Designation: E3344 – 22

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

This standard is issued under the fixed designation E3344; 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 selection of sediment background reference areas from aquatic environments for the purpose of determining representative sediment background concentrations. These concentrations are typically used in contaminated sediment corrective 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, tribal, federal, and international cleanup programs. However, this guide does not describe the requirements for each jurisdiction.

1.1.1 The sediment background reference areas chosen using this guide will need to be approved by the regulatory agency having jurisdiction (or they should take no exception to the areas chosen), especially if the representative background sediment concentrations will potentially be used to develop sediment remedial criteria.

1.2 This guide provides a framework to select appropriate sediment background reference areas for collection of sediment data in the determination of representative sediment background concentrations. It is intended to inform, complement, and support, but not supersede, local, state, tribal, federal, or international guidelines.

1.2.1 This guide is designed to apply to contaminated sediment sites where sediment data have been collected and are readily available. Additionally, it assumes that risk assessments have been performed, so that the potential contaminants of concern (PCOCs) that exceed risk-based thresholds have been identified. This guide can be applied at multiple points within the project life cycle (such as site assessment and remedial design).

1.2.2 Furthermore, this guide presumes that the identified risk-based thresholds are low enough to pose corrective action implementation challenges or that the sediment site is subject to recontamination from ongoing anthropogenic or natural sources that are not controlled. In either case, representative sediment background concentrations are 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.

1.2.3 A case study for selecting a background reference area using a tiered decision analysis approach is presented in Appendix X1. It compares various characteristics of a hypothetical sediment site associated with a former manufactured gas plant (MGP) facility to three candidate background reference areas and identifies the reference area that best satisfies the decision analysis objectives.

1.3 Methodologies used to determine representative background concentrations at contaminated sediment sites are not discussed in this guide—refer to Guide E3242 for a discussion of these methodologies.

1.4 *Related ASTM Standards*—This guide is related to Guide E3242, which provides a framework for determination of representative sediment background concentrations, including statistical and geochemical considerations. This guide is also related to Guide E3164, which addresses corrective action monitoring before, during, and after sediment remediation activities, as well as Guide E3163, which concerns sediment sampling and analytical techniques used during sediment corrective action projects. Guide D4823, which concerns sediment core sampling, is also related to this guide.

1.4.1 Specifically, this guide is intended to be used in conjunction with the framework to calculate representative background values outlined in Guide E3242, to help ensure appropriate background reference areas are chosen for use in representative background concentration calculations.

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

1.6 *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] 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.

Current edition approved Aug. 1, 2022. Published September 2022. DOI: 10.1520/E3344–22

1.7 *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]

D4823 Guide for Core Sampling Submerged, Unconsolidated Sediments

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

E3240 Guide for Risk-Based Corrective Action for Contaminated Sediment Sites

E3242 Guide for Determination of Representative Sediment Background Concentrations

3. Terminology

3.1 *Definitions:*

3.1.1 *background conditions (aka reference conditions), n*—substances, conditions, or locations that are not influenced by releases from a site; are usually naturally occurring (consistently present in the environment, but not influenced by human activity) or anthropogenic (influenced by human activity, but not related to specific activities at the site). **E3164**

3.1.2 *background reference areas, n*—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. **E3242**

3.1.3 *cleanup level, n*—the prescribed average or point sediment concentration of a chemical that shall not be exceeded at the remediated site. **E3242**

3.1.4 *conceptual site model (CSM), n*—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. **E3242**

3.1.4.1 *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.

3.1.5 *population, n*—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. **E3242**

3.1.6 *potential contaminant of concern (PCOC), n*—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). **E3242**

3.1.7 *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. **E3164**

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

3.1.9 *sediment site, n*—the area(s) defined by the likely physical distribution of COC(s) from a source area and the adjacent areas required to implement the corrective action. A site could be an entire water body or a defined portion of a water body. **E3240**

3.1.10 *trace element, n*—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. **E3242**

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *anthropogenic background, n*—for the purposes of this guide, human-made substances present in the environment due to human activities, not specifically related to current or historical site-related releases or activities (**1**).[3]

3.2.1.1 *Discussion*—The definition of "anthropogenic background" varies with jurisdiction. In some jurisdictions, the regulator defines anthropogenic background as having both human-made and naturally occurring substances. In this guide, the definition of anthropogenic background includes only the human-made substances.

