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Contents

Page

Foreword ... **v**
Introduction ... **vi**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Overall investigation strategy ... **5**
4.1 General ... 5
4.2 Zoning ... 7
4.3 Types of investigation ... 7
4.3.1 General ... 7
4.3.2 Preliminary investigation ... 10
4.3.3 Exploratory investigation ... 11
4.3.4 Detailed investigation ... 11
4.3.5 Supplementary investigations ... 11
4.4 Conceptual site model ... 12
4.5 Preliminary risk assessment ... 12
5 Sampling strategies — General aspects ... **13**
5.1 Sampling objectives ... 13
5.2 Scope of the sampling strategy ... 13
5.3 Designing the sampling strategy ... 14
5.4 Principal sampling situations ... 15
5.5 Representative and sufficiently representative samples ... 16
5.6 Characteristics of the spatial distribution ... 17
5.7 Statistical aspects ... 18
5.8 Uncertainty of measurements caused by sampling and analysis ... 18
5.9 Safety and environmental protection ... 19
5.10 Barriers to sampling ... 19
5.11 Timing of investigations ... 19
6 Sampling strategies — Key aspects and concepts ... **20**
6.1 Statistics and geostatistics ... 20
6.1.1 General ... 20
6.1.2 Statistics ... 20
6.1.3 Geostatistics ... 20
6.2 Approaches to sampling ... 22
6.2.1 General ... 22
6.2.2 Judgemental sampling ... 22
6.2.3 Systematic sampling ... 23
6.2.4 Convenience sampling ... 23
6.3 Average properties ... 24
6.4 Types of samples ... 24
6.4.1 General ... 24
6.4.2 Disturbed and undisturbed samples ... 24
6.4.3 Spot (single) samples ... 25
6.4.4 Cluster samples ... 25
6.4.5 Spatial (composite) samples ... 25
6.4.6 Selective samples ... 27
6.5 Number of samples ... 27
6.5.1 General ... 27
6.5.2 Number of samples at discrete sampling points ... 28
6.5.3 Number of cluster samples ... 28
6.5.4 Number of composite samples ... 28
6.6 Sample sizes ... 29

საინფორმაციო ნაწილი. სრული ტექსტის სანახავად შეიძინეთ სტანდარტი.

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6.6.1 General ... 29
6.6.2 Practical considerations ... 30

7 Deciding how many samples to take ... 32
7.1 General ... 32
7.2 Basic situations ... 33
7.3 Determining average concentrations ... 33
7.3.1 General ... 33
7.3.2 Using spatial composite samples ... 34
7.3.3 Using spot samples ... 35
7.3.4 Determining relation to threshold limit ... 35
7.4 Finding (hot spots and) areas of interest of a specified minimum size ... 35
7.5 Sampling for particular purposes ... 36
7.5.1 Determination of background values ... 36
7.5.2 Waste classification ... 36
7.5.3 Supplementary investigations for remediation ... 36
7.5.4 Validation of remediation and other works ... 37

8 Sampling strategies for in-ground sampling ... 38
8.1 Approach to sampling ... 38
8.2 Sampling patterns ... 38
8.2.1 General ... 38
8.2.2 Potentially contaminated sites ... 39
8.2.3 Hot spot detection, site investigation design and sampling ... 40
8.3 Types of samples ... 41
8.4 Sampling depths ... 42
8.4.1 General ... 42
8.4.2 Potentially contaminated sites ... 42
8.4.3 Sampling in relation to the groundwater profile and aquifer ... 43
8.5 Size of samples ... 44
8.6 Number of samples ... 45
8.6.1 General ... 45
8.6.2 Number of samples at individual sampling points ... 45
8.6.3 Number of composite samples ... 45

9 Sampling of above-ground deposits ... 46
9.1 General ... 46
9.2 Sampling patterns ... 46
9.3 Types of sample ... 46
9.3.1 General ... 46
9.3.2 Convenience sampling ... 47
9.4 Sampling depths ... 47
9.5 Size of samples ... 47
9.6 Number of samples ... 47

Annex A (informative) **Basic statistical concepts ... 48**
Annex B (informative) **Sampling patterns ... 54**
Annex C (informative) **Assessment and modification of sampling uncertainty ... 68**
Annex D (informative) **Examples of sampling for particular purposes ... 72**
Annex E (informative) **Scale of sampling ... 77**
Annex F (informative) **Determination of size and number of samples and increments ... 82**
Annex G (informative) **Statistical methods for estimating soil parameters ... 90**
Annex H (informative) **Geostatistical methods for sampling design and evaluation of soil quality ... 103**
Annex I (informative) **Sampling strategies for risk assessment ... 119**
Bibliography ... 129

საინფორმაციო ნაწილი. სრული ტექსტის სანახავად შეიძინეთ სტანდარტი.

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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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The committee responsible for this document is ISO/TC 190, *Soil quality*, Subcommittee SC 2, *Sampling*.

This first edition of ISO 18400-104, together with ISO 18400-101, ISO 18400-102, ISO 18400-105, ISO 18400-107, ISO 18400-202, ISO 18400-203 and ISO 18400-206, cancels and replaces the first editions of ISO 10381-1:2002, ISO 10381-4:2003, ISO 10381-5:2005, ISO 10381-6:2009 and ISO 10381-8:2006, which have been structurally and technically revised.

The new ISO 18400 series is based on a modular structure and cannot be compared to the ISO 10381 series clause by clause.

A list of all parts in the ISO 18400 series can be found on the ISO website.

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.

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Introduction

This document is part of a series of sampling standards for soil (the role/position of the individual standards within the total investigation programme is shown in Figure 1). It provides guidance on the development of site investigation strategies in general (more specific guidance is given in other standards) and of sampling strategies [e.g. what to sample, where to sample (locations and depths) and the types of samples to take] taking into account the need to obtain representative samples and to have regard to relevant statistical principles.

Soils (and other soil materials) are composed of a mixture of mineral particles, organic matter, water, air (soil gas) and living organisms. In the case of some contaminated soils, a non-aqueous liquid phase might also be present. The solid matrix (phase), consists of particles of different size, shape and physical and chemical properties. The aim when carrying out soil sampling is usually to obtain sufficiently representative samples that can be used to characterize the properties of the whole soil entity (e.g. *in situ* soil in the form of a volume or horizon, or surface deposit such as a stockpile) or the portion considered relevant to the objectives of the investigation (e.g. <0,1 mm fraction for exposure assessment via hand-to-mouth activity). The properties of discrete entities such as individual soil particles are not addressed. As the soil as a whole cannot be analysed, soil samples are taken instead. The assumption that the results of these investigations on samples represent the total soil volume of interest is always an approximation, the reliability of which depends on additional information about the soil, the site and use of an appropriate sampling strategy. In other words, the sampling strategy should guarantee that, together with additional information (on-site observations, background information, previous investigation results, etc.), the results for the samples analysed allow a model to be developed of relevant properties of the soil volume of interest to a sufficiently reliable degree, in accordance with the investigation objectives.

Whatever the purpose of the investigation, a sound conceptual site model is required. Every property of a soil or soil material is a result of their dynamic development influenced by natural and human-induced processes such as weathering, leaching, dislocation, contamination, and many others. Without considering this, the results of any investigation of samples cannot be interpreted and evaluated properly. When spatial variability of soil properties (including contamination) is of particular interest, the conceptual site model includes what is known, or believed to be known, about the processes that led to the anticipated spatial distribution of properties.

The sampling strategy, especially when average properties are of interest, is preferably based on statistical methods, as far as practical and appropriate.

Having first defined key elements such as involved parties, objectives, properties of interest, phase of the investigation, background and site information, as well as health and safety aspects, a sampling strategy is developed that can form the basis of a sampling plan in accordance with ISO 18400-101 (the sampling plan covers a number of practical issues as well as the sampling strategy).

The appropriate sampling strategy in any particular case depends on

— the objectives of the investigation,

— the special situation and characteristics of the material to be sampled,

— the properties of interest, and

— the required degree of precision and reliability of the results.

Many other factors can also influence the design of the sampling strategy including:

— accessibility of the site as well as the sampled material;

— financial, personnel, and technical resources;

— weather conditions;

— the time schedule/frame;

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— legal/environmental restrictions.

Following the definition of the sampling approach, the appropriate sampling techniques are selected following the guidance in ISO 18400-102 with regard to health and safety (ISO 18400-103) and various practical considerations. The decisions made regarding sampling techniques form part of the sampling plan.

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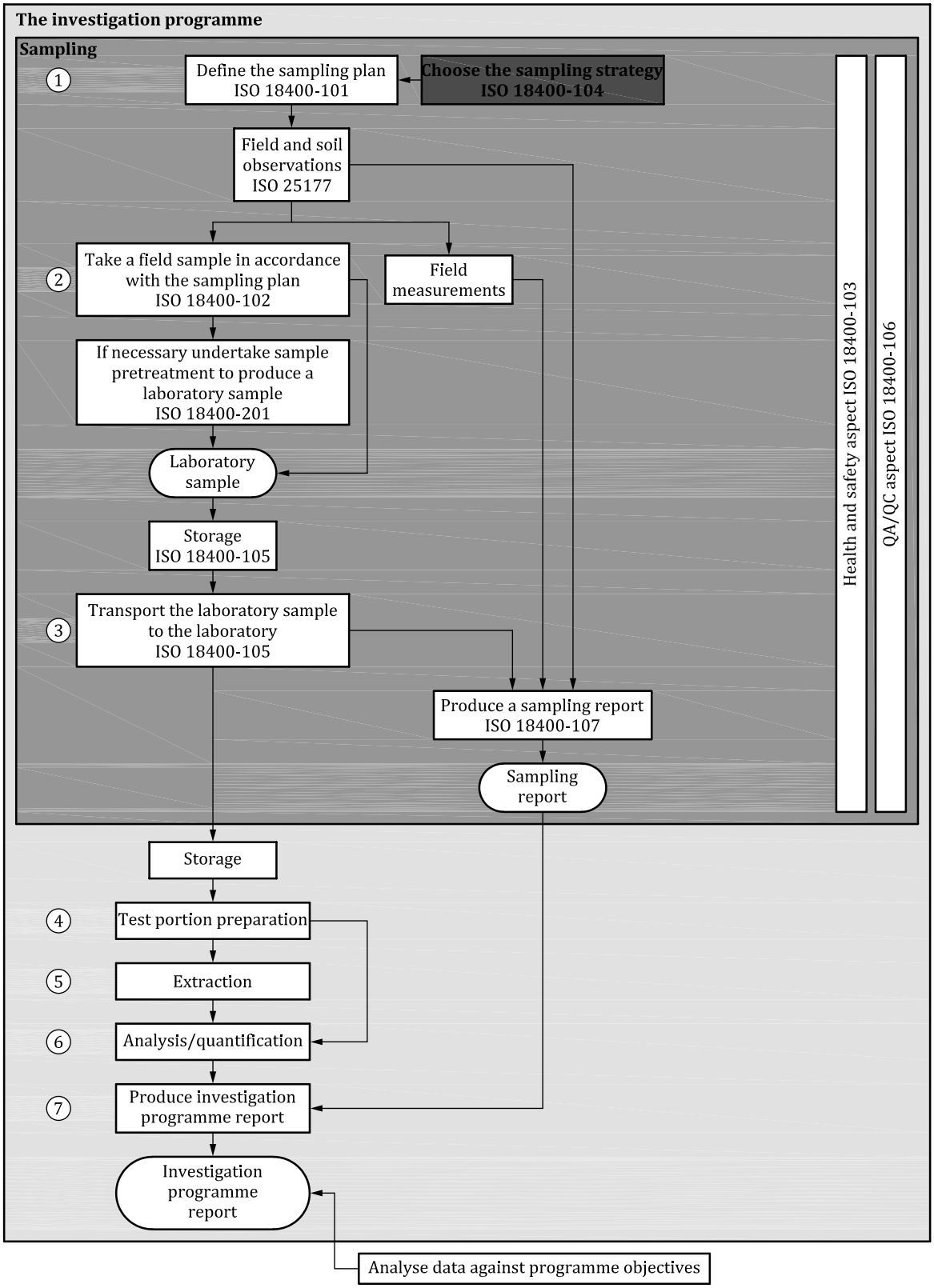

NOTE 1 The numbers in circles in Figure 1 define the key elements (1 to 7) of the investigation programme.

NOTE 2 Figure 1 displays a generic process which can be amended when necessary.

Figure 1 — Links between the essential elements of an investigation programme

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