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Standard Guide for Determination of Representative Sediment Background Concentrations[1]

This standard is issued under the fixed designation E3242; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide focuses on the approach for determination of representative sediment background concentrations used for remedial actions performed under various regulatory programs, including the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Although many of the references cited in this guide are CERCLA oriented, the guide is applicable to remedial actions performed under local, state, federal, and international cleanup programs. However, the guide does not describe requirements for each jurisdiction. The requirements for the regulatory entity under which the cleanup is performed should be reviewed to confirm compliance.

1.2 This guide provides a framework, including specific statistical and geochemical considerations, as well as case studies, demonstrating the approach to determine representative sediment background concentrations. This guide is intended to inform, complement, and support, but not supersede, local, state, federal, or international regulations.

1.2.1 This guide does not address methods and means of data collection (Guide E3163, Guide E3164.)

1.2.2 This guide is designed to apply to contaminated sediment sites where sediment data have been collected and are readily available. Additionally, this guide assumes that risk assessments have been performed, so that the contaminants/chemicals of interest that exceed risk-based thresholds have been identified.

1.2.3 Furthermore, this guide presumes that risk-based thresholds identified are low enough to pose corrective action implementation challenges, and/or the site is subject to recontamination from ongoing anthropogenic and/or natural sources that are not controlled. In both cases, representative sediment background concentrations will be useful for determining the extent of corrective remedial actions (when used as remedial goals), evaluating risks posed by representative background concentrations, and establishing appropriate post-remedial monitoring plans.

1.3 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D6312 Guide for Developing Appropriate Statistical Approaches for Groundwater Detection Monitoring Programs at Waste Disposal Facilities

D7048 Guide for Applying Statistical Methods for Assessment and Corrective Action Environmental Monitoring Programs

E178 Practice for Dealing With Outlying Observations

E1689 Guide for Developing Conceptual Site Models for Contaminated Sites

E3163 Guide for Selection and Application of Analytical Methods and Procedures Used during Sediment Corrective Action

E3164 Guide for Sediment Corrective Action – Monitoring

3. Terminology

3.1 *Definitions:*

[1] This guide is under the jurisdiction of ASTM Committee E50 on Environmental Assessment, Risk Management and Corrective Action and is the direct responsibility of Subcommittee E50.04 on Corrective Action.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.1.1 *anthropogenic background, n*—natural and human-made substances present in the environment as a result of human activities, not specifically related to the site release in question. **(1)**[3]

3.1.2 *arithmetic mean, n*—a measure of central tendency that is the sum of observed values in the sample divided by the sample size.

3.1.3 *distribution, n*—in statistics, a set of all values that individual observations may acquire and the frequency of their occurrence in the sample or population.

3.1.4 *false negative error, n*—also known as "Type II" error. For the purposes of this guide, in site versus background comparisons, the error that occurs when the statistical procedure does not indicate concentrations above background, when such concentrations are present.

3.1.5 *false outlier, n*—measurements that are very large or small relative to the rest of the data, but represent true extreme values of a distribution and indicate more variability in the population than was expected. **(2)**

3.1.6 *false positive error, n*—also known as "Type I" error. For the purposes of this guide, in site versus background comparisons, the error that occurs when the statistical procedure indicates concentrations above background, when such concentrations are not present.

3.1.7 *high nondetect, n*—a nondetect concentration that resides in the upper decile of the analyte's distribution (that is, above the 90th percentile of the data set).

3.1.8 *median, n*—in statistics, the value below which 50 % of a sample or population falls.

3.1.9 *nonparametric, adj*—a term referring to a statistical technique in which the distribution of the constituent in the population is unknown and is not restricted to be of a specified form (Guide D7048).

3.1.10 *outlier, n*—see *outlying observation*.

3.1.11 *outlying observation, n*—an extreme observation in either direction that appears to deviate markedly in value from other members of the sample in which it appears (Practice E178).

3.1.12 *parametric, adj*—a term referring to a statistical technique in which the distribution of the constituent in the population is assumed to be known (Guide D7048)

3.1.13 *probability plot, n*—a plot of ascending observations in a sample, versus their corresponding cumulative probabilities, based on a specified distribution function.

3.1.14 *representative background concentrations, n*—a chemical concentration that is inclusive of naturally occurring sources and anthropogenic sources, similar to those present at a site, but not related to site releases and site-related activities (Guide E3164).

3.1.15 *sample, n*—in statistics, a group of observations taken from a population that serve to provide information that may be used as a basis for making a decision concerning the population.

3.1.16 *sample size, n*—in statistics, the number of observations or measurements in the sample.

3.1.17 *sediment(s), n*—a matrix of pore water and particles including gravel, sand, silt, clay and other natural and anthropogenic substances that have settled at the bottom of a tidal or nontidal body of water (Guide E3163).

3.1.18 *significance, n*—in statistical hypothesis testing, the probability of the test rejecting the null hypothesis, when the null hypothesis is actually true.

3.1.19 *tolerable error rate, n*—the specified maximum acceptable error rate set by the decision maker.

3.1.20 *true outlier, n*—measurements that are very large or small relative to the rest of the data, but are a result of transcription errors, data-coding errors, or measurement system problems. **(2)**

3.1.21 *upper confidence limit (UCL), n*—an upper limit of an estimated value, such as the mean, that has a specified probability of including the true value, with a specified confidence level.

3.1.22 *upper percentile, n*—the value below which a specified percentage of observed values falls.

3.1.23 *upper prediction limit (UPL), n*—the value below which a specified number of future independent measurements will fall, with a specified confidence level.

3.1.24 *upper tolerance limit (UTL), n*—the value below which a specified percentage of observed values falls, with a specified confidence level.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *background reference areas, n*—for the purposes of this guide, sediment areas that have similar physical, chemical, geological, biological, and land-use characteristics as the site being investigated, but are not affected by site-related releases and/or activities.

3.2.2 *background threshold value (BTV), n*—for the purposes of this guide, a measure of the upper limit of representative background concentrations.

3.2.3 *cleanup level, n*—for the purposes of this guide, the prescribed average or point sediment concentration of a chemical that shall not be exceeded at the remediated site.

3.2.4 *conceptual site model (CSM), n*—for the purposes of this guide, the integrated representation of the physical and environmental context, the complete and potentially complete exposure pathways and the potential fate and transport of potential contaminants of concern at a site.

3.2.4.1 *Discussion*—The CSM should include both the current understanding of the site and an understanding of the potential future conditions and uses for the site. It provides a method to conduct the exposure pathway evaluation, inventory the exposure pathways evaluated, and determine the status of the exposure pathways as incomplete, potentially complete, or complete.

3.2.5 *population, n*—for the purposes of this guide, in statistics, a comprehensive set of values consisting of all possible observations or measurements of a certain phenomenon from which a sample is to be drawn.

[3] The boldface numbers in parentheses refer to a list of references at the end of this standard.

3.2.6 *potential contaminant of concern (PCOC), n*—for the purposes of this guide, a contaminant whose sediment concentrations at the site may exceed applicable screening levels; this includes chemicals of potential environmental concern (COPECs) and chemicals of potential concern (COPCs).

3.2.7 *reference element, n*—for the purposes of this guide, a major element that represents the mineral to which a trace element may be adsorbed.

3.2.8 *trace element, n*—for the purposes of this guide, an element defined as generally being present at less than 0.1 weight percent in the sediment sample; its natural concentrations are typically one or more orders of magnitude lower than those of the reference elements.

4. Significance and Use

4.1 *Intended Use:* This guide may be used by various parties involved in sediment corrective action programs, including regulatory agencies, project sponsors, environmental consultants, toxicologists, risk assessors, site remediation professionals, environmental contractors, and other stakeholders.

4.2 *Related ASTM Standards:* This guide is related to Guide E3164, which addresses corrective action monitoring before, during, and after sediment remediation activities; as well as Guide E3163, concerning sediment analytical techniques used during sediment programs.

4.3 *Use of Representative Background to Set a Boundary:* Representative background concentrations for sediments can be used to delineate a sediment corrective action, establishing the boundary of the sediment corrective action by distinguishing site-related impacts from representative background concentrations.

4.4 *Use of Representative Background to Establish Cleanup Levels:* Representative background concentrations for sediments can also be used to establish cleanup levels for use in sediment corrective actions. In cases where risk-based sediment cleanup levels are below representative background concentrations, background concentrations are typically used as the cleanup level. This ensures that the cleanup levels are sustainable. Any recontamination from ongoing sources will eventually result in surface sediment concentrations greater than the risk-based cleanup level, but the surface sediment should still meet a cleanup level based on representative background concentrations, even after recontamination.

4.5 *Use of Representative Background in Risk Assessments:* Representative background concentrations can be used in the risk assessment process (including human and ecological risk assessments) to understand risks posed by background levels of contaminants to human health and the environment, and the incremental risks posed by site-related releases and/or activities that result in sediment concentrations that exceed representative background concentrations. Conversely, they can be used to estimate the risk reduction for various contaminants, if sediment is remediated from existing PCOC concentrations to lower values (that is, representative background concentrations).

4.6 *Use of Representative Background in Long-Term Monitoring Programs:* Long-term monitoring programs can also use representative background concentrations in sediment, either as a corrective action target or to understand how post-corrective action concentrations compare to sources not attributable to site releases and/or activities. Typically, source control actions taken to ensure that site-related releases are controlled and will not re-contaminate the post-corrective action sediments must be developed based on an understanding of ongoing contributions from representative background. Ongoing sources not related to site-related releases and/or activities (that may or may not be subject to source control actions) must be considered in this evaluation.

4.7 *Importance of the CSM:* The users of this guide are encouraged to continuously update and refine the CSM used to describe the physical properties, chemical composition and occurrence, biologic features, and environmental conditions of the sediment corrective action project (Guide E1689).

4.8 *Reference Material:* This guide should be used in conjunction with other reference material (refer to Section 2 and References at the end of this guide) to direct the user in developing and implementing sediment corrective action programs.

4.9 *Flexible Site-Specific Implementation:* This guide provides a systematic, but flexible, framework to accommodate variations in approaches by regulatory agencies and by the user based on project objectives, site complexity, unique site features, regulatory requirements, newly developed guidance, newly published scientific research, changes in regulatory criteria, advances in scientific knowledge and technical capability, and unforeseen circumstances.

4.10 *Systematic Project Planning and Scoping Process:* When applying this guide, the user should undertake a systematic project planning and scoping process to collect information to assist in making site-specific, user-defined decisions for a particular project, including assembling an experienced team of project professionals (that is, experienced practitioners familiar with current sediment site characterization and remediation techniques, as well as geochemistry, and statistics). These practitioners should have the appropriate expertise to scope, plan, and execute a sediment data acquisition and analysis program. This team may include, but is not limited to, project sponsors, environmental consultants, toxicologists, site remediation professionals, analytical chemists, geochemists, and statisticians.

5. Importance of Representative Background

5.1 At many sediment sites, multiple sources may contribute to the nature and extent of contamination. The largest contribution of contamination at sediment sites is typically attributed to site releases and/or activities. However, contamination can also result from natural and ongoing anthropogenic sources not related to site releases and/or activities. Discharges from combined sewer overflows (CSOs), industrial outfalls, surface runoff, and/or storm sewer systems (municipal and private) are examples of ongoing anthropogenic sources that may be unrelated to site releases and/or activities.