3.2.2 *biological reference areas, n*—for the purposes of this guide, a location that is representative of background conditions resulting from localized and regional pollutant inputs but is not affected by site-related releases or activities, which is used to collect biological samples (such as fish and shellfish tissue, benthic community organisms) and sediment for laboratory bioassay testing (such as toxicity or bioaccumulation testing).

3.2.2.1 *Discussion*—A biological reference area can also serve as a background reference area, if sediment samples are also submitted for chemical analysis of PCOCs.

3.2.3 *natural background, n*—for the purposes of this guide, naturally occurring substances present in the environment in forms (and at concentrations) that have not been influenced by human activity (**1**).

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

3.2.4 *urban runoff, n*—for the purposes of this guide, a non-point source of contaminants to the water body.

3.2.4.1 *Discussion*—Typically, this is stormwater from city streets and adjacent properties that carries contaminants into receiving waters directly, or indirectly via sewer systems (**2**).

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 *Importance of the CSM*—The CSM should be continuously updated and refined to describe the physical properties, chemical composition and occurrence, biologic features, and environmental conditions of the sediment corrective action project (Guide E1689).

4.3 *Reference Material*—This guide should be used in conjunction with other ASTM guides listed in 2.1 (especially Guide E3242); this guide should also be used in conjunction with the material in the References at the end of this guide (including **3**). Utilizing these reference materials will direct the user in deriving representative sediment background concentrations.

4.4 *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.

4.5 *Regulatory Frameworks*—This guide is intended to be applicable at a broad range of local, state, tribal, federal (such as CERCLA), or international jurisdictions, each with its own unique regulatory framework. As such, this guide does not provide a detailed discussion of the requirements or guidance associated with any of these regulatory frameworks, nor is it intended to supplant applicable regulations and guidance. The user of this guide will need to be aware of the regulatory requirements and guidance in the jurisdiction where the work is being performed.

4.6 *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.

4.6.1 Depending on the regulatory requirements in a jurisdiction, the choice of background reference areas may need to consider critical habitats and ecological receptors.

4.6.2 In this guide, sediment (3.1.8) is defined as material being found at the bottom of a water body. Upland soils of sedimentary origin are excluded from consideration as sediment in this guide.

4.7 *Other Considerations*—This guide does not cover all components of a program to derive representative sediment background concentrations.

4.7.1 Sediment sampling and laboratory analyses are not covered in this guide. Guide E3163 contains extensive information concerning sediment sampling and laboratory analyses.

4.7.2 Data quality objectives are not covered in this guide. Data quality objectives are described in (**4**).

4.7.3 Background study design considerations are not covered in this guide but are described in other references, including Guides E3163 and E3164, as well as (**5**).

4.7.4 Data extraction methodologies to obtain representative background concentrations from sediment site data sets are not covered here, but are explained in Guide E3242. Identification and removal of outliers from data sets are discussed in detail in Guide E178, as well as Guide E3242. Other statistical and geochemical methods used in deriving representative background concentrations are also discussed in Guide E3242.

4.7.5 Geospatial analysis considerations are not thoroughly discussed in this guidance but are discussed in more depth relative to environmental evaluations in (**6**), which focuses on quality assurance concerns relative to geospatial analyses.

4.7.6 In this guide, only the concentrations of PCOCs are considered to be in scope. Residual background radioactivity is considered to be out of scope for this guide.

4.8 *Structure and Components of this Guide*—The user of this guide should review the overall structure and components of this guide before proceeding with use, including:

Section 1	Scope
Section 2	Referenced Documents
Section 3	Terminology
Section 4	Significance and Use
Section 5	Overview of Representative Background Concentrations and Calculation Process
Section 6	Background Reference Area Selection Criteria
Section 7	Keywords
Appendix X1	Case Study
References	

5. Overview of Representative Background Concentrations and Calculation Process

5.1 *Importance of Representative Background Concentrations:*

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

5.1.2 Off-site contamination not associated with site releases or activities is considered a component of representative background concentrations and will continue to be a source of contamination to the sediment site, unless all transport pathways onto the sediment site are eliminated. A primary objective of determining representative background concentrations is to account for any background chemical input (both natural and anthropogenic) that is expected to continue migrating onto the sediment site after the completion of corrective actions. It is recognized that one of the important principles for management of contaminated sediment sites is the control of background sources of contamination, to the greatest extent practicable, prior to the initiation of corrective actions at the sediment site. However, it is rarely practicable to control all background sources.

