair the amenity of the site or cause comparable violation of the public or private good.'

Therefore, we define the site to be contaminated or not contaminated based on the environmental and health risks. The EPA a government decree on the assessment of soil contamination and remediation needs (214/2007) came into force June 2007. It emphasises site-specific risk assessment. Also, guidelines for 52 substances or substance groups were introduced. At the same time [the] environmental administration guideline (2/2007) 'Assessment of contamination and the remediation need' was published.

Reply Q11a (France): France uses a formal procedure for assessing the status of the sites under investigation. The evaluation of the national methodology and the experience feedback made it possible to distinguish two main types of management situation.

For sites already urbanised or occupied, the interpretation of the state of the environments (IEM) approach.

Comparable to the study of a photograph of the state of environments and uses, it is necessary to ensure that the state of the soil (or groundwater) is compatible with current uses already fixed.

For the sites to be urbanised or to be remediated, the management plan.

It intervenes when the situation makes it possible to act as well on the state of the site (by planning or remediation measures) as on the uses that can be chosen or adapted.

Reply Q11a (Germany): The Laender have guidelines and handbooks to follow formal

procedures. The procedures are widely comparable.

Reply Q11a (Hungary): Yes, and is regulated by:

Government Decree No 219/2004 (VII. 21.) on the protection of underground waters (decree sets the values of background concentration); pollution-limit values separately for the geological medium and for groundwater; and lists standards to be applied. Remediation target values are calculated by a site-specific risk assessment.

Ministerial decree No 18/2007. (V. 10.) on the reporting in the environmental register system of groundwater and geological medium (FAVI).

Government Decree No 90/2007 (IV.26.) on the rules for preventing and remedying damage to the environment.

Ministerial decree No 6/2009 (IV. 14.) on the limit values and pollution measurements necessary for the protection of geological medium and groundwater.

Ministerial decree No 14/2005 (VI. 28.) on the rules of screening tests in the investigation for hazardous substances in geological medium and groundwater.

Act No 53 in 1995 on the general rules of environmental protection.

Reply Q11a (Ireland): There is a procedure for assessing former waste disposal/recovery sites as described above.

Reply Q11a (Italy): The identification procedure starts when an event occurs that may cause soil and/or groundwater contamination or when an historical contamination is discovered. In these cases, a preliminary investigation is required to determine contaminant concentrations in the environmental media (soil, subsoil and groundwater) and to make comparison with 'contamination threshold concentrations' (CTCs, i.e. screening values for residential and industrial commercial land uses).

After preliminary investigation the site is defined as [a] 'potentially contaminated site' if the concentrations of one or more chemicals in the environmental media (soil, subsoil and groundwater) exceed 'contamination threshold concentrations' (CTCs, i.e. generic screening values).

Contamination threshold concentrations (CTCs) are defined for 92 contaminants in soil according to two different land uses (residential and industrial commercial land uses) and for 94 chemicals in groundwater.

Potentially contaminated sites (i.e. sites where screening values (CTCs) are exceeded) need a detailed site investigation followed by a site-specific risk assessment to evaluate the contamination level and calculate site-specific 'risk threshold concentrations' (RTCs, i.e. site-specific target values). However, the polluter may decide directly to remediate the site to screening values (CTCs) without performing the site-specific risk assessment.

If risk threshold concentrations (RTCs) are exceeded, then the site is defined as [a] 'contaminated site' and needs for intervention, i.e. remediation or risk-reduction measures.

Site is defined as [an] 'uncontaminated site' if contamination found in the environmental media (soil, subsoil and groundwater) is below CTCs or, if CTCs are exceeded, is below the RTCs derived by the site-specific risk assessment.

Reply Q11a (Latvia): Requirements for remediation or investigation for each site could be set by REBs, when site is registered. Owners are obliged to report to municipalities and REBs if they found contamination in their property. REBs make decision what kind of actions need to be done in each particular case.

Reply Q11a (Lithuania): Yes, according the technical instrument act ('Ekogeologinių tyrimų reglamentas=Regulations of eco-geological investigations') [there] are five stages of investigations of contaminated sites: recognition (collecting information concerning the contamination activity at present & past), preliminary investigation (survey at potentially

contaminated site and examination of contamination including sampling and analyses), detail investigation (measurement and adjustment of area contaminated higher than action values), treatment of contaminated site (according the officially approved plan), control investigation (sampling and analyses after site treatment).

Reply Q11a (Luxembourg): We use a list of trigger and remediation values form Germany (Rhineland-Palatinate).

Reply Q11a (The former Yugoslav Republic of Macedonia): No.

Reply Q11a (Malta): Yes, the procedure is based on the general requirements which are sometimes amended due to other site-specific considerations.

Reply Q11a (Norway): Normative values for 58 substances define contaminated soil/ not contaminated soil. Assessed according to standards for minimum amount of soil samples according to guidance material.

Reply Q11a (Poland): Legislation provides an obligation of notification of environmental damage to regional director for environmental protection (RDEP) by operator. There is also provision of a voluntary notification of environmental damage to RDEP by anyone who identifies the damage (private person, administration representative, scientist, etc.). The provisions on historical contamination are similar: mandatory notification by the holder of land surface to RDEP and voluntary notification by anyone who identifies the possible contamination to the Starost. Moreover, the Starost is obliged to identify the sites where historical contamination occurs and obliged to pass a list of these sites to RDEP.

According to legislation RDEP may also oblige an operator/a holder of land surface to conduct an assessment of land surface contamination.

Reply Q11a (Portugal): While legislation is not approved, there is no formal procedure for assessing the status of sites under investigation. Despite the above, it is recommended to develop a conceptual site model, a soil (and groundwater sampling, if relevant) plan and, if appropriate, a site-specific risk assessment.

Reply Q11a (Romania): Yes, there is two ministerial orders: order of the minister of waters, forests and environmental protection no. 184/1997 for the approval of the procedure for the realisation of the environmental balances; order of the minister of waters, forests and environmental protection no. 756/1997 for the approval of the regulation on the environment pollution evaluation.

Reply Q11a (Serbia): The regulation on the criteria for determining the status of the vulnerable environment and priorities for rehabilitation and remediation (Official Gazette of the Republic of Serbia, No 22/2010) determine the status of the vulnerable environment. In the law on environmental protection there is no specific definition of 'contaminated site', 'contaminated soil' or 'contaminated site management'. However, a definition for 'contaminated sites' is given within the regulation on the programme for systematic monitoring of the soil quality, indicators for evaluation of soil degradation and methodology for preparation of remediation programme (Official Gazette of the Republic of Serbia, No 88/2010): 'Contaminated sites are sites with confirmed presence of hazardous and dangerous substances caused by human activity in concentrations that may cause a significant risk to human health and the environment'. A register (cadastre) of contaminated sites is currently being developed in the Serbian environmental protection agency. Data are collected from local governments and industry based on the questionnaire for determination of contaminated sites with the instruction for completing. The cadastre is to provide systemised data on pollution sources such as type, amount, manner and place of discharge of pollutants into the soil, so the measures of prevention; rehabilitation and remediation can be implemented.

The criteria for determining the status of an endangered environment, by subjects, according to which in each individual sub-area is determined, with a precisely defined point system, are specified by Articles 3-6. The next two articles define the sources of

information and documentation, on which basis the status of the environment is determined, and prescribes the way of submission of score sheets, data and documentation to determine the status of the environment. Article 9 provides the basis for determining the status of an endangered environment. Criteria are given in detail in the appendix to this regulation, but they are very sophisticated because they require knowledge of a great amount of data, and it is very difficult to apply them in practice.

The regulation determines the status of the vulnerable environment using the following criteria:

- the type and concentration of pollution sources in the area;
- the degree of contamination, as determined by measuring, testing and evaluation of conditions of indicators in relation to the prescribed value in accordance with special regulations;
- the impact of pollution on human health and natural resources.

The evaluation of each criterion is based on the number of points, given in this regulation and the ministry responsible for environmental protection determines areas of endangered environment status and the prioritisation of the environmental hotspots as well as remediation regime. In addition, in order to determine the status of the environment and/or priorities for rehabilitation and remediation of areas of importance for the Republic of Serbia [Serbia], the local authority submits to the ministry in charge of environmental protection a list of criteria/elements with the number of points and with all of the documentation used for evaluation.

Reply Q11a (Slovakia): Slovakia has two levels (tiers) in identification and classification of contaminated sites and risk assessment: 1. priority on the base of classification of locality in ISCS (so-called preliminary risk assessment (evaluation) 2. detailed investigation with actual risk analysis (risk assessment).

The first tier: classification is approximately evaluated in order to determine priority in comparison with other contaminated sites (without detailed investigation).

The second tier is risk assessment. Slovakia has a procedure of risk assessment. The risk assessment is connected with detailed investigation. Slovakia has valid legislation, the commission for appraisal and approval of final reports with risk assessment of contaminated sites [is] in [the] position of an advisory organ for the ministry of environment of the Slovak Republic [Slovakia]. All final reports dealing with detailed investigation of contaminated site have to contain risk analysis. (Each final report has to be submitted to commission regardless of financial resource of the investigation).

Reply Q11a (Slovenia): Slovenia has regulations at national level (i.e. decree on limit values, alert thresholds and critical levels of dangerous substances in the soil) as regards to the emission standard. A new decree on status of soil is under preparation which will specify the procedure for assessing the status of the site in more detail.

Reply Q11a (Spain): [The] soil decree indicates the circumstances in which an ad hoc risk analysis is required, which would eventually lead to conclude decontamination is needed. To a large extent, this decision is made by contrasting the analytical data of the soil versus the soil-quality standards and procedures included in this legislative piece.

Reply Q11a (Sweden): We have comprehensive guidance material on how investigations, risk assessments and evaluation of remedial actions should be done, issued by the environmental protection agency. The guidance material is not legally binding. The legally binding framework related to contaminated sites is included in the environmental code.

Reply Q11a (Switzerland): Yes. Based on the list of priorities, the authorities require a preliminary investigation to be carried out for sites in need of investigation. This will normally consist of a historical and a technical investigation, so that the need for monitoring and remediation can be assessed, and the environmental hazard evaluated

(risk assessment). The details are specified in execution aids. Based on the results of the preliminary investigation the polluted site is classified as a site: a) in need of monitoring or b) in need of remediation or c) in need of neither monitoring nor remediation.

Reply Q11a (The Netherlands): Yes. Dutch policy concerning contaminated land has evolved over a period of more than three decades from a rigid assessment procedure, partly based on expert judgement, to a more flexible and tiered fitness-for-use approach with risk assessment as the underlying principle. The procedure to assess and appraise soil and groundwater quality follows a tiered approach, under the principle 'simple if possible, complex when necessary'. The web-based decision support system Sanscrit has been designed to support the risk assessments within the respective policy contexts, which combine the scientific aspects of risk assessment with policy choices for protection targets and protection levels.

The competent authority has to make a formal decision about the results of the investigations (unacceptable risks yes or no).

Reply Q11a (United Kingdom (England)): Local authorities will use the contaminated land statutory guidance. The site has to meet 'significant possibility of significant harm'

Question 11b: Is this procedure based on screening values (soil quality standards) or thresholds, or also on site-specific risk assessment?

Reply Q11b (Austria): Site characterisation and assessments provide for (i) a status assessment with regard to soil and groundwater quality, which includes comparisons to environmental quality standards for soil and groundwater, and (ii) site-specific risk assessment.

Reply Q11b (Belgium (Flanders)): The need for remediation on a specific site is determined by results found to be in excess of those limits specified in soil-remediation standards or by a site-specific risk assessment, depending on the type of contamination (new or historical).

The objective for the remediation of new contamination is to reach the target values for soil quality. If this is not possible using the best available techniques not entailing excessive costs (Batneec), soil remediation should be aimed at obtaining a better soil quality than specified by the soil remediation standards. If this would not be possible using the Batneec, remediation should avoid that the soil quality poses risks for human health or for the environment.

The remediation of historical contamination is aimed at avoiding that the soil quality poses risks for human health or for the environment using the Batneec.

OVAM, in collaboration with the Flemish institute for technological research (VITO), has developed a state-of-the-art model for the calculation of the site-specific risk assessment of contaminated sites, named S-Risk. More English information on this model (www.s-risk.be).

Reply Q11b (Belgium (Wallonia)): Screening values for soil decree (see Annex 1 of soil decree (http://environnement.wallonie.be/legis/solsoussol/sol003.htm)) as well as site-specific risk assessment. Currently, the procedure for SAR is based on a site-specific risk assessment. However, with the new spatial-planning legislation (code for the development of the territory), SAR procedures will be linked to the soil decree procedures (Livre V, Titre 1er 'Sites á réaménager', chap. 1er, Art. DV1, 2°).

Reply Q11b (Bulgaria): Regarding contaminated sites by certain economic activities (according to Lpreda), the own assessment of the possible cases under Lpreda (of an imminent threat/environmental damage to the soil) is based on a risk assessment applying the norms stipulated by the national legislation on soil protection.

Regarding the sites with 'historic pollution': the assessment of past environmental damage is based on a risk assessment carried out by methodology approved by the

minister of environment and water, according to the regulation mentioned in Reply Q1.

Reply Q11b (Croatia): No data.

Reply Q11b (Cyprus): No soil threshold values have been legislated for as of yet although the natural geochemical background as well as the current state for most land usages is well known. The investigation procedures are usually based on soil-quality standards and on specific risk assessment studies although there is no single formal methodology for doing so.

Reply Q11b (Czech Republic): Yes, there are indicators and limit values in methodical guidelines, including the methodology for site-specific risk assessment.

Reply Q11b (Denmark): For contact risk it is based solely on threshold values. For vapour intrusion, it is based on calculated contribution value based on a measured concentration at the source. For groundwater it is based on a risk assessment.

For vapour intrusion and groundwater, the risk-assessment tool JAGG 2.1 is applied:

(http://mst.dk/virksomhed-myndighed/jord/it-vaerktoejer-til-vurdering-af-jord/jagg-21-programmet/).

Reply Q11b (Estonia): Both. Screening values for consider it complete. Site-specific risk assessment for prioritise and schedule (WBM plans) if it is not remediated yet.

Reply Q11b (Finland): In the government decree on the assessment of soil contamination and remediation needs (214/2007) definition for 'contaminated site' and 'contaminated soil' is case by case risk based taking into account both environmental and health risks.

Guideline values are practical tools in risk identification and assessment, and in the surveillance of remediation works. They also form a certain harmonised basis for practices on national level. However, it is important to notice that though our guideline values are given in a decree, it is still possible to deviate from them based on site-specific risk assessment.

The threshold value indicates negligible environmental risk and is used as a trigger value. Thus, soil contamination and the need for remediation must be assessed following the decree, if concentration of one or more substances in the soil exceeds the threshold value.

The guideline values (lower and upper), referring to significant risks to human health or the soil ecosystem, are used as reference concentrations in the assessment of soil contamination and the need for remediation. The upper guideline values are applied in industrial or similar insensitive sites and the lower guideline values in the case of other land use. Soil is regarded as contaminated, unless otherwise indicated in the risk assessment, if the guideline value is exceeded. In practice this means that contrary to threshold values, the guideline values are only indicative, giving priority to actual site-specific assessment.

The threshold and guideline values have been given for 52 substances or group of substances. The criteria for selection of substances included usage volume in Finland, occurrence in soil and the availability of data on contaminants' toxicity and environmental behaviour.

Reply Q11b (France): The French methodology does not propose guide values because it directly takes into account the specificities of each context.

Reply Q11b (Germany): The attached background paper will present a clear answer to this question. In fact, we use trigger values and site-specific risk assessment.

Reply Q11b (Hungary): Procedures are regulated in the Ministerial Decree No 6/2009 (IV. 14.) on the contamination-limit values and measurements necessary for the protection of geological formations and groundwater, but remediation target limits are

determined by authorities depending on site-specific risk assessment.

Reply Q11b (Ireland): A guidance document and templates for reporting in relation to management of contaminated land and groundwater at EPA licensed sites can be found at this web location.

Reply Q11b (Italy): As described above, the procedure is based on screening values for assessing the need of investigation and on site-specific risk assessment for assessing the need of intervention.

Reply Q11b (Latvia): Yes, procedures are based on screening of soil quality standards. regulations of cabinet of ministers No 804 (2005) describe soils quality standards for different soil types.

Reply Q11b (Lithuania): Yes, soil and groundwater action values on different land-use sites (protected, living, agriculture, industrial areas) are determined in the acts (Cheminėmis medžiagomis užterštų teritorijų tvarkymo aplinkos apsaugos reikalavimai/Requirements on treatment of contaminated sites with chemical substances and LAND 9-2009 Grunto ir požeminio vandens užteršimo naftos produktais valymo bei taršos apribojimo reikalavimai/Requirements on cleaning and pollution limitation for soil and groundwater contamination with oil products).

Reply Q11b (Luxembourg): We use a list of trigger and remediation values form Germany, since the values are very conservative there is a need to use a risk-based approach on a site per site basis.

Reply Q11b (The former Yugoslav Republic of Macedonia): No.

Reply Q11b (Malta): Soil-screening values and groundwater-threshold values for Malta were determined based on relevant EU regulations and international guidance documents. A site-specific risk assessment is also carried out in each case to add/exclude certain contaminants to/from the group of standard contaminants to be analysed for the land and groundwater samples taken from a specific site. The requirement for remediation may depend on the projected after use of the site. Soil-screening values and groundwater-threshold values established are different in cases of 'industrial' and 'residential' after uses.

Reply Q11b (Norway): Both. We have soil-quality standards for health risk according to land use (living area, industrial, kindergarten etc.) and site-specific risk assessments for health and environment.

Health risk from staying on the site. Dependent on existing and planned land use. (Stricter requirements for residential areas than for industrial areas).

Environmental risk from spreading/leaking of contaminants to nearby recipients (rivers, lakes, sea, groundwater).

Reply Q11b (Poland): Land-surface contamination is defined in EPA as an exceeding of permissible level of hazardous substance. Permissible levels are determined separately for different types of use of the land (present or planned). Permissible level means [the] level below which none of [the] functions of land surface (services) is significantly harmed, considering [the] influence of this substance on human health and the environment.

Regulation of the minister of the environment of 1 September 2016 on the assessment of the land surface contamination defines:

a) hazardous substances of particular significance for the protection of the land surface, their permissible contents in soil and in the ground (differentiated for the particular properties of a soil and groups of soils distinguished on the basis of their uses);

b) detailed requirements for the determination of the permissible content of a hazardous substance in soil and in the ground, other than a substance directly defined in the regulation (taking into account its impact on human health and the condition of the

environment);

c) the stages of identification of a contaminated site;

d) the types of activities which are very likely to have caused historical contamination of the land surface, with an indication of examples of contaminants relevant to such activities;

e) reference methods for testing soil and ground contamination.

If the permissible levels of hazardous substance are exceeded a draft remediation plan should be prepared by the operator/person/RDEP [responsible]. Draft remediation plan contains inter alia risk assessment of human health and state of the environment.

Remediation means the treatment of the soil, ground and groundwater aimed at removing or reducing the amount of the hazardous substance, controlling and limiting their spread, so that the contaminated site no longer poses a risk to human health or the environment, taking into account current and planned land use; remediation may consist of natural attenuation where it is most beneficial to the environment. In some, defined in EPA and damage act, cases RDEP is authorised by law to exempt an operator or owner of the land from the obligation of remediation, basing on the risk assessment of human health and state of the environment.

Reply Q11b (Portugal): Privilege is given to soil initial state or soil background values, if available, otherwise international standards/thresholds/reference values are recommended. National legislation already establishes quality-standards values for groundwater and sediment.

The results of soil investigation (contaminant's concentration) shall be compared with the thresholds/reference values. Soil is considered contaminated for the contaminants which concentration values exceed the correspondent thresholds.

Soil shall be remediated to values equal or below the thresholds or a site-specific risk assessment can be accomplished. In the latter case, if the risk is acceptable, no remediation is needed, but if the risk is unacceptable, remediation shall be performed in order to achieve soil-concentration values for which the risk is acceptable.

Reply Q11b (Romania): Yes. In those ministerial orders are alert and intervention thresholds for soils pollutants. Those values are established for sensitive land use and less sensitive land use.

Reply Q11b (Serbia): The regulation on the programme for systematic monitoring of the soil quality, indicators for evaluation of soil degradation and methodology for preparation of remediation programme (Official Gazette of the Republic of Serbia, No 88/2010) prescribes the limit values, concentration of hazardous and harmful substances that could indicate significant contamination and remediation values in soil and groundwater.

Reply Q11b (Slovakia): The first tier: classification based on threshold (indication and intervention criteria for rock environment, soil and groundwater).

The second tier: this procedure [is] based on specific risk assessment. Slovakia has legislation (Guideline of the Ministry of Environment of the Slovak Republic No 1/2015-7) on risk assessment of contaminated sites.

Reply Q11b (Slovenia): This procedure is based on soil quality standards which are defined in the decree on limit values, alert thresholds and critical levels of dangerous substances into the soil. There are three different soil quality standards.

1. Limit value: the effects or impacts on human health or the environment are acceptable.

2. Warning value: there is the likelihood of adverse effects or impacts on human health or the environment on certain types of land use.

3. Critical value: due to adverse effects or impacts on people and the environment, contaminated soil is not suitable for the cultivation of crops intended for human or animal consumption and for retaining or filtering water.

A new decree on status of soil is under preparation.

Reply Q11b (Spain): At the end of the day is a pure risk-based procedure since, both, preliminary exploration by means of soil screening levels and subsequent reports are risk oriented.

Reply Q11b (Sweden): uses generic soil-guideline values for screening purposes and for evaluation of [the] need of further investigations and risk assessment before eventual remedial actions. These are included in the comprehensive guidance material issued by the environmental protection agency.

The general idea behind Sweden's guidance material on management of contaminated areas is that risks should be assessed and evaluated at a site-specific level. The guidance material includes guidance on how a site-specific risk assessment should be done, and also a tool for calculation of site-specific guideline values which could be used as remedial target at the specific site.

Reply Q11b (Switzerland): The procedure is based on threshold values and site-specific risk assessment.

Reply Q11b (The Netherlands): The procedure to assess and appraise soil and groundwater quality is based on a combination of soil and groundwater quality standards (screening values) and site-specific risk assessment.

In Tier 1, measured soil or groundwater concentrations are compared with generic quality standards for soil or groundwater (target and intervention values) in order to determine the class of contamination (clean, slightly contaminated or seriously contaminated soils). Cases of slightly contaminated land can be managed in a sustainable way, allowing reuse of soil material within a region. Maximal values were developed in relation to different land-use categories in order to deal with this. background, maximal and intervention values divide contaminated sites into four quality classes which are related to the land-use categories: soils that are 'always suitable', 'suitable for residential land use', 'suitable for industrial land use' and 'not applicable', respectively.

In [a] case of serious soil contamination (exceeding the Intervention Value), remediation is in principle necessary and the urgency of remediation has to be determined based on site-specific risks in successive tiers. In Tiers 2 (standard site-specific risk assessment) and 3 (detailed site-specific risk assessment), the risk assessor has to refine the risk assessments for human health, the ecosystem and groundwater. When remediation is necessary, maximal values are used to set land-use-specific remediation objectives for soil.

Reply Q11b (United Kingdom (England)): Site-specific risk assessment.

Question 12: Does your country have formalised procedures to evaluate hazardous substances found on site (soil, groundwater, sediment, land), but not occurring in the list of quality standards?

Reply Q12 (Austria): With regard to historically contaminated sites (activities having started and caused contamination before 1.7.1989) environmental quality standards (EQS; trigger and intervention values) for soil, soil vapour and groundwater are established by technical standards (ÖNORM S 2088, part 1: groundwater; part 2: soil; part 3: air) published by the Austrian Standards Institute (ASI). Aiming on transparency these technical standards generally provide references on the origin of EQS (e.g. drinking water ordinance) or describe the derivation process (e.g. describing a relevant generic exposure scenario, exposure parameters and the algorithm/equation to derive a trigger value).

Reply Q12 (Belgium (Flanders)): If for a specific parameter no soil remediation standards are defined, different test values need to be calculated by the soil remediation expert.

Reply Q12 (Belgium (Wallonia)): Yes, hazardous substances not occurring in the list of quality standards are handled on a case-by-case basis (external expertise from SPAQuE and ISSeP), and an internal dedicated database is continuously enriched with information.

Reply Q12 (Bulgaria): Regarding a contaminated sites by certain economic activities (according Lpreda), no. Regarding the sites with 'historic pollution', no.

Reply Q12 (Croatia): -

Reply Q12 (Cyprus): No.

Reply Q12 (Czech Republic): Yes. The procedure for specific risk assessment can be used with US EPA or WHO thresholds.

Reply Q12 (Denmark): We have no such procedures.

Reply Q12 (Estonia): No, evaluation goes according to quality standards.

Reply Q12 (Finland): In the government decree on the assessment of soil contamination and remediation needs (214/2007) risk-based threshold and guideline values for harmful substances in soil are prescribed.

In Environmental administration guideline 6/2014 (risk assessment and sustainable risk management of contaminated land) describes a gradually advancing procedure for the assessment of soil contamination and the remediation need. The procedure leads to the identification of health risks and risks to the environment that stem from harmful substances, either directly or indirectly i.e. through air or water.

In the Finnish environment report 23/2007 (derivation basis of threshold and guideline values for soil) the derivation process of threshold and guideline values is presented. The threshold and guideline values are based on a risk assessment carried out on a general level, in which various reference values for soil concentrations were derived, describing both negligible and maximum acceptable risks to the environment and human health. The methods, data and results of the risk assessment and an estimate of the uncertainty related to them are presented in the report. Furthermore, it is described, how the results of the risk assessment have been applied in the setting of the threshold and guideline values, and which additional factors have been taken into account.

If necessary Finnish environment institute's experts also provide help to risk assessment e.g. determine site-specific target values or guideline values to substances, which are not defined in the government decree.

Reply Q12 (France): -

Reply Q12 (Germany): The methods and standards used to derive the trigger and action values listed in Annex 2 have been published in the federal law gazette (Bundesanzeiger) No 161a of 28 August 1999 as well as in 'Berechnung von Prüfwerten zur Bewertung von Altlasten' (Calculation of trigger values for the assessment of contaminated sites) (Erich Schmidt Verlag, Berlin, 1999). Article 4 (5) BBodSchV provides that these methods and standards must be taken into account when deriving trigger or action values for additional pollutants.

Reply Q12 (Hungary): Ministerial decree No 14/2005 (VI. 28.) on the rules of screening tests in the investigation for hazardous substances in geological medium and groundwater regulates procedures as regards to substances not occurring in the list of quality standards as follows.

'Article 2. b) historical research: collection of information relating to the forming of the presumed contamination, the activity carried out in the area and supposed to have caused the contamination, the technologies applied, the land use, and the historical

polluting activities taken place in the area under examination'.

'Article 4. (1) The extent of the pollutants detected by the screening survey in a concentration exceeding the pollution limit value shall be delimited in the course of the site investigation.

(2) Pollutants, whose occurrence may be presumed based on historical research, but are not subject and not identified among those being subject to the screening survey, shall be investigated in a separate process.

(3) Pollutants and characteristics to be investigated in the course of the screening survey are specified:

a) in Annex 1 for groundwater, and

b) in Annex 2 for the geological medium'.

Reply Q12 (Ireland): As stated above there is guidance and templates for reporting in relation to management of contaminated land and groundwater at EPA-licensed sites.

Reply Q12 (Italy): Yes, for contaminants not included in the list of CTCs, the national health institute may define the screening value in soil, groundwater or both.

Reply Q12 (Latvia): REBs set requirements for investigation in each site according to site profile. If information about specific chemicals is available (storage or used in production), then measures for these contaminants could be required for investigation.

Reply Q12 (Lithuania): No, we do not have formalised procedures.

Reply Q12 (Luxembourg): No.

Reply Q12 (The former Yugoslav Republic of Macedonia): No.

Reply Q12 (Malta): The list of EPA, EN, ISO or equivalent standards for analysis of the various contaminants as well as the associated detection limits has to be submitted by the applicant/operator and approved by the competent authority for each site investigation. Analyses have to be carried out by laboratories accredited to at least EN ISO 17025:2005/Cor 1:2006 and preferably accredited for each and every analysis.

In cases where soil is to be managed as waste once excavated, the presence of hazardous substances contained in waste is assessed in accordance to Annex III to the waste framework directive (2008/98/EC) as transposed by S.L. 549.63.

