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Report to Congressional Requesters

September 2025

NUCLEAR WASTE CLEANUP

DOE Should Collect Information Specific to Soil and Legacy Landfills to Inform Overall Remediation Efforts

GAO-25-107565

GAO Highlights

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GAO-25-107565 September 2025

A report to congressional requesters.

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What GAO Found

The U.S. Department of Energy's Office of Environmental Management (EM) is responsible for cleaning up contaminated soil and legacy landfills resulting from Manhattan Project-era and Cold War-era waste disposal at 12 of its 15 sites. GAO examined eight sites with such contamination and found that site-specific factors inform cleanup decisions in the context of federal and state laws and regulations, as well as agreements EM follows to conduct cleanup. These factors include future land use, physical parameters, and community acceptance.

For the eight sites GAO examined, soil and legacy landfill cleanup is estimated to cost approximately $15 billion over the next 6 decades. However, the sites' estimated scope, schedule, and cost for cleanup may change as more information becomes available. In particular, at two of the sites, EM and regulators have worked for more than a decade on the scope of remedial actions needed to clean up contaminated soil and legacy landfills. The final remedy decisions will affect the sites' cost estimates. For example, cleanup of one legacy landfill at an EM site in Los Alamos, New Mexico, could cost about $12 million under one potential remedy but about $805 million if another remedy is selected.

Removal of Contaminated Soil at Oak Ridge Office of Environmental Management

Source: U.S. Department of Energy. | GAO-25-107565

EM headquarters is unable to readily identify the scope, schedule, and cost of soil and legacy landfill cleanup over the 12 sites. While EM sites have information on soil and legacy landfill cleanup, sites report data to EM in an aggregated form, with soil cleanup information combined with those of other activities, such as groundwater cleanup. EM's 2020 Program Management Protocol states that headquarters provides technical and policy support in the planning and field execution of soil and other cleanup. With distinct information on soil cleanup activities, EM headquarters could better provide technical support for planning. In addition, as remedy decisions are made, having information available that is specific to soil and legacy landfill cleanup at EM sites would improve headquarters' ability to track resources needed to implement remedy decisions and their schedule and cost implications on the entire EM program.

Why GAO Did This Study

EM is responsible for addressing hazardous and radioactive waste from nuclear weapons production and energy research at DOE sites. Contaminated soil at these sites poses a threat to public health and the environment, making soil and legacy landfill cleanup critical to EM's mission.

GAO was asked to review EM's soil and legacy landfill cleanup efforts. This report examines (1) the regulatory framework for soil and legacy landfill cleanup at selected EM sites and how site-specific factors inform remedy decisions and (2) available data on the scope, schedule, and cost for soil and legacy landfill cleanup.

GAO examined eight sites selected to include various regulatory frameworks governing EM's cleanup, different stages of cleanup, remaining remediation decisions, and various end uses for the land. GAO conducted site visits at three of these sites. GAO examined relevant laws and regulations and reviewed agency documents on soil and legacy landfill cleanup. GAO interviewed officials from EM, the U.S. Environmental Protection Agency, and state regulatory agencies.

What GAO Recommends

GAO recommends that EM headquarters collect information specific to the scope, schedule, and cost of soil and legacy landfill cleanup and use it to enhance technical and policy support provided to sites and inform prioritization decisions to reduce risk. EM neither agreed nor disagreed with the recommendation and deferred its response regarding implementation to a later date.

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Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended
DOE	U.S. Department of Energy
DTSC	California Department of Toxic Substances Control
EM	Office of Environmental Management
EPA	U.S. Environmental Protection Agency
ETEC	Energy Technology Engineering Center
MDA-C	Material Disposal Area C
NNSA	National Nuclear Security Administration
RCRA	Resource Conservation and Recovery Act of 1976, as amended

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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September 26, 2025

Congressional Requesters

Decades of nuclear weapons production and nuclear energy research have left hazardous and radioactive waste at the U.S. Department of Energy's (DOE) sites and facilities. These include 12 sites with contaminated soils and legacy landfills that are the result of Manhattan Project-era and Cold War-era waste disposal.[1] Contamination in soil and legacy landfills may pose risks to human health and the environment, making cleanup of this contamination critical to the mission of DOE's Office of Environmental Management (EM). See figure 1 for an example of a legacy landfill at the Idaho National Laboratory, which the Idaho Cleanup Project is now in the process of remediating.

Figure 1: Waste Disposal at a Legacy Landfill at the Idaho National Laboratory in the 1960s

Source: U.S. Department of Energy. | GAO-25-107565

[1]We use the term "legacy landfills" to refer to trenches or pits with radioactive or chemically contaminated legacy wastes disposed of prior to 1970. This does not include other disposal facilities managed by DOE.

EM works with its regulatory partners, the U.S. Environmental Protection Agency (EPA) and state regulators, to select remedies to complete soil and legacy landfill cleanup. There are many ways to clean up contaminated soil and legacy landfills to meet regulatory standards that range in complexity and cost. EM and its regulatory partners consider various factors at each site to select the appropriate remedy.

You requested that we review soil and legacy landfill cleanup at sites across the EM complex. This report examines (1) the regulatory framework for soil and legacy landfill cleanup at selected EM sites and how site-specific factors inform remedy decisions, and (2) available data on the scope, schedule, and cost for soil and legacy landfill cleanup.

To address our two objectives, we reviewed documentation and interviewed EM officials and contractors from a non-generalizable sample of eight EM sites. The eight selected sites are the (1) Energy Technology Engineering Center (ETEC) in California, (2) Hanford Site in Washington State, (3) Idaho Cleanup Project in Idaho, (4) EM-Livermore in California, (5) EM-Los Alamos in New Mexico, (6) EM-Nevada in Nevada, (7) Oak Ridge-EM in Tennessee, and (8) Savannah River Site in South Carolina. The selected sites were chosen to ensure we had examples representing a range of the following:

- **Regulatory frameworks**, including sites on the National Priorities List, which are addressed under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), and sites not on the National Priorities List, which may be regulated under several federal or state laws.[2]
- **Remaining scope and regulatory decisions**, including sites closer to completing soil and legacy landfill cleanup and sites that still have long-term cleanup actions.
- **End uses**, including sites cleaning up to industrial use or recreational use standards.

[2]The National Priorities List is the list of sites of national priority among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. See 42 U.S.C. § 9605(a)(8)(B); 40 C.F.R. pt. 300, app. B. Revised annually, the list is intended primarily to guide EPA in determining which sites warrant further investigation. Cleanup of contaminated sites not on the National Priorities List may be addressed under CERCLA, the Resource Conservation and Recovery Act of 1976, as amended, or under state laws, depending on the site's status.

- **Locations**, including sites in seven states to provide a variety of viewpoints from state and EPA regulatory partners.

Finally, we also selected certain sites—including the Idaho Cleanup Project and EM-Los Alamos—to ensure we captured sufficient examples of legacy landfills. Findings from our nongeneralizable sample cannot be used to make inferences about all 12 EM sites with soil cleanup, but the eight selected sites provide illustrative examples of soil and legacy landfill cleanup operations. We also conducted site visits at three of the selected sites—EM-Los Alamos, ETEC, and Hanford Site—to tour soil and legacy landfill cleanups and hold in-depth discussions with EM officials.

To identify the regulatory framework for soil and legacy landfill cleanup at EM sites and how site-specific factors inform remedy decisions at selected sites, we reviewed relevant laws, regulations, agreements, and agency guidance. We interviewed EM officials from headquarters and selected sites to confirm how each site plans and manages its activities to meet the requirements of the relevant laws, regulations, agreements, and agency guidance. We also interviewed EPA and state regulators to learn about each site's regulatory framework. We reviewed site documents to determine the factors that site officials and their regulatory partners considered when selecting cleanup remedies.

To determine what is known about the scope, schedule, and cost for soil and legacy landfill cleanup, we reviewed documents on scope, schedule, and cost from each selected site. We interviewed site officials to better understand how the site developed its estimates, including the underlying assumptions, and determined that each selected site's estimates of its expected future schedules and costs were reliable for our purposes. We also interviewed headquarters-level EM officials to better understand the database that stores information on agency cleanup scope, schedule, and cost and its ability to provide soil and legacy landfill cleanup information for all EM sites. Because sites have slightly different methods for creating estimates, the scope, schedule, and cost information is not directly comparable across sites.