5.1.3 Technically defensible representative background concentrations are those that reflect chemical inputs to a sediment site from natural and ongoing anthropogenic sources unrelated to site releases or activities. In addition to informing or establishing cleanup levels, representative background concentrations can assist in determining sediment site boundaries, understanding risks at a sediment site due to background concentrations, establishing and optimizing realistic long-term monitoring plans, and assessing the performance of corrective actions (Guide E3242).

5.1.4 In the absence of technically defensible representative background concentrations, risk-based cleanup levels may be used inappropriately at sediment sites where representative background concentrations are actually greater than the risk-based cleanup levels. Similarly, if the representative background concentrations have been erroneously calculated, inappropriately low cleanup goals could be used in the corrective action evaluation process. Under both circumstances, sediment sites will eventually return to representative background concentrations after corrective actions are completed and cleanup goals will again be exceeded. Due to exceedances of the inappropriately low cleanup goals, the corrective actions would be perceived as failures.

5.1.5 Attempting to implement corrective actions to achieve concentrations less than representative background is not sustainable over the long-term and can require considerable expenditures that serve no environmental or public health purpose. The process described in Guide E3242 is intended to help promote a scientifically sound approach for establishing representative background concentrations, leading to corrective action decisions that avoid costly perceived corrective action failures at sediment sites. The subject of this guide, the selection of suitable background reference areas, is a critical component of the process outlined in Guide E3242.

5.2 *Overview of Process to Calculate Representative Background Concentrations in Sediment:*

5.2.1 Fig. 1 presents the overall framework to calculate representative background concentrations at a sediment site; this process is presented in detail in Guide E3242. As a first step, a thorough understanding of the sediment site is necessary before calculating representative background concentrations. This can be accomplished by developing a CSM (refer to Guide E3164). As part of this CSM, the sediment site PCOCs must be identified.

5.2.2 Once the preliminary sediment site CSM has been developed, a suitable background reference area (or areas) can be identified for sampling (that is, the second step in Fig. 1); this second step is the focus of this guide.

5.2.3 Once analytical data are available for the background reference area sediment samples, the methodologies described in detail in Guide E3242 can be utilized to calculate representative background concentrations for the PCOCs.

6. Background Reference Area Selection Criteria

6.1 *Selection Rationale*—Sediment sites are dynamic in nature; they are constantly receiving suspended sediment from off-site sources. The background reference area (or areas) used to calculate representative sediment background concentrations should have physical, geological, anthropogenic (land-use), chemical, and biological characteristics that are as similar as possible to the sediment site. Importantly, the background reference areas should not be influenced by current or historical site-related activities and releases, but they should include ongoing sources that contribute to regional contamination, including ongoing sources at the sediment site. Typically, any selected background reference area should not have been designated as a contaminated sediment site (that is, contaminated from its own current or historical site-related activities and releases) by a regulatory agency.

6.1.1 When there are multiple characteristics to consider, categorizing and ranking important characteristics can aid in background reference area selection decisions. Examples of the characteristics where the similarity between sediment site and the candidate background reference areas could be evaluated are summarized in Table 1; these are grouped into three categories in the table and the characteristics in each category are discussed in more detail in the following sub-sections. The characteristics used in the evaluation process will depend on site-specific project goals; they could include all of these example characteristics, some of these example characteristics, or characteristics not listed in Table 1.

6.2 *Location*—Specific example characteristics related to this category are listed in Table 1 and discussed in detail in Table 2, which also provides references to related ASTM documents and the scientific literature.

6.2.1 Pragmatically, the candidate background reference area (or areas) should be as close to the sediment site as possible, without being affected by any site-related impacts. Background reference areas farther away from the sediment site may have a different set of ambient conditions compared to conditions nearby (or adjacent to) the sediment site.

6.2.2 In addition to off-site background reference areas, it may be helpful to include background samples from unimpacted areas of the sediment site, if available. This methodology is known as “background extraction” and is discussed in detail in Guide E3242.

6.2.3 Notably, selection of a background reference area can be complicated because sediment background concentrations

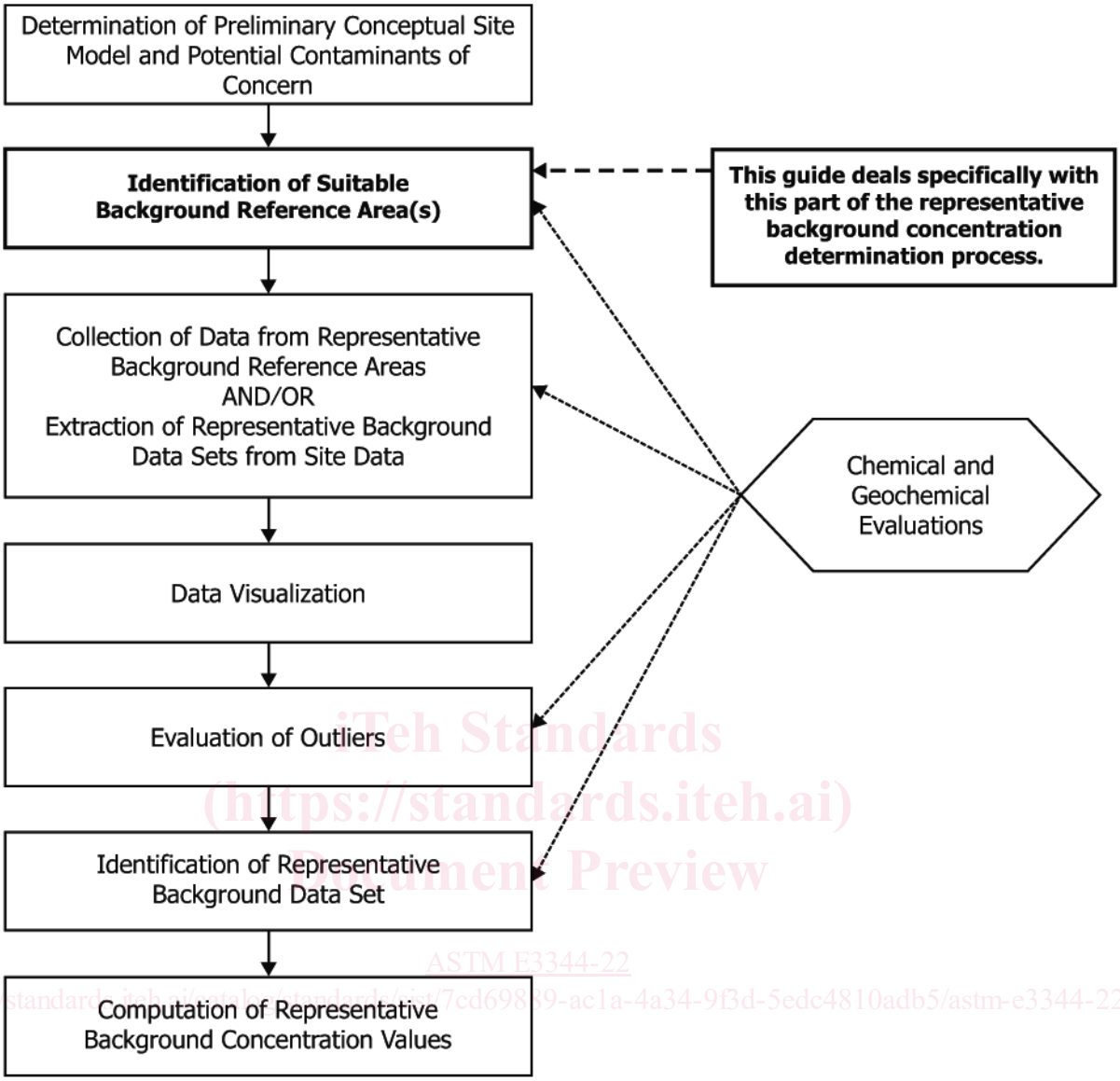

FIG. 1 Process to Determine Representative Sediment Background Concentrations (Modified from Guide E3242)

TABLE 1 Example Sediment Background Reference Area Characteristics

Characteristic Category	Characteristics
Location	• Proximity to sediment site (distance from sediment site and geographic location) • Geologic setting (compared to sediment site geology) • Proximity to contaminated upland property (where the upland property is not adjacent to the subject sediment site)
Sediment Properties	• Hydrodynamics and sediment transport (sediment movement and stratification) • Sediment source material (PCOC concentrations) • Naturally occurring modifying features (such as sediment deposition rates) • Geochemistry (PCOC concentrations)
Land Use and Other Anthropogenic Impacts	• Type of land use (degree of urbanization) • Permitted point sources (industrial outfalls, CSOs, stormwater sewer outfalls) • Diffuse sources (stormwater runoff, atmospheric deposition) • Anthropogenic modifying features (such as shoreline infrastructure)

often represent mixtures of naturally occurring and anthropogenic influences. In some cases, these mixtures yield geographically distinct background populations, such that the background reference area has sub-areas with varying degrees of anthropogenic influences. Under such situations, the portion of the targeted background reference area (or sub-areas) most