Reply Q12 (Norway): Please explain briefly. Yes, possible to calculate site-specific values based on available human and ecotoxicological data and chemical and physical properties of substances.

Reply Q12 (Poland): Regulation of the minister of the environment 1 September 2016 on the assessment of the land surface contamination defines inter alia detailed requirements for the determination of the permissible content of a hazardous substance in soil and in the ground, other than a substance directly defined in the regulation (taking into account its impact on human health and the condition of the environment).

Reply Q12 (Portugal): See answer to question 11b.

Reply Q12 (Romania): Order of the minister of waters, forests and environmental protection no. 756/1997 for the approval of the regulation on the environment pollution evaluation include the reference values for traces of chemicals in the soil and these values includes hazardous substances also. There are no special references, only for dangerous substances.

Reply Q12 (Serbia): No, we do not have formalised procedures to evaluate hazardous substances found on the site.

Reply Q12 (Slovakia): Next possibilities are available:

1. use international standards,

2. discussion with commission for the assessment and approval of final reports with risk assessment of contaminated sites (established under the ministry of environment),

3. consultation with Regional Institutes of Health of Slovakia.

Reply Q12 (Slovenia): Not at the moment. However, we are preparing the new environmental-protection act, which will fully regulate the area of contaminated site.

Reply Q12 (Spain): Yes, in the case of the soil matrix, according to the decree the assessment of contamination rely primarily on ad hoc risk assessments, not limiting the assessment to a certain number of substances being opened to those that could appear in each case. On the other hand, as it has been pointed out, decree establishes screening levels for a total of 54 substances but setting, at the same time, a clear methodology to calculate these levels for other substances different from those mentioned in the decree.

Reply Q12 (Sweden): No, Sweden continuously updates the guidance materials and guideline values as new knowledge of new contaminants is retrieved. In cases where no guideline values are available for a certain substance, the risks and need for remediation must be evaluated in another way that is considered relevant in the specific case.

Reply Q12 (Switzerland): If hazardous substances are found where no guideline concentration values are given, the cantonal authority has to specify a value on a case-by-case basis with the consent of the FOEN.

Reply Q12 (The Netherlands): The regulation to the soil-quality decree stipulates that 'duty of care' must be observed for substances that are not included in the list of quality standards. This means that anyone who is aware or could reasonably suspect that adverse effects may occur because of an activity in or with the soil or sediment should take measures to prevent or limit the contamination as far as possible.

Furthermore, in the ministerial letter of 2013 alternative possibilities for background values, Maximal Values for soil and target values for groundwater and intervention values for soil and groundwater have been described. Moreover, alternatives for the assessment of the determination of the urgency of remediation are given.

As ultimate action, ad hoc human-health-based or eco-toxicologic-based ad hoc risk limits and intervention values (only valid for a specific case of soil or groundwater pollution) can be derived by the national institute for public health and the environment.

Reply Q12 (United Kingdom): —

Question 13: Could you please provide a reference(s) for any of the answers above? (References can include websites where the information is available)

Reply Q13 in Annex2

Question 14: Has your country an approach to deal with 'orphan sites' (where the polluter's pays principle cannot apply)? Has your country a specific budget to deal with 'orphan sites'?

Reply Q14 (Austria): For managing orphan sites (no liable polluter and no voluntary party) BMLUFW [the federal ministry of agriculture, forestry, environment and water management] established a private company (BALSA GmbH) in 2004. The necessary budget is allocated from a national fund, which relies on a waste-taxation system (actual annual revenue ~ EUR 55 million) and is used to (i) fund remediation projects implemented by site owners or other voluntary parties and to (ii) finance 'orphan site' management.

Reply Q14 (Belgium (Flanders)): The term 'orphan sites' is not legally defined in Belgium (Flanders) and may lead to confusion.

OVAM uses the unofficial concept of a 'blackfield' which is a site where the remediation

costs are higher than the selling value. This situation often leads to a total neglect of the site because the revenue of the sale of the property is insufficient to finance the remediation. OVAM developed a special procedure to unlock abandoned blackfields in possession of bankrupt companies and can buy such a site from the responsible insolvency administrator for [a] symbolic EUR 1 when certain conditions are met. OVAM finances and carries out the soil investigation, the soil remediation and all other expenses related to the land. From a purely financial point of view, the balance of these acquisitions is negative for OVAM and thus for the taxpayer. However, the bigger picture is that OVAM can at least recover part of the remediation costs by reselling the remediated site. The alternative would be worse: if the site becomes an abandoned blackfield, according to the ex officio procedure, OVAM would sooner or later have to remediate the site because of the risks of the contamination. In that case, OVAM would try to recover the remediation costs from the polluter in court, but since that company has gone bankrupt OVAM would not stand a chance.

According to the ex officio procedure OVAM is responsible for the soil investigation and remediation on sites where no other party has the legal obligation to do this.

OVAM has a total budget dedicated to ex officio investigation and remediation of about EUR 30 million per year. It is estimated that approximately EUR 2 million of this budget is spent to deal with orphan sites.

Reply Q14 (Belgium (Wallonia)): The soil decree allows the administration identified by the government to act ex officio in case of the absence of an obligation holder or in extreme emergency, in order to undertake soil investigations and remediation if necessary, at the expense of who will be further designated (see Articles 73 and 74 of the soil decree). The action can go as far as expropriation on the basis of public utility in order to allow remediation works.

SPAQuE (Société Publique d'Aide a la Qualité de l'Environnement, a state-owned company established in 1991 and having tasks defined among others in Article 39 of the waste decree of 27 June 1996) is in charge of the ex officio rehabilitations of 'orphan sites' for which the responsible of the pollution is no longer identifiable, cannot be found, is not solvent, or refuses to rehabilitate, or when the pollution is at a so dangerous level that, without an action, the persistence of the pollution would pose [a] heavy threat for environment or human health (see Article 43 of waste decree). The cost is supported by the public authority in absence of other solution, unless court proceedings can establish the liability holder.

The budget dedicated to orphan sites management since 2004 amounts to about EUR 500 million (EUR 250 million in the first Marshall Plan, EUR 120 million in Marshall Plan 2. Green, and EUR 130 million foreseen in Marshall Plan 4.0). Some of these sites also benefited from ERDF funds according to an allocation key of 60 % from regional funding and 40 % from ERDF (for the period 2007-2013, up to 17 sites were co-funded by ERDF for about EUR 75 million during Marshall Plan 1 and Marshall Plan 2. Green).

Reply Q14 (Bulgaria): Regarding contaminated sites by certain economic activities (according to Lpreda), no. Regarding the sites with 'historic pollution', no.

Reply Q14 (Croatia): Some of the hot-spot sites referred in previous answers are orphan sites and they are managed by [the] environmental protection and energy efficiency fund (EPEEF) which is state institution.

Reply Q14 (Cyprus): There have been examples of dealing with orphan sites in the past. These have been remediated according to ownership. Private land was remediated using private funds and state-owned land was remediated using public funds.

Reply Q14 (Czech Republic): All the contaminated sites solved by the ministry of environment are 'orphan sites'. Other contaminated sites are under the 'polluter pay' principle which is in legislation.

Reply Q14 (Denmark): Yes. EUR 56 million are allocated to the regions every year to

fund the investigation and remediation of orphan sites. The total cost of all assumed orphan sites was estimated to EUR 1.8 billion in 2012.

Reply Q14 (Estonia): Yes, all answers above are given about 'orphan sites'. Nowadays pollution is managed by environmental inspectorate and PPP is applied and these objects are not in the database as residual pollution sites.

Reply Q14 (Finland): The state has supported the remediation of unmanaged sites [which are] posing a significant risk to health and the environment. Through the state waste-management system (legislative basis: waste act, 1072/1993 (http://www.finlex.fi/en/laki/kaannokset/1993/en19931072.pdf)) steered by the ministry of the environment, approximately 410 sites have been remediated since the 1990s. In recent years these projects have accounted for approximately 5 % of the remediation (10-15 sites) started each year. The appropriation available has been EUR 1.5-3 million per year by the state budget.

In addition to the state waste-management system, secondary financing has been channelled through the Finnish oil-pollution-compensation fund (legislative basis: decree on the oil pollution compensation Fund 1409/2004, initial decree without updated (http://www.finlex.fi/en/laki/kaannokset/1985/en19850828.pdf)), to the tune of EUR 2-2.5 million per year, for the investigation and remediation of areas contaminated with oil. The number of remediated sites is in the same range as those in the state waste-management system, i.e. by 2016 approximately 400 sites had been remediated through the oil-pollution-compensation fund (http://www.ym.fi/en-US/The_environment/Finnish_Oil_Pollution_Fund)).

The environmental impairment liability insurance is compulsory for companies whose activities involve an essential risk of environmental damage, or whose activities generally cause damage to the environment (legislative basis: environmental damage insurance decree (http://www.finlex.fi/en/laki/kaannokset/1998/en19980717.pdf)). The obligation to insure applies to corporations whose operations require an environmental permit granted or a permit for processing or storing hazardous chemicals or explosives. The Finnish environmental insurance centre ultimately safeguards the rights of the injured party by handling environmental damage caused by the unknown, uninsured and insolvent. Compensable environmental damage is damage which has been caused by activities performed in a specific area, and which has been caused by contaminated water, air or soil, noise, vibration, radiation, light, heat or odour, or any similar disruption. Compensation will only be paid if there is a probable causal connection between the damage and the activity governed by the legislation. [The] Finnish environmental insurance centre has paid only little compensation during 17 years of operation.

Reply Q14 (France): The prevention of risks of any kind caused by a classified installation is the responsibility of the operator or the custodian. Consequently, the French state is not intended to carry out risk prevention measures on an installation that is classified as operating or stopped. However, when the administrative authorities are required to ask the person in charge of a site to take actions to assess and/or eliminate or reduce an environmental risk and the person remains unidentified (disappeared) or insolvent, and after having initiated all possible procedures, the site is called 'orphan site'. After the deposit of the sums necessary to carry out remediation or safety work failed, the ministry in charge of environment entrusts the management project to the French agency for the environment and energy management (ADEME), which will be responsible for the implementation of sanitary and environmental safety measures. A specific budget is dedicated to these interventions (EUR 18 million in 2016).

In order to limit these interventions in the future, a system of financial guarantees of certain installations likely to pollute the soil has been put in place in July 2012.

See French ministry of environment website (https://www.ecologique-solidaire.gouv.fr/sites/default/files/Th%C3%A9ma%20-

%20ODD%20et%20territoires.pdf).

See French agency for the environment and energy management.

- http://www.ademe.fr/expertises/sols-pollues/dossier/modalites-dintervention-lademe/operations-mise-securite-sites-pollues-a-responsable-defaillant
- http://www.ademe.fr/

Reply Q14 (Germany): Our soil protection regulations deal as well with contaminated land management. The regulations about the responsibilities of the parties involved do not allow sites to fall into an orphan status. There is always someone who (as a principle) can be drawn to fulfil the remediation duties. If those mentioned to be responsible are for different reasons not able to remediate, or if it is (e.g. politically) unwise to insist on the remediation through the land owner, who did not pollute, then the competent authority has to remediate. Article 25 SPA allows a public encumbrance on the piece of land. Some Laender are using means dedicated to municipal or structural development to support remediation.

Reply Q14 (Hungary): In cases where the 'polluter-pays principle' cannot be applied, remediation of the site becomes a governmental task and must be performed within the framework of the OKKP and its subprograms, by the organisations selected by the assigned ministries. Currently, funds for site remediation are allocated from the government budget (non-specific) or financed through the EU Cohesion Fund.

Reply Q14 (Ireland): Ireland does not have a formal approach to deal with 'orphan sites'. These are currently dealt with on a case-by-case basis, however work has recently commenced on developing a multi-agency protocol for dealing with such sites. The EPA has a programme underway of securing financial provision for environmental liabilities at licensed sites including landfills, extractive waste and other high-risk sites. Sites which have contaminated soil or groundwater which requires remediation are also required to put in place financial provision to cover the liability.

Reply Q14 (Italy): The costs of 'potentially-contaminated-sites' investigation and remediation, if the site is thereof identified as 'contaminated', are in charge of the polluter (i.e. the subject responsible for the contamination), in application of the EU 'polluter-pays principle'.

However, if the subject responsible of the contamination cannot be identified or cannot pay for site investigation and remediation, the land owner, or another subject interested in the site redevelopment, may carry out these activities.

Public authorities are responsible for identifying the polluter and, in case of no liable subject or not economically sustainable remediation costs (orphan site), public funds are available at local or national level to carry out investigation and remediation following a priority list.

However, the land owner, after discovering the potential contamination of the site, has the duty to apply 'prevention measures' in order to limit or avoid potential environmental damage.

After the completion of an 'orphan site' remediation and redevelopment by public authorities, if the land owner is not interested or is not able to refund the relevant costs, the site property is transferred to the public with a 'real burden' mechanism.

Besides the 'real burden' mechanism, other instruments aimed at collecting public funds for contaminated sites remediation, are 'environmental liability procedures'.

Reply Q14 (Latvia): Yes. 6 biggest contaminates sites was included in Historical contaminated sites remediation programme (2007-2013). State and European fund money was used for remediation projects. Also, [the] Swiss foundation is used for remediation.

In regulation of cabinet of ministers 174 (28.03.2017.) is set amount of financing what is

available for sites remediation. Total amount is EUR 29 257 750 (European Commission financing: EUR 24 869 088. Latvia state: financing EUR 4 388 662).

Reply Q14 (Lithuania): If contaminated orphan site is on state land, [the] municipality is responsible for investigation and remediation. If 'historical' pollution is observed on private land, [the] country does not have [a] specific budged to deal with it or other solutions, but this approach is in progress now, e.g. dealing concerning POP's.

Reply Q14 (Luxembourg): We have a possibility for funding through environmental protection funds (fonds pour la protection de l'environnement). Money has to be made available by the government. This happens on a case-by-case basis.

Reply Q14 (The former Yugoslav Republic of Macedonia): No.

Reply Q14 (Malta): There is no specific national funding mechanism for remediation of orphan sites.

Reply Q14 (Norway): Yes, some funds are made available by the ministry of environment each year. Most of these funds are used for remediating sediments, where the identification of responsible parties is difficult. The criteria for considering funding are:

- if the state is the polluter responsible,

- if the responsible party cannot be identified, is not able to fund, or for other reasons should not be held responsible o if the need for remediation is urgent, the state can finance the remediation and claim a refund from the responsible party after remediation is complete o if there is a need for gathering information and getting more knowledge to assess the need for remediation,

- if it is necessary to assist in ensuring a collective remediation in an area with multiple responsible parties,

- or if there for other reasons is unreasonable that the responsible party bear to pay all the costs.

Reply Q14 (Poland): [The] EPA and damage act, mentioned above, include clear regulations concerning abandoned sites where potential or confirmed contamination of land surface occurs.

Reply Q14 (Portugal): The identification of the 173 old mining orphan sites in 2003/2004 and the industrial orphan sites in 2008 were based on specific methodologies.

More recently, Portugal established guidelines to identify new orphan sites: Guia Metodológico para a Identificação de Novos Passivos Ambientais, available at (http://www.apambiente.pt/_zdata/Politicas/Residuos/PassivosAmbientais/2016-12-15_Guia %20metodolgico %20Novos %20Passivos %20Ambientais.pdf).

Portugal has a budget, supported by private funds, public/national environmental funds and EU funds to deal with orphan sites.

Reply Q14 (Romania): For contaminated orphan and abandoned sites belonging to the public domain, the responsibility works for investigation and pollution assessment are financed from the state budget through government budgets they manage, or the Structural and Cohesion Funds, through projects approved for funding accordance with the rules of implementation of these funds.

Reply Q14 (Serbia): In the Republic of Serbia, the question of contaminated-site liability is dealt according with the principle of polluter and legal-successor liability. This means that any legal or natural entity who shall be involved in environmental pollution by illegal or improper activities shall be liable in compliance with the law. The polluter or its legal successor shall be bound to eliminate the cause of pollution and the consequences of direct or indirect environmental pollution and, in addition to that, the polluter shall be liable for environmental pollution also in the case of liquidation or bankruptcy of the

company or other legal entities, in accordance with the law.

Furthermore, when changes in the ownership of companies or other legal entities or other changes in the ownership structure occurs, an assessment and allocation of liability for environmental pollution, and settlement of debts (charges) of the ex-owner on account of pollution or damage to the environment shall also happen. It is also possible that the liability to be passed, contractually, from the polluter to a purchaser of the contaminated site.

However, when the polluter is unknown, the principle of subsidiary liability is applicable. This means that state authorities, within their financial abilities, shall eliminate the consequences of environmental pollution and reduce damages when the polluter is unknown, and when pollution originates from the sources outside the territory of the country. When contamination is new, it can be managed in a regime of emergency.

On the basis of the law on environmental protection (Official Gazette of the Republic of Serbia, No 135/2004, 36/2009, 36/2009 (other law, 72/2009) other law, 43/2011 (decision of Constitutional Court) and 14/2016), in 2017 the Republic of Serbia green fund, which is a budgetary fund for recording the funds intended for financing the preparation, implementation and development of programmes, projects and other activities in the field of conservation, sustainable use, protection and improvement of the environment, will operate again.

Reply Q14 (Slovakia): Slovakia has [a] procedure in the legislation: act No 409/2011 on certain measures in relation to contaminated sites and on the amendment of certain acts.

Section 4 of the article 3: If the originator does not ensure the preparation and implementation of a work plan, the competent ministry shall provide for this activity using public funds where there is an immediate threat to human life and health or to the environment; this shall not free the originator from liability. The originator is obliged to reimburse expenditure to the competent ministry within a period of at most 1 year from the date when a decision on the completion of the work plan issued under Section 9(3) becomes final.

Section 5 of the article 5: The regional environment office shall terminate proceedings for the determination of the obliged person if the obliged person cannot be determined and send the decision on the termination of proceedings to the ministry for the purposes of updating the information in the information system of contaminated sites.

Section 7 of the article 5: If it was not possible to determine the obliged person, the government of the Slovak Republic shall decide, at the proposal of the ministry, that the competent ministry shall provide for the performance of the obligations of an obliged person under Section 2 and 3 of the §3.

Section 8 of the article 5: The government of the Slovak Republic shall decide at the proposal of the ministry which is the competent ministry under Section 4 of the §3.

Reply Q14 (Slovenia): No and there is no specific budget.

Reply Q14 (Spain): There is no clear frame on how to deal with cases in which the polluter-payer principle is difficult to apply neither specific budget for these cases. However, in some particular cases decontamination costs can be assumed on [a] case-by-case basis by the regional administration and, occasionally, by the ministry of the environment.

Reply Q14 (Sweden): In Sweden the main objective is to get the polluter to pay for any soil and groundwater contamination. This is done through regional or local supervision of environmentally hazardous operations. For orphan sites, where no responsible party is available to pay for investigations and clean-up, government funding is available to deal with these.

In Sweden we have a yearly budget for funding of clean-up of orphan sites and

associated activities. This is managed by the environmental protection agency. The orphan sites are well known and are included in our national register of contaminated sites. The prioritisation of site clean-up, is based on the risk classification system, where the two highest risk classes are prioritised. The order of clean-up is prioritised at a regional level by the county administrative boards, which apply for grant[s] from the environmental protection agency which prioritises nationally. The clean-up is generally undertaken by the municipalities where the orphan site is located. In some special cases, the clean-up could be undertaken by the national agency SGU [Geological Survey of Sweden/Sveriges geologiska undersökning].

Reply Q14 (Switzerland): The measures to take are basically the same as for the other contaminated sites. Nevertheless, the costs have to be borne mainly by the local authorities. Federal government is funding 40 % of these costs. The owner of the site (who is only responsible as the proprietor of the site) has to bear only a small part of the cost, depending on his responsibility. He has not to bear any costs if, by exercising the required care, he could not have had any knowledge of the pollution.

Reply Q14 (The Netherlands): In the Netherlands, there is no specific approach for dealing with 'orphan sites'. However, the general procedure for dealing with polluted land offers possibilities. The 'polluter-pays principle' has been embedded in Dutch soil legislation since 1987, when liability became the key term in recovering the cost of soil remediation. In [the] case of orphan sites, when the 'polluter-pays principle' is not applicable, the competent authorities are subsidised for remediation by the national government.

Reply Q14 (United Kingdom (England)): Local authorities are responsible for dealing with orphan sites.

Question 15: Besides the number of sites, can you provide additional data on:

area remediated (explanation: 1 mega site might outweigh > 100 petrol stations);

area/mass of contaminated soil excavated and treated/landfilled off-site;

area/mass of contaminated soil excavated, treated on-site and refilled;

area/mass of contaminated (*) soil treated in situ. (*) It can be an estimate

Reply Q15 (Austria): Available data stem from 2006 (> 10 years) and are qualified out of date.

Reply Q15 (Belgium (Flanders)): N/A.

Reply Q15 (Belgium (Wallonia)): not yet (foreseen in the future).

Reply Q15 (Bulgaria): Regarding contaminated sites by certain economic activities (according to Lpreda), no. Regarding the sites with 'historic pollution', no, the Ministry of environment and water (MOEW) does not have the information in required form.

Reply Q15 (Croatia): No data.

Reply Q15 (Cyprus): Not available.

Reply Q15 (Czech Republic): The data from SEKM cannot provide the answer for this question.

Reply Q15 (Denmark):

a) No such data, we do not use area as a measure.

b) 2.5 million tonnes,

c) No such data,

d) No such data.

Reply Q15 (Estonia):

Total 53 hectares remediated (at 166 objects).

No reliable data about on-site works.

At least 3.5 hectares and 50 600 m3 treated in situ.

Reply Q15 (Finland):

Areas/sites varied from small petrol-station properties to large-scale industrial-sites landfills and mining-waste facilities

Remediation of contaminated land is usually carried out by removing soil and depositing it off-site (ex situ). Each year, 1-1.5 million tonnes of contaminated extractable soil resources are excavated to be processed or disposed at one of over 70 landfill sites or other processing plants.

At the moment, we are unable to assess area/mass treated and reuse on-site.

In situ remediation is annually initiated on 10-15 sites. Examples of remediation techniques used on-site are soil vapour extraction, biological methods and chemical oxidation.

Reply Q15 (France):

(a) In March 2015, the importance of the deposit or of the polluted area is defined for only one quarter of the 5 991 sites registered in the Basol database. Among them, about 500 are greater than 1 ha and only 14 greater than 1 000 ha (à mettre à jour avec la base 2017: champs utilisés = SP2_VOL).

(b), (c), (d) In March 2015, the mass of the deposit or of the polluted area is defined for only 13 % of the 5 991 sites registered in the Basol database. Among them, about 150 are greater than 5 000 t (à mettre à jour avec la base 2017: champs utilisés = SP2_TON, SP2_VOL).

(b) In March 2015, the contaminated soil excavated and treated/landfilled off-site concerns about 650 sites. Among them, the information concerning the mass is reported for only about 150 sites and represents in total 1 132 000 tonnes, whereas the information concerning the area is reported for only about 135 sites and represents in total less than 10 000 ha. (à mettre à jour avec la base 2017: champs utilisés = SP2_TON, SP2_VOL, SP4_TRTTER1, SP4_TRTTER2).

Reply Q15 (Germany): These figures are not available

Reply Q15 (Hungary): We can only provide data on state liability sites, which do include orphan sites, but also sites where state-owned companies caused contamination.

97(*) orphan sites underwent remediation during the 2011-2016 period.

972 370 t (*) of contaminated soil was excavated/treated.

1 468 550 t (*) contaminated soil was treated on-site.

87 530 m2 (*) was treated in situ.

(*) according to our most recent survey (22.3.2017) sent out to the regional environmental authorities.

Reply Q15 (Ireland): Not available.

Reply Q15 (Italy): Not available.

Reply Q15 (Latvia): No total information available. For biggest remediation projects only, separate information is available.

Reply Q15 (Lithuania): N/A.

Reply Q15 (Luxembourg): we do not have any megasites so far.

On average: 150 000 to/year.

Unknown.

Reply Q15 (The former Yugoslav Republic of Macedonia): No data.

Reply Q15 (Malta): In the case of the two sites which have been remediated, the following can be provided: Site 1, 68 m3 of contaminated fill removed. For other sites mentioned earlier in the report, remediation is still underway and thus volumes cannot yet be quantified.

Reply Q15 (Norway): No data.

Reply Q15 (Poland): Question 15 a, as indicated in response to a question Q2 registry data are incomplete. Question 15 b, c and d, no data.

Reply Q15 (Portugal): Portugal does not have the area and mass of contaminated soil remediated concerning the interventions that occurred in the old mining sites. The following data applies only to industrial sites:

a) 27.21 ha of soil remediated;

b.1) 27.21 ha of contaminated soil excavated and treated/landfilled off-site;

b.2) 646 911.00 t of contaminated soil excavated and treated/landfilled off-site;

c.1) 0 ha of contaminated soil excavated, treated on-site and refilled;

c.2) 0 t of contaminated soil excavated, treated on-site and refilled;

d.1) 0 ha of contaminated soil treated in situ;

d.2) 0 t of contaminated soil treated in situ.

Reply Q15 (Romania): No data available.

Reply Q15 (Serbia): Due to unavailable information, we cannot provide the answer to this question.

Reply Q15 (Slovakia): No relevant data are available.

Reply Q15 (Slovenia): No data.

Reply Q15 (Spain): No reliable information on this regard.

Reply Q15 (Sweden): No data.

Reply Q15 (Switzerland):

a) Area remediated (estimated): 6 million m2 (area still in need of remediation: 18 million m2).

b) Mass of contaminated soil excavated and treated/landfilled off-site (roughly estimated). 2 million tonnes (only the two Megasites 'Kolliken' and 'Bonfol': 720 000 tonnes).

c) Mass contaminated soil excavated, treated on-site and refilled (roughly estimated): 80 000 tonnes.

d) Area of contaminated soil treated in situ (roughly estimated): 700 000 m2.

Reply Q15 (The Netherlands): This information is not available.

Reply Q15 (United Kingdom): Not available.

Question 16: Can you estimate the overall management costs (unit: EUR million) which are expected to arise in your country (public +private)?

Reply Q16 (Austria): EUR 10 000-12 000 million (estimate from 2007 in a scenario without major legal amendments) EUR 5 000-6 000 million (estimate in a scenario with

major legal amendments allowing for site-specific risk reduction as well as monitoring for seriously contaminated sites not causing environmental or human-health risks.

Reply Q16 (Belgium (Flanders)): The total remediation cost (past and future) in the whole of Flanders is estimated to be EUR 7 billion. Approximately 70 % of these costs will eventually be borne by the private sector, only 30 % by the public sector. According to the 2014 JRC report Progress in the management of contaminated sites in Europe, Flanders has the lowest proportion of public intervention for remediation costs in Europe.

Reply Q16 (Belgium (Wallonia)): Such costs are difficult to estimate as long as the 'pool' of potentially polluted sites is not stabilised. However, there is currently a project to settle down an observatory of cost for soil remediation in Wallonia. This should help to answer such questions in the future. Some general data available on cost issues can be used to discuss such issues.

Concerning the biggest polluted sites, SPAQuE indicates in its 2015 annual report an average of 207 000 EUR per site for soil investigations, and an overall average of 108 EUR /remediated m2; the management of orphan sites cost EUR 500 million about since 2004 (benefits from recycling the land should however also be accounted in order to have a correct view on the situation/investment).

Concerning other polluted sites, private cost for soil investigation and remediation have been estimated by the Federation of Soil Experts in Wallonia (FEDEXSOL) in 2009 to vary according to the step of the procedure as the following:

Step of Soil procedure	Estimated cost (EUR)
Orientation study	3 000 to 10 000
Characterisation study	5 000 to 100 000
Remediation Plan	3 000 to 15 000
Remediation works	Minimum 20 000

That would give a range from EUR 31 000 to more than EUR 145 000 per site. Such cost is function of the extend of various parameters such as the area/mass to remediate, the complexity of the site (history of the site, pollution types/levels, presence of buildings, stability, presence of groundwater, accessibility, etc.), the emergency of the situation, remediation techniques, recovery project (land use, etc.), etc. However, such figures cannot be cross-checked by other sources yet.

Reply Q16 (Bulgaria): Regarding contaminated sites by certain economic activities (according to Lpreda), in the state budget 2018-2020 will be planned BGN 60 000 for the cases of art. 34 Lpreda (for preparation of the reports on a determination of remedial measures for cases where the operator is unknown and a factual complexity exists and/or the need for additional analyses).

Regarding the sites with historic pollution, in the state budget 2018-2020 will be planned BGN 515 119 for ensuring the remediation of the one site with contaminated soil.

Reply Q16 (Croatia): No data.

Reply Q16 (Cyprus): Not available.

Reply Q16 (Czech Republic): The overall management cost from state budget (including EU funds) is estimated for EUR 2 000 million. There are no data on private funds.

Reply Q16 (Denmark): The total cost of orphan sites was estimated in 2012 to

EUR 1 800 million. There is no estimate of the expected private sector equivalent total, but it was estimated in 2013 that the total turnover of the soil remediation sector (incl. public spending which is roughly half) was EUR 1 200-1 400 million a year (99).

Reply Q16 (Estonia): EUR 8.75 million.

Reply Q16 (Finland): The overall management costs vary considerably each year; a rough estimate is EUR 50-100 million per year. Companies and other private sector bear by a rough estimation 70 % of the costs and rest municipalities and the state.

Reply Q16 (France): There is no information about the management costs which are expected to arise. However, there are some figures from the balance-sheet published in the 'environmental accounts' report of the French ministry of environment in 2013.

In 2013, the turnover of the market for the remediation of polluted sites and soil (largely entrusted to specialised companies) is assessed to EUR 593 million, an increase of 5 % compared with 2012.

Investments by industrialists in the field of soil have increased slightly. Specific investments (excluding studies) achieved in the context of the prevention of soil pollution amounted to EUR 129.7 million in 2013, compared with EUR 118.2 million in 2012. The investments specifically dedicated to the pre-treatment and elimination of these pollution (excluding studies) fell in 2013 after having increased in 2012: EUR 35.3 million compared with EUR 40.5 million in 2012.

See publication of the French ministry in charge of environment: Les comptes de l'environnement en 2013 and Rapport de la Commission des comptes et de l'économie de l'environnement — 2015

Reply Q16 (Germany): We do not have precise numbers about financial efforts of the Laender and private duties within their responsibilities. About EUR 19.5 billion of public budgets have been spent for remediation measures of 21 large-scale projects, for lignite mining sites and for uranium mining sites based on the reunification treaty.

Reply Q16 (Hungary): At the start of the OKKP, the experts estimated the total costs at approximately EUR 3.33 billion. No new estimates have been made since.

Reply Q16 (Ireland): The estimated remediation costs are as follows for historic landfills:

	Cost/Ha Min	Cost/Ha Max
Class A	EUR 200 000	EUR 350 000
Class B	EUR 140 000	EUR 200 000
Class C	EUR 10 000	EUR 140 000

Some budget has been set aside by the department to commence this work and local authorities have to apply to draw it down.

Reply Q16 (Italy): Not available.

Reply Q16 (Latvia): Full costs are not available. Private remediation works do not have obligation to report about costs of remediation.

In four biggest remediation projects (Incukalns acid tar ponds, Olaine hazardous-waste storage, Jelgava hazardous-waste storage, Sarkandaugava oil-polluted site) is spent EUR 55 512 612 and CHF 15 300 000. Latvia state financing is 30 %, other is ERDF and Switzerland finances.

(99) Brancheanalyse af jordforureningssektoren, Miljøprojekt nr. 1500, 2013.

Reply Q16 (Lithuania): About EUR 19 million-

Reply Q16 (Luxembourg): The cost is borne by the private sector; the administration has no data on costs.

Reply Q16 (The former Yugoslav Republic of Macedonia): No-

Reply Q16 (Malta): Data on overall management costs is not available.

Reply Q16 (Norway): No.

Reply Q16 (Poland): We have no data on management of contaminated sites costs.

Reply Q16 (Portugal): Although Portugal does not have an estimation of the overall management costs of the abovementioned orphan sites, the environmental remediation of the old mining areas is estimated [at] EUR 90 million, from which circa EUR 88 million were invested since 2001.

Reply Q16 (Romania): No.

Reply Q16 (Serbia): We are not able to estimate costs due to lack of information.

Reply Q16 (Slovakia): Overall management cost of contaminated sites EUR 78 million within the framework of the operational programme environment (public).

Detailed investigation on 138 sites (105 potentially contaminated sites and 33 contaminated sites), remediation of 19 sites and monitoring on 161 sites (all from European Union funds in the framework of the operational programme environment) cost EUR 76 million (20.5 + 47.5 + 8) in 2015. Public awareness, education and publicity in the field of contaminated sites: EUR 2 million.

49 sites (waste disposals) were rehabilitated from 2008 to 2013 (41 within the framework of the operational programme environment and eight within the framework of the state environment fund). Overall cost: EUR 69 million.

The first estimation of the overall management costs was made in 2008 (project systematic identification of contaminated sites in the Slovak Republic [Slovakia]): preliminary investigation of potentially contaminated sites (878 sites at that time), EUR 6.5-8.3 million: detailed investigation, remediation and monitoring of contaminated sites (257 sites at that time), EUR 480-715 million (only investigation approximately EUR 5 million of it). On the base of analogy, 75 % of identified sites need remediation or risk-reduction measures (RRM) including natural attenuation (658 from 878 potentially contaminated sites). It means that estimation of costs of detail investigation, remediation and monitoring of 658 sites would be EUR 1 230-1 830 million. Well, the first estimation of the overall management costs would be EUR 1 716-2 553.3 million (on the base of data from year 2008).

At the present time, (see text above) 950 sites are in need of detailed investigation and globally 956 sites need and or might need remediation or risk-reduction measures (RRM). Estimation of the overall management cost on the base of costs in year 2008 was in frame EUR 1 780-2 660 million (public + private). Estimation of the overall management cost in year 2015 was about EUR 2 580 million (public + private).

Estimation of the cost to addressing of contaminated sites according to the State remediation programme of contaminated sites (2016-2021) for period 2016-2021 is EUR 210 million (public).

Reply Q16 (Slovenia): Due to lack of registers and inventories, the overall management costs cannot be estimated.

Reply Q16 (Spain): No reliable information on this regard.

Reply Q16 (Sweden): The budget for 2017 was approximately EUR 87 million, including a special section of EUR 30 million for remediation for residential construction. According to the not yet approved government budget, the annual budget for remediation of contaminated land is approximately EUR 87 million per year 2018. Where the budget for

remediation for residential construction has been decreased to EUR 20 million and a new special section for remediation of sediments has been added (EUR 8 million). In 2019, the budget is planned to increase to a total of approximately EUR 98 million.

There is a special section of the government budget targeting remediation for construction of residential areas, which in 2017 is about EUR 30 million and in 2018 is about EUR 20 million. From 2018 a special section for remediation of sediments will be added to the annual budget (EUR 8 million).

In total the government budget in 2018 for remediation is about EUR 36 + EUR 20 + EUR 8 million, and for investigations the budget is EUR 22 million. About EUR 230 000 are spent on maintaining the national registry of contaminated sites.

Two new reports have been published, on behalf of the government. The report called 'New forms of financing remediation of contaminated sites' considers new ways of private funding, to ensure remedial costs end up on the polluting activity. The other report, Proposed strategy for managing mining waste, considers how mining industries may ensure sufficient funds for handling environmental issues during and after operations.

Reply Q16 (Switzerland): The overall estimated costs for the contaminated sites management in Switzerland is roughly EUR 4 700 million (~ CHF 5 000 million). The estimated ratio public/private is about 60 % public/40 % private.

Reply Q16 (The Netherlands): Since 2016 the national inventory has been updated with more detailed questions on costs (both public and private). However, currently the response to these questions is not reliable enough to provide cost estimation for a certain year or a longer period. The total public funds available for remediation and risk management under the first convention on soil and underground, which ran from 2010 to 2015, are EUR 998 million.

Reply Q16 (United Kingdom): Not available.

Question 17: Does your country have a public available register/inventory of contaminated/remediated sites?

Reply Q17 (Austria): Access to the register of seriously contaminated sites (cross-reference: see Q 5-1): http://www.umweltbundesamt.at/umweltsituation/altlasten/verzeichnisse/

Access to the register of historical activities and landfills (cross-reference: see Q2): http://www.umweltbundesamt.at/umweltsituation/altlasten/vfka/

Reply Q17 (Belgium (Flanders)): The land-information register which contains the location of potentially contaminated sites and all known data on soil contamination in Flanders, is publicly accessible by requesting a soil certificate for a specific site. For every requested soil certificate retribution needs to be paid.

OVAM has also developed a free GIS-based tool, the Geoloket, which is a publicly accessible online map with all locations on which soil investigations or remediation projects were conducted (http://services.ovam.be/geoloket).

Reply Q17 (Belgium (Wallonia)): Not yet (foreseen in the future).

Reply Q17 (Bulgaria): In 2018, the Executive Environment Agency (ExEA) will provide a public register of sites with contaminated soil.

Reply Q17 (Croatia): No.

Reply Q17 (Cyprus): N/A.

Reply Q17 (Czech Republic): http://www.sekm.cz/

Reply Q17 (Denmark): http://arealinformation.miljoeportal.dk/distribution/

Reply Q17 (Estonia): Yes, [the] environmental registry is the central database of

environmental information. 'Residual pollution' can be used as a filter in hazard source fields

(http://register.keskkonnainfo.ee/envreg/main#HTTP7jYxWxSrvLrlpHAm1KeEzbzhGQRO2e).

Reply Q17 (Finland): All the documents in possession of authorities are mainly public according to act on the openness of government activities. The data of environment quality is always public. For that reason, that the data of the national database system includes errors and partly is not updated the database is limited open. Authorities of the centres for economic development, transport and the environment (ELY-centre), regional state administrative agencies, Finnish environmental institute and ministry of the environment have watching rights and the limited group of maintenance-rights. The authorities of municipalities (e.g. environmental, land-use and building authorities) have also the right to watch data and limited right to update the data.

Anyone could get information about single site from the ELY centres (in Helsinki and Turku from the municipalities' environmental centre) and nationwide data from the Finnish environment institute. The locations of the sites are also displayed as dots through the state environmental administration's Kárpalo-websites of the map service.

Reply Q17 (France):

Basol French database of contaminated or potentially contaminated sites and soils calling for administrative action for prevention or remediation (http://basol.developpement-durable.gouv.fr/).

Basias French historical regional inventories of former sites of industrial and service activities likely to be contaminated (http://basias.brgm.fr/).

Reply Q17 (Germany): Registers are public available, but just in case of a serious interest. (e.g. buying land) and mostly not available on [the] internet.

Reply Q17 (Hungary): Webpage to the environmental register system of groundwater and Geological Medium (http://web.okir.hu/en/tart/index/96/Queries).

Reply Q17 (Ireland): We only have a register of historic landfill sites available at waste management act s22 register

Reply Q17 (Italy): Not yet at national level, there are many at regional level (e.g. Tuscany, Veneto, Piedmontonte, etc.).

http://sira.arpat.toscana.it/apex/f?p=SISBON:REPORT:0:::::

http://map.arpa.veneto.it/website/siticontaminati_www/viewer.htm

http://www.regione.piemonte.it/ambiente/bonifiche/anagr.htm

Reply Q17 (Latvia): Yes — http://oas.vdc.lv:7779/lva/ppv_read_pub/

Reply Q17 (Lithuania): Yes, [the] Lithuanian geological survey (LGS) holds [the] register of potentially contaminated sites and it is open to public registered users via internet — LGS web page or via electronic services (https://www.lgt.lt/epaslaugos/).

Reply Q17 (Luxembourg): Demands for information on individual sites or planning area through (caddech@aev.etat.lu).

Reply Q17 (The former Yugoslav Republic of Macedonia): No.

Reply Q17 (Malta): Malta began compiling a register in 2012, it is constantly being updated. It is not yet publicly available since it is still being compiled.

Reply Q17 (Norway): yes, http://grunn.miljodirektoratet.no/ (in Norwegian only).

Reply Q17 (Poland): In Poland the register is not available to the public.

Reply Q17 (Portugal): Not yet (see answers to Questions 1 and 9a).

Reply Q17 (Romania): No.

Reply Q17 (Serbia): The Republic of Serbia does not have the public available register.

Reply Q17 (Slovakia): Yes. Slovakia has information system of contaminated sites (ISCS) which is public available. ISCS has been created and published 1.1.2009.

http://www.enviroportal.sk/environmentalne-temy/vybrane-environmentalne-problemy/environmentalne-zataze/informacny-system-ez

https://envirozataze.enviroportal.sk/Informacny-system

http://envirozataze.enviroportal.sk/Mapa/

Reply Q17 (Slovenia): No.

Reply Q17 (Spain): yes.

Reply Q17 (Sweden): The register is not yet publicly available.

Reply Q17 (Switzerland): Each of the 26 cantons (and three of the federal authorities) who are in charge to enforce the contaminated-sites ordinance for their sites have established their own register of polluted sites and published it in the internet

(https://www.bafu.admin.ch/bafu/de/home/themen/altlasten/fachinformationen/altlastenbearbeitung/stand-der-altlastenbearbeitung-in-der-schweiz/online-kataster-von-kantonen-und-bundesstellen.html).

At national level in 2019 The cadastre of public-law restrictions on landownership (PLR-cadastre) will be released (https://www.cadastre.ch/en/oereb/result.html). It will be a reliable, official system providing information about the most important public-law restrictions on landownership. The polluted sites are also part of this register.

Reply Q17 (The Netherlands): Yes. There is a system publicly available: soil counter (in Dutch; Bodemloket). The system includes digital maps, showing the locations of polluted and remediated sites (http://www.bodemloket.nl/).

Reply Q17 (United Kingdom (England)): No registry.

Question 18: Has your country initiated actions to implement the Inspire directive in the context of registers/inventories of contaminated/remediated sites?

Reply Q18 (Austria): Yes. The Austrian register of historically seriously contaminated sites (including remediated sites) has been linked for providing geospatial data and downloads.

http://gis.bmlfuw.gv.at/wmsgw/gs103603/?&service=wms&version=1.3.0&request=GetCapabilities

http://gis.lfrz.at/wmsgw-ds/?alias=32337e35-7de0-4&request=GetServiceFeed

Reply Q18 (Belgium (Flanders)): Flanders implemented the Inspire directive. There are no specific codes or labels for soil contamination or remediation.

Reply Q18 (Belgium (Wallonia)): For the contaminated and remediated sites, the data specifications, the metadata and the services are not yet implemented. Technically and for other soil data, the metadata and services are yet in conformity with Inspire rules. The maintenance and implementation group (European Commission) works to simplify the data specifications for Annex 3 data. In this context and at the Walloon Region, the data specifications for Annex 3 data will be taken into account in the near future (April 2017) in the context of a generic study, followed by implementation testing for all data.

Reply Q18 (Bulgaria): No.

Reply Q18 (Croatia): Inspire directive is being implemented in all segments available.

Reply Q18 (Cyprus): N/A.

Reply Q18 (Czech Republic): Data from SEKM databases are a part of Inspire geoportal.

Reply Q18 (Denmark): No, the Inspire directive only applies to areas included by EU legislation. Not soil.

Reply Q18 (Estonia): Yes, the metadata about contaminated/remediated sites is described and all services should be ready by 2020.

Reply Q18 (Finland): We have not initiated actions to implement the Inspire directive in the context of registers/inventories of contaminated/remediated sites.

Reply Q18 (France): No answer.

Reply Q18 (Germany): Yes, a discussion process was started on the Laender level initiated by the working group on soil-protection issues of the German federal states and the federal government. Competent authorities on the Laender level are responsible and working on implementation.

Reply Q18 (Hungary): Government Decree No 241/2009 (X. 29.) on the establishment and operation of the national geographic information system regulates the implementation of the Inspire directive. We need further methodological improvement for determining the areal extent of the contaminated sites. There are no current actions to implement the Inspire directive in the context of the inventory of contaminated sites, but future plans entail such harmonisation efforts.

Reply Q18 (Ireland): Not at this stage.

Reply Q18 (Italy): In the definition of the national database of contaminated sites relevant provisions of the Inspire directive in the field of contaminated sites have been taken into account.

Reply Q18 (Latvia): Yes. CPCS information will be included in Inspire dataset (theme: utility governmental services).

Reply Q18 (Lithuania): No, not yet.

Reply Q18 (Luxembourg): No.

Reply Q18 (The former Yugoslav Republic of Macedonia): No.

Reply Q18 (Malta): There are moves towards Inspire compliance. Also new data gathered aims to be Inspire compliant. Further information can be accessed through this link:

https://msdi.data.gov.mt/geonetwork/srv/eng/catalog.search?node=srv#/metadata/fe6d0480-746c-43e1-b765-7015354bba00

Reply Q18 (Norway): yes, our register of contaminated sites is public also possible to download data. We include contaminated sites as part of our rapport to Inspire.

Reply Q18 (Poland): No.

Reply Q18 (Portugal): Yes.

Reply Q18 (Romania): Not at the moment

Reply Q18 (Serbia): The Republic of Serbia developed the initial geoportal which provides access to discovery and view services for selected metadata, spatial data sets, and services via the internet, for professional users, as well as for the public. The initial geoportal 'geoSrbija' was launched on 27 November 2009. National spatial data infrastructure (NSDI) represents an integrated geospatial data system, enabling users to identify and access spatial information acquired from different sources, from local, via national to global level, in a comprehensive manner. The initial geoportal still does not

include data on contaminated and remediated sites.

Reply Q18 (Slovakia): Metadata are available about services publishing spatial data sets of contaminated sites. Spatial data sets are published in accordance to the technical guidance for the implementation of Inspire View services and partially in accordance to Inspire download services (http://envirozataze.enviroportal.sk/PriestoroveUdaje.aspx). Spatial data of involved services are not harmonised to this time.

Reply Q18 (Slovenia): Actions to implement the Inspire directive were initiated.

Reply Q18 (Spain): No.

Reply Q18 (Sweden): Actions to start implementing the Inspire directive has been initiated.

Reply Q18 (Switzerland): Probably none of the cantonal registers of contaminated sites have implemented the Inspire directive. Most of them where established before 2007.

Reply Q18 (The Netherlands): The Dutch procedure for assessing spatial information closely relates to the requirements of the infrastructure for spatial information in Europe to support Community [EU] environmental policies according to the Inspire directive.

Reply Q18 (United Kingdom): —

Question 19: Would you like to share some special, challenging or successful information to make progress in the management of contaminated sites?

Reply Q19 (Austria): A contaminated site contribution is charged to finance reliably the measures necessary for the implementation of a comprehensive management programme for contaminated sites in Austria. This contribution is earmarked primarily for registration, assessment and remediation of contaminated sites.

The contaminated site contribution introduced by the ALSAG act in 1989, which has been payable since 1990, is essentially comprised of a charge on the landfilling of waste; it was amended to take into account the latest changes in the landfill ordinance during the adjustment period (1996-2004 and 2009), and thereby turned into an effective steering mechanism. From 2006 onwards, an additional charge was introduced for the incineration of waste and the production of fuel products while the residues from incineration remained exempt.

Reply Q19 (Belgium (Flanders)): OVAM has participated in the writing of the two editions of the JRC report, Remediated sites and brownfields: success stories in Europe, where it has described a total of nine inspiring good practices. We stay interested to contribute to a possible third edition.

Reply Q19 (Belgium (Wallonia)): See publication, The Remediated sites and brownfields-Success stories in Europe, pages 24 and 66

(http://esdac.jrc.ec.europa.eu/content/remediated-sites-and-brownfields %E2 %80 %93success-stories-europe).

Reply Q19 (Bulgaria): -

Reply Q19 (Croatia): -

Reply Q19 (Cyprus): We would like to be kept informed on the development of other countries on this issue.

Reply Q19 (Czech Republic): The remediation methodologies used by the private firms in the Czech Republic are not available.

Reply Q19 (Denmark): The regions in Denmark have launched the cooperation platform Danish Soil Partnership (www.danishsoil.org) to promote Danish solutions. A booklet has been prepared about selected solutions:

http://miljoeogressourcer.dk/filer/lix/4479/A_common_ground_for_clean_soil.pdf

Reply Q19 (Estonia): International know-how sharing is useful in management view but also for remediation companies. Holding qualification requirements very high in public tenders of residual pollution remediation was good strategy. Estonian companies invited foreign experts and companies to enter into joint tenders and after all there have been very competing business environment in this field. Tough conditions in qualification rules have not reduced the participation. And as a result, we have got more competence in the field.

Reply Q19 (Finland): The ministry of the environment established a working group to draw up the national risk management strategy for contaminated land. The group's tasks were:

- to formulate the key and specific objectives for the operations;

- to propose concrete means by which the target state for contaminated land can be reached;

- to present a preliminary proposal for the reform of the state waste management work system;

- to prepare the national investigation and remediation programme.

The strategy was prepared in close cooperation with operators in the sector. During the course of the work, two workshops were organised for interest groups (vision and means workshops), and a separate workshop and email questionnaire were organised for officials from ELY centres. Additionally, the strategy was presented in a number of different forums during the preparation stage. The strategy was finalised on the basis of a broad round of comments at the end of 2015.

The strategy is a national perspective on how the risk management and remediation of contaminated areas can be managed cost effectively and sustainably in Finland, taking into account health and environmental protection in the best way possible. The goal of the strategy is to have the significant risks posed to health and the environment by contaminated land under control in a sustainable way by 2040. Six objectives have been set for achieving the strategy's goal, all of which support sustainable risk management.

Risk sites are identified investigated and remediated systematically (the national investigation and remediation programme).

Spatial planning and risk management in contaminated land support each in order to achieve sustainable and comprehensive solutions.

Data management systems support planning and decision-making in a user-friendly way.

Remediation methods are cost-efficient, save natural resources, minimise adverse environmental effects and promote circular economy.

Procedures are interactive and the roles, responsibilities, and liabilities of the actors are explicit.

Practices and communication are open, transparent, and interactive.

The strategy contains recommendations for policy means and measures to achieve the objectives in an efficient and feasible way. The responsible actors for the measures and actions are identified as well. The purpose of the national investigation and remediation programme for contaminated sites is to identify significant contaminated areas and promote research on these and the implementation of necessary risk management measures.

Realisation of the objectives of the strategy is to be monitored using indicators. The indicators have been selected to ensure that they show the progress of the measures and achievement of the objectives, and so that the associated data collection can be realised with as little additional work as possible, using existing data systems. Some of the

indicators, such as 'Improvement of knowledge and expertise' will require a separate report. Indicators linked to monitoring the realisation of the strategy are e.g.:

Risk sites are to be identified, investigated and if necessary, remediated in accordance with the objectives of the national investigation and remediation programme: Investigation and remediation of sites classified as urgent, number per year.

Functionality of the state management waste system: Investigation and remediation of orphan sites classified as urgent, number per year and costs per site

Realisation of sustainable use of the areas: remediation related to land-use changes and their risk management targets.

Development of the processing and reuse of excavated soil: Mass of contaminated soil excavated, treated and reused.

Reply Q19 (France): -

Reply Q19 (Germany): A serious progress was made by applying a legally based implementation, by an accompanying national research programme, an experienced sector of service providers and existing infrastructure for soil and groundwater treatment. Finally, political support is a key.

Reply Q19 (Hungary): In Hungary, the number of sites remediated under state liability is typically high; therefore, a well-functioning governmental collaboration between ministries is needed. This has been achieved and in the past 20 years more than 500 remediation measures were implemented with the cooperation of OKKP subprograms lead by the different ministries.

Reply Q19 (Ireland): As noted previously Ireland does not have a significant problem with contaminated sites.

Reply Q19 (Italy): —

Reply Q19 (Latvia): New CPCS register will be developed in year 2017. Since begging of 2017 new register will be available for municipalities and REBs for data input. Municipalities will be asked to review existing information about sites in their territory. If there are any new information available about CPCS, municipalities could add new information. Information flow will be organised electronically.

Reply Q19 (Lithuania): [The] Lithuanian geological survey initiated and carried out the project 'assessment of contaminated sites'. The project was implemented under EU Cohesion funds in 2007-2013. [The] project was carried out in two stages. During the first stage in 2009-2011 the potentially contaminated sites (PCS) in rural areas were inventoried and the PCS at the highest risk were investigated. The second stage in 2014-2015 was focused on PCS in the urban areas. Inventory was completed in the 10 largest cities, and PCS at the highest risk of contamination were investigated. In total, about 5 000 PCS were inventoried, as well as 250 sites were preliminary, and 100 sites were detailed investigated.

Reply Q19 (Luxembourg): It is extremely difficult to work on contaminated sites without appropriate legal framework. For a small country, in the absence of EU directive it is however difficult to elaborate a national legal framework.

Reply Q19 (The former Yugoslav Republic of Macedonia): -

Reply Q19 (Malta): Some challenges faced by Malta when processing and reviewing land investigation and remediation proposals can be linked to:

- operators/owners questioning the requirement for investigations,

- procurement of historical information on past activities within the site which are required to establish analyses to be tested.

Recently there have been great improvements in this area, since the (former) site operators were successfully convinced about the importance of these investigations and

remediation activities. Many investigations have been carried out on these sites, and the implementation most of the remediation programmes are currently in progress. Procurement of historical data is still a challenge which has been partially circumvented through analysis of aerial photography.

Reply Q19 (Norway): We are currently in the process of releasing a new and modernised inventory of contaminated sites

Reply Q19 (Poland): -

Reply Q19 (Portugal): -

Reply Q19 (Romania): Only the government Decision No 683/2015 on the national strategy and national plan for managing contaminated sites from Romania; other legislation is available only in Romanian language.

Reply Q19 (Serbia): A 3-year Global Environment Fund (GEF) funded project 'Enhanced cross-sectoral land management through land-use pressure reduction and planning' is the first one to deal with soil degradation and its consequences on the national level. This project is implemented by the United Nations Environment Programme (UNEP Vienna Office). Contribution to this project is a project 'Assistance to the Republic of Serbia in the implementation of multilateral environmental agreements and EU obligations through improvement of pollution monitoring of soil quality at industrial sites' which aims at helping Serbia to set up a national soil pollution monitoring system in compliance with the major international environmental agreements (i.e. the UN Convention to Combat Desertification) and with the EU environmental standards. Through this project, [the] Italian ministry of environment, land and sea has provided technical assistance to the Serbian counterparts, both the ministry of agriculture and environmental protection and the Serbian environment protection agency (SEPA), and training courses are being organised in order to strengthen the national technical capacities for monitoring soil quality and identifying pollution at industrial sites. The project also supporting accreditation of SEPA national laboratory for soil sampling and analysis.

Reply Q19 (Slovakia): An enactment of the state remediation programme of contaminated sites (2010-2015) and the state remediation programme of contaminated sites (2016-2021) and the fulfilment of their priorities.

Reply Q19 (Slovenia): The challenging and successful information on the Upper Meža Valley was published in Remediated sites and brownfields — success stories in Europe by European Commission, Joint Research Centre in 2015 (http://esdac.jrc.ec.europa.eu/content/remediated-sites-and-brownfields %E2 %80 %93success-stories-europe).

Reply Q19 (Spain): —

Reply Q19 (Sweden): The inventory of contaminated sites was completed in 2015, and we have good knowledge of the contaminated and potentially sites.

Sweden will not be able to reach the environmental quality objective of reducing risks associated with contaminated site to an acceptable level by the next generation. In order to speed up the clean-up, we are focusing on effective supervision of hazardous operations, stimulation of innovative remedial solutions within the government funding program, and making the data of contaminated sites publicly available.

Reply Q19 (Switzerland): Strong points of the contaminated sites management in Switzerland.

Funding (on national and regional level) shows to strongly stimulate the activity in the contaminated sites management.

Clear and simple legislation on contaminated sites: relatively small latitude of judgement, easier to communicate to the public and to accept by the monetary involved industry.

Possibility to realise all necessary measures without any decree, distribution of costs

often by a non-official agreement

Reply Q19 (The Netherlands): Please explain briefly.

We believe that a tiered approach is the way to appraise contaminated soil and groundwater (under the principle 'simple if possible, complex when necessary'), providing efficiency without compromising risks.

We consider the international cooperation (Common Forum, Nicole, TAIEF programmes of the EU and international conferences) as an efficient means to share, learn, expose and motivate.

Reply Q19 (United Kingdom): —

Question 20: Would you like to explain about constrains your country has been confronted and how you have addressed bottlenecks?

Reply Q20 (Austria): Managing orphan sites had been a major bottleneck. To address this BMLUFW established a private company (BALSA GmbH) in 2004 (see also reply Q14).

Since 2003 the budget available for running the national programme has been decreasing seriously (> 40 % %). To allow for more tailor-made site-specific remediation a major revision of the legal framing on historically contaminated sites is envisaged. Accompanying with a future major revision of the legal framing it is envisaged to establish a new funding scheme setting incentives for encouraging brownfield revitalisation.

