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Soil quality — Guidance on the establishment and maintenance of monitoring programmes

Qualité du sol — Lignes directrices pour l'établissement et l'entretien de programmes de surveillance

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 7, *Impact assessment*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This second edition cancels and replaces the first edition (ISO 16133:2004), which has been technically revised. The main changes compared to the previous edition are as follows:

— Clause 2 has been updated;

— Clause 3 has been updated, definitions that were not used in the document have been deleted;

— new subclauses have been introduced regarding sampling designs (5.2.4), sampling in space (5.2.5) and in time (5.2.6);

— all examples of monitoring programmes described in Annex A have been deleted as part were outdated.

Introduction

Monitoring is the process of repetitive observation, for defined purposes, of one or more components of the environment according to pre-arranged schedules in space and time using comparable methods for environmental sensing and data collection[14][15]. Monitoring schemes are used all over the world for a large number of purposes. Soil monitoring, particularly, is a long-term undertaking. The quality and the utility of the information from the monitoring is to a large degree determined by the choice of monitoring sites and by their maintenance over the years, and by appropriate quality control at all stages of the process.

Monitoring associated with industrial (contaminated) sites can involve many specific considerations, including legal requirements. The guidance in this document is not designed or intended to cover such situations.

Soil quality — Guidance on the establishment and maintenance of monitoring programmes

1 Scope

This document gives general guidance on the selection of procedures for the establishment and maintenance of programmes for long-term monitoring of soil quality. It takes into account the large number of objectives for soil-monitoring programmes.

This document is intended to help provide a basis for dialogue between parties which might be involved in a monitoring scheme.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15903, *Soil quality — Format for recording soil and site information*

ISO 18400 (all parts), *Soil quality — Sampling*

ISO 25177, *Soil quality — Field soil description*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11074 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org./obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
anthropogenic change
change in soil properties caused by human activities

[SOURCE: ISO 11074:2015, 5.1.1, modified — “influence on” has been replaced by “change in”]

3.2
background concentration
concentration of an element or a substance characteristic of a soil type in an area or region arising from both natural sources and anthropogenic diffuse sources such as atmospheric deposition

[SOURCE: ISO 11074:2015, 3.5.1, modified — in the definition, “an element or” has been introduced before “a substance” and “anthropogenic” has replaced “non-natural”. Note 1 to entry has been removed.]

3.3
habitat
sum of the environment of a particular species or community (e.g. in terms of soil properties, land use, climate)

[SOURCE: ISO 23611-6:2012, 3.2.2]

3.4
monitoring site
area in which investigations take place

Note 1 to entry: Such an area is usually chosen to be relatively homogenous.

[SOURCE: ISO 11074:2015, 5.1.5 modified — the following part of the definition "such an area is usually chosen to be relatively homogenous" has been moved to Note 1 to entry]

4 Monitoring objectives

4.1 General

Monitoring programmes provide baseline soil information and help in deriving soil quality values for managing soils (e.g. to verify soil quality after the implementation of remediation actions in contaminated sites).

Monitoring is also an important tool for the early detection of changes in soil properties and soil processes[16]. It, thus, has a major role in the prevention or minimization of environmental damage or the detection of environmental improvement. By the early detection of environmental impact, or the potential for such impact, a monitoring programme could help to reduce or remove the costs of reaching or maintaining a given level of environmental management, protection or quality.

Monitoring programmes can also be used to evaluate the outcome of environmental policies, to assist in the development of strategies for soil protection and environmental management. They can also serve as research platforms for the development and validation of field and analytical methods and of models of soil and related environmental processes.

The range of purposes for which soil-monitoring programmes can be designed encompasses such a vast range of time scales, variables and processes that it is not possible to give specific guidance on the design of a monitoring programme to meet all the objectives which might be covered by this diversity. The selection of sites, sampling schemes, etc. should be made following consideration of the specific objectives of the particular monitoring programme. This document identifies the principles underlying such programmes.

4.2 Examples of monitoring purposes

Some examples of monitoring purposes might include the need to establish one or more of the following:

— short-, intermediate- and long-term environmental impacts varying in magnitude, importance, duration and probability;

— changes in chemical, biological and physical soil properties (e.g. pH, adsorption processes, toxic element accumulation, radiation, compaction, erosion) and the dynamics of changes in such properties;

— effects of human impacts;

— differentiation of human impacts from inter-annual variability and longer-term climate change;

— differentiation of local contamination from long-range transport;

— evaluation of productivity;

— assessment of biological diversity;

— input of elements into the soil environment and output of elements from the soil environment;

— transport processes in the soil profile (gases; particles; elements or compounds in solution);

— calculations of uptake and retention of elements, compounds or substances by particular components of the ecosystem.

5 Monitoring programme

5.1 General considerations

It is generally not feasible to monitor all variables at all locations of the studied area. Wherever possible, consideration should be given to the monitoring of soil properties which, as well as being of specific interest themselves, might also act as a surrogate for some property or process which is otherwise difficult, time consuming or expensive to measure directly. For example, soil pH, organic matter concentration and clay content (a potential surrogate for soil hydrological behaviour) might act as factors for ranking pollutant mobility. It will be important to establish what long-term records already exist at a site before identifying additional variables for monitoring and what degree of continuity of measurement is required into the future. The close reciprocal benefits of monitoring and research on specific scientific questions should be considered.

The final series of potential monitoring options should be ranked according to their value (such as scientific relevance, sensitivity to impacts, value as an index for changes in many other environmental variables that are not measured) and feasibility (such as financial, logistic, analytical, ease of interpretation). This prioritization should be revised and updated at regular intervals. The costs of appropriate storage of samples and long-term quality assurance, such as cross-checking when improvements in analytical techniques are made, should not be underestimated.

Identification of habitat types is a key element of the monitoring plan, and is also a logical starting point for the development of an environmental monitoring strategy. It is also necessary to consider the number of sites that might be required to give appropriate spatial and temporal cover for the monitoring, and whether the site density is appropriate for all variables. It is usually impractical to establish sites that cover all combinations of soil and habitat. Consideration needs to be given, for example, to combinations that are most common or most sensitive to a given impact. It should be remembered that other research, into e.g. water quality or biodiversity, might be possible on the same site, thus adding to its value.

It is very strongly recommended that all parties to a long-term monitoring programme agree to the objectives, funding, mutual responsibilities and other relevant issues before a monitoring programme begins, and that they enter into a formal agreement which defines each party's role in the programme, including financial and legal constraints.

Some other factors that have to be considered are the following:

— partners and organizations involved, and an assessment of their objectives and long-term commitment;

— existing guides, protocols and quality standards, and the degree to which they satisfy the objectives of the programme;

— access to the sites both in terms of physical and legal aspects (a long-term commitment of owners of the monitoring sites is usually required);

— availability of sites;

— long term storage of the samples and their availability;

— effects of future changes in land use (if this is an important factor), or the landscape in the vicinity of the site(s) since changes might affect the usefulness of the site in the long term;

— the funding of the programme, and its long-term security;

— quality assurance, including documentation (see below);