TABLE 2 Background Reference Area Selection Characteristics – Location

Characteristic	Description	Considerations	References from Other ASTM Documents and Literature
Proximity to sediment site	• It is advantageous to have the candidate background area be located in close proximity to the sediment site, in the same watershed.	• Increases chances candidate background reference areas will have similar geology and other ambient conditions to the sediment site.	E3164 X2.2.5 and X2.2.6
Geologic setting	• The underlying geology of an area, to a large degree (and depending on the climate), determines the physical and chemical makeup of sediment particles. Different geological formations have different rock types (examples include sandstone, basalt, and gneiss), which contain different mineral assemblages and different elemental concentrations. • Physical and chemical weathering of these rocks results in different dominant particle sizes (such as clay versus sand), as well as different geochemistry (such as trace metal concentrations).	• Sediment particle size and chemistry are related to chemical transport and fate. Ensuring similar geologic settings at the sediment site and candidate background reference areas minimizes differences that may affect the natural component of representative background chemical concentrations. • Background reference areas with significantly different geology from the sediment site should be avoided.	E3242 7.3.1 and E3163
Proximity to contaminated upland site	• Sediment adjacent to a contaminated upland site that is not the subject sediment site may have elevated concentrations of some PCOCs associated with that upland site.	• Sediment contaminated by an upland property that is not adjacent to the subject sediment site may not be suitable for use as a background reference area. Concentrations of some PCOCs in the candidate background reference area may be elevated relative to representative background values.	E3164 X2.2.5 Geiselbrecht et al. **(7)**

analogous to the sediment site must be selected as the background reference area. Any other choice would result in unrepresentative background data sets.

6.3 *Sediment Properties*—Specific example characteristics related to this category are listed in Table 1 and discussed in detail in Table 3, which also provides references to related ASTM documents and the scientific literature.

6.3.1 Sediment properties strongly influence the distribution of naturally occurring and anthropogenic background chemicals in the environment; these properties are described in detail in Guide E3164. Sediment properties have a direct influence on the fate and transport of chemicals, so properties in the background reference area should be as similar as possible to those at the sediment site.

6.3.2 The sediment properties in Table 3 can be used to inform background reference area selection decisions. It is important to recognize that site-specific differences related to sediment properties such as hydrodynamics, sediment transport, naturally occurring modifying features, and sediment geochemistry are inherently spatially and temporally variable.

6.3.3 Sediment site and candidate background reference area geochemistry should be as similar as possible. Determining the degree of similarity is complex and should be done by experienced geochemists in support of background reference area selection.

6.3.3.1 For example, sediment at the site and candidate background reference areas might have similar total organic carbon concentrations. However, if the organic carbon at the sediment site is primarily composed of soot carbon from fuel combustion, while the organic carbon at the candidate background reference area is primarily composed of labile organic material from CSOs, then the geochemical differences between the two organic carbon types might be significant enough that this would weigh against the selection of this candidate area as a background reference area.

6.3.3.2 Guide E3242 provides a detailed discussion of geochemical processes relevant to background data evaluation, including association of elements with minerals, sorption of elements on mineral surfaces, and water–mineral interactions. Element concentrations in sediments are controlled by adsorption/desorption ("sorption"), as well as dissolution/precipitation reactions and other processes.

6.4 *Land Use and Anthropogenic Impact*—Specific example characteristics related to this category are listed in Table 1 and discussed in detail in Table 4, which also provides references to related ASTM documents and the scientific literature.

6.4.1 Historical and current land use in the vicinity of the sediment site contributes to sediment PCOC concentrations, so it is important to understand and articulate these features in the CSM to help guide the selection of appropriate background reference areas.

6.4.2 Sediment sites are often affected by legacy contributions and point-source releases within the watershed. These sediment sites are often located within urban areas, with multiple potential sources of additional ongoing contaminant inputs from point and non-point sources that are unrelated to the sediment site.

6.4.3 In general, direct discharges are associated with industrial facilities or municipally owned systems discharging wastewater or stormwater to waterbodies via discharge points such as industrial outfalls, stormwater outfalls, and CSOs connected to conveyance systems. Chemical loading from stormwater and wastewater discharges are typically regulated by regulatory programs (such as the Clean Water Act) that may

TABLE 3 Background Reference Area Selection Characteristics – Sediment Properties

Characteristic	Description	Considerations	References from Other ASTM Documents and Literature
Hydrodynamics and sediment transport	• Sediment suspension and settling are a function of the physical configuration of the waterbody, hydrodynamics, and particle size. Shoreline configuration, current velocity and direction, water depth, and sediment surface geomorphology all influence sediment transport. • In general, coarse-grained sediments are deposited in relatively high-energy environments (such as beaches and river channels), whereas fine-grained sediments deposit in lower energy areas (such as offshore, lakes, and more quiescent areas of rivers and streams). • Changes in the hydrodynamic environment and sediment sources can result in distinct sediment stratification. Change in land use over time, such as increasing urbanization, may produce distinct sediment layers with different compositions, particle size distributions, and PCOC concentrations.	Similar hydrodynamic features at background reference areas indicates that there may be some consistency with the sediment particle distribution at the sediment site. •Sediment transport informs an understanding of how background concentrations are distributed by depth. •Fine-grained sediments, which typically have a greater sorption capacity than coarse-grained sediments, will be enriched in more quiescent sediment environments.	E3164 X2.2.6.3 and X2.2.8
Sediment source material	• Erosion of upland soil is a sediment source in the water body. Erosion can be enhanced by land disturbance and increase solids and PCOC loading to the water body.	• Upland soils with similar composition for the sediment site and background reference area indicate that the physical/chemical properties may be somewhat consistent.	Rosgen **(8)**, E3164 X2.2.8 and E3163
Naturally occurring modifying features	• The rates of sediment deposition, erosion and removal, and mixing can vary widely. During these processes, PCOCs present in sediments may be redistributed by the physical mixing of surface and deeper sediments. • Sediment mixing may also occur through bioturbation, which is a function of benthic community structure. • Natural changes to vegetation within a watershed may alter the concentration and types of organic carbon in sediment layers. These can influence the distribution of PCOCs at the sediment site and within candidate background reference areas.	• Naturally occurring modifying features between the sediment site and candidate background reference areas that are as similar as possible should be a consideration for selecting a background reference area.	E3164 X2.2.5.2
Geochemistry	• Geochemical processes act on sediment to influence chemical forms and can vary with environmental parameters such as water depth and dissolved oxygen content. • Fine-grained sediment minerals and organic carbon are strongly associated with greater organic and inorganic PCOC concentrations in most aquatic systems.	• Geochemical conditions of the candidate background reference areas should be as similar as possible to the sediment site when selecting a background reference area. More than one background reference area may be needed to capture the range of geochemical conditions at the sediment site.	E3242 7.3, 12.4, and X2.2, E3164 6.1.4.2 and 6.1.4.3, E3163

set limits for chemical concentrations (or chemical loadings) from these conveyance systems but will not completely eliminate chemicals from within the discharge. Additionally, the regulatory programs associated with waterbody discharges may not measure or exercise authority over contaminants associated with contaminated sediment sites (such as PCBs).

6.4.4 Urban runoff is a non-point source that is a significant contributor of contamination to sediments. In addition to contaminants washed off impervious surfaces during precipitation events that make their way to the water body, urban runoff also contains contaminants from different air/dust deposition sources including global emissions, regional contributions, and local contributions. Urban runoff contains those contaminants most commonly found at sediment sites (PCBs, PAHs, and metals), as detailed in Guide E3164 Appendix X2.

6.4.5 Anthropogenic modifying features (such as bulkheads and dredged navigation channels) may change the geomorphology, sediment source material, and sediment transport dynamics. Generally, if the type and level of anthropogenic modifying features of the candidate background reference area are similar to the sediment site, then this is favorable for the selection of that candidate background reference area.

6.4.5.1 Anthropogenic maritime activities can also affect sediment conditions; propeller wash and other events that disturb the sediment surface will redistribute the sediment and the associated PCOCs.

6.4.6 For sediment sites in urban areas with multiple, temporally variable anthropogenic inputs like CSOs, industrial discharges, stormwater discharges, and surface runoff, samples from several background reference areas located across the region may be useful to help differentiate between sediment site and representative background conditions.

6.5 *Purpose of Biological Reference Areas*—Physical characteristics not only impact the transport and fate of anthropogenic contamination, but also control the characteristics of the aquatic biota present at the sediment site. This is important for putting the selection of suitable background reference areas into the context of the ecological and human health risk assessment, as well as establishing baseline conditions and goals for monitoring of corrective actions (refer to Guide E3164).

6.5.1 CSMs guiding biological reference area selection for ecological risk assessments typically address the relationships of the performance of biological endpoints versus physical