Appendix A – Presumptive Remedy Guidance for CERCLA Municipal Landfill Sites

U.S. Environmental Protection Agency

Presumptive Remedies

Municipal Landfills

- Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (December 1996) [PDF: 1.5M / 18pp.]
- Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites (Executive Summary only) (February 1991) [PDF: 33K / 6pp.]
- Landfill Presumptive Remedy Saves Time and Cost (January 1997) [PDF: 48K / 6pp.]
- Presumptive Remedies: CERCLA Landfill Caps RI/FS Data Collection Guide (August 1995) [PDF: 67K / 8pp.]
- Presumptive Remedy for CERCLA Municipal Landfill Sites (September 1993) [PDF: 472K / 14pp.]
- Reuse of CERCLA Landfill and Containment Sites (September 1999) [PDF: 413K / 17pp.]
- Superfund Accelerated Cleanup Bulletin: Presumptive Remedies for Municipal Landfill Sites (Volume 1 Number 1, April 1992) [PDF: 132K / 1pp.]
- Superfund Accelerated Cleanup Bulletin: Presumptive Remedies for Municipal Landfill Sites (Volume 2 Number 1, February 1993) [PDF: 424K / 2pp.]

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Office of Solid Waste and Emergency Response
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EPA

Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills

Federal Facilities Restoration and Reuse Office
Mail Code 5101
Quick Reference Fact Sheet

Presumptive remedies are preferred technologies for common categories of sites based on historical patterns of remedy selection and the U.S. Environmental Protection Agency's (EPA's) scientific and engineering evaluation of performance data on technology implementation. By streamlining site investigation and accelerating the remedy selection process, presumptive remedies are expected to ensure the consistent selection of remedial actions and reduce the cost and time required to clean up similar sites. Presumptive remedies are expected to be used at all appropriate sites. Site-specific circumstances dictate whether a presumptive remedy is appropriate at a given site.

EPA established source containment as the presumptive remedy for municipal landfill sites regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) in September of 1993 (see the directive *Presumptive Remedy for CERCLA Municipal Landfill Sites*). The municipal landfill presumptive remedy should also be applied to all appropriate military landfills. This directive highlights a step-by-step approach to determining when a specific military landfill is an appropriate site for application of the containment presumptive remedy. It identifies the characteristics of municipal landfills that are relevant to the applicability of the presumptive remedy, addresses characteristics specific to military landfills, outlines an approach to determining whether the presumptive remedy applies to a given military landfill, and discusses administrative record documentation requirements.

PURPOSE

This directive provides guidance on applying the containment presumptive remedy to military landfills. Specifically, this guidance:

- Describes the relevant characteristics of municipal landfills for applicability of the presumptive remedy;
- Presents the characteristics specific to military installations that affect application of the presumptive remedy;
- Provides a decision framework to determine applicability of the presumptive remedy to military landfills; and
- Provides relevant contacts/specialists in military wastes, case histories, administrative record documentation requirements, and references.

BACKGROUND

Municipal landfills are those facilities in which a combination of household, commercial and, to a lesser extent, industrial wastes have been co-disposed. The presumptive remedy for municipal landfills – source containment – is described in detail in the directive *Presumptive Remedy for CERCLA Municipal Landfill Sites*. Highlight 1 outlines the components of the containment presumptive remedy. Highlight 2 lists the characteristics of municipal landfills that are compatible with the presumptive remedy of containment.

Highlight 1
Components of the Containment Presumptive Remedy

- Landfill cap
- Source area groundwater control to contain plume
- Leachate collection and treatment
- Landfill gas collection and treatment
- Institutional controls to supplement engineering controls

Highlight 2

Appropriate Municipal Landfill Characteristics for Applicability of the Presumptive Remedy

- Risks are low-level, except for "hot spots"
- Treatment of wastes is usually impractical due to the volume and heterogeneity of waste
- Waste types include household, commercial, nonhazardous sludge, and industrial solid wastes
- Lesser quantities of hazardous wastes are present as compared to municipal wastes
- Land application units, surface impoundments, injection wells, and waste piles are not included

The presumptive remedy process involves streamlining of the remedial investigation/feasibility study (RI/FS) or, for non-time-critical removals, an Engineering Evaluation/Cost Analysis (EE/CA) by:

- Relying on existing data to the extent possible rather than characterizing landfill contents (limited or no landfill source investigation unless there is information indicating a need to investigate hot spots);
- Conducting a streamlined risk assessment; and
- Developing a focused feasibility study that analyzes only alternatives consisting of appropriate components of the presumptive remedy and, as required by the National Contingency Plan, the no action alternative.

Several directives, including ***Presumptive Remedy for CERCLA Municipal Landfill Sites, Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites***, and ***Streamlining the RI/FS for CERCLA Municipal Landfill Sites,*** provide a complete discussion of these streamlining principles.

USE OF THIS GUIDANCE

EPA anticipates that the containment presumptive remedy will be applicable to a significant number of landfills found at military facilities. Although waste types may differ between municipal and military landfills, these differences do not preclude use of source containment as the primary remedy at appropriate military landfills.

Additionally, EPA continues to seek greater consistency among cleanup programs, especially in the process of selecting response actions for sites regulated under CERCLA and corrective measures for facilities regulated under the Resource Conservation and Recovery Act (RCRA). In general, even though the Agency's presumptive remedy guidances were developed for CERCLA sites, they should also be used at RCRA Corrective Action sites to focus RCRA Facility Investigations, simplify evaluation of remedial alternatives in the Corrective Measures Study, and influence remedy selection in the Statement of Basis. For more information, refer to the *RCRA Corrective Action Plan*, the proposed *Subpart S regulations,* and the *RCRA Corrective Action Advance Notice of Proposed Rulemaking.*

CHARACTERISTICS OF MILITARY LANDFILLS

The size of the landfill and the presence, proportion, distribution, and nature of wastes are fundamental to the application of the containment presumptive remedy to military landfills.

An examination of 31 Records of Decisions (RODs) that document the remedial decisions for 51 landfills at military installations revealed that no action was chosen for 10 landfills and remedial actions were chosen at 41 landfills (see Appendix). Of these 41 landfills, containment was selected at 23 (56 percent). For the remaining 18 landfills where other remedies were selected, institutional controls only were selected at three landfills, excavation and on-site consolidation were selected at four landfills, and excavation and off-site disposal were selected for 11 landfills.

The military landfills examined in the 51 RODs mentioned above ranged in size from 100 square feet to 150 acres and contained a wide variety of waste types. Of the 41 landfills for which remedial actions were chosen, 14 (34 percent) were one acre or less in size; containment was not selected for any of these landfills. Containment was chosen at 23 (85 percent) of the 27 landfills that were greater than one acre in size. This information suggests that the size of the landfill area is an important factor in determining the use of source containment at military landfills.

The wastes most frequently deposited at these military landfills were municipal-type wastes: household, commercial (e.g., hospital wastes, grease, construction debris), and industrial (e.g., process wastes, solvents, paints) wastes. Containment was the remedy selected at the majority of these sites. Military-specific wastes (e.g., munitions) were found at only 5 of the 51 landfills (10 percent).

Highlight 3 lists typical municipal and military wastes, including:

(1) Wastes that are common to both municipal landfills and military landfills;

(2) Wastes that are usually specific to military bases but that do not necessarily pose higher risks than other industrial wastes commonly found in municipal landfills (i.e., low-hazard military-specific wastes), depending on the volume and heterogeneity of the wastes; and

(3) High-hazard military wastes that, because of their unique characteristics, would require special consideration (i.e., high-hazard military-specific wastes).

The proportion and distribution of hazardous wastes in a landfill are important considerations. Generally, municipal landfills produce low-level threats with occasional hot spots. Similarly, most military landfills present only low-level threats with pockets of some high-hazard waste. However, some military facilities (e.g., weapons fabrication or testing, shipbuilding, major aircraft or equipment repair depots) have a high level of industrial activity compared to overall site activities. In these cases, there may be a higher proportion and wider distribution of industrial (i.e., potentially hazardous) wastes present than at other less industrialized facilities.

PRACTICAL CONSIDERATIONS

Sensitive Environments

Site-specific conditions may limit the use of the containment presumptive remedy at military landfills. For example, the presence of high water tables, wetlands and other sensitive environments, and the possible destruction or alteration of existing habitats as a result of a particular remedial action could all be important factors in the selection of the remedy.

Land Use

Reasonably anticipated future land use is also an important consideration at all sites. However, at military bases undergoing base closure procedures, where expeditiously converting property to civilian use is one of the primary goals, land use may receive heightened attention. Thus, at bases that are closing, it is particularly important for reuse planning to proceed concurrently with environmental investigation and restoration activities. The local reuse group is responsible for developing the preferred reuse alternatives. The Base Realignment and Closure Team should work closely with the reuse group to integrate reuse planning into the cleanup process, where practicable (see the *Land Use in CERCLA Remedy Selection* directive).

Highlight 3
Examples of Municipal-Type and Military-Specific Wastes

Municipal-Type Wastes

Municipal landfills contain predominantly non-hazardous materials. However, industrial solid waste and even some household refuse (e.g., pesticides, paints, and solvents) can possess hazardous components. Further, hazardous wastes are found in most municipal landfills as a result of past disposal practices.

Predominant Constituents

Household refuse, garbage, and debris
Commercial refuse, garbage, and debris
Construction debris
Yard wastes

Found in Low Proportion

Asbestos
Batteries
Hospital wastes
Industrial solid waste(s)
Paints and paint thinner
Pesticides
Transformer oils
Other solvents

Military-Specific Wastes

The majority of military landfills contain primarily nonhazardous wastes. The materials listed in this column are rarely predominant constituents of military landfills.

Low-Hazard Military-Specific Wastes

These types of wastes are specific to military bases but generally are no more hazardous than some wastes found in municipal landfills.

Low-level radioactive wastes
Decontamination kits
Munitions hardware

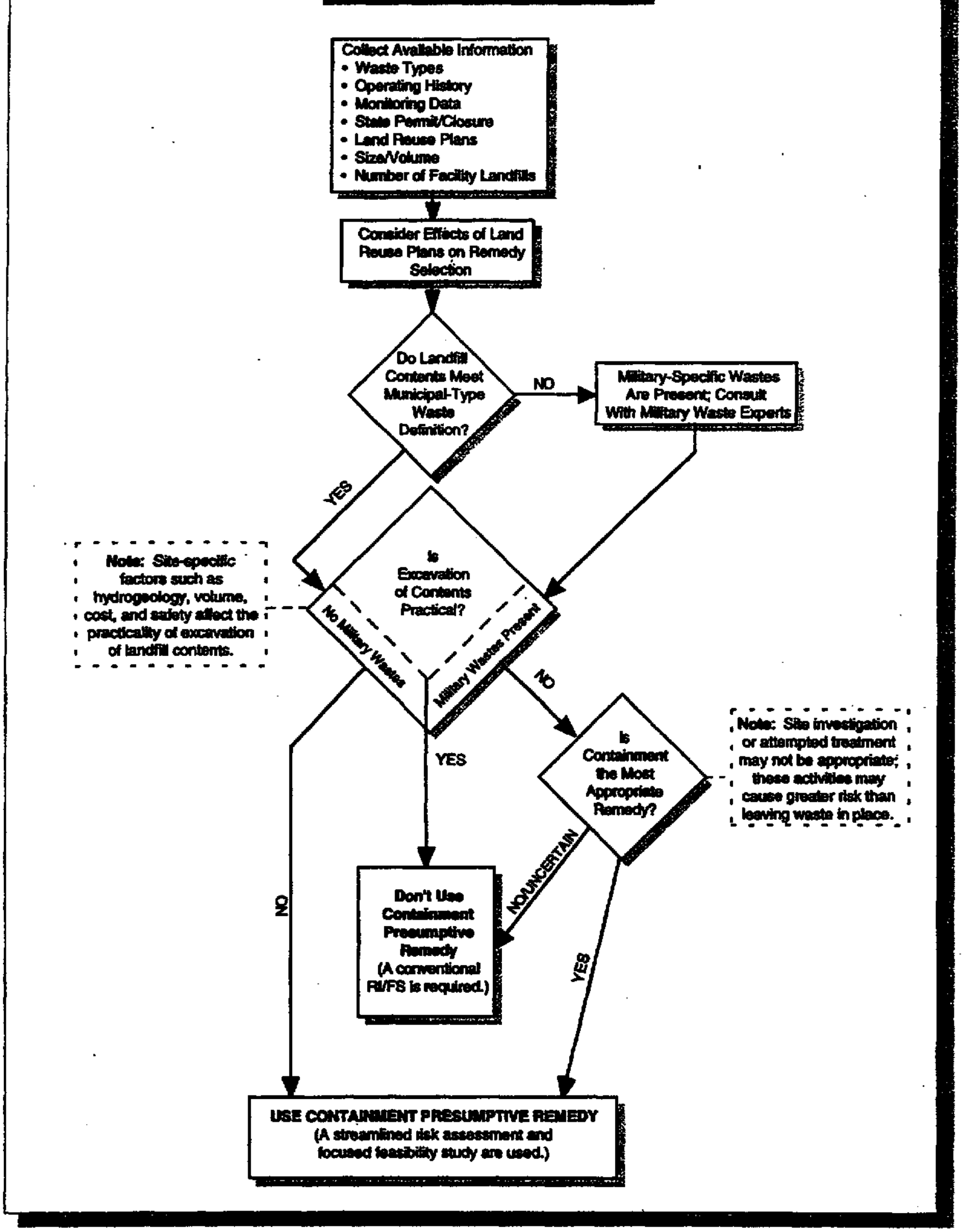
High-Hazard Military-Specific Wastes

These wastes are extremely hazardous and may possess unique safety, risk, and toxicity characteristics. Special consideration and expertise are required to address these wastes.

Military Munitions

Chemical warfare agents
(e.g., mustard gas, tear agents)
Chemical warfare agent training kits
Artillery, small arms, bombs
Other military chemicals
(e.g., demolition charges, pyrotechnics, propellants)
Smoke grenades

Highlight 4
Decision Framework



DECISION FRAMEWORK TO EVALUATE APPLICABILITY OF THE PRESUMPTIVE REMEDY TO MILITARY LANDFILLS

This Section and Highlight 4 describe the steps involved in determining whether the containment presumptive remedy applies to a specific military landfill.

1. What Information Should Be Collected? Determine the sources, types, and volumes of landfill wastes using historical records, state files, closure plans, available sampling data, etc. This information should be sufficient to determine whether source containment is the appropriate remedy for the landfill. If adequate data do not exist, it may be necessary to collect additional sampling or monitoring data. The installation point of contact (environmental coordinator, base civil engineer, or public works office) should be contacted to obtain records of disposal practices. Current and former employees are also good sources of information.

2. How May Land Reuse Plans Affect Remedy Selection? For smaller landfills (generally less than two acres), land reuse plans may influence the decision on the practicality of excavation and consolidation or treatment of landfill contents. Excavation is a remedial alternative that is fundamentally incompatible with the presumptive remedy of source containment.

3. Do Landfill Contents Meet Municipal Landfill-Type Waste Definition? To determine whether a specific military landfill is appropriate for application of the containment presumptive remedy, compare the characteristics of the wastes to the information in Highlights 2 and 3.

4. Are Military-Specific Wastes Present? Military wastes, especially high-hazard military wastes, may possess unique safety, risk, and toxicity characteristics. Highlight 3 presents examples of these types of materials. If historical records or sampling data indicate that these wastes may have been disposed at the site, special consideration should be given to their handling and remediation. Caution is warranted because site investigation or attempted treatment of these contaminants may pose safety issues for site workers and the community. Some high-hazard military-specific wastes could be considered to present low-level risk, depending on the location, volume, and concentration of these materials relative to environmental receptors. Consult specialists in military wastes (see Highlight 5) when determining whether military-specific wastes at a site fall into either the low-hazard or the high-hazard military-specific waste category found in Highlight 3.

Highlight 5

Specialists in Military Wastes

The installation point of contact will notify the major military command's specialists in military wastes (Explosive Ordnance Disposal Team) for assistance with regard to safety and disposal issues related to any type of military items.

Army chemical warfare agents specialists:

- Project Manager, Non-Stockpile Chemical Materiel, Aberdeen Proving Ground, Maryland 21010-5401, (410) 671-1083.

Navy ordnance related items specialists:

- The Navy Ordnance Environmental Support Office, Naval Surface Warfare Center, Indian Head, Maryland 20460-5035, (301) 743-4534/4906/4450.

Navy low-level radioactive wastes specialists:

- The Naval Sea Systems Command Detachment, Radiological Affairs Support Office, Yorktown, Virginia 23691-0260, (804) 887-4692.

Air Force ordnance specialists:

- The Air Force Civil Engineering Support Agency, Contingency Support Division, Tyndall AFB, Florida 32403-5319, (904) 283-6410.

Responsibilities for response are clearly spelled out in the regulation *Interservice Responsibilities For Explosive Ordnance Disposal.*

5. Is Excavation of Contents Practical? The volume of landfill contents, types of wastes, hydrogeology, and safety must be considered when assessing the practicality of excavation and consolidation or treatment of wastes. Consideration of excavation must balance the long-term benefits of lower operation and maintenance costs and unrestricted land use with the initial high capital construction costs and potential risks associated with excavation. Although no set excavation volume limit exists, landfills with a content of more than 100,000 cubic yards (approximately two acres, 30 feet deep) would normally not be considered for excavation. If military wastes are present, especially high-hazard military wastes such as ordnance, safety considerations may be very important in determining the practicality of excavation.

If excavation of the landfill contents is being considered as an alternative, the presumptive remedy should not be used. Therefore, a standard RI/FS would be required to adequately analyze and select the appropriate remedial actions.

6. Can the Presumptive Remedy Be Used? The site manager will make the initial decision of whether a particular military landfill site is suitable for the presumptive remedy or whether a more comprehensive RI/FS is required. This determination must be made before the RI/FS is initiated. This decision will depend on whether the site is a potential candidate for excavation, and if not, whether the nature of contamination is such that a streamlined risk evaluation can be conducted.* A site generally is eligible for a streamlined risk evaluation if groundwater contaminant concentrations clearly exceed chemical-specific standards or the Agency's level of risk or if other conditions exist that provide a justification for action (e.g., direct contact with landfill contents due to unstable slopes). If these conditions do not exist, a quantitative risk assessment that addresses all exposure pathways will be necessary to determine whether action is needed. Before work on the RI/FS workplan is initiated, the community and state should be notified that a presumptive remedy is being considered for the site. It is important for all stakeholders to understand completely how the presumptive remedy process varies from the usual clean-up process, and the benefits of using the presumptive remedy process.

TREATING "HOT SPOTS"

The presumptive remedy also allows for the treatment of hot spots containing military-specific (or other) waste. While the analysis, *Feasibility Study Analysis for CERCLA Municipal Landfill Sites,* that justified the selection of source containment as the presumptive remedy for municipal landfill sites did not specifically take into account high-hazard military wastes, the high-hazard materials present in some military landfills may be compared to the hazardous wastes at municipal landfills and could potentially be treated as hot spots. For further information and case studies on treatment of hot spots, see the *Presumptive Remedy for CERCLA Municipal Landfill Sites* directive.

CASE HISTORIES

The case histories below illustrate how use of the municipal landfill presumptive remedy at military landfills follows the decision framework in Highlight 4.

* See *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, which states that if MCLs or non-zero MCLGs are exceeded [a response] action generally is warranted.

The decision to use the presumptive remedy can be made for one landfill or as a part of a site-wide strategy (as in the Loring Air Force Base example below), depending on factors such as the nature of the wastes, size of the landfill, land reuse potential, and public acceptance.

The following case histories present examples of where the containment presumptive remedy was or was not applied, based on site-specific conditions.

Disposal of Municipal-Type Wastes

The **Naval Reactor Facility (NRF)** site in Idaho Falls, Idaho, was established in 1949 as a testing site for the nuclear propulsion program. The three landfill units at the site received solid wastes similar to municipal landfills. These wastes included petroleum and paint products, construction debris, and cafeteria wastes. Historical records do not indicate that any radioactive wastes were disposed of in these landfill units. The selected remedy for the landfills at the site included the installation of a 24-inch native soil cover designed to incorporate erosion control measures to reduce the effects from rain and wind. The remedy also provided for maintenance of the landfill covers, including subsidence correction and erosion control. Monitoring of the landfills will include sampling of soil gas to assess the effectiveness of the cover and sampling of the groundwater to ensure that the remedy remains protective. Institutional controls will also be implemented to prevent direct exposure to the landfill. The NRF site is an example of where the streamlining principles of the presumptive remedy process, including a streamlined risk assessment and a focused feasibility study, were successfully employed.

Co-Disposal of High-Hazard Wastes

At the **Massachusetts Military Reservation**, in Cape Cod, Massachusetts, anecdotal information indicated that munitions had been disposed of at an unidentified location in a landfill that primarily contained municipal-type waste. Ground penetrating radar was utilized to determine if there were any discrete disposal areas containing potential hot spots at this site and found none. Because the munitions waste was not in a known discrete and accessible area, it could not be treated as a hot spot. Consequently, without excavating or treating the munitions waste as a hot spot, the authorities decided to cap the landfill. In this case, the streamlining principles of the presumptive remedy process were applied. For example, site investigation was limited and treatment options were not considered.

Land Reuse Considerations

At **Loring Air Force Base**, a closing base in Limestone, Maine, base landfills 2 and 3 (9 and 17 acres, respectively) consisted primarily of municipal and flightline wastes. The selected remedy for these landfills included a multi-layer cap, passive venting system, and institutional controls. The RODs for the landfills, signed in September 1994, required placing a RCRA Subtitle C cap on the landfills. To construct the RCRA cap, the designers estimated that 400,000 to 600,000 cyds of material would have to be placed on the landfills prior to construction of the cap to ensure proper drainage and slopes.

At Loring, the streamlining principles of the containment remedy, a focused feasibility study, and a streamlined risk assessment were applied for landfills 2 and 3. Additionally, the RODs signed for these landfills specified that excavated material from other parts of the base would be used at the landfills to meet subgrade design specifications. To date, more than 500,000 cyds of contaminated soils have been excavated and used as subgrade for the landfills (after demonstrating compliance with RCRA Land Disposal Restrictions). In addition to cost savings realized by providing subgrade, other benefits have been realized, such as limiting the number of parcels requiring deed restrictions and minimizing locations requiring operation and maintenance. At this base, the landfill consolidation efforts resulted in an estimated total cost savings of $12–20 million while incorporating future land use considerations into the decision process.

The Brunswick Naval Air Station in Brunswick, Maine, contained several landfill sites. One of the first RODs signed, for Sites 1 and 3, called for construction of a 12-acre RCRA Subtitle C cap and a slurry wall, as well as for groundwater extraction and treatment. Subsequently, during the remedy selection process for Site 8, the public objected to containment as the proposed remedy for this relatively small (0.6 acre) site on the grounds that should the base eventually close, containment would create several useless parcels of land. After public comment, the Navy reconsidered, proposing instead to excavate Site 8 and consolidate the removed materials (which consisted of construction debris and soil contaminated with nonhazardous levels of polycyclic aromatic hydrocarbons) as part of the necessary subgrade fill for the landfill cap to be constructed at Sites 1 and 3. In this case, land reuse considerations preempted the selection of a containment remedy.

PRESUMPTIVE REMEDY ADMINISTRATIVE RECORD DOCUMENTATION REQUIREMENTS

As stated earlier, it must be determined whether the military landfill in question contains military-specific wastes, as described in Highlight 3. This should be followed by a determination of whether anything about these wastes would make the engineering controls specified in the presumptive remedy for municipal landfills less suitable at that site. These determinations must be documented in the administrative record, which supports the final decision. This information, in turn, will assist the public in understanding the evaluation of the site as a candidate for use of the presumptive remedy and the advantage it provides. For further reference, the administrative record requirements for all Superfund sites including military landfills are explained in the *Final Guidance on Administrative Records for Selecting CERCLA Response Actions.*

The administrative record must contain the following generic and site-specific information, which documents the selection or non-selection of the containment presumptive remedy.

Generic Information

A. **Generic Documents.** These documents should be placed in the docket for each federal facility site where the containment presumptive remedy is selected. Each EPA Regional Office has copies of the following presumptive remedy documents:

- *Presumptive Remedy: Policy and Procedures*
- *Presumptive Remedy for CERCLA Municipal Landfill Sites*
- *Application of the Municipal Landfill Presumptive Remedy to Military Landfills*
- *Feasibility Study Analysis for CERCLA Municipal Landfill Sites*

B. **Notice Regarding Backup File.** The docket should include a notice specifying the location of and times when public access is available to the generic file of backup materials used in developing the *Feasibility Study Analysis for CERCLA Municipal Landfill Sites*. This file contains background materials such as technical references and portions of the feasibility studies used in the generic study. Each EPA Regional Office has a copy of this file.

Site-specific Information

Focused FS or EE/CA. Military-specific wastes need to be addressed in site-specific analyses when determining the applicability of the containment presumptive remedy to military landfills. High-hazard military-specific waste materials (e.g., military munitions) require special consideration when applying the presumptive remedy.

As noted on pages 1 and 2 of this directive, the presumptive remedy approach allows you to streamline and focus the FS or EE/CA by eliminating the technology screening step from the feasibility study process. EPA has already conducted this step on a generic basis in the *Feasibility Study Analysis for CERCLA Municipal Landfill Sites*. Thus, the FS analyzes only alternatives comprised of components of the containment remedy identified in Highlight 1. In addition, the focused FS or EE/CA should include a site-specific explanation of how the application of the presumptive remedy satisfies the National Contingency Plan's three site-specific remedy selection criteria (i.e., compliance with state applicable or relevant and appropriate requirements, state acceptance, and community acceptance).

CONCLUSION

This directive provides guidance for the use of the containment presumptive remedy at appropriate military landfills. The remedies selected at numerous military installations indicate that source containment is applicable to a significant number of military landfills. These landfills need not be identical to municipal landfills in all regards. Key factors determining whether the containment presumptive remedy should be applied to a specific military landfill include the size of the landfill; volume and the type of landfill contents; future land use of the area; and the presence, proportion, and distribution of military-specific wastes.

REFERENCES

California Base Closure Environmental Committee, *Integrating Land Use and Cleanup Planning at Closing Bases*, December 1994.

Federal Register, 1996. Volume 61, No. 85, May 1, 1996; *Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities, Advance Notice of Proposed Rulemaking.*

Federal Register, 1990. Volume 55, No. 145, July 27, 1990; 40 CFR Parts 264, 265, 270 and 271; *Corrective Action for Solid Waste Management Units at Hazardous Waste Facilities; Proposed* (proposed Subpart S regulations).

U.S. Environmental Protection Agency, OSWER Directive 93557-04, *Land Use in the CERCLA Remedy Selection*, May 25, 1995.

U.S. Environmental Protection Agency, OSWER Directive 9356.0-03, EPA/540/R-94/081, *Feasibility Study Analysis for CERCLA Municipal Landfill Sites*, August 1994.

U.S. Environmental Protection Agency, OSWER Directive 9902.3-2A, EPA/520/R-94/004, *RCRA Corrective Action Plan*, May 1994.

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U.S. Environmental Protection Agency, OSWER Directive 9355.0-47FS, EPA/540/F-93/047, *Presumptive Remedy: Policy and Procedures*, September, 1993.

U.S. Environmental Protection Agency, OSWER Publication 9380.3-06FS, *Guide to Principal Threat and Low Level Threat Wastes*, November 1991.

U.S. Environmental Protection Agency, OSWER Directive 9355.0-30, *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, April 22, 1991.

U.S. Environmental Protection Agency, OERR, EPA/540/P-91/001, *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites*, February 1991.

U.S. Environmental Protection Agency, OSWER Directive 9833.3A.1, *Final Guidance on Administrative Records for Selecting CERCLA Response Actions*, December 3, 1990.

U.S. Environmental Protection Agency, OSWER Directive 9355.3-11FS, *Streamlining the RI/FS for CERCLA Municipal Landfill Sites*, September 1990.

U.S. Department of Navy, *Interservice Responsibilities for Explosive Ordnance Disposal* OPNAVINST 8027.1G (also known as MCO 8027.1D, AR 75-14; or AFR 32-3002), February 14, 1992.

NOTICE

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Brunswick NAS, Sites 1 and 3 (OU1), ME, Region 1 6/16/92	Site 1, 8.5 acres; Site 3, 1.5 acres. Sites are in close proximity and not easily distinguishable; the combined volume of Sites 1 and 3 is 300,000 cy	Household refuse, waste oil, solvents, pesticides, paints, isopropyl alcohol	Metals, VOCs, PAHs, PCBs, pesticides	**Remedy:** Capping (permanent, low-permeability, RCRA Subtitle C cap), of 12 acres with a slurry wall and pump and treat ground water within cap and slurry wall.
Brunswick NAS, Sites 5 and 6 (OU3), ME, Region 1 8/31/93	Site 5, 0.25 acres, 12 cy	Asbestos-covered pipes	Asbestos	**Remedy:** Excavation, containerization, and transport to landfill Sites 1 and 3 for use as fill under cap.
Brunswick NAS, Sites 5 and 6 (OU3), ME, Region 1 8/31/93	Site 6, 1.0 acre, 8,800 - 18,700 cy	Construction debris, and aircraft parts, asbestos pipes	Asbestos	**Remedy:** Excavation, containerization, and transport to Sites 1 and 3 landfill for use as fill under cap.
Brunswick NAS, Site 8 (OU4), ME, Region 1 8/31/93	Site 8, 0.6 acres, 5,600 - 14,000 cy	Rubble, debris, trash, and possibly solvents	Metals, pesticides, PCBs[1]	**Remedy:** Excavation, containerization, and transport to landfill Sites 1 and 3 for use as fill under cap.
Loring AFB, Landfills 2 and 3 (OU2), ME, Region 1 9/30/94	Landfill 2, 9 acres	Domestic waste, construction debris, flightline wastes, sewage sludge and oil-filled switches	PCBs, VOCs, SVOCs, metals, DDT[1]	**Remedy:** Capping (low-permeability cover system which meets RCRA Subtitle C and Maine hazardous waste landfill cap requirements), passive gas venting system and controls, and institutional controls.
Loring AFB, Landfills 2 and 3 (OU2), ME, Region 1 9/30/94	Landfill 3, 17 acres	Waste oil/fuels, solvents, paints, thinners, and hydraulic fluids	VOCs, SVOCs, DDT, PCBs, metals[1]	**Remedy:** Capping (low-permeability cover system which meets RCRA Subtitle C and Maine hazardous waste landfill cap requirements), passive gas venting system and controls, and institutional controls.

[1] Contaminants of Potential Concern

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Newport Naval Education and Training Center, McAllister Point Landfill, RI, Region 1 9/27/93	McAllister Point Landfill, 11.5 acres	Domestic refuse, spent acids, paints, solvents, waste oils, and PCB-contaminated transformer oil	VOCs, PAHs, PCBs, pesticides, phenols, metals	**Remedy:** Capping (RCRA Subtitle C, multi-layer cap), landfill gas management, surface controls, and institutional controls.
Otis Air National Guard, Camp Edwards, Massachusetts Military Reservation, MA, Region 1 1/14/93	Landfill Number 1 (LF-1), 100 acres	General refuse, fuel tank sludge, herbicides, blank ammunition, paints, paint thinners, batteries, DDT, