



Designation: E2893 – 16<sup>ε1</sup>

## Standard Guide for Greener Cleanups<sup>1</sup>

This standard is issued under the fixed designation E2893; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

<sup>ε1</sup> NOTE—The adjunct order number for the X2. Technical Summary Form in Writable PDF format was editorially corrected (see 2.4) in January 2017.

### 1. Scope

1.1 Cleaning up *sites* improves environmental and public health conditions and as such can be viewed as “green.” However, *cleanup* activities use energy, water, and natural resources. The process of *cleanup* therefore creates its own *environmental footprint*. This *guide* describes a process for evaluating and implementing activities to reduce the *environmental footprint* of a *cleanup* project in the United States while working within the applicable regulatory framework and satisfying all applicable legal requirements.

1.2 This *guide* may also be used as a process for *sites* that are not located in the United States; however, the specific legal references are not applicable.

1.3 This *guide* describes a process for identifying, evaluating, and incorporating *best management practices* (BMPs) and, when deemed appropriate, for integrating a *quantitative evaluation* into a *cleanup* to reduce its *environmental footprint*.

1.4 This *guide* is designed to be implemented in conjunction with any *cleanup* framework and should be used with other technical tools, guidance, policy, laws, and regulations to integrate *greener cleanup* practices, processes, and technologies into *cleanup* projects.

1.5 This *guide* provides a process for evaluating and implementing activities to reduce the *environmental footprint* of a *cleanup* and is not designed to instruct *users* on how to clean up contaminated *sites*.

1.6 ASTM also has a *guide* on Integrating Sustainable Objectives into *Cleanup* (E2876). That *guide* provides a broad framework for integrating elements of environmental, economic, and social aspects into *cleanups*. This *guide* may

provide assistance with implementing E2876 and other sustainable remediation guidance, such as Holland, et al. (2011)(1).

1.7 This *guide* specifically applies to the *cleanup*, not the redevelopment, of a *site*. However, the reasonably anticipated use of a *site*, if known, may influence the *cleanup* goals and scope.

1.8 This *guide* should not be used as a justification to avoid, minimize, or delay implementation of specific *cleanup* activities. Nor should this *guide* be used as a justification for selecting *cleanup* activities that compromise *stakeholder* interests or goals for the *site*.

1.9 This *guide* does not supersede federal, state, or local regulations relating to protection of human health and the environment. No action taken in connection with implementing this *guide* should generate unacceptable risks to human health or the environment.

1.10 This *guide* may be integrated into complementary standards, *site*-specific regulatory documents, guidelines, or contractual agreements relating to sustainable or greener *cleanups*.

1.10.1 If the *cleanup* is governed by a regulatory program, the *user* should discuss with the regulator responsible for the *site* how this *guide* could be incorporated into the *cleanup* and whether the regulator deems it appropriate for the *user* to report the process and results to the regulatory program.

1.10.2 The contractual relationship or legal obligations existing between and among the parties associated with a *site* or *site cleanup* are beyond the scope of this *guide*.

1.11 This *guide* is composed of the following sections: Referenced Documents (Section 2); Terminology (Section 3); Significance and Use (Section 4); Planning and Scoping (Section 5); *BMP Process* (Section 6); *Quantitative Evaluation* (Section 7); Documentation and Reporting (Section 8); and Keywords (Section 9).

1.12 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the

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responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

**E1527 Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process**

**E2091 Guide for Use of Activity and Use Limitations, Including Institutional and Engineering Controls**

**E2876 Guide for Integrating Sustainable Objectives into Cleanup**

### 2.2 USEPA Documents:<sup>3</sup>

**USEPA, Life Cycle Assessment: Principles and Practice, EPA/600/R-06/060 (May 2006)**

**USEPA, Green Remediation: Best Management Practices for Excavation and Surface Restoration, EPA 542-F-08-012 (December 2008)**

**USEPA, Principles for Greener Cleanups (August 2009a)**

**USEPA, Green Remediation Best Management Practices: Pump and Treat Technologies, EPA 542-F-09-005 (December 2009b)**

**USEPA, Green Remediation Best Management Practices: Site Investigation, EPA 542-F-09-004 (December 2009c)**

**USEPA, Green Remediation Best Management Practices: Bioremediation, EPA 542-F-10-006 (March 2010a)**

**USEPA, Green Remediation Best Management Practices: Soil Vapor Extraction & Air Sparging, EPA 542-F-10-007 (March 2010b)**

**USEPA, Green Remediation Best Management Practices: Clean Fuel & Emission Technologies for Site Cleanup, EPA 542-F-10-008 (August 2010c)**

**USEPA, Green Remediation Best Management Practices: Integrating Renewable Energy into Site Cleanup, EPA 542-F-11-006 (April 2011a)**

**USEPA, Green Remediation Best Management Practices: Sites with Leaking Underground Storage Tank Systems, EPA 542-F-11-008 (June 2011b)**

**USEPA, Green Remediation Best Management Practices: Landfill Cover Systems & Energy Production, EPA 542-F-11-024 (December 2011c)**

**USEPA, Methodology for Understanding and Reducing a Project's Environmental Footprint, EPA 542-R-12-002 (February 2012a)**

**USEPA, Green Remediation Best Management Practices: Implementing In Situ Thermal Technologies, EPA 542-F-12-029 (October 2012b)**

### 2.3 Other Documents:<sup>4</sup>

**International Standards Organization—Environmental Management—Life Cycle Assessment—Requirements and Guidelines, ISO 14044:2006 (2006)**

### 2.4 ASTM Adjuncts:

X2. Technical Summary Form<sup>5</sup>

X3. Greener Cleanup BMP Table<sup>6</sup>

NOTE 1—Appendix X1 of this guide lists relevant material available from other government agencies and non-government organizations.

## 3. Terminology

### 3.1 Definitions:

3.1.1 *activity and use limitations*—legal or physical restrictions or limitations (that is, institutional or engineering controls) on the use of, or access to, a *site* or facility: (1) to reduce or eliminate potential exposure to *contaminants* in the environmental media on the property, or (2) to prevent activities that could interfere with the effectiveness of a response action in order to ensure maintenance of a condition of no significant risk to public health or the environment. See Guide E2091 for more information on *activity and use limitations*.

3.1.2 *best management practices (BMPs)*—activities that, if applicable to the situation, typically will reduce the *environmental footprint* of a *cleanup* activity.

3.1.3 *BMP categories*—groupings of *BMPs* based on how the *user* would consider each activity during the planning stages of the *cleanup*. *BMP categories* are intended as general guidance for organization and assessment purposes. Some *BMPs* are associated with multiple *BMP categories* in Appendix X3, *Greener Cleanup BMP Table*; therefore, generally the *user* should not eliminate *BMPs* by *BMP category*. The *Greener Cleanup BMP Table* identifies the *BMP category* that best applies to each *BMP*. These *BMPs* are organized into the following *BMP categories*: (1) Project Planning and Team Management; (2) Sampling and Analysis; (3) Materials; (4) Vehicles and Equipment; (5) Site Preparation and Land Restoration; (6) Buildings; (7) Power and Fuel; (8) Surface and Storm Water; and (9) Residual Solid and Liquid Waste.

3.1.4 *BMP process*—a systematic protocol to identify, prioritize, select, implement, and document the use of *BMPs* to reduce the *environmental footprint* of *cleanup* activities.

3.1.5 *cleanup*—the range of activities that may occur to address *releases* of *contaminants* at a *site* from the initiation of *site assessment* activities to achievement of *no further cleanup*. The environmental remediation industry also refers to *cleanup* as remediation or corrective action.

3.1.6 *cleanup phase*—the segments of a *cleanup* project that take place from the initiation of *site assessment* to achievement

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

<sup>3</sup> Available from United States Environmental Protection Agency (EPA), William Jefferson Clinton Federal Building, 1200 Pennsylvania Ave., NW, Washington, DC 20004, <http://www.epa.gov>.

<sup>4</sup> Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, <http://www.iso.org>.

<sup>5</sup> Appendix X2 for E2893 Technical Summary Form in Writable PDF format available from ASTM International Headquarters. Order Adjunct No. [ADJE289301B-E-PDF](#). Original adjunct produced in 2014. Adjunct last revised in 2016.

<sup>6</sup> Appendix X3 for E2893 BMP Table in Excel Format available from ASTM International Headquarters. Order Adjunct No. [ADJE289302A-EA](#). Original adjunct produced in 2014. Adjunct last revised in 2016.

of *no further cleanup*. This *guide* divides a *cleanup* project into the following five segments: *site assessment*; *remedy selection*; *remedy design/implementation*; *operation, maintenance, and monitoring*; and *remedy optimization*. This terminology is generally consistent with standard industry terminology, but does not conform to every environmental *cleanup* program.

3.1.7 *CERCLA*—the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. § 9601 *et seq.*, as amended, the primary federal statute that governs the imposition of liability for environmental *cleanups*. *CERCLA* is commonly referred to as Superfund.

3.1.8 *contaminant*—a *hazardous substance*, petroleum product, or other chemical that may pose a threat to human health or the environment when present in environmental media.

3.1.9 *core elements*—for purposes of this *guide*, five factors representing key areas for potentially reducing the *environmental footprint* of a *site cleanup*. These factors are: minimize total energy use and maximize use of renewable energy; minimize air pollutants and *greenhouse gas emissions*; minimize water use and impacts to water resources; reduce, reuse, and recycle materials and waste; and protect land and ecosystems.

3.1.10 *disturbance of vegetation*—removal, cutting, or alteration of plants, bushes, or canopy trees, particularly those that are mature, non-invasive, native species that provide food sources, micro-climates, nesting areas, or refuge supporting indigenous flora and fauna.

3.1.11 *emissions*—the discharge of a *contaminant* to air. However, in the context of *life cycle assessment (LCA)* and *footprint analysis*, this term refers to discharges to air, water, and soil, including *site contaminants* as well as discharges not typically considered *contaminants* in *site cleanup* such as water, nitrogen oxides, and particulate matter.

3.1.12 *environmental footprint*—a qualitative or quantitative estimate of various environmental contributions of a *cleanup phase* or activity to the *core elements*. A quantitative *environmental footprint* may be obtained through either a *footprint analysis* or *LCA*. **Appendix X4** provides further clarification on the use of *footprint analysis* and *LCA*.

3.1.13 *environmental law*—any federal, state, or local statute, regulation, or ordinance relating to: the protection of the environment; pollution, investigation, or restoration of the environment or natural resources; or the handling, management, use, presence, transportation, processing, disposal, *release*, or threatened *release* of any *contaminant*. The term *environmental law* in the United States includes, but is not limited to, *CERCLA*, *RCRA*, and *TSCA*.

3.1.14 *final cleanup goals*—the objectives established to address *contaminants* at a *site* by a regulatory agency or through a voluntary *cleanup* program that, when met, protect human health and the environment. Users should review the applicable *cleanup* program for more information on establishing *final cleanup goals* at a particular *site*.

3.1.15 *footprint analysis*—a quantitative estimate of an *environmental footprint* for a *cleanup phase* or activity. The analysis entails the compilation of inputs and outputs to

estimate potential contributions (that is, *emissions* or resource use) to the *core elements*. A *footprint analysis* may include raw material acquisition, materials manufacturing, and transportation related to the *cleanup*, in addition to on-site construction, implementation, monitoring, and decommissioning. Results from a *footprint analysis* are typically reported as *emissions* (for example, nitrogen oxides, carbon dioxide equivalents, or total hazardous air pollutants) or resource use (for example, water, energy, or materials use) organized in terms of the five *core elements*.

3.1.15.1 *Discussion*—there are two fundamental differences between *footprint analysis* and *LCA*: (1) an *LCA* typically considers the full life cycle of the components of a *cleanup phase* or activity. In contrast, a *footprint analysis* may consider the full life cycle of the components of a *cleanup phase* or activity, but more commonly selects abbreviated boundaries; and (2) results from an *LCA* are described in terms of human health and environmental impacts whereas the results from a *footprint analysis* are reported in terms of quantities of *emissions* and resource use, without taking the next step to evaluate the human health and environmental impacts from those *emissions* and resource use.

3.1.16 *greener cleanup*—the incorporation of practices, processes, and technologies into *cleanup* activities with the goal of reducing impacts to the environment through reduced demands on natural resources and decreased *emissions* to the environment. A *greener cleanup* considers the five *core elements*, while protecting human health and the environment. In the environmental remediation industry, this term is used interchangeably with green *cleanup*, green remediation, and greener remediation.

3.1.17 *greenhouse gases*—vaporous constituents of the earth's atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths, including carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

3.1.17.1 *Discussion*—carbon dioxide, methane, and nitrous oxide have been the main focus of *greenhouse gas* emission evaluations within the environmental remediation industry.

3.1.18 *guide*—a compendium of information or series of options that does not recommend a specific course of action. A *guide* increases the awareness of information and approaches in a given subject area.

3.1.19 *habitat*—the physical and natural environment, including niche environments (micro-habitats) that support local indigenous species and related supporting vegetation, food sources, areas for nesting and refuge, soils, and hydrology; and larger environmental features (macro-habitats), such as a bank on a waterway or vegetated, open, wildlife corridors for foraging and natural migration. Areas of *habitat* may be used temporarily by species and timing of a disturbance may minimize impact.

3.1.20 *hazardous substance*—a substance defined as a *hazardous substance* pursuant to *CERCLA*, 42 U.S.C. § 9601(14), as interpreted by EPA regulations.

3.1.21 *impact category*—an *LCA* term representing a compilation of different *emissions* or other metrics, such as