Reply Q20 (Belgium (Flanders)): Biggest bottleneck is the completion of the municipal register with the location of the potentially contaminated sites and their risk activities, which has cost the municipalities way more time than expected. The municipal register is in fact the starting point for the whole soil remediation policy, because it determines the locations on which soil investigations need to be conducted.

Reply Q20 (Belgium (Wallonia)): The adoption of the soil decree took a long time, partly due to the lack of law voids to manage contaminated sites as already existing legislation on coal mines/economic wasteland renovation/waste and environmental legislations/protection at work regulation were running, to the attempt to link environmental and land planning procedures, and to the time and budget needed to elaborate appropriate tools for its implementation (guidelines, inventories, geodatabases, human resources, etc.). Even adopted, Article 21 of the soil decree is not in force yet, which also shows the political difficulty to implement such triggers when the number of potentially polluted sites is known to be high due to the industrial history of Wallonia (economical, administrative impacts vs environmental needs). However, discussions on Article 21 should be finalised in 2017.

Constraints are also arising from the cost of soil investigation and remediation (simplification of guidelines are provided along with their update, a project to build an observatory of cost is running, refining of risk assessment is in discussion, establishment of the background concentration is well on its way, platforms involving stakeholders are settled, etc.), from the streamlining between spatial planning and environmental issues (permit delivery issues, recognition of various historical procedures for soil investigations and remediation by the soil decree, management of excavated/backfilled soil, etc.), from the level of prioritisation for the management of (potentially) polluted sites, from the process for publication of soil status database itself (legal and technical constraints), from the degree of involvement of different levels of authorities/competencies (local/inter-municipal/regional and their segmented competencies).

Reply Q20 (Bulgaria): —

Reply Q20 (Croatia): —

Reply Q20 (Cyprus): Difficulties: monitoring the establishments near the sites.

There is no specific governmental body specialising on soil issues (including pollution). Most of these are distributed across the various state departments making policy refinement difficult.

The expertise on matters of pollution and its monitoring is fragmented in various governmental departments something that sometimes makes progress difficult.

Participation in forums that study progress (such as the Eionet network) in the field is also difficult because of luck of funds. For example we were not able to make it to the latest meeting on 23rd September 2016 in Ferrara (Italy).

We have addressed bottlenecks of general importance by a legal institutional framework of coastal monitoring.

Reply Q20 (Czech Republic): No unified national system for management of contaminated sites is available. The problem with inventory can be solved in few years by finishing the national inventory system (SEKM).

Reply Q20 (Denmark): In 2015 the regional administrations mapped their main technical challenges: 'Challenges concerning contaminated sites common to the five Danish regions' — available on the link below.

Reply Q20 (Estonia): One bottleneck is the measuring uncertainty of investigations. It is not possible to estimate exactly all amounts of polluted soils in any site no matter how much you drill and test. Real works of remediation always reveal a bit different pollution spread and different amounts of soil that needs to be treated. We have addressed the risk to contractors as 10 % of additional amounts. If additional amounts are higher, then additional funding is common based on unit prizes. These rules have to be very clear in tendering docs. Sometimes an additional tender for additional amounts of pollution is also a good alternative.

Reply Q20 (Finland): To tackle the regulatory barriers for sustainable soil management a new government decree on the reuse of soils from construction activities, including remediation, is being prepared in the Finnish environmental administration in collaboration with key stakeholder groups. The objective of the decree is to promote reasonable, but controlled usage of surplus soils in earth construction by the adoption of a simple notification system that would replace the time-consuming environmental permit procedure. The decree is expected to be issued around autumn 2017.

The scope of the decree will be restricted to predefined materials, construction applications and site conditions with specific requirements. The materials, included in the decree, cover both contaminated and uncontaminated soils that are or may be classified as waste, soils including small amounts of mineral construction waste, in situ stabilisation of clayey soils with certain industrial wastes or by-products, excavated stabilised soils, and dredged sediments when reused on land. The construction applications intended to be included in the decree include e.g. traffic lanes, field structures, noise barriers, and filling applications. The decree will also include new risk-based environmental acceptability criteria for the leaching of contaminants from the soils to be reused. Moreover, required quality assurance protocols covering e.g. leaching tests and the necessary sampling approaches based on representative multi-increment samples will be given in the decree.

Reply Q20 (France): —

Reply Q20 (Germany): A general constrains are necessary resources and financial burden for remediation measures, especially for megasites.

In fact hazard prevention (as guiding principle for contaminated land management within the soil protection act) means that ecological concessions need to be made in terms of restorable soil quality. Sustained protection of soil quality can only be achieved by the means provided by preventive approaches. The requirements for protection of the medium 'soil' must therefore be effectively integrated, at the precautionary level, into affected legislative fields (particularly the implementation and strengthening IPPC, land-

use planning, agriculture and forestry, and nature conservation). Only in this way can the high costs of remedial soil protection be noticeably reduced in the medium and long term.

Reply Q20 (Hungary): Our constraints are foremost a long term and continuously available budget, that can serve as the base for planning and timing of OKKP and also a stable structural system, providing the background knowledge and can facilitate the timely development of the programme.

Reply Q20 (Ireland): —

Reply Q20 (Italy): —

Reply Q20 (Latvia): Information availability about ownership of sites is problematic to update in an electronic way. In Latvia's case then CPCS register needs to follow up for all deals with land in Latvia.

Reply Q20 (Lithuania): —

Reply Q20 (Luxembourg): For Luxembourg it is not easy to measure the progress in the management of contaminated sites: many contaminated sites are remediated by the private sector in the scope of development projects, some industrial brownfields of several hectares are being remediated and redeveloped by public companies. Like explained above, however, all this happens without an appropriate legal framework. The applied laws hardly give room for the implementation of the concept of risk bases land management. Acceptance for a new law is low because the ongoing activities seem to show that we can live very well without it.

Reply Q20 (The former Yugoslav Republic of Macedonia): Lack of political will for dealing with contaminated sites. No existing legislation for management of contaminated sites. No existing registration and monitoring for contaminated sites.

Reply Q20 (Malta): It is a challenging task to convince site operators to implement infrastructural and/or technical changes in their facilities for solely (long term) environmental benefits which mostly require significant financial investments. Close cooperation with the operators is ensured in order to achieve improvements for the benefit of the local residents and the environment. This process is a common learning curve for the operators. The competent authorities focus on teaching/dissemination of information in terms of potential impacts rather than enforcement.

Reply Q20 (Norway): Remediation techniques: little innovation in this area over the past years. Most contaminated soil is excavated and landfilled without prior treatment.

Although there has been a substantial effort to deal with contaminated sites since the 1990s we have not finished assessing, registering and cleaning up contaminated sites. The prioritisations made are always done on today's knowledge and this, changes with time. An example of new cases is airports that where remediated for oil contamination but now are assessed for PFAS-contamination.

Reply Q20 (Poland): —

Reply Q20 (Portugal): The absence of specific legislation on contamination prevention and soil remediation is the major constraint for the inventory of contaminated and remediated sites and for a mandatory procedure for assessing the status of a site, among other aspects.

While national legislation is not approved, remediation projects of contaminated sites are approved (licensed) under the scope of the waste legislation and the reference values to be adopted are recommended.

Reply Q20 (Romania): In Romania there is no delimitation between actual and historic contamination. This issue is still unsolved because of the privatisation process. This process was extended more than 25 years after 1989. Some sites have changed the owner in 1990 and some 10 years ago. For this reason we cannot establish a reference

date.

Reply Q20 (Serbia): The environmental protection fund was founded in 2009, but it was shut down in 2012 which is our major constrain. In 2017, [the] green fund of the Republic of Serbia will be active again.

Lack of resources and capacity on all level of authorities directly affect efficiency in cooperation and conducting the process of registration and investigation of contaminated and potentially contaminated sites and finally implementation of RRM.

Reply Q20 (Slovakia): Obstacles in public procurement in general (process prolongation).

Reply Q20 (Slovenia): The main constrains are that there are no comprehensive national register of contaminated sites and systematic approach of dealing with contaminated sites. However, two important regulations are under preparations: The environmental protection act and the decree on status of soil. They are expected to solve the main constrains regarding contaminated sites.

Reply Q20 (Spain): Main bottlenecks detected in the management of contaminated soils in Spain are related to the following facts.

1) An excessive dependence of polluted soil management activity related to urban land development and public works.

2) A lack of alignment between the groundwater policies and soil quality policies.

3) An excessive weight of unsustainable decontamination solutions (dig and landfilling) versus solutions more sustainable options to minimise the amount of waste to be managed.

Reply Q20 (Sweden): —

Reply Q20 (Switzerland): As most of the contaminated sites lie in the densely populated areas, where the land price is often much higher than the remediation costs, a high percentage of polluted and contaminated sites were (and will be) fully decontaminated.

A recent study of the Swiss centre for applied human toxicology (SCAHT) showed that the soil guidelines values in the soil and the contaminated sites legislation are probably too high for some pollutants. The federal office for the environment (FOEN) has to evaluate if and how the legislation has to be adapted.

There are some lack of homogeneity between the soil and the contaminated sites legislation, which leads sometimes to measures which are difficult to execute for the cantons and which difficult to understand for the public. (For example: if or if not a polluted soil fulfils the legal criteria for a 'polluted site' corresponding to the contaminated-sites ordinance has strong impacts on the evaluation of a polluted soil and on the possibility of funding the required measures for this pollution.) The aim of a current project of the FOEN in collaboration with the cantons is to harmonise the soil and the contaminated sites legislation in several aspects.

Reply Q20 (The Netherlands): We consider lack of harmonisation of technical tools as a limitation in soil and groundwater quality assessment at the level of the European Union. Differences in human-health risk assessment tools throughout the European Union, for example, results in different assessments and conclusions about the status of (potentially) polluted sites, which is in conflict with a level playing field.

Reply Q20 (United Kingdom): —

Annex 2. References provided by countries in question 13

Brief explanation	Reference
Austria	
The legal information system of the Republic of Austria is a platform and data base providing information on Austrian law.	https://www.ris.bka.gv.at/defaultEn.aspx
The revision of general policy objectives ('Leitbild Altlastenmanagement') has been published by the ministry of agriculture and forestry, environment and water management in 2009.	https://www.bmnt.gv.at/umwelt/abfall-ressourcen/altlastenmanagement/altlastenmanagement.html
The latest state-of-the-environment report describes the environmental situation in Austria during the period from January 2013 to July 2016.	http://www.umweltbundesamt.at/en/soer/en_ukb/en_ukb2016/
Technical standards are available at the Austrian Standardisation Institute (ASI).	https://shop.austrian-standards.at
Belgium (Flanders)	
Standard procedures for the exploratory and descriptive soil investigation.	http://www.ovam.be/standaardprocedures
Information on the risk model S-risk.	www.s-risk.be
Text of the soil decree.	https://navigator.emis.vito.be/mijn-navigator?woId=304
The executive order Vlarebo.	https://navigator.emis.vito.be/mijn-navigator?woId=22989
List of potentially contaminating risk activities (Vlarebo appendix I).	https://navigator.emis.vito.be/mijn-navigator?woId=23569
Belgium (Wallonia)	
Soil decree.	http://environnement.wallonie.be/legis/solsoussol/sol003.htm
The state-of-the-environment report of Wallonia.	https://www.eea.europa.eu/soer-2015/countries/belgium
Bulgaria	
Liability for preventing and remedying environmental damage act.	http://www5.moew.government.bg/?page_id=45948
Cyprus	
Mining waste management on Cyprus assessment, strategy development and implementation. Final report.	Cyprus ministry of agriculture, Lefkosia. LIFE 94/CY/B21/CY/0977/MED, (1994-1998)
Reflections of the geological characteristics of Cyprus in soil rare earth element patterns.	L. Ren, D. R. Cohen, N. F. Rutherford, A.M. Zissimos, E.G. Morisseau. Applied Geochemistry, 56 (2015) 80-93.
Geochemical patterns in the soils of Cyprus.	David R. Cohen, Neil F. Rutherford, Eleni Morisseau, Andreas M. Zissimos. Science of the Total Environment 420 (2012) 250-262.
Anthropogenic versus lithological influences on soil geochemical patterns in Cyprus.	Cohen, D. R., Rutherford, N. F., Morisseau, E., Christoforou, I, Zissimos, A.M. Geochemistry: Exploration, Environment, Analysis (2012), Vol. 12, 349-360.
Distribution of water-soluble inorganic ions in the soils of Cyprus.	Zissimos, A. M., Christoforou, I. C., Morisseau, E., Cohen, D. R., Rutherford,

	N. F. Journal of Geochemical Exploration 146 (2014) 1-8.
National inventory of potential sources of soil contamination in Cyprus.	Demetriades, A., Androulakakis, N., Charalambides, A., 2006. Report to the Cyprus ministry of agriculture, Lefkosia.
Legacy soil contamination at abandoned mine sites: making a case for guidance on soil protection.	Kostarelos, K., Gavriel, I., Stylianou, M., Zissimos, A.M., Morisseau, E., Dermatas, D. Bulletin of environmental contamination and toxicology, DOI 10.1007/s00128-015-1461-4 (2015).
Czech Republic	
	http://www.mzp.cz/
	http://www.mzp.cz/cz/kompetence
	http://www.mzp.cz/cz/metodiky
	http://www.cizp.cz/
	http://www.geology.cz/extranet
	http://www.sekm.cz/
	http://www.mzp.cz/cz/metodiky_ekologicke_zateze
Denmark	
Regionernes arbejde med jordforurening i 2015, Danske Regioner.	http://miljoeogressourcer.dk/media/materialer/10/Jordredegoerelse_2015.pdf
Estonia	
WBM plans.	http://www.envir.ee/en/river-basin-management-plans
Database of hazardous sites (polluted areas).	http://register.keskkonnainfo.ee/envreg/main#HTTP7jYxWxSrvLrlpHAm1KeEzbzhGQRO2e
Finland	
The government decree on the assessment of soil contamination and remediation needs (214/2007).	http://www.finlex.fi/en/laki/kaannokset/2007/en20070214.pdf
Risk assessment and sustainable risk management of contaminated land environmental administration guideline 6/2014 (Finnish).	https://helda.helsinki.fi/bitstream/handle/10138/136564/OH_6_2014.pdf?sequence=1
Derivation basis of threshold and guideline values for soil, Finnish environment 23 /2007 (Finnish).	http://www.finlex.fi/en/laki/kaannokset/2007/en20070214.pdf
The foreseeable future.	http://www.cleansoil.fi/fi-FI
There are also some English environment administration's websites.	http://www.ymparisto.fi/en-US/Consumption_and_production/Contaminated_soil_sites
	http://www.ym.fi/en-US/The_environment/Contaminated_areas
France	
Basol French database of contaminated or potentially contaminated sites and soils	http://basol.developpement-

calling for administrative action for prevention or remediation.	durable.gouv.fr/
Basias French historical regional inventories of former sites of industrial and service activities likely to be contaminated.	http://basias.brgm.fr/
Contaminated sites and soils on the **French ministry of environment website.**	https://www.ecologique-solidaire.gouv.fr/sites-et-sols-pollues
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Hungary	
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URL for the national register.	http://web.okir.hu/hu/
URL for the legal framework about Hungarian contaminated land management.	http://www.commonforum.eu/Questionnaires/LF/LF_HU.asp
URL for historical information.	http://www.kvvm.hu/szakmai/karmentes/
Ireland	
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Latvia	
CPCS register.	http://oas.vdc.lv:7779/lva/ppv_read_pub/
legislation portal.	www.likumi.lv
State programmes for remediation	http://www.varam.gov.lv/lat/fondi/kohez/?doc=7754
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Serbia	
The law on environmental protection (*Official Gazette of the Republic of Serbia*, No 135/2004, 36/2009, 36/2009- — other Law, 72/2009- — other Law, 43/2011- — decision of Constitutional Court and 14/2016).	http://www.pravno-informacioni-sistem.rs/SlGlasnikPortal/reg/viewAct/2f958463-27e5-4d10-921d-49872e7726bb
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Ministry of Environment of the Slovak Republic (Directorate for geology and natural resources).	https://www.minzp.sk/en/areas/geology/ https://www.minzp.sk/postupy-ziadosti/ochrana-prirody-krajiny/l
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Renewal of acid tar lagoon site at Pesniški dvor.	http://www.srdit.si/gzo07/papers/82FLipovsek_FinalPaperGzO07.pdf
Spain	
Information on contaminated soils.	http://www.mapama.gob.es/es/calidad-y-evaluacion-ambiental/temas/suelos-contaminados/
Sweden	
Guidance material.	http://www.naturvardsverket.se/Stod-i-miljoarbetet/Vagledningar/Fororenade-omraden/
Guidance material on risk classification and inventory.	http://www.naturvardsverket.se/Documents/publikationer/620-5053-2.pdf?pid=2816
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Switzerland	
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The cantonal and federal registers of polluted sites (German or French).	http://bit.ly/2o041Fv
The formal procedure for assessing the status of a polluted site (preliminary investigation).	http://bit.ly/2nxpWHX

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Annex 3. Methodology and data

This annex presents the raw data provided by countries and the methodology for derived index and extrapolations.

— Raw data extracted from countries' questionnaires (Table 10).

— Density of registered sites per km^2 of artificial surface in countries' inventories (Table 11), calculated as: [Number of registered sites (site status 1)]/[artificial surface (km^2)].

— Status of completed risk-reduction measures (Table 12), calculated as: [Number of remediated sites (site statuses 6 and 3)]/[Number of registered sites where polluting activities took/are taking place]*100.

— Trends of the progress in the management of contaminated sites (Table 13), calculated as: the difference between the number of sites for each management step in 2016 and the same number reported at the baseline (data from the period 2001-2005). A negative number does not always mean a reduction, but changes in the criteria.

Table 10. The number of sites in each management status reported by replying countries and their artificial surface (km^2).

Country	S Status 1 (estimated sites where polluting activities took place)	S Status 1 (registered sites where polluting activities took place)	S Status 2a (sites in need of investigation/ still to be investigated)	S Status 2b (sites under investigation)	S Status 3 (sites that have been investigated, but no remediation needed)	S Status 4 (sites that need or might need remediation or risk-reduction measures)	S Status 5 (sites under/with ongoing remediation or RRMs)	S Status 6 (site remediation or RRMs completed)	Artificial surface km^2
Austria	72 000	68 569	10 000	1 497	622	5 288	104	203	4 711.0
Belgium (Brussels-Capital)									136.3
Belgium (Flanders)	85 000	68 000	46 478	38 522	32 431	18 591	1 584	3 509	3 683.4
Belgium (Wallonia)	17 700	3 796	15 275	1 489	927			1 593	2 524.8
Bulgaria		26	4		2	1	2	20	5 321.2
Croatia		2 264	247			3	5	5	2 001.0
Cyprus		84	5			3	2	4	8 14.5
Czech Republic	20 000	9 300	828	405	543		106	257	5 194.9
Denmark	45 000	16 865	32 000	16 985	10 191	9 031	403	2 483	3 342.6
Estonia		300	70			78	4	110	988.6
Finland		26 200	17 700	2 200	660	29 850	300	5 700	4 722.8
France	300 000	6 478	514	1 194	796	1 708	924	3 054	30 717.8
former Yugoslav Republic of Macedonia		70	62			78	70	5	429.6
Germany	485 856	260 883			19 382	35 358	5 094	38 242	34 053.7
Hungary	778	5 375	2 071	1 587	145	649	398	347	5 753.1
Ireland						66			1 747.1
Italy		22 100	6 754	1 710	5 521	2 600	2 054	2 904	16 021.7
Latvia		3 574	2 637	115	692	245		44	1 291.2
Lithuania	50 000	12 341	4 621		460	800	92	96	2 114.8
Luxembourg		12 000		30	1 606	61	26	1 060	273.0
Malta	600	135	121	5	5	614	9	1	93.1
Netherlands		1 455	0	10	13	466	807	176	5 541.2
Norway		6 500	1 162			508		1 400	2 866.0
Poland									17 681.8
Portugal		181	21	3	53	37	10	83	3 602.2
Romania	1 183	210							12 722.4
Serbia		709	478	103		657	41	52	3 203.7
Slovakia	3 200	1 758	945	408	166	956	18	678	2 904.5
Slovenia		378		1			2		617.7
Spain	133 344	43 092	4 924	270	2 203	1 149	198	157	12 622.0

Sweden	(**)	83 000	25 000	4 108	1 775	16 116	1 520	1 930	6 532.6
Switzerland	(**)	38 000	6 700	9 600	6 900	4 300	180	1 000	2 823.0
United Kingdom (England) (*)	325 000	600				511	493	433	10 455.9

(*) Data for the United Kingdom corresponds to England only. Information for Wales, Scotland and Northern Ireland is not available.
(**) the registration of all polluted sites is completed. Empty fields correspond to information not provided by countries.

Table 11. Density of registered sites per km^2 of artificial surface in countries' inventories.

Country	Status 1 (registered sites where polluting activities took place)	Artificial surface (km^2)	Density of registered sites/km^2
Austria	68 569	4 711.0	14.56
Belgium (Flanders)	68 000	3 683.4	18.46
Belgium (Wallonia)	3 796	2 524.8	1.50
Bulgaria	26	5 321.2	0.01
Croatia	2 264	2 001.0	1.13
Cyprus	84	814.5	0.10
Czech Republic	9 300	5 194.9	1.79
Denmark	16 865	3 342.6	5.05
Estonia	300	988.6	0.30
Finland	26 200	4 722.8	5.55
France	6 478	30 717.8	0.21
Germany	260 883	34 053.7	7.66
Hungary	5 375	5 753.1	0.93
Italy	22 100	16 021.7	1.38
Latvia	3 574	1 291.2	2.77
Lithuania	12 341	2 114.8	5.84
Luxembourg	12 000	273.0	43.96
Malta	135	93.1	1.45
Netherlands	1 455	5 541.2	0.26
Portugal	181	3 602.2	0.05
Romania	210	12 722.4	0.02
Slovakia	1 758	2 904.5	0.61
Slovenia	378	617.7	0.61
Spain	43 092	12 622.0	3.41
Sweden	83 000	6 532.6	12.71
United Kingdom (England)	600	10 455.9	0.06
Total EU-28	**648 964 sites**	**178 622.04 km^2**	
former Yugoslav Republic of Macedonia	70	429.7	0.16
Norway	6 500	2 866.0	2.27
Serbia	709	3 203.7	0.22
Switzerland	38 000	2 823.0	13.46
Total Europe	**694 243 sites**	**187 944.37 km^2**	
EU-28: Average of registered sites by km^2	**3.63 sites/km^2**		
Europe: Average of registered sites by km^2	**3.69 sites/km^2**		

Table 12. Status of completed risk-reduction measures.

Country	Density of registered contaminated sites per km^2 of artificial surface	Status of completed risk reduction measures
Austria	14.56	1.20
Belgium (Flanders)	18.46	52.85
Belgium (Wallonia)	1.50	66.39
Bulgaria	0.01	84.62
Croatia	1.13	0.22
Cyprus	0.10	4.76
Czech Republic	1.79	8.60
Denmark	5.05	75.15
Estonia	0.30	36.67
Finland	5.55	24.27
France	0.21	59.43
former Yugoslav Republic of Macedonia	0.16	7.14
Germany	7.66	22.09
Hungary	0.93	9.15
Ireland	—	—
Italy	1.38	38.12
Latvia	2.77	20.59
Lithuania	5.84	4.51
Luxembourg	43.96	22.22
Malta	1.45	—
Netherlands	0.26	12.99
Norway	2.27	21.54
Poland	—	0.00
Portugal	0.05	75.14
Romania	0.02	—
Serbia	0.22	7.33
Slovakia	0.61	48.01
Slovenia	0.61	0.00
Spain	3.41	5.48
Sweden	12.71	4.46
Switzerland	13.46	20.79
United Kingdom (England)	0.06	72.17

Table 13. Progress in the management of contaminated sites from the baseline and the last data-collection exercise in 2011.

Country	Site Status 1 — registered			Progress in site status 1 since 2011	Site status 2			Progress in site status 2 since 2011	Site status 4			Progress in site status 4 since 2011
	2001-2005	2011	2016		2001-2005	2011	2016		2001-2005	2011	2016	
Austria	1 996	63 000	68 569	**5 569**	338	0	11 497	**11 159**	2 608	10 507	5 288	– 5 219
Belgium (Flanders)	25 344	46 772	68 000	**21 228**	16 688	31 997	85 000	**53 003**	26 752	36 468	18 591	– 17 877
Bulgaria	0	0	26	0	0	0	4	0	1	0	1	**1**
Croatia	1 839	13	2 264	**2 251**	89	0	247	**158**	847	0	3	**3**
Czech Republic	9 675	0	9 300	– 375	1 150	0	1 233	**83**	1 804	0	0	0
Denmark	17 795	0	16 865	– 930	9 317	14 072	48 985	**34 913**	21 815	13 395	9 031	– 4 364
Estonia	354	230	300	**70**	231	230	70	– 160	128	430	78	– 352
Finland	20 000	23 000	26 200	**3 200**	0	0	19 900	0	0	5 882	29 850	**23 968**
France	722 300	257 200	6 478	– 250 722	3 703	869	1 708	**839**	4 709	470	1 708	**1 238**
Hungary	14 643	15 000	5 375	– 9 625	0	0	3 658	0	4 436	3 500	649	– 2 851
Italy	14 312	15 000	22 100	**7 100**	2 860	0	8 464	**5 604**	6 884	6 700	2 600	– 4 100
Lithuania	3 195	11 136	12 341	**1 205**	659	1 700	4 621	**2 921**	78	2 410	800	– 1 610
Luxembourg	9 752	0	12 000	**2 248**	122	0	30	– 92	230	0	61	**61**
Netherlands	425 000	425 000	1 455	– 423 545	180 000	0	10	– 179 990	59 012	78 500	466	– 78 034
Norway	3 459	4 706	6 500	**1 794**	458	0	1 162	**704**	1 199	2 162	508	– 1 654
Slovakia	1 666	15 000	1 758	– 13 242	500	1 151	1 353	**202**	500	2 494	956	– 1 538
Spain	15 126	71 202	43 092	– 28 110	0	2 436	5 194	**2 758**	66	285	1 149	**864**
Sweden	8 000	0	83 000	**75 000**	8 400	0	26 408	**18 008**	14 500	0	16 116	**16 116**
Switzerland	30 000	34 400	38 000	**3 600**	0	5 000	6 800	**1 800**	3 000	18 000	4 300	– 13 700

Table 13. Progress in the management of contaminated sites from the baseline and the last data-collection exercise in 2011.

Country	Site Status 5			Progress in site status 5 since 2011	Site Status 6			Progress in site status 6 since 2011	Progress in site status 6 since 2001-2005
	2001-2005	2011	2016		2001-2005	2011	2016		
Austria	108	80	104	**24**	57	108	203	**95**	**146**
Belgium (Flanders)	1 109	1 808	1 584	– 224	135	2 187	3 509	**1 322**	**3 374**
Bulgaria	0	0	2	0	194	194	20	– 174	– 174
Croatia	51	5	5	0	231	4	5	**1**	– 226
Czech Republic	741	0	106	– 635	163	769	257	– 512	**94**
Denmark	0	0	403	0	9 436	10 930	2 483	– 8 447	– 6 953
Estonia	0	14	4	– 10	7	184	110	– 74	**103**
Finland	400	250	300	**50**	2 600	5 880	5 700	– 180	**3 100**
France	53	470	924	**454**	1 794	2 601	3 054	**453**	**1 260**
Hungary	433	149	398	**249**	536	640	347	– 293	– 189
Italy	983	5 159	2 054	– 3 105	1 264	1 780	2 904	**1 124**	**1 640**
Lithuania	1	0	92	**91**	62	40	96	**56**	**34**
Luxembourg	90	0	26	– 64	233	239	1 060	**821**	**827**
Netherlands	1 700	0	807	– 893	19 000	8 200	176	– 8 024	– 18 824
Norway	99	127	0	– 127	559	1 645	1 400	– 245	**841**
Slovakia	50	96	18	– 78	100	703	678	– 25	**578**
Spain	0	61	198	**137**	288	235	157	– 78	– 131
Sweden	500	0	1 520	**1 020**	1 600	1 700	1 930	**230**	**330**
Switzerland	0	120	180	**60**	100	500	1 000	**500**	**900**

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doi:10.2760/093804

ISBN 978-92-79-80072-6