We conducted this performance audit from May 2024 to September 2025 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

EM Mission, Structure, and Cleanup Sites

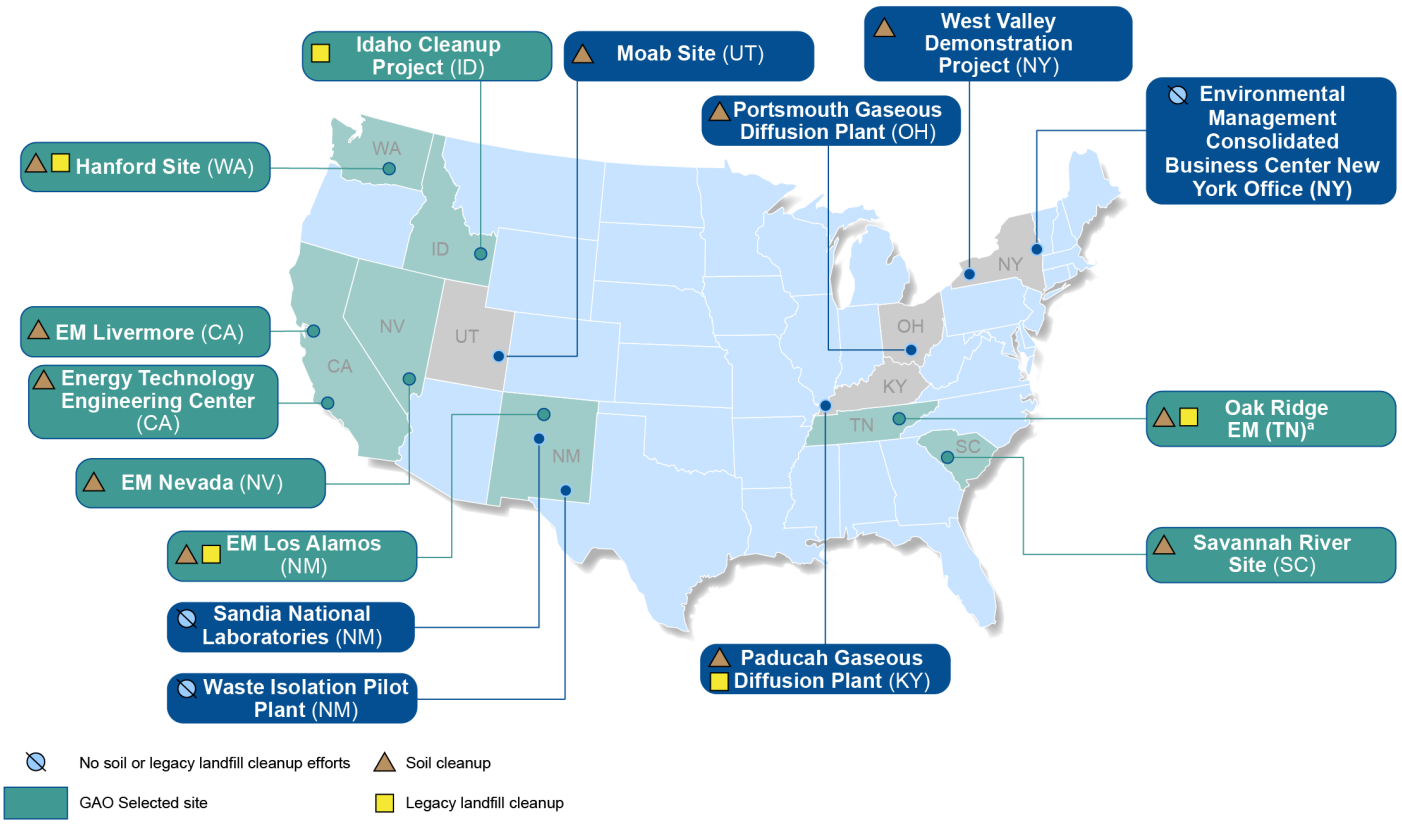
EM is responsible for the cleanup of legacy waste—hazardous and radioactive waste generated by the development and production of nuclear weapons and government-sponsored nuclear energy research dating back to World War II and the Cold War. This cleanup scope makes EM the largest environmental cleanup program in the world, according to EM documents. As of fiscal year 2024, DOE reported environmental liabilities of $544 billion, of which more than $417 billion was for EM's cleanup. We added the U.S. government's environmental liability, which includes EM's liabilities, to our High Risk List in 2017.[3]

EM headquarters oversees 15 active cleanup sites located around the country. Twelve of EM's active sites have remaining soil or legacy landfill cleanup.[4] These sites contain about 40 million cubic meters—approximately the volume of 40 Empire State Buildings—of contaminated soil and debris. For our report, we examined the soil and legacy landfill cleanup at eight selected sites (see fig. 2). See appendix I for more information about the sites' histories and the scope of remaining soil and legacy landfill cleanup.

[3]GAO, *Heightened Attention Could Save Billions More and Improve Government Efficiency and Effectiveness*, GAO-25-107743 (Washington, D.C.: Feb. 25, 2025) and *Progress on Many High-Risk Areas, While Substantial Efforts Needed on Others*, GAO-17-317 (Washington, D.C.: Feb. 15, 2017).

[4]The other three sites either completed cleanup of soil and legacy landfills or did not have contaminated soil or legacy landfill at the site.

Figure 2: Active U.S. Department of Energy Office of Environmental Management (EM) Sites



Sources: GAO analysis of Office of Environmental Management documentation and Map Resources (map). | GAO-25-107565

[a]Oak Ridge EM conducts environmental cleanup at the Oak Ridge Reservation, which includes (1) the East Tennessee Technology Park, managed by the Office of Environmental Management; (2) the Oak Ridge National Laboratory, managed by the Office of Science; and (3) the Y-12 National Security Complex, managed by the National Nuclear Security Administration.

Additionally, six of our selected EM sites are co-located on sites with active missions managed by the National Nuclear Security Administration (NNSA) to support nuclear weapons production.[5] EM officials must coordinate with NNSA officials to navigate around mission activities. This can include working with NNSA stakeholders at the site to determine

[5]The NNSA—a separately organized agency within DOE—is responsible for managing our nation's nuclear stockpile and production infrastructure modernization activities. The six EM sites out of selected sites that are co-located on NNSA sites are EM-Livermore, EM-Los Alamos, EM-Nevada, Idaho Cleanup Project, Oak Ridge-EM, and Savannah River Site.

when to relocate utilities and plan outages so the soil cleanup work can occur in certain areas, according to EM officials.

To enhance the management of the cleanup programs at each of the sites, EM headquarters updated the Program Management Protocol in 2020.[6] The Protocol broadly establishes requirements and expectations for planning, budgeting, executing, and evaluating EM's work across all cleanup sites and management of the entire EM program. EM's 2020 Program Management Protocol also emphasizes the importance of risk reduction when prioritizing cleanup activities. Specifically, the Protocol states that EM's first priority is to address any issues posing an immediate risk to human health or the environment followed by prioritizing activities with the highest risk reduction benefit per radioactive content as well as prioritizing activities that reduce risks to the public, workers, and the environment.

Under the Protocol, EM headquarters has various responsibilities, including developing overall EM program management documents, such as the EM Program Plan and EM Program Lifecycle Estimate; issuing guidance on acquisition planning; and reviewing and approving life cycle estimates. Field site managers at EM field offices are responsible for all activities at their sites, including prioritizing cleanup work, completing risk assessments, and overseeing and evaluating contractor performance.

Relevant Federal Laws Governing Soil and Landfill Cleanup at EM Sites

The management, treatment, and disposal of contaminated soil at EM sites is governed by various federal and state laws and regulations, DOE Orders, cleanup agreements, compliance orders, and judicial consent orders and decrees. Key federal laws that govern EM's soil cleanup of its sites include the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), and the

[6]U.S. Department of Energy, Office of Environmental Management, *Environmental Management Program Management Protocol* (Washington, D.C.: Oct. 30, 2020).

Resource Conservation and Recovery Act of 1976, as amended (RCRA).[7]

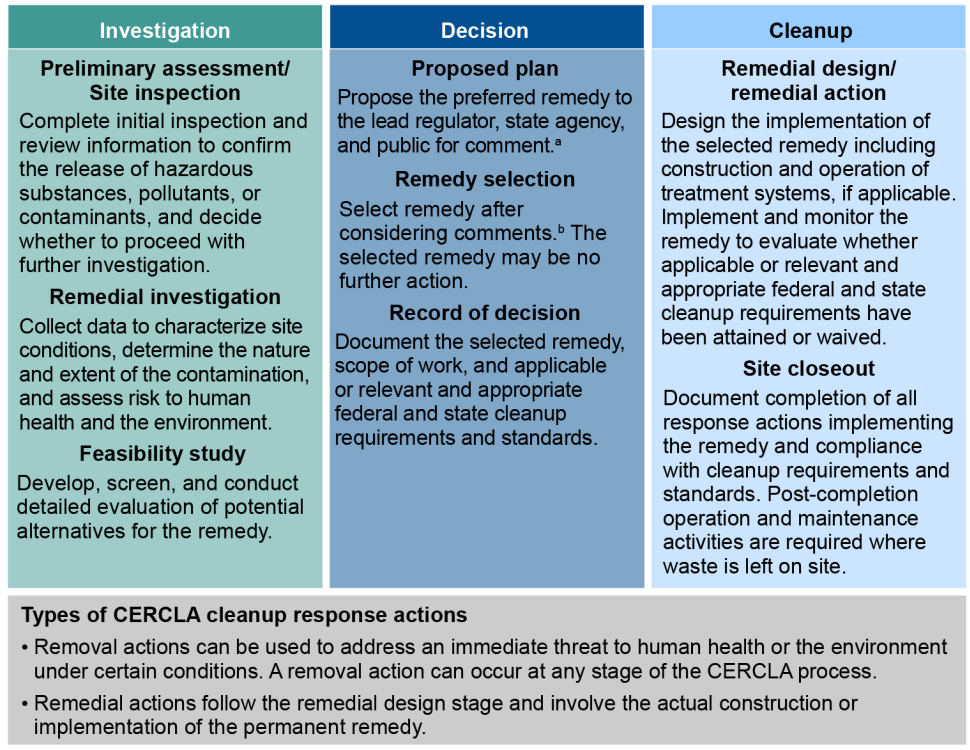
CERCLA

Commonly known as Superfund, CERCLA authorizes federal agencies to respond to releases or threatened releases of hazardous substances, pollutants, and contaminants that may endanger public health or the environment. Under CERCLA, EPA has certain oversight authorities for cleaning up releases of hazardous substances, pollutants, or contaminants at federal facilities on the National Priorities List. At EM's National Priorities List sites, DOE has entered into an interagency agreement with EPA and the relevant states, known as a federal facility agreement, that governs the investigation and cleanup of any such releases at these facilities.[8] There are several activities in the typical CERCLA process, including the investigation, decision, and cleanup stages. Figure 3 outlines the general CERCLA process used for cleanup at National Priorities List sites.

