



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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MEMORANDUM

SUBJECT: Consideration of Greener Cleanup Activities in the Superfund Cleanup Process

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This memorandum¹ recommends approaches for regional remedial Superfund programs to consider when evaluating "greener cleanup activities" throughout the remedy selection process, including during response action selection and implementation. Regional managers should also consider these recommendations when evaluating non-time critical removal actions (NCRAs). The recommended approaches include use of best practices (BPs) and other activities designed to reduce or mitigate potential environmental impacts when implementing response actions under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, (CERCLA).²

¹ This document provides recommendations to regional staff and management regarding how the Agency intends to interpret and implement the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), which serves as the CERCLA implementation blueprint, with respect to greener remediation. However, this document is neither a substitute for those provisions or regulations, nor is it a regulation itself. Thus, it cannot impose legally binding requirements on EPA, states or the regulated community and, based upon specific circumstances, may not apply to a particular situation. EPA will make any decisions regarding a particular situation based on the statute and the regulations, and EPA decision-makers retain the discretion to adopt approaches that differ from the guidance on a site-specific basis where appropriate.

² 42 U.S.C. § 9601 et seq.

This memorandum encourages regions to consider both conducting a BP or footprint analysis and using greener cleanup activities throughout the CERCLA cleanup process. Consideration of greener cleanup activities should be carried out in a manner consistent with CERCLA, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP),³ and EPA guidance. This memorandum supplements the Agency's fact sheets and policy statements addressing greener cleanup activities, tools and considerations;⁴ however, it neither amends nor modifies the NCP in any way (e.g., consideration of greener cleanup activities should not be treated as a new criterion under 40 CFR § 300.430(e)(9)(iii)).

This memorandum supports the goals as stated in the *Principles for Greener Cleanups (Principles)*,⁵ the FY 2014-2018 *EPA Strategic Plan*,⁶ the Administrator's themes,⁷ and the President's energy management memorandum to federal agencies.⁸ EPA intends for this guidance to be used at fund-, federal facility- and potentially responsible party (PRP)-lead sites. EPA recommends the consideration of greener cleanup activities at sites addressed under CERCLA authority whenever possible and encourages regions to work with PRPs, including federal agencies, to consider this guidance's recommendations throughout the CERCLA cleanup process.

Background and Legal Authority

Consistent with CERCLA, the NCP and Executive Order 12580,⁹ the Agency has broad authority as the lead agency at private party Superfund sites to carry out response actions to protect human health and the environment with respect to hazardous substance, pollutant or contaminant releases.¹⁰ EPA also has oversight responsibilities at National Priorities List (NPL) federal facility Superfund sites. In addition to ensuring that CERCLA response actions are protective of human health and the environment, the Agency (along with the lead federal agency, where applicable) may consider a number of factors when evaluating remedial action alternatives, including response actions' potential environmental impacts, mitigative measures' effectiveness and reliability during implementation,¹¹ and innovative technologies' use.¹² Innovative technologies¹³ may include greener cleanup activities when those technologies have the potential to reduce adverse environmental impacts as compared to other available approaches.

As stated in the *Principles*:

OSWER's [OLEM¹⁴] goal is to evaluate cleanup actions comprehensively to ensure protection of human health and the environment and to reduce the environmental footprint of cleanup activities, to the maximum extent possible. In considering these

³ 40 CFR Part 300.

⁴ For additional information, see <http://www.epa.gov/superfund/greenercleanups> or <http://clu.in.org/greenremediation>.

⁵ US EPA, Assistant Administrator Mathy Stanislaus, Office of Solid Waste and Emergency Response, "Principles for Greener Cleanups" (August 2009). The Office of Solid Waste and Emergency Response (OSWER) is now titled the Office of Land and Emergency Management (OLEM).

⁶ US EPA, Administrator Gina McCarthy, "FY 2014-2018 EPA Strategic Plan" (April 2014).

⁷ US EPA, Administrator Gina McCarthy, "EPA's Themes - Meeting the Challenge" (September 2013).

⁸ President Barack Obama, "Presidential Memorandum - Federal Leadership on Energy Management." (December 2013). See <http://www.whitehouse.gov/the-press-office/2013/12/05/presidential-memorandum-federal-leadership-energy-management>.

⁹ Executive Order 12580 as amended, "Superfund Implementation" (January 23, 1987) delegates to various federal officials the responsibilities vested in the President for implementing CERCLA.

¹⁰ 42 USC § 9604(a)(1).

¹¹ 40 CFR § 300.430(e)(9)(iii)(E)(3).

¹² 40 CFR § 300.430(a)(1)(iii)(E).

¹³ See e.g., 55 Fed. Reg. at 8714 (March 8, 1990).

¹⁴ The EPA's Office of Solid Waste and Emergency Response (OSWER) was renamed the Office of Land and Emergency Management (OLEM) in November 2015.

Principles, OSWER cleanup programs will assure that the cleanups and subsequent environmental footprint reduction occur in a manner that is consistent with statutes and regulations governing EPA cleanup programs and without compromising cleanup objectives, community interests, the reasonableness of cleanup timeframes, or the protectiveness of the cleanup actions. OSWER will continue to coordinate with its partners and develop approaches to facilitate continued progress in furthering these Principles for Greener Cleanups.

These Principles for Greener Cleanups are not intended to allow cleanups that do not satisfy threshold requirements for protectiveness, or do not meet other site specific cleanup objectives, to be considered greener cleanup. The Principles are not intended to trade cleanup program objectives for other environmental objectives.

Successful green cleanup practices can help achieve cleanup objectives by ensuring protectiveness while decreasing the environmental footprint of the cleanup activity itself. Some examples include using equipment that emits less particulate matter to the air, sizing equipment accurately to avoid wasted energy, water, and material, and using renewable energy or recycled material to decrease greenhouse gas emissions and conserve resources. (Emphasis added.)

Greener cleanup activities may cover a broad range of approaches, including but not limited to, waste management, fuel conservation, greenhouse gas emissions reduction and water conservation. CERCLA section 107(a) authorizes the Agency to recover all incurred costs for removal or remedial actions that are not inconsistent with the NCP. Therefore, greener cleanup activities undertaken as part of a response action generally are cost recoverable under CERCLA.

Definitions of Key Terms

For purposes of this guidance, the following terms are defined to help explain greener cleanup activities, and how they may fit into the CERCLA cleanup process:

Best Practices (BPs) – “activities that, if applicable to the situation, typically will reduce the *environmental footprint* of a *cleanup* activity.”¹⁵

Core elements -- five key factors, further discussed in the *Principles*, that regional staff should generally consider when implementing greener cleanups (*i.e.*, 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).

Environmental footprint -- “a qualitative or quantitative estimate of various environmental contributions of a cleanup phase or activity to the core elements of a greener cleanup.”¹⁶

¹⁵ “Standard Guide for Greener Cleanups” (American Society for Testing and Materials [ASTM] Cleanups” (ASTM E2893; Section 3.1.2, “Terminology”), http://compass.astm.org/EDIT/html_annot.cgi?E2893+16#s00020) Superfund stakeholders partnered with others in the site cleanup community to develop a voluntary, consensus-based guide for greener cleanups. In a subsequent memorandum from Mathy Stanislaus, AA OLEM (December 23, 2013), EPA recognized the standard as a tool that, when implemented appropriately, can reduce the environmental footprint of cleanup activities while still meeting site-specific regulatory requirements and objectives. It should be noted that “The Guide does not affect or supersede existing regulations and guidance issued pursuant to federal cleanup statutes, including for example, the CERCLA remedy selection process provided for in the National Contingency Plan (40 CFR Part 300) and associated EPA Superfund guidance.”

¹⁶ ASTM International, Standard Guide for Greener Cleanups (ASTM E2893), <http://www.astm.org/Standards/E2893.htm>. See 3.1.12.

Environmental impacts -- the effects of response implementation on the environment.

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 (*i.e.*, 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 onsite construction, implementation, monitoring, and decommissioning. Results from a footprint analysis are typically reported as emissions (*e.g.*, nitrogen oxides, carbon dioxide equivalents, total hazardous air pollutants) or resource use (*e.g.*, water, energy, or raw materials use) organized in terms of the five core elements."¹⁷ EPA's 2012 guidance, "Methodology for Understanding and Reducing a Project's Environmental Footprint," is designed to assist with this analysis.¹⁸

Greener cleanup activities -- the practices or technologies that reduce or mitigate the environmental impacts of CERCLA removal and remedial actions, while meeting regulatory and other cleanup requirements. The term "greener cleanup activities" used in this guidance is synonymous with "greener remediation," "green remediation" and "greener cleanups" used in other EPA guidance documents. In many cases, greener cleanup activities may be identified from EPA's green remediation BP fact sheets¹⁹ and other documents such as the *American Society for Testing and Materials (ASTM) International Standard Guide for Greener Cleanups (ASTM Standard Guide)*.^{20,21} See Attachment 1 for additional examples of greener cleanup activities.

Mitigative measures -- an NCP term (40 CFR § 300.430(e)(9)(iii)(E)(3)) describing the short-term effectiveness criterion used to evaluate remedial action alternatives, as follows: "Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation." As discussed in the final NCP's preamble, "This criterion also addresses potential adverse impacts on the environment that may result from the construction and implementation of an alternative and evaluates the reliability of the available mitigation measures in preventing or reducing potential impacts on either of these potential receptors."²²

Recommended Approaches

Consistent with CERCLA, the NCP and EPA guidance and whenever possible we encourage regions to consider:

Greener cleanup activities throughout the CERCLA process. Typically, regions may find opportunities to consider or implement greener cleanup activities during various cleanup process phases, including site characterization, engineering evaluation/cost analysis (EE/CA), NTCRA, remedial investigation and feasibility study (RI/FS), remedy selection, remedy implementation (*e.g.*, remedial design, construction),

¹⁷ *Ibid.* See 3.1.15.

¹⁸ US EPA, "Methodology for Understanding and Reducing a Project's Environmental Footprint" (EPA 542-R-12-002, February 2012).

¹⁹ See "GR Best Practice" fact sheets at <http://www.clu-in.org/greenremediation/index.cfm>. These have been generally referred to as Best Management Practices, however in the future OLEM will be using the term Best Practices.

²⁰ ASTM E2893-13e1, "Standard Guide for Greener Cleanups" (November 2013). See <http://www.astm.org/Standards/E2893.htm>.

²¹ US EPA, Assistant Administrator Mathy Stanislaus, Office of Solid Waste and Emergency Response, "Encouraging Greener Cleanup Practices Through the Use of ASTM International's Standard Guide for Greener Cleanups" (December 23, 2013).

²² 55 Fed.Reg. at 8722 (March 8, 1990).

and operation and maintenance (O&M). Some greener cleanup activities that may be considered include those discussed in the EPA BP fact sheets or other resources, such as the *ASTM Standard Guide*.

Conducting a BP or footprint analysis. Regions should consider conducting a BP analysis to help identify greener cleanup activities that may help minimize the environmental footprint on a site-specific basis. A BP analysis typically would be appropriate at a site with less complex issues (e.g., removal of contaminated soil and disposal off-site at a RCRA subtitle C facility).

At more complex cleanup sites (e.g., multiple operable units involving a combination of various treatment technologies, complicated media scenarios or complex contaminants of concern), regions should consider conducting a footprint analysis to help quantify site-specific metrics (such as material, water and energy usage, and emissions and waste generation) and better identify greener cleanup activities that may reduce a cleanup's environmental footprint. As discussed in the *Principles*, a footprint analysis can be a tool to assist decision-makers when considering greener cleanup activities.²³

A footprint analysis can help identify which activities may make the greatest contribution to the environmental footprint and also can help prioritize among potential greener cleanup activities.²⁴ Regions should consider conducting a footprint analysis early in the process, particularly for complex sites, and then updating this information throughout the process. In addition, regions should refer to the Agency's "Methodology for Understanding and Reducing a Project's Environmental Footprint"²⁵ to help determine when a particular site merits a footprint analysis. The associated Spreadsheets for Environmental Footprint Assessment (SEFA)²⁶ may further facilitate undertaking a footprint analysis. A wide and increasing variety of quantitative applications, calculators, and proprietary and non-proprietary models are available for footprint analyses. While such tools may have been used previously or been accepted in certain circumstances, this memorandum recommends the use of EPA's Methodology and SEFA.

It is within the Agency's discretion to determine whether or when to conduct a BP or footprint analysis. This decision normally will depend on a number of factors, including a site's size and complexity, a given site's environmental impact reduction potential, and site-specific characteristics that may provide opportunities to identify greener cleanup activities.

Greener cleanup activities as part of site characterization. Environmental footprint minimization opportunities may arise during the site characterization phase. These activities might be as simple as consolidating trips, investigation-derived waste management conservation, and alternative energy sources for site characterization activities.

Evaluating and incorporating greener cleanup activities in the RI/FS or EE/CA. A BP analysis or a footprint analysis, and related information, may help inform an RI/FS' or an EE/CA's NCP response alternative evaluation criteria. Generally, the most relevant of the nine criteria for evaluating remedial action alternatives will be short-term effectiveness, one of the primary balancing criteria (see 40 CFR § 300.430 (e)(9)(iii)(E)). Attachment 2 provides additional information for how greener cleanup activities

²³ US EPA, "Green Remediation BMP: Overview of Footprint Methodology" (EPA 542-F-12-023, March 2012, https://clu-in.org/greenremediation/methodology/docs/GR_Overview_of_Footprint_Methodology_FS_3-29-12.pdf).

²⁴ See <http://www.clu-in.org/greenremediation> for additional information on Best Practices and other tools.

²⁵ US EPA, "Methodology for Understanding and Reducing a Project's Environmental Footprint" (EPA 542-R-12-002, February 2012).

²⁶ See http://www.clu-in.org/greenremediation/subtab_b3.cfm.

may be evaluated as part of this criterion. Regions also may consider evaluating greener cleanup activities under any of the other eight criteria as part of the remedy selection process (such as the “long-term effectiveness and permanence” and “cost” balancing criteria and the “community acceptance” modifying criterion). NTCRAs generally are evaluated using the three criteria of effectiveness (which includes protectiveness of human health and the environment), implementability and cost. Consideration of greener cleanup activities is not a new criterion for evaluating alternatives for remedial actions or NTCRAs.

Selecting and documenting greener cleanup activities in decision documents. When greener cleanup activities are selected as part of the response action, they should be specifically addressed in the decision document (e.g., Action Memorandum, Explanation of Significant Differences (ESD), Record of Decision (ROD) or ROD Amendment). They should be treated in the same manner as any other integral part of alternatives being evaluated, consistent with the NCP (40 CFR § 300.415 for removal actions and § 300.430 for remedial actions) and CERCLA guidance.²⁷ For example, the decision document should explain how various alternatives were evaluated and provide the basis for the response action’s selection; this explanation should include how specific greener cleanup activities are incorporated as part of alternatives and how the greener cleanup activities were evaluated considering the NCP nine-criteria evaluation for remedial actions and the three-criteria NTCRA evaluation.

The decision document should present the specific activities’ basis, including a concise discussion of how the greener cleanup activities will reduce the environmental footprint. **Consistent with the NCP, considerations raised by other criteria cannot supplant 40 CFR § 300.430 (e)(9)(iii)’s two threshold criteria (protect human health and the environment and comply with applicable or relevant and appropriate requirements [ARARs] unless a waiver is justified.)** EPA does not have to select the alternative with the minimum environmental footprint. Rather, project managers and other decision-makers should consider greener cleanup activities in the context of a complete balancing criteria analysis for evaluating alternatives after determining that the alternative meets the threshold criteria of protectiveness and compliance with ARARs.

As part of the public participation process, the Agency considers timely and relevant public comment at appropriate points in the response selection process. Regions may consider a footprint analysis, or portions thereof, submitted by a stakeholder (e.g., PRP, state, tribe, locality or community member). A stakeholder analysis would generally be most useful when: (1) the Agency receives the information early in the response evaluation process (i.e., EE/CA or FS); (2) the footprint analysis’ preparation is consistent with EPA guidance (e.g., EPA’s 2012 Methodology); (3) the footprint analysis aligns with Agency policies and practices; (4) the footprint analysis provides useful information regarding greener cleanup activities that can reduce or mitigate the cleanup’s environmental impacts; and (5) the footprint analysis considers site-specific factors. Regions may assist stakeholders wishing to conduct a footprint analysis by providing them with the relevant EPA guidance documents and tools.

Regions also may consider greener cleanup activities during remedy implementation. In some cases, they may alter the remedy’s basic features with respect to scope, performance or cost (e.g., where one or more BPs taken together trigger a significant or fundamental change to the scope, performance or cost of

²⁷ For remedial actions, see “A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents” (OSWER 9200.1-23.P, July 1999) Section 6.3.10, and for non-time critical removal actions see “Guidance on Conducting Non-Time Critical Removal Actions under CERCLA” (Publication 9360.0-32, August 1993), Section 2.6.

the selected remedy). Regions should document such greener cleanup activities in post-ROD decision documents, consistent with the NCP and EPA's guidance.¹

Enforcement mechanisms when incorporating greener cleanup activities into the response action.² At many sites, PRPs carry out a CERCLA cleanup pursuant to enforcement authorities in Section 106 or settlement authorities in Section 122. Implementation of a response action selected in an Action Memorandum or ROD often is carried out by PRPs with EPA oversight consistent with the terms and conditions of a unilateral order, an administrative order on consent, a consent decree, or a Federal Facility Agreement. For purposes of using an enforcement mechanism to implement greener cleanup activities identified during the response selection process, those activities should be within an action memorandum's or ROD's scope. An enforcement mechanism typically contains provisions governing a cleanup's implementation (*e.g.*, statement of work or additional work clause)³ that can be used to address such greener cleanup activities.

Section 107(a) of CERCLA authorizes the Agency to recover all costs incurred for removal or remedial actions that are not inconsistent with the NCP. Under CERCLA § 107(a)(4)(A), greener cleanup activities selected consistent with the NCP are recoverable costs like any other selected response component. Thus, for cost recovery purposes, as with any other response action, regions should evaluate greener cleanup activities in a manner consistent with CERCLA, the NCP, and EPA guidance. Regions should adequately document in the administrative record⁴ what they considered and relied upon when reaching their final response selection, including greener cleanup activity components. A complete administrative record helps ensure a successful court outcome for the United States if the selection of greener cleanup activities as part of a response action is the subject of a legal challenge. The recommended procedures for establishing and maintaining administrative records for response actions can be found in Agency guidance.⁵

Conclusion

Throughout the CERCLA cleanup process, regions should consider and, as appropriate, incorporate greener cleanup activities into the response decision-making and implementation processes. Regions are encouraged to consider conducting a BP or footprint analysis to evaluate whether greener cleanup activities are appropriate on a site-specific basis. Regions should document response selection decisions, including those incorporating greener cleanup activities, consistent with CERCLA, the NCP and EPA guidance in order to be able to successfully recover costs associated with greener cleanup activities. Regional staff should continue to use the existing response selection process consistent with CERCLA, the NCP and EPA guidance, **as consideration of greener cleanup activities is not a new criterion for evaluating alternatives for remedial actions under 40 CFR § 300.430(e)(9)(iii) or a new factor for evaluating NTCRAs.**

¹ *Ibid.*, see Chapter 7, "Documenting Post-ROD Changes: Minor Changes, Explanations of Significant Differences, and ROD Amendments"

² This recommendation addresses sites where EPA is the lead agency and has taken an enforcement action (*e.g.*, consent decree or unilateral order). At federal facilities, where applicable, EPA will work with the affected federal agency to determine if there are opportunities to incorporate greener cleanup activities.

³ The Model RD/RA CD provides that if a modification is necessary "to achieve and maintain the Performance Standards or to carry out and maintain the effectiveness of the remedy set forth in the ROD, and such modification is consistent with the scope of the remedy set forth in the ROD, then the Region may issue such modification in writing and shall notify Settling Defendants of such modification."

⁴ See NCP, 40 CFR § 300.160.

⁵ Revised Guidance for Compiling Administrative Records for CERCLA Response Actions (September 2010). See http://www.clu-in.org/conf/tio/CECOSC4_121813/AR-Guidance-dated-9.20.2010.pdf.

If you have questions or would like assistance with greener cleanup activities as they relate to remedy selection at non-federal facilities, please contact Robin M. Anderson, Office of Superfund Remediation and Technology Innovation (OSRTI) (anderson.robinm@epa.gov, 703-603-8747). For questions related to the use of greener cleanup activities at federal facilities, please contact John Burchette, Federal Facilities Restoration and Reuse Office (FFRRO) (burchette.john@epa.gov, 202-564-3338). For enforcement-related issues involving greener cleanup activities, please contact Elisabeth Freed, Office of Site Remediation Enforcement (OSRE) (freed.elisabeth@epa.gov, 202-564-5117). For federal facility enforcement-related matters, please contact Melanie Garvey, Federal Facilities Enforcement Office (FFEO) (garvey.melanie@epa.gov, 202-564-2579). For technical questions related to greener cleanup activities or methodologies for conducting environmental footprint analysis, please contact Carlos Pachon (OSRTI) (pachon.carlos@epa.gov, 703-603-9904).

Attachments (2)

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Attachment 1

Examples of CERCLA Greener Cleanup Activities and Ways to Reduce Environmental Footprints

Greener cleanup activities potentially span a broad spectrum of activities and may include consideration of innovative technologies. Depending on site-specific circumstances, there may be a number of ways to reduce or mitigate the environmental impacts associated with response actions. For a more complete best practices (BPs) listing that regions may consider to reduce a site's environmental footprint, please consult the EPA remedy-specific green remediation BP fact sheets or the ASTM Standard Guide. Where appropriate, regions should consider the following examples:

Use the various EPA green remediation BP fact sheets. The fact sheets cover different types of cleanup activities and can be used to meet resource reduction use goals. Refer to <http://www.clu-in.org/greenremediation/> for more information.

Use an environmental footprint calculator. Use the Spreadsheets for Environmental Footprint Analysis (SEFA), which are designed to assist EPA in conducting a site cleanup environmental footprint analysis, as described in EPA's methodology. SEFA is primarily intended for compiling data on activities associated with alternative remedies, remedy designs or implemented remedies but may also be applied to other phases of a project. More can be found at: <http://www.clu-in.org/greenremediation/methodology/>.

Consider potential land uses such as greenways and pollinator habitats, as appropriate.

Greenways and pollinator habitats may improve the ecosystem and result in fewer greenhouse gas emissions due to operation and maintenance. For example, landfill caps may be created/converted to pollinator habitats, and reduce the need for mowing.

Implement responses in a more energy-efficient manner. There may be equally protective ways to implement the selected response action such that it uses dramatically less electricity or fuel. Examples include:

- *in-situ* groundwater treatment and bio-remediation that use materials generated near the site, and
- reuse of the heat generated as part of treatment for other purposes on-site.

Use Cleaner and More Energy-Efficient Equipment and Construction Techniques. Examples include:

- use high-efficiency, variable speed pumps for groundwater extraction and treatment plant operations;
- optimize pump-and-treat systems to minimize excess extraction or energy usage;
- use the extracted groundwater itself to provide heating and cooling (through heat exchangers) of the structure housing a pump-and-treat system;
- thoroughly insulate structures such as treatment plants;
- design structures to take full advantage of passive solar heating and cooling;
- use 2007 or newer diesel trucks or retro-fitted diesel trucks with equivalent emissions reductions that get better fuel mileage, reduce air toxics, and/or use low sulfur fuel or alternative fuel;

- include idling restrictions on all construction equipment on the site such as meeting idling regulations, or in the absence of such regulations, limiting engine idling time to less than three minutes in any sixty-minute period;
- use EPA Tier 2 or higher non-road construction equipment or non-road construction equipment retrofitted with EPA-verified technology to meet equivalent emissions reductions. (This equipment is readily available as much of it has been in the market since 2007.); and
- use resource recovery in construction projects (e.g., recycling steel and other materials from demolition projects as appropriate.)

Use more “sustainable” materials: The choice of cleanup materials can have a profound impact on the project’s overall environmental footprint. For example, many projects require a significant amount of concrete (e.g., for the construction of an onsite treatment plant or storage pads, etc.). Concrete generally has a relatively high carbon footprint, primarily because manufacture of the Portland cement that hardens and binds it together is very energy-intensive.³³ Examples of sustainable materials include:

- Reused PVC pipe;
- Green concrete;
- Sustainable building materials; and
- Plant native vegetation.

Generate renewable energy on-site: In some situations electricity can be generated on-site using wind, solar, or geothermal energy. For example:

- electricity generated onsite by windmills and solar arrays can be used to drive pumps (e.g., the former St. Croix Alumina site in the U.S. Virgin Islands).³⁴ Similarly, at the BP Petroleum site in Paulsboro, NJ, a 275-KV solar field powers six recovery well pumps, aerators and blowers.³⁵ In appropriate settings, fans for vapor intrusion mitigation systems can be powered by roof-top solar panels or wind-driven vacuum systems, as at the former Ferula Landfill in New York.³⁶
- Captured landfill gas (methane) can be used to produce energy at closed landfills (e.g., Operating Industries Landfill in California).³⁷

³³ Making one ton of Portland cement results in the emission of nearly a ton of carbon dioxide. The concrete industry accounts for 5 percent or more of the world’s greenhouse gas emission. *Emission Reduction of Greenhouse Gases from the Cement Industry*, C.A. Hendricks et al., IEA Greenhouse Gas R&D Programme, and August 2004. Some commentators assert that the total is as high as 8 to 10 percent of the world’s greenhouse gas emissions. See <http://www.worldchanging.com/archives/003151.html> the manufacture of Portland cement accounts for 80% or more of the GHG emission associated with concrete. J.M. Flower & J. Sanjayan, *Greenhouse Gas Emissions Due to Concrete Manufacture*, The International Journal of Life Cycle Assessment, July 2007.

³⁴ See http://www.clu-in.org/greenremediation/subtab_d7.cfm.

³⁵ See http://www.clu-in.org/greenremediation/subtab_d2.cfm.

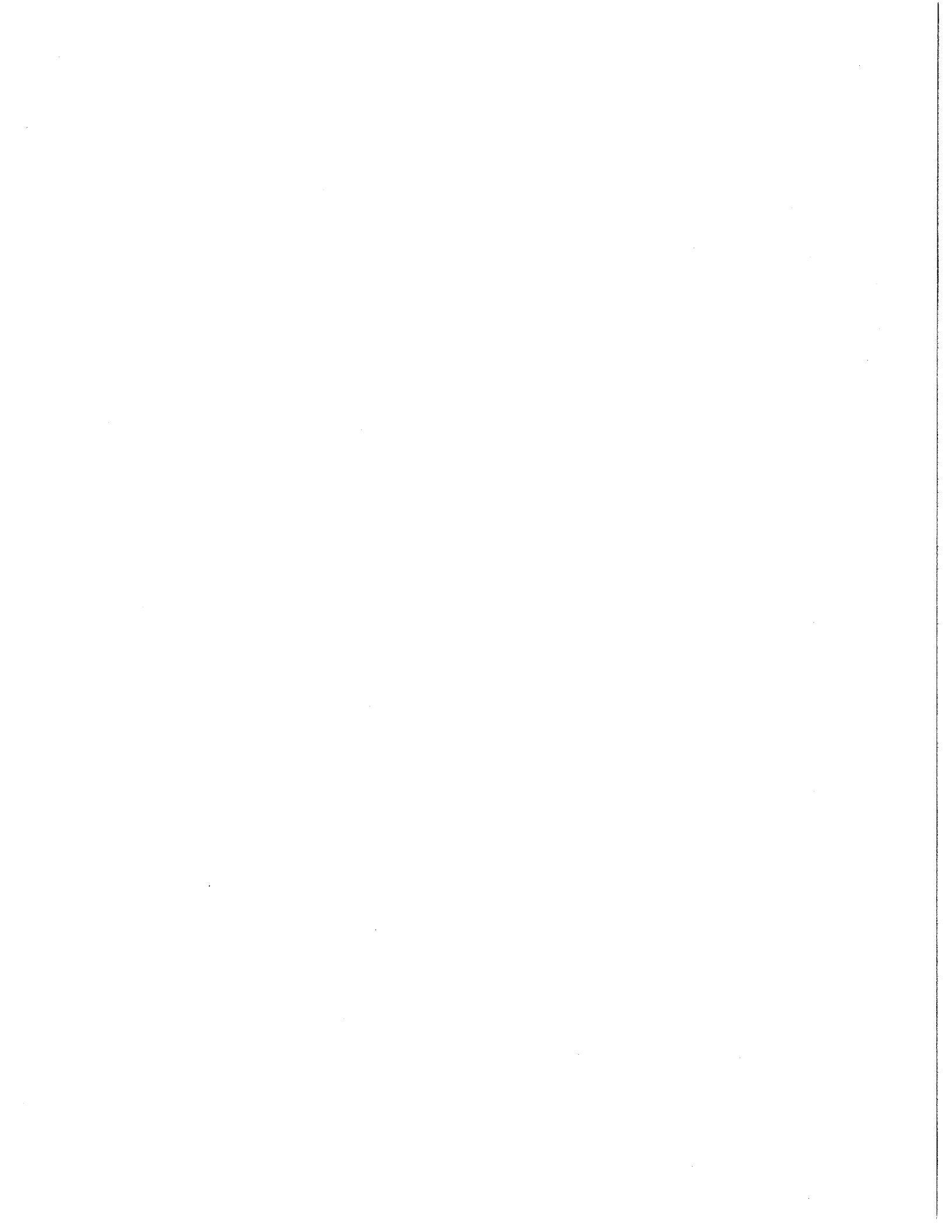
³⁶ See http://www.clu-in.org/greenremediation/subtab_d21.cfm.

³⁷ See http://www.clu-in.org/greenremediation/subtab_d10.cfm Six 70-KW microturbines generate 70% of the on-site power needs for the remediation systems and long-term O&M, saving up to \$400,000 annually in grid-supplied electricity.

Purchase renewable energy: Some utilities offer power created by renewable energy sources.

- Purchase "green power" or power from renewable sources is an option that is available for some sites.³⁸
- Purchase renewable energy certificates - A Renewable Energy Certificate (REC) represents the reduced environmental footprint associated with generating one-megawatt hour (MWh) of electricity from a renewable energy source. EPA's Office of Administration purchases RECs to offset the environmental impact associated with the emissions of fossil fuels used to generate electricity. In order to support the goal of minimizing 100 percent of the electrical use footprint at Superfund sites, OSRTI has been purchasing RECs to compensate for electrical use at fund lead sites since 2012.

³⁸ A US Department of Energy website provides links that inform users how to purchase green energy across the country. See http://apps3.eere.energy.gov/greenpower/buying/buying_power.shtml



Attachment 2

Short-Term Effectiveness Criteria

Below is an excerpt from the “Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA” (EPA/540/g-89/004, October, 1988), which discusses recommended analysis factors that can be considered when evaluating the NCP’s existing short-term effectiveness criterion (40 CFR § 300.430 (e)(9)(iii)(E)). The bolded text provides factors that may be most relevant when evaluating greener cleanup activities’ short-term effectiveness as part of the remedy selection analysis. The other eight criteria, such as cost effectiveness and community acceptance, may also be relevant criteria as part of the evaluation alternatives incorporating greener cleanup activities.

Table 6-3. Short-Term Effectiveness

Analysis Factor	Basis for Evaluation During Detailed Analysis
Protection of community during remedial actions	How will the risks to the community be addressed and mitigated? What risks remain to the community that cannot be readily controlled? What are the risks to the community during remedial actions that must be addressed?
Protection of workers during remedial actions	What are the risks to the workers that must be addressed? What risks remain to the workers that cannot be readily controlled? How will the risks to the workers be addressed and mitigated?
Environmental impacts	What environmental impacts are expected with the construction and implementation of the alternative? What are the available mitigation measures to be used and what is their reliability to minimize potential impacts? What are the impacts that cannot be avoided should the alternative be implemented?
Time until remedial objectives are achieved	How long until protection against the threats being addressed by the specific action? How long until any remaining site threats will be addressed? How long until remedial response objectives are achieved?