[7]Comprehensive Environmental Response, Compensation, and Liability Act of 1980, Pub. L. No. 96-510, 94 Stat. 2767 (codified as amended at 42 U.S.C. §§ 9601-9675); Resource Conservation and Recovery Act of 1976, Pub. L. No. 94-580, 90 Stat. 2795 (codified as amended at 42 U.S.C. §§ 6901-6987). Other federal laws are relevant to soil cleanup at EM sites, which may include (1) the Atomic Energy Act of 1954, as amended, which regulates the possession and use of nuclear material, including radioactive waste; and (2) the Nuclear Waste Policy Act of 1982, as amended, which establishes procedures for the evaluation, selection, and approval of sites for deep geologic repositories for the permanent disposal of spent nuclear fuel and high-level radioactive waste. For further discussion of these and other federal laws that may be relevant to soil remediation, see GAO, *Nuclear Waste: An Integrated Disposal Plan Could Help DOE Complete Its Cleanup Mission and Save Billions*, GAO-25-107109 (Washington, D.C.: May 29, 2025).

[8]*See* 42 U.S.C. § 9620(e)(2). Of the eight EM sites we selected, five of them are on the National Priorities List: Hanford Site, Idaho Cleanup Project, EM-Livermore, Oak Ridge-EM, and Savannah River Site.

Figure 3: Typical Stages of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as Amended (CERCLA), Cleanup Process



Source: GAO analysis of legal requirements and agency guidance documents. | GAO-25-107565

Notes: This figure groups CERCLA cleanup framework for National Priorities List sites into the high-level stages of investigation, decision, and cleanup, as generally set forth in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) at 40 C.F.R. Part 300. The process for the lead agency may vary depending on site-specific conditions. The U.S. Environmental Protection Agency (EPA) defines the "lead agency" as the agency that plans and implements response actions under the NCP. 40 C.F.R. § 300.5.

[a]EPA defines the "lead regulator" as the primary agency (i.e., EPA or the state) that oversees the cleanup. EPA, Lead Regulator Policy for Cleanup Activities at Federal Facilities on the National Priorities List (Nov. 6, 1997).

[b]For a federal facility on the CERCLA National Priorities List, the final remedy must be selected jointly by the lead agency and EPA. If the agencies cannot reach agreement on the remedy, EPA will select the final remedy. 42 U.S.C. § 9620(e)(4); 40 C.F.R. § 300.430(f)(4)(iii).

At EM's CERCLA sites, EM selects the cleanup remedies in conjunction with EPA. EM must consider nine criteria when evaluating remedy alternatives, two of which EPA regulations categorize as "threshold

criteria."[9] The threshold criteria require that the remedy alternatives must be (1) protective of human health and the environment and (2) comply with all applicable or relevant and appropriate legal requirements.[10] Other criteria include long-term effectiveness and permanence, implementability, and cost.[11]

RCRA

RCRA regulations establish detailed and often waste-specific requirements for the treatment, storage, or disposal of hazardous wastes. Under RCRA, EPA may authorize states to administer their own hazardous waste regulatory programs in lieu of the federal program, as long as the state programs meet certain requirements and are at least as stringent as, and equivalent to, the federal program.[12] State hazardous waste programs may be broader in scope than the federal program.[13] RCRA's statutory provisions require corrective action for all releases of hazardous waste and mixed waste from any solid waste management unit at permitted treatment, storage, or disposal facilities.[14] Under the RCRA corrective action process, EPA and authorized states impose remedial measures to clean up hazardous waste releases at facilities through permits. Figure 4 outlines the typical RCRA process used for cleanup of hazardous waste releases.

[9]The nine CERCLA criteria include (1) overall protection of human health and the environment; (2) compliance with applicable or relevant and appropriate requirements; (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility or volume; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state acceptance; and (9) community acceptance. 40 C.F.R. § 300.430(e)(9)(iii). EPA regulations categorize these criteria as threshold criteria, primary balancing criteria, and modifying criteria. 40 C.F.R. § 300.430(f)(1)(i).

[10]40 C.F.R. § 300.430(f)(1)(i)(A).

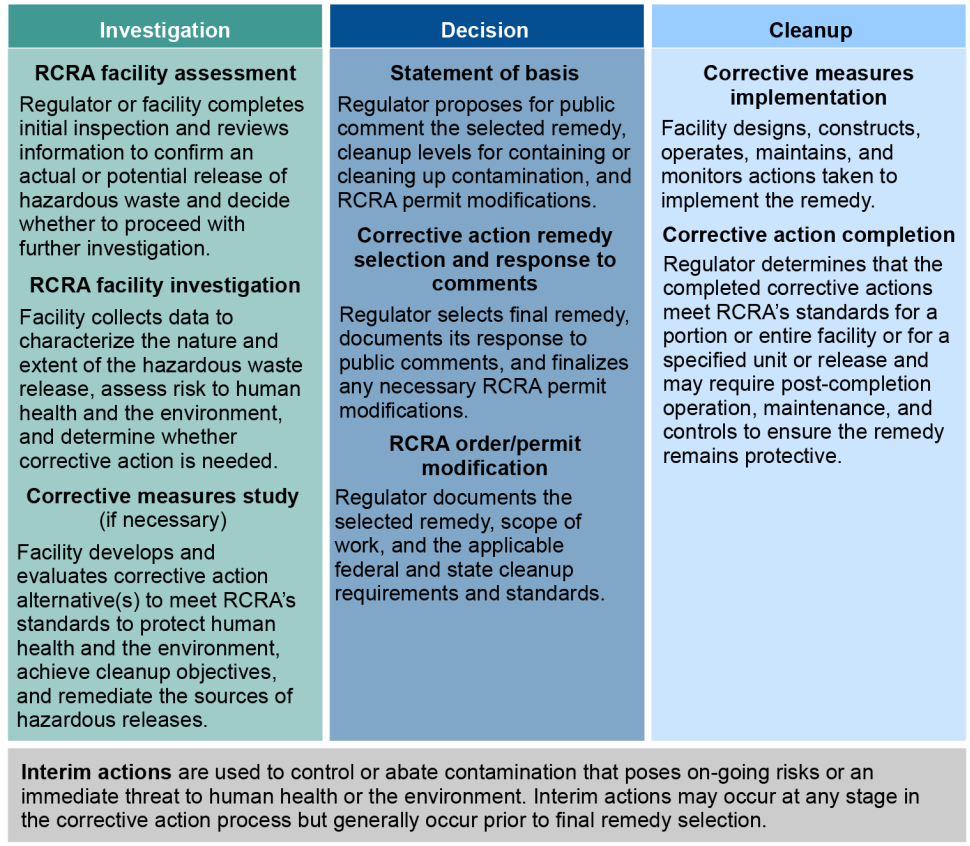
[11]40 C.F.R. § 300.430(e)(9)(iii).

[12]42 U.S.C. § 6926(b). See also 40 C.F.R. pt. 271. RCRA defines a "state" as any of the 50 states, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands. 42 U.S.C. § 6903(31).

[13]42 U.S.C. § 6929.

[14]42 U.S.C. § 6924(u), (v). RCRA defines "mixed waste" as waste containing both hazardous waste and source, special nuclear, or by-product material subject to the Atomic Energy Act of 1954. 42 U.S.C. § 6903(41).

Figure 4: Typical Stages of the Resource Conservation and Recovery Act, as Amended (RCRA), Corrective Action Process



Source: GAO analysis of legal requirements and agency guidance documents. | GAO-25-107565

Note: This figure groups the Resource Conservation and Recovery Act, as amended (RCRA), corrective action cleanup framework into the high-level stages of investigation, decision, and cleanup as generally set forth in U.S. Environmental Protection Agency regulations and guidance documents. The cleanup process may vary depending on site-specific conditions.

At RCRA EM sites, states authorized by EPA to implement and enforce the RCRA hazardous waste program primarily determine soil cleanup requirements and select remedies.[15] Under RCRA, EM must clean up hazardous waste releases at its facilities by implementing corrective action remedial measures that protect human health and the environment. EPA's RCRA guidance also provides balancing criteria, such as cost and long-term effectiveness, when the state evaluates and selects the remedy alternatives.

[15]*See* 42 U.S.C. § 6926(b).

Selected Soil and Legacy Landfill Cleanup Approaches Used at EM Sites

EM sites use various approaches to clean up contaminated soil and landfills. The selection of soil cleanup approaches for a specific area is based on the evaluation of cleanup remedy alternatives where specific criteria—effectiveness, implementability, and cost, for example—are used to determine a preferred remedy. A few examples of soil cleanup approaches used at EM sites are described in the following sections.

Landfill and Soil Capping

Landfill and soil capping, also known as cap and cover, are containment technologies that form a barrier between a contamination source area and the ground surface. The cap is typically designed to restrict surface water and rainwater infiltration into the contamination source area to reduce the potential for leaching of site contaminants.

The design of a cap is site-specific and depends on many factors including the nature of wastes being managed; the desired functions of the cap materials; the local climate, hydrogeology, and terrain; and the anticipated future use of the site. For instance, dry climates generally require less complex designs and wet climates generally require more complex designs. Caps can range from a one-layer system of vegetated soil to a complex multi-layer system depending on the type of waste.

Excavation

When a site remediates soil or legacy landfills by excavation, the contaminated material—typically a solid or semi-solid material such as soil or sludge—is removed for treatment and disposal. Excavation is the mechanical removal of waste or contaminated soil from the subsurface (see fig. 5). The rate of excavation depends on a number of factors, including the types of materials being excavated, selected excavation technique, soil type, access constraints to the site, and underground utilities or other sensitive structures.

In general, waste excavation and disposal activities require significant attention to personal protection and safety. This requires provisions for worker protection, such as special clothing and equipment decontamination.

Figure 5: Workers Remove Contaminated Soil from Oak Ridge Office of Environmental Management

Source: U.S. Department of Energy. | GAO-25-107565

Land Use Controls

According to EPA documents, land use controls may consist of non-engineered instruments, such as administrative and legal controls to limit access to the site, or engineered and physical barriers, such as fences and security guards. Land use controls help to minimize the potential for exposure to contamination, such as that in soil or legacy landfills, and are typically designed to work by limiting land or resource use or by providing information that helps modify or guide human behavior at a site.

Land use controls may be used when contamination is first discovered, when remedies are ongoing, and when residual contamination remains on-site at a level that does not allow for unrestricted use and unlimited exposure after cleanup. According to EPA, land use controls are meant to supplement engineering controls and should rarely be the sole remedy at a site.

Regulatory Agreements and Site-Specific Factors Inform How Sites Decide to Clean Up Soil and Legacy Landfills

Cleanup at EM Sites Is Governed by Agreements and Federal and State Laws

For EM sites on the National Priorities List, DOE entered into federal facility agreements with EPA and the relevant states. There may also be DOE orders, cleanup agreements, compliance orders, consent orders, and consent decrees governing cleanup at the sites. Federal facility agreements generally set out a process for deciding on cleanup actions and a sequence for accomplishing cleanup work, tend to cover a relatively large number of cleanup activities, and include enforceable milestones that DOE must meet. These agreements may integrate DOE's CERCLA and RCRA response action obligations at the site.

Regulators can work with DOE to amend agreements and other orders for cleanup. For example, EPA officials told us they are actively engaged in renegotiating three cleanup milestones under the federal facility agreement for the Hanford Site, largely because of resource constraints. In addition, EM-Los Alamos officials said that they worked with the State of New Mexico to revise the 2016 Compliance Order on Consent in 2024 to clarify the annual planning process.

EM sites must also comply with federal and state laws, and binding agreements. EM CERCLA sites must comply with applicable or relevant and appropriate requirements, which include federal and state laws and regulations. For example, regulators identify and agree upon the applicable or relevant and appropriate requirements of the Endangered Species Act on a site-by-site basis. Certain agreements for sites may also identify applicable state laws that EM must follow. For example, at ETEC, DOE is required under its 2010 State of California Administrative Order on Consent for Remedial Action to provide all available information necessary to facilitate the California Department of Toxic Substances Control's preparation of an analysis under the California Environmental

Quality Act.[16] The act, as amended, requires that California public agencies evaluate potential environmental impacts of certain proposed projects or activities carried out or approved by state public agencies, which could include the proposed cleanup activities at ETEC.[17]

DOE and Regulators Generally Work Together to Identify Appropriate Remedies Informed by Site-Specific Factors

While ensuring legal requirements are met, DOE and regulators also use site-specific factors to inform remedy decisions. Site officials we spoke with noted that DOE, EPA, and state regulators are generally able to work together to identify appropriate cleanup remedies. Site-specific factors considered include future land use, physical parameters, and community acceptance.

Future Land Use

At all our selected sites, EM and regulators consider what the future land use of the site—such as residential, industrial, or recreational use—will entail when selecting an appropriate remedy. For example, EM-Nevada is responsible for remediation of land in areas controlled by DOE as well as the U.S. Air Force. According to the 1996 Record of Decision for the site, negotiated soil cleanup levels were to be based on several factors including anticipated land uses and risk posed by contamination.[18] For DOE-controlled land, DOE and state regulators agreed to leave the contaminated soil in place in many parts of that land because DOE would be able to implement land use controls to limit access to contaminated areas to protect human health. On Air Force-controlled land, state regulators and Air Force officials used a risk-based approach to select remedies, considering the amount of time service members would be in an area to determine the appropriate levels of soil cleanup. The various remedies in different areas included excavation of soil, leaving contaminated soil in place, and capping of soil.

Similarly, various areas of Oak Ridge-EM will have differing future land uses. Cleaned-up land will either go back to the community to be redeveloped or remain as active DOE sites, according to site documentation. EM officials are in the final stages of cleanup at the East Tennessee Technology Park at Oak Ridge; plans for that land include a multi-use industrial center, a historical park, and a conservation area for

[16]Administrative Order on Consent for Remedial Action, *In re* Santa Susana Field Laboratory Simi Hills Ventura County, California, No. HSA-CO 10/11-037 (Cal. Env't. Prot. Agency, Dep't of Toxic Substances Control Dec. 6, 2010).

[17]*See* Cal. Pub. Res. Code §§ 21000–21189; Cal. Code Regs. tit. 14, §§ 15000–15387.

[18]Record of Decision: Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada, 61 Fed. Reg. 65551, 65560 (Dec. 13, 1996).

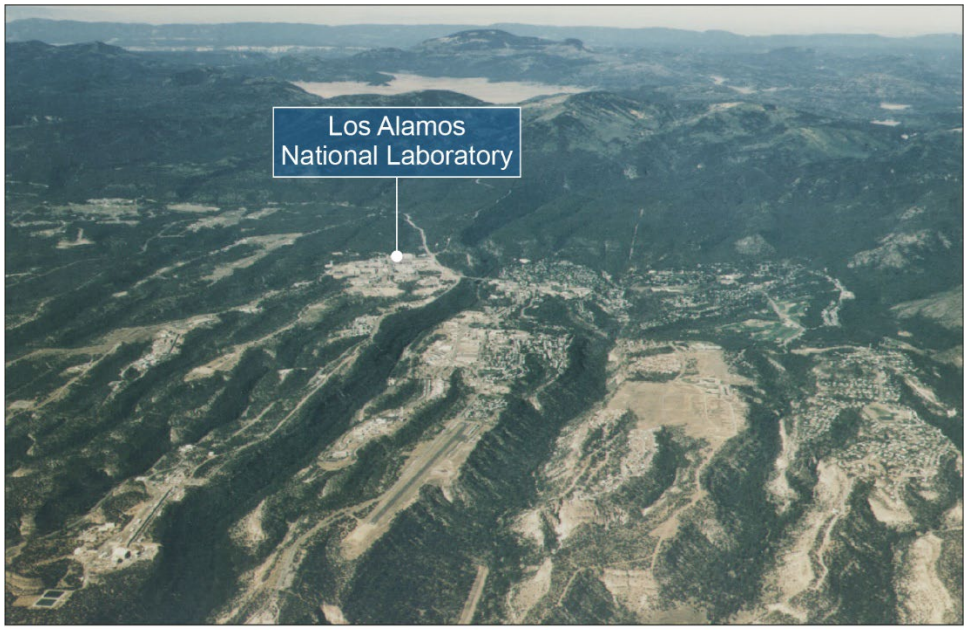
the community. EM is cleaning up portions of two other areas at Oak Ridge—the Y-12 National Security Complex and the Oak Ridge National Laboratory. Officials said the land is primarily in DOE-controlled industrial use areas and will be used to support ongoing national security missions and scientific research following completion of Oak Ridge-EM cleanup actions.

Physical Parameters

Physical parameters, including the geography, ecosystem, and hydrology of a site, are factors that regulators and EM consider in identifying remedies at all our selected sites. For example, site officials explained that the landscape and geography of the Savannah River Site has swampy areas and quicksand that makes it hard to operate equipment. They said these areas require innovative, less-invasive approaches for remediation. In a swampy portion of the site, for instance, the Savannah River Site and its regulators agreed to implement land use controls because removing contaminated soil from that landscape would cost several million dollars more than planned and present a major challenge, according to site officials.

The unique geography of the EM-Los Alamos site may also impact remedy selection because regulators must consider the complexities of working around the site's geography, according to site officials. Specifically, the site sits on the Pajarito Plateau, a series of finger mesas separated by deep canyons (see fig. 6). Officials said that this geography presents challenges such as handling stormwater runoff, collecting samples to test for contamination, and monitoring contamination.

Figure 6: Geography of Finger Mesas at the Los Alamos National Laboratory Where the Office of Environmental Management Conducts Cleanup



Source: GAO adaptation of U.S. Department of Energy photo. | GAO-25-107565

Community Acceptance

Agency officials at four of our eight selected sites said that community acceptance of cleanup remedies is a factor in remedy selection. Community acceptance is also one of the criteria used to evaluate remedy alternatives under CERCLA. At Oak Ridge-EM, for example, DOE worked with a community-based advisory organization established to provide recommendations to DOE on remediation decisions at the site, according to agency documentation. DOE's selected remedy for the site, which was finalized in 2005 and includes excavation and disposal of contaminated soil, is consistent with recommendations from the organization. Prior to selecting a remedy, DOE also extended public comment periods for cleanup plans twice, at the public's request, and held a public meeting to solicit input.

Officials at ETEC also said that they engage with stakeholders to gain community input and acceptance of their proposed cleanup remedies. They said they use best practices that EM has learned at various sites to help stakeholders, including the public, understand EM's plans and goals for remediation. For example, ETEC officials brought on additional staff to work specifically on stakeholder engagement, building bridges between federal staff, contractors, and the public. Additionally, in March 2025,

ETEC officials held two public meetings to gather public comments on potential options to address soil contamination at the site.

Selected Sites Reported Soil and Legacy Landfill Cleanup Will Take Decades and Cost about $15 Billion, but EM Headquarters Cannot Identify Total Schedule and Cost

Soil and Legacy Landfill Cleanup at Selected Sites Is Estimated to Take More Than 6 Decades and Cost about $15 Billion, Though Substantial Uncertainties Remain

Across the eight selected sites we reviewed, remaining soil and legacy landfill cleanup is estimated to take more than 60 years and cost approximately $15 billion.[19] The Hanford Site has the most extensive remaining soil and legacy landfill cleanup, estimated to last until 2086 and cost up to $8 billion, according to site officials. This includes soil remediation and legacy landfill cleanup activities in 26 areas. For example, the site needs to complete soil cleanup beneath the 324 Building, where highly radioactive liquid leaked into the soil during research on radioactive materials. In contrast, officials at EM-Nevada expect that they will complete its remaining soil cleanup by 2030 at an estimated cost of between $0.9 million and $1.8 million. The remaining work at EM-Nevada consists of cleaning up the residual contaminated soil in areas where the site is conducting activities such as decommissioning and demolishing infrastructure. According to EM officials, as of August 2025, EM is in the process of evaluating and updating estimated completion dates and costs, which will be reflected in the next EM Program Plan, expected in 2026.

[19]The schedule and cost estimates we received from sites are not directly comparable due to how each site separated out soil and legacy landfill activities from other cleanup activities in response to our request. For example, Oak Ridge-EM officials said that their cost estimate of $1.9 billion for remaining soil and legacy landfill cleanup does not include long-term maintenance. However, the cost estimate of $4.3 billion at the Savannah River Site does include long-term maintenance.

See appendix I for more information about scope, schedule, and cost estimates for soil and legacy landfill cleanup from each of the selected sites.

Substantial uncertainties may affect future cleanup scope, schedule, and cost at the eight selected sites. These uncertainties around scope can have large implications for the total schedule and cost of the cleanup. Such uncertainties can come from (1) remaining remedy decisions and (2) additional challenges that can come up while conducting cleanup activities.

Uncertainty Due to Remaining Remedy Decisions

EM officials expect that the scope, schedule, and cost for cleanup activities will change based on future decisions for areas that have not yet determined cleanup remedies for the soil or legacy landfills. Five of our eight selected sites have remaining remedy decisions to make, with one site—Oak Ridge-EM—not expecting finalized plans for cleanup for some areas until the 2040s, according to site officials. As another example, the Hanford Site officials told us that, in the next decade, the site needs to finalize remedy decisions for 16 of the 26 areas with remaining cleanup scope. Hanford officials said that they created their cost estimate based on historical knowledge to inform and select the most likely remedy they will use at each area. However, officials also said there is a chance that costs may increase as EM and the regulators finalize remediation plans. Officials told us that for sites with remaining remedy decisions, they update schedule and cost estimates as more information becomes available.

At two of our selected sites—ETEC and EM-Los Alamos—EM and regulators have been working for more than a decade on the scope of remedial actions that the sites will take to clean up soil and legacy landfills. At both sites, the remedy selected by the state regulator will have significant implications for EM's final cleanup costs.

ETEC

At ETEC, the site and the State of California are working together to decide how to address soil cleanup at the site. In an Administrative Order on Consent for Remedial Action signed in 2010, DOE consented to clean up the contaminated soil at the site to "background"—no contaminants will remain in the soil above local background levels at the cleanup

completion.[20] As required by the 2010 Order, the California Department of Toxic Substances Control (DTSC) prepared a table listing the chemical cleanup levels, including the local background concentrations for various soil contaminants.[21] DTSC completed the list of cleanup levels for soil contamination in 2013.

However, while conducting initial assessments, ETEC found that there were challenges to implementing the cleanup of the contaminated soil to the set background levels. Among other technical considerations, ETEC reported the following challenges in its 2018 report on the environmental impacts of remedy alternatives:[22]

(1) **Some state-determined cleanup levels are too low for laboratories to measure accurately.** The report stated that DTSC set cleanup levels for many contaminants at a standard that could be difficult for analytical instruments to accurately measure. The report noted that this could lead to false positives, or instances in which the analytical instruments find that the contaminant exceeds cleanup levels in the soil sample, when the contaminant does not actually exceed these levels. The report stated that such false positives could lead to unnecessary cleanup of soil. Increased volumes of disposed soil would result in higher costs to taxpayers.

[20]*See* Administrative Order on Consent for Remedial Action, *In re* Santa Susana Field Laboratory Simi Hills Ventura County, California, No. HSA-CO 10/11-037 (Cal. Env't. Prot. Agency DTSC Dec. 6, 2010) (amended in May 2020 to add provisions related to the demolition of eight DOE buildings in Area IV at ETEC).

[21]The DTSC table listing the final cleanup levels were not included the 2010 Order, but established after the parties signed the Order. The 2010 Order incorporated an Agreement in Principle that governs DOE's cleanup obligations for ETEC's soil contamination. *Administrative Order on Consent for Remedial Action*, § 1.7. This Agreement in Principle required DTSC to conduct a study to determine local background levels and chemical detection limits, in coordination with the U.S. Environmental Protection Agency, and prepare a "look-up" table of the chemical cleanup levels. The table would include both local background concentrations as well as minimum detection limits for specific contaminants whose minimum detection limits exceed local background concentrations. *See* Administrative Order on Consent for Remedial Action, § 1.7 and Attachment B, Final Agreement in Principle. *See also* DTSC, *Chemical Look-Up Table Technical Memorandum, Santa Susana Field Laboratory, Ventura County, California* (June 11, 2013).

[22]DOE prepared this environmental impact statement in accordance with the National Environmental Policy Act requirements and the Council on Environmental Quality and DOE's implementing regulations in effect at the time. *See* DOE, *Final Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory* (Nov. 2018).

(2) **DOE was not able to find soil clean enough to meet standards.** The report stated that ETEC conducted an initial evaluation in 2015 of three other sites that could potentially provide clean soil to replace the contaminated soil at ETEC. The evaluation concluded that none of the sites had soil clean enough to meet the cleanup levels. Additionally, ETEC tested soil products sold by home improvement stores, which also exceeded the level of contamination that would meet cleanup standards.

In 2023, DTSC released its final environmental impact report that acknowledged these challenges but reiterated that DTSC expects ETEC to clean up the site to background levels as required by the terms of the 2010 Order.[23] The report presented different options to minimize the false positives for soil samples and stated that the 2010 Order allows final cleanup levels to be adjusted based on the ability of multiple laboratories to meet the order's cleanup reporting limits. DTSC also acknowledged in the report that sources of suitable backfill soil have not yet been fully identified and noted that if identified backfill soils cannot achieve the cleanup standards, DTSC will determine the best alternative source of backfill that is still protective of human health and the environment. According to both ETEC and DTSC officials, the two parties have had meetings since then to move forward on figuring out the best way to meet the background level standards.

As of April 2025, ETEC officials are conducting updated studies on laboratory technical capabilities and on the potential sources of clean soil that ETEC could use to replace the contaminated soil. ETEC and DTSC officials said that these studies will be complete by the end of 2025. According to ETEC officials, the studies will inform its supplemental environmental impact statement for the analysis of alternatives for cleaning up the soil at the site, which officials said would be complete in 2027.[24] The analysis of alternatives will assess the environmental impact of a few different cleanup options.

[23]DTSC prepared this report on the possible environmental impacts from the cleanup of contaminated soil and groundwater at ETEC in compliance with the California Environmental Quality Act and implementing regulations that were in effect at the time. *See* DTSC, *Final Program Environmental Impact Report for the Santa Susana Field Laboratory, Ventura County, California* (Los Angeles, CA: June 2023).

[24]*See* Notice of Intent To Prepare a Supplemental Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory and Conduct Public Scoping Meetings, 89 Fed. Reg. 105555 (Dec. 27, 2024).

For example, these alternatives will include one that uses risk assessment and different types of supporting evidence to determine which areas ETEC needs to cleanup. Another alternative would follow standard risk assessment protocols to clean up the site to a level that will be safe for people to live on-site and eat produce grown in the soil.[25] In a February 2025 letter to ETEC officials regarding the supplemental environmental impact statement, DTSC reiterated that DOE is required to comply with cleanup requirements in the 2010 Order.[26] In the letter, DTSC recommended that DOE focus its supplemental analysis on remedy alternatives that adhere with that Order and DTSC's environmental impact report.

In its 2018 report on the environmental impacts of remedy alternatives, ETEC estimated it would take about $774 million to meet the cleanup levels in the Order. In 2025, ETEC officials estimated potential cleanup costs ranging from $57 million to $1 billion, based on the remedy alternatives ETEC evaluated in the 2018 report.[27] ETEC officials will update cost estimates as they develop their supplemental environmental impact statement for the analysis of alternatives.

[25]ETEC officials presented these various alternatives in a public scoping meeting in March 2025. The officials stated that these alternatives are preliminary and can change as ETEC collects more information and analyses the potential options. According to ETEC officials, an alternative that follows standard risk assessment protocols to clean up the site to a level that will be safe for people to live on-site and eat produce grown in the soil will not meet the cleanup standards determined by DTSC as required by the 2010 Administrative Order on Consent. However, ETEC officials said that they plan to include this alternative because that is the standard that another entity is taking to clean up soil adjacent to the ETEC site.

[26]DTSC sent this letter to ETEC officials to provide comments on DOE's notice of its intent to prepare a supplemental environmental impact statement. *See* DTSC, *Department of Toxic Substances Control Comments on the Department of Energy's (DOE) Notice of Intent (NOI) to prepare a Supplemental Environmental Impact Statement (SEIS) for Remediation of Area IV and the Northern Buffer Zone (NBZ) of the Santa Susana Field Laboratory* (Feb. 12, 2025). In the letter, DTSC stated that DOE's supplemental environmental impact statement under the National Environmental Policy Act will not change DTSC's analysis of the possible environmental impacts from the cleanup of contaminated soil at ETEC certified under the California Environmental Quality Act.

[27]These remedy alternatives include cleanup to meet the state-determined cleanup levels, cleanup to meet revised background levels that differ from cleanup levels determined by DTSC, and a risk-based cleanup that is protective of human health and the environment. *See* DTSC, *Final Program Environmental Impact Report for the Santa Susana Field Laboratory, Ventura County, California* (Los Angeles, CA: June 2023).

EM-Los Alamos

The New Mexico Environment Department has yet to issue a final decision on the remedy on the legacy landfill known as Material Disposal Area C (MDA-C), one of 17 legacy landfills at the Los Alamos site that the site still needs to remediate. The 2016 Compliance Order on Consent as modified in 2024 sets the framework for cleanup of hazardous wastes at the site, with the state acting as the lead regulator.[28] EM-Los Alamos conducts analyses on alternatives for remediation and the state chooses a remedy for the site to implement based on specified criteria and requirements in the Order. Officials from EM-Los Alamos initially investigated MDA-C and submitted a Corrective Measures Evaluation Report with their preferred alternative for remediation for cleanup in 2012, but the New Mexico Environment Department did not take action to select a cleanup remedy. Officials from the New Mexico Environment Department said that they had competing priorities at that time.

EM-Los Alamos submitted a revised Corrective Measures Evaluation Report to the state agency in 2021 with the preferred alternative for remediation of capping the legacy landfill and performing long-term monitoring and maintenance of the site, among other remedial actions.[29] In the report, EM-Los Alamos stated that this alternative for remediation had an approximate cost of about $12 million. In its evaluation of alternatives, EM-Los Alamos stated that its preferred alternative for remediation meets the requisite threshold criteria and was evaluated

[28]*See* New Mexico Environment Department, Compliance Order on Consent, U.S. Department of Energy Los Alamos National Laboratory (June 2016, modified Sept. 2024). EPA has authorized the state of New Mexico to regulate hazardous waste and implement its corrective action program under the New Mexico Hazardous Waste Act in lieu of the federal RCRA program. *See* N.M. Stat. Ann. §§ 74-4-1—74-4-14.

[29]DOE, *Corrective Measures Evaluation Report for Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50, Revision 1* (Los Alamos, NM: June 2021). See footnote 32 for more details.

using balancing criteria. The site had agreed upon these criteria with the State of New Mexico in the 2016 Order.[30]

In 2023, the New Mexico Environment Department released its Statement of Basis, which determined that a remedy of excavation of the legacy landfill, extraction of vapor, subsequent site monitoring, and institutional controls as the appropriate cleanup measure.[31] According to EM-Los Alamos' Corrective Measures Evaluation Report, this option would cost about $805 million. Officials from the New Mexico Environment Department said that they prioritized the protection of human health and the environment in the surrounding community when making their remedial decision. They stated that the additional protectiveness of excavation outweighs the consideration of cost-effectiveness. The New Mexico Environment Department questions the reliability of the cap over the long term and whether it will prevent the intrusion of deep-rooting plants and burrowing animals. Additionally, New Mexico Environment Department officials said that EM-Los Alamos' preferred remedy would not sufficiently address vapor contamination.

EM-Los Alamos and other parties requested a public hearing on the Statement of Basis. A public hearing on the Statement of Basis has not been scheduled as of September 15, 2025, because of various circumstances and differing views between EM-Los Alamos and the New

[30]New Mexico Environment Department, Compliance Order on Consent, U.S. Department of Energy Los Alamos National Laboratory § 16.C (June 2016, modified Sept. 2024). The threshold criteria agreed upon between DOE and the state of New Mexico in the 2016 Order are (1) be protective of human health and the environment, (2) attain media cleanup objectives, (3) control the source of the releases, and (4) comply with applicable standards for management of wastes. The 2016 Order requires DOE to use balancing criteria to evaluate alternatives meeting the threshold criteria. The balancing criteria include (1) long-term reliability and effectiveness (including sustainability, long-term stewardship considerations, and long-term environmental impacts); (2) reduction of toxicity, mobility, or volume of waste and contaminated media; (3) short-term effectiveness (including near-term environmental impacts); (4) implementability; and (5) cost.

[31]New Mexico Environment Department, Statement of Basis, Selection of a Remedy for Corrective Action at Material Disposal Area C, SWMU 50-009, at Technical Area 50 (Sept. 7, 2023).

Mexico Environment Department on whether to proceed with the hearing.[32]

Uncertainty Due to Challenges During Cleanup

Once a remedy decision is made, DOE may run into additional challenges in conducting soil and legacy landfill cleanup, which can increase costs and extend the cleanup schedule at EM sites. For example, sites may face (1) unexpected contamination, (2) geographical and technical complexity, (3) protecting and working around biological and cultural resources, and (4) difficulty obtaining resources.[33] Some EM sites have been able to mitigate the impact these challenges have had on costs and schedule. EM officials told us that sites routinely check and update schedules and costs and report updated schedules and costs annually.

Unexpected Contamination

When preparing for and conducting cleanup, sites may encounter unexpected contamination, which can increase the scope of cleanup, affecting schedule and cost. Four of the eight selected sites reported challenges with unexpected contamination. For example, demolition plans at the Hanford Site's 324 Building were postponed when officials found significant soil contamination under the building. As previously mentioned, this was likely caused by a spill of highly radioactive liquid. When they later went to stabilize the building in preparation for soil excavation, they discovered that the extent of soil contamination was greater than expected. This discovery required them to revise demolition and remediation plans.

[32]In July and August 2025, EM-Los Alamos notified the New Mexico Environment Department that it was withdrawing the 2021 Corrective Measures Evaluation Report because the site would be deferring cleanup actions for MDA-C due to active facility operations and filed a motion, along with NNSA and other parties, to dismiss the public hearing proceedings. *See* Motion of U.S. Department of Energy Office of Environmental Management, Los Alamos Field Office to Dismiss the Administrative Proceedings in this Docket, Vacate the Hearing, and Remand the Matter for Further Action Pursuant to the Consent Order, *In re* Determination Request Statement of Basis for Material Disposal Area C, at LANL, Exhibits C and D, No. HWB 24-33 (N.M. Env't Dept. Aug. 1, 2025). The New Mexico Environment Department has opposed the hearing dismissal, the withdrawal of the 2021 report, and EM-Los Alamos's determination that MDA-C is eligible for deferment status. *See* NMED's Response to Motion, No. HWB 24-33 (N.M. Env't Dept. Aug. 25, 2025). As of mid-September 2025, the hearing officer has not yet issued a decision on whether the hearing will be dismissed.

[33]Other factors include working around active missions at sites. For example, Oak Ridge-EM officials have negotiated future milestones with their regulators to accommodate an NNSA project and coordinate the re-routing of NNSA utilities.

Oak Ridge-EM officials also said that, due to a lack of site documentation, they often encounter unexpected contamination when digging up contaminated soil. For example, officials said that they had difficulty conducting soil remediation at the site's East Tennessee Technology Park because the amount of soil that needed to be remediated was significantly above initial estimates. However, through planning and adapting their cleanup approaches, they were able to complete soil cleanup in that area on schedule, though at a higher cost. Officials told us they make sure to incorporate any new findings that they encounter during cleanup in their risk modeling to bound the site's future schedule and cost estimates.

Geographical and Technical Complexity

Geographical and technical complexity at EM sites can create uncertainty around future soil and legacy landfill schedule and cost. Six of the selected sites reported facing geographical and technical complexity. For example, officials said that a steep cliff at EM-Livermore makes accessing and digging up soil difficult. They plan to work with regulators on a feasibility study to inform the remedy selection in this area.

At the Hanford Site, contaminated soil is sometimes much deeper in the ground than expected. In one instance, officials had to remove soil that was greater than 40 feet below ground, which is more soil than they typically remove. Additionally, some of the contamination at the site spread horizontally, including under buildings that are currently in use. Officials have addressed this by adapting their design approach to incorporate certain techniques to identify the depth of soil contamination. They are also looking at ways to mitigate this challenge for sites moving forward. Officials said that cost estimates are based on presumptive future remedies, dimensions, and designs. If there are design changes, such as the example described above, cost estimates may need to be updated. Hanford Site officials also said that one of the site's burial grounds has been more complicated to remediate, as it is adjacent to an active commercial nuclear power plant. The ongoing operations of the power plant, among other challenges, has required that they push the start date of remediation out to 2030.

Protecting and Working Around Biological and Cultural Resources

Working around the protected biological and cultural resources at each site can also increase schedule and cost. Three of the selected sites reported having to protect and work around biological and cultural

resources. At EM-Los Alamos, for example, there are certain cultural sites that require engagement with federally recognized Tribes, and DOE officials said they follow DOE's policy on engaging with federally recognized Tribes. An EM contract archeologist engages with federally recognized Tribes on culturally sensitive issues and works to ensure minimal disturbance of cultural resources. According to officials, it can sometimes take 6 months to a year from when they discover cultural resources in an area to conduct cleanup work.

With regard to biological resources, some sites, such as EM-Livermore, contain federally protected habitats for threatened and endangered species. EM-Livermore officials have coordinated with the U.S. Fish and Wildlife Service and discussed using offsets to mitigate the biological impacts of soil remediation. However, officials said that this solution may be costly.

Difficulty Obtaining Resources

Limited workforce capacity and funding can also generate increased schedule and costs. Seven of the selected sites reported having difficulty obtaining resources, including workforce and budgetary resources. In July 2024, we reported that workforce management challenges at EM sites can lead to schedule delays, cost overruns, and workplace accidents.[34] For example, EM-Los Alamos officials said that they have struggled to maintain their workforce capacity partly because EM must compete with NNSA's contractor, which generally has greater financial resources and more competitive employment offers. EM has also faced ongoing vacancies and reductions in its mission-critical federal workforce, which could potentially affect the progression of soil cleanup projects. According to EM officials, from January 2025 to April 2025, eight EM-Los Alamos federal employees left the site, creating a total of 21 vacancies for 41 federal positions at the site.

Furthermore, budget constraints have required some EM sites to adjust deadlines for some soil cleanup projects that it had previously agreed on with their regulatory partners. For example, Idaho Cleanup Project officials and their regulatory partners recently renegotiated the schedule for capping the site's remaining legacy landfill. Officials said that they plan to use a subcontractor with off-site workers to construct the cap; however,

[34]GAO, *Nuclear Waste Cleanup: Changes Needed to Address Current and Growing Shortages in Mission-Critical Positions,* GAO-24-106479 (Washington, D.C.: July 18, 2024).

their current funding stream is being used to maintain existing personnel for ongoing cleanup efforts. Without additional funding, they needed to delay cap construction or lay off existing personnel to afford the subcontract. The renegotiated schedule allows them to maintain their current workforce and extend the cap completion date from 2028 to 2033.

Unrealistic resource expectations may lead to EM sites needing to extend their schedules over a longer time than expected, which can increase costs for soil cleanup projects at EM sites. In June 2024, we recommended that the Senior Advisor for the Office of Environmental Management should ensure the EM program's integrated master schedule is based on realistic assumptions, among other factors.[35] We also noted that implementing this recommendation would allow EM to better ensure that it has an accurate cost and schedule estimate for the entire EM program. EM agreed with our recommendation and estimated that it would complete this action by June 2026.

EM Headquarters Cannot Readily Identify Information on the Scope, Schedule, and Cost of Soil and Legacy Landfill Cleanup

Based on our review of agency documentation and interviews with EM headquarters officials, we found that EM headquarters cannot readily identify information on the scope, schedule, and cost of soil and legacy landfill cleanup. However, individual sites do have readily accessible data specific to soil and legacy landfill cleanup that are available upon request. EM officials also told us that requesting this information from sites can place a burden on the site.

EM headquarters officials said that they use the One Enterprise Management System to manage data about cleanup scope, schedule, and cost. Officials said that sites report data to the system in an aggregated form, meaning soil and legacy landfill activities are combined with other activities including groundwater cleanup and the deactivation and decommissioning of inactive facilities. Officials said these are combined because they generally occur near the end of a cleanup project. However, these activities are often on very different time frames. For example, our prior work has shown that groundwater cleanup can take many additional years—sometimes over a decade—after soil cleanup is complete.[36] Aggregating groundwater projects with soil

[35]GAO, *Nuclear Waste Cleanup: Closer Alignment with Leading Practices Needed to Improve Department of Energy Program Management,* GAO-24-105975 (Washington, D.C.: June 4, 2024).

[36]GAO, *Nuclear Waste Cleanup: DOE Should Use Available Information to Measure the Effectiveness of Its Groundwater Efforts,* GAO-25-106938 (Washington, D.C.: November 19, 2024).

projects makes it difficult for headquarters to understand the specific timelines for each aspect of cleanup scope that is being addressed complex-wide.

In the absence of specific data in the One Enterprise Management System about soil cleanup, EM headquarters officials said they also review and approve life cycle baselines—schedule and cost estimates for each site. These documents include more detailed site-specific information about soil and legacy landfill cleanup activities, but not in a format that makes it easy compare cleanup projects across sites to assess risks.

EM's 2020 Program Management Protocol and its Strategic Vision emphasize the importance of risk reduction when prioritizing cleanup activities.[37] The protocol also states that the headquarters organization responsible for regulatory and environmental compliance provides technical and policy support in the planning and field execution of cleanup. EM sites submit annual prioritized lists of cleanup activities, which headquarters uses to inform budget decisions. However, EM headquarters considers these prioritized lists on a site-by-site basis, and it does not use them to prioritize risk-reduction across sites or on a complex-wide level.

Without information at the headquarters level specifically on the scope, schedule, and cost of soil and legacy landfill cleanup at EM sites, EM cannot effectively implement its risk-informed approach nationwide. Specifically, EM does not have full information to provide Congress to inform the allocation of resources for soil and legacy landfill cleanup for each site relative to other priorities or cleanup efforts at other sites. Relying on site-specific prioritization decisions may yield suboptimal investments of taxpayer resources—potentially allocating resources to relatively lower risk soil remediation activities at certain sites compared to those at other sites that may pose greater risks. Furthermore, having distinct information on soil cleanup activities could better position EM headquarters to provide technical support for planning and guiding prioritization decisions within and across sites, particularly when limited resources require EM to make tradeoffs.

[37]Department of Energy, Office of Environmental Management, *EM Strategic Vision: 2024-2034*, (Washington, D.C.: March 12, 2024).

EM sites are still working with regulators to make remedy decisions for at least dozens of additional areas of soil and legacy landfill cleanup, which could cost billions of dollars and last decades. As these remedy decisions are made, having information available that is specific to soil and legacy landfill cleanup at EM sites would also improve headquarters' ability to track the resources needed to implement remedy decisions and their schedule and cost implications on the entire EM program. For instance, as described above, Idaho Cleanup Project officials renegotiated the schedule with regulators for capping the site's remaining legacy landfill due to resource constraints. By collecting scope, schedule, and cost information on soil and legacy landfill cleanup efforts, EM headquarters could better analyze such decisions in the context of the entire EM program to ensure that that the new milestones are cost-effective for the program. Additionally, such information would enable EM headquarters, DOE, regulators, and Congress to better weigh the risks and prioritize the resources needed to meet soil and legacy landfill cleanup requirements across EM sites.

Conclusions

Cleaning up soil and legacy landfill contamination is critical to EM's mission and is expected to take decades and cost billions. Yet, EM headquarters cannot readily identify information on the scope, schedule, and cost of soil and legacy landfill cleanup. Being able to identify soil cleanup activities—distinct from broader cleanup efforts—would allow EM headquarters to more adequately prioritize cleanup across sites to achieve the most efficient risk reduction.

With looming decisions at numerous sites, including ETEC, Hanford, and EM-Los Alamos, EM has the opportunity to enhance its technical and policy support to EM sites and potentially improve management and prioritization decisions by collecting and using scope, schedule, and cost information on soil and legacy landfill cleanup. Such information would enable EM headquarters, DOE, regulators, and Congress to better weigh the risks and prioritize the resources needed to meet soil and legacy landfill cleanup requirements across EM sites.

Recommendation for Executive Action

The Assistant Secretary for the Office of Environmental Management should ensure that EM headquarters collects and uses information specific to the scope, schedule, and cost of soil and legacy landfill cleanup to enhance technical and policy support provided to sites and inform prioritization decisions to reduce risk. (Recommendation 1)

Agency Comments

We provided a draft of this report to DOE and EPA for review and comment. DOE neither agreed nor disagreed with our recommendations

and stated that it would provide management decisions for our recommendation in a later response to this report. DOE and EPA provided technical comments, which we incorporated as appropriated.

If you or your staff have any questions about this report, please contact me at or AndersonN@gao.gov. GAO staff who made key contributions to this report are listed in appendix II.

//SIGNED//

Nathan J. Anderson
Director, Natural Resources and Environment

List of Requesters

The Honorable Brett Guthrie
Chairman
The Honorable Frank Pallone, Jr.
Ranking Member
Committee on Energy and Commerce
House of Representatives

The Honorable Robert Latta
Chairman
The Honorable Kathy Castor
Ranking Member
Subcommittee on Energy
Committee on Energy and Commerce
House of Representatives

The Honorable H. Morgan Griffith
Chairman
The Honorable Diana DeGette
Ranking Member
Subcommittee on Health
Committee on Energy and Commerce
House of Representatives

The Honorable John Joyce, M.D.
Chairman
Subcommittee on Oversight and Investigations
Committee on Energy and Commerce
House of Representatives

The Honorable Gary Palmer
House of Representatives

Appendix I: Site-Specific Scope, Schedule, and Cost Information for Soil and Legacy Landfill Cleanup

Out of the 12 U.S. Department of Energy (DOE) Office of Environmental Management (EM) sites that have remaining soil and legacy landfill cleanup, we selected eight sites to gather information about the remaining scope, schedule, and cost.[1] EM officials told us that, as of August 2025, EM is in the process of evaluating and updating estimated completion dates and costs, which will be reflected in the next EM Program Plan expected in 2026. The sections below describe the history of the selected sites, the scope of remaining soil and legacy landfill cleanup, and the estimated schedule and cost of these activities. We received this information from officials at each of the eight sites.

Energy Technology Engineering Center

SITE BACKGROUND AND REMAINING SCOPE

EM's Energy Technology Engineering Center (ETEC) is located within the Santa Susana Field Laboratory in Ventura County, California. ETEC is responsible for remediating about 0.74 square miles. Contaminants on the site include chemicals and radionuclides from liquid metals research and various research activities at 10 small nuclear reactors that started operation in the 1950s.

ETEC completed the demolition of all DOE-owned buildings in 2021 and is now working with California state regulators to determine the remedial actions ETEC will take to clean up the soil.

ESTIMATED SCHEDULE AND COST

Estimated Completion Date: 2033–2055

Estimated Remaining Costs: $57 million to $1 billion

Officials at ETEC based their cost estimate on the remedy alternatives ETEC considered in its 2018 statement on the environmental impacts of remedy alternatives. These alternatives include cleaning up to state-determined cleanup levels and cleaning up to a standard that protects human health and the environment, among others. The schedule and cost estimates are partially based on the volume of soil that would be remediated under the various alternatives, ranging from 38,200 to 881,000 cubic yards of soil, among other assumptions. ETEC officials are currently conducting studies to inform a supplemental environmental impact statement of analysis of alternatives. Officials expect to complete the supplemental environmental analysis of alternatives in 2027.

[1]We selected the eight sites to ensure we had examples of sites that represent a range of regulatory frameworks, remaining scope and regulatory decisions, end uses, and locations (i.e., which state the site is located in).

Hanford Site

SITE BACKGROUND AND REMAINING SCOPE

The 580-square mile Hanford Site was established in eastern Washington State during World War II to produce plutonium for the nation's nuclear weapons, which it did through 1987. Soil contamination includes contamination from intentional and unintentional liquid waste discharges to soil.

The site still has soil remediation and legacy landfill cleanup remaining in 26 areas, including 31 legacy landfills. In 16 of the 26 areas, officials have not yet determined how they will conduct cleanup.

ESTIMATED SCHEDULE AND COST

Estimated Completion Date: 2086

Estimated Remaining Costs: $6.5 billion to $8 billion

The cost estimate includes costs to implement soil and legacy landfill cleanup, such as waste removal, treatment and disposal, and the construction of caps. For areas for which the Hanford Site has not yet determined the cleanup remedy, officials said that they based their cost estimates on historical knowledge at the site.

Idaho Cleanup Project

SITE BACKGROUND AND REMAINING SCOPE

EM manages the Idaho Cleanup Project to clean up Idaho National Laboratory, which was established in 1949 as the National Reactor Testing Station. Fifty-two reactors were built at the site, and four remain in operation. The 890-square-mile site is located in southeastern Idaho, and it will remain an active nuclear energy site.

According to officials, much of the soil remediation at the site is complete and remaining work includes constructing a final cap for a legacy landfill, called the Subsurface Disposal Area. Additionally, the site will design and construct a cap after removing radioactive waste stored in tanks at the Idaho Nuclear Technology and Engineering Center.

ESTIMATED SCHEDULE AND COST

Estimated Completion Date: 2062

Estimated Remaining Costs: $214 million to $271 million

This cost estimate excludes the costs of deactivation and decommissioning of contaminated infrastructure and other activities to prepare the area for construction. Idaho Cleanup Project officials said they plan to prioritize other ongoing cleanup at the site, such as cleaning up tank waste, and that costs for completing the cap may increase due to inflation and additional contract oversight costs.

EM-Livermore

SITE BACKGROUND AND REMAINING SCOPE

Located in California, the Lawrence Livermore National Laboratory was established in 1952 as a multidisciplinary research and development center focusing on weapons development and stewardship and homeland security. The site consists of almost 12 square miles across two separate areas—the Main Site and Site 300. EM-Livermore also oversees and provides funding for the National Nuclear Security Administration (NNSA) to manage soil remediation at the site.

NNSA officials said that most of the remaining soil cleanup is within three areas at Site 300. Officials said they are currently conducting investigations and studies to determine how to proceed with soil remediation at Site 300 and that they do not expect remedial actions to begin for another 6 to 10 years.

ESTIMATED SCHEDULE AND COST

Estimated Completion Date: 2035 or later

Estimated Remaining Costs: More than $44 million

This cost estimate includes a preliminary cost of cleanup for the area that the site plans to remediate first, which ranges from $8.5 million to $44 million. Because the cost estimate is preliminary, officials told us they expect the estimate to change as they get closer to determining how they plan to clean up that area. Officials said that this cost estimate includes costs for investigations and sampling for the entire area, including for media other than soil. The estimate does not include cleanup costs for the other two areas, which will be developed later.

EM-Los Alamos

SITE BACKGROUND AND REMAINING SCOPE

EM's field office at Los Alamos, New Mexico, is responsible for cleanup at the Los Alamos National Laboratory. Established in 1943, the site includes almost 40 square miles of DOE-owned land. Activities from the site generated and released radioactive and hazardous waste into the environment.

Officials at the site told us that they have 14 areas under the site's Consent Order with remaining soil or legacy landfill cleanup work. There are 17 legacy landfills that require remediation.

ESTIMATED SCHEDULE AND COST

Estimated Completion Date: 2044

Estimated Remaining Costs: $1 billion

Activities that EM-Los Alamos included in their estimated schedule and costs for soil and legacy landfill cleanup consist of demolition and cleanup, risk assessments, and long-term maintenance, in addition to the implementation of the cleanup remedies. For the areas for which regulators have not yet selected the remedy for cleanup, EM-Los Alamos officials said that they make assumptions about the remedy, for planning purposes and to calculate the cost estimates. However, the cost estimates may change depending on the remedy the State of New Mexico selects. In some instances, the potential corrective measures alternatives for remediation may have a large difference in cost. For example, EM-Los Alamos' preferred alternative for remediation as stated in EM-Los Alamos' 2021 Corrective Measures Evaluation Report for one of the legacy landfills has a cost estimate of about $12 million, but the regulator's recommended remedy selection has a cost estimate of about $805 million.

EM-Nevada

SITE BACKGROUND AND REMAINING SCOPE

EM-Nevada is responsible for cleanup work at the Nevada National Security Site and surrounding federal lands. From 1951 through 1992, the site and surrounding federal lands served as official nuclear testing grounds for the DOE and U.S. Department of Defense. The site stretches over 1,355 square miles in the southern part of the state. EM-Nevada also supports cleanup at other federal sites involved in nuclear activities by disposing of up to 750,000 cubic feet of waste materials annually.

EM-Nevada officials said that they have cleaned up all of its 22 legacy landfills and the majority of the contaminated soil. In 2020, EM-Nevada completed cleanup of all of its areas that primarily had soil contamination, but there is still soil remediation work left to do in some of the remaining areas. Specifically, there is still contaminated soil in areas under buildings and other infrastructure that EM-Nevada needs to address.

ESTIMATED SCHEDULE AND COST

Estimated Completion Date: 2030

Estimated Remaining Costs: $0.9 million to $1.8 million

EM-Nevada used historical information to estimate the percentage of soil that would need to be cleaned up out of the remaining remediation activities, according to site officials. These activities include decommissioning and demolishing infrastructure on the site.

Oak Ridge-EM

SITE BACKGROUND AND REMAINING SCOPE

The Oak Ridge-EM office manages cleanup efforts at the Oak Ridge Reservation, which occupies more than 50 square miles in eastern Tennessee and includes three sites: East Tennessee Technology Park (ETTP), Oak Ridge National Laboratory (ORNL), and Y-12. The Oak Ridge Reservation conducts research, built weapons, and enriched uranium.

At ETTP, EM has completed demolition of more than 500 facilities, along with a majority of soil cleanup and is now focused on facility demolition and soil cleanup at ORNL and Y-12. Cleanup remaining at these two sites includes the demolition of more than 300 structures. Oak Ridge-EM officials said that cleanup is still needed for several legacy landfills at the two sites.

ESTIMATED SCHEDULE AND COST

Estimated Completion Date: 2046

Estimated Remaining Costs: $1.9 billion

The current estimated remaining cost for ORNL soil remediation cleanup is approximately $762 million, and the estimated remaining cost for Y-12 soil remediation cleanup is $1.1 billion. Oak Ridge-EM officials told us these cost estimates include demolition costs related to soil remediation (e.g., cleanup of slabs and below-grade structures). However, officials said that the cost estimates do not include the demolition of buildings prior to soil remediation or long-term stewardship of the site.

Savannah River Site

SITE BACKGROUND AND REMAINING SCOPE

The Savannah River Site, a 310-square-mile EM site, is located in South Carolina. The federal government constructed the site in the early 1950s to produce materials for nuclear weapons.

While the Savannah River Site has already completed substantial soil cleanup of its many contaminated areas, officials said that remaining cleanup work includes completing soil remediation under buildings that have not yet been decommissioned. EM officials told us that they expect to transfer site responsibilities to the NNSA—which operates on site—in 2025, but EM will continue its site environmental cleanup mission, including by conducting surveillance and maintenance of areas that have already been closed.

ESTIMATED SCHEDULE AND COST

Estimated Completion Date: 2065

Estimated Remaining Costs: $4.3 billion

In addition to implementing soil cleanup activities, the site's schedule and cost estimates for soil cleanup include costs to complete ecological studies and regulatory documents and the maintenance of completed caps. Officials from the site said that future resource constraints may affect their schedule and cost estimates.

Appendix II: GAO Contacts and Staff Acknowledgments

GAO Contacts

Nathan Anderson at AndersonN@gao.gov.

Staff Acknowledgments

In addition to the contact named above, Janice Poling (Assistant Director), Karen Chen (Analyst in Charge), Adrian Apodaca, Gwen Kirby, Mollie Lemon, Steven Putansu, Linda Tsang, and Briscoe Turner made key contributions to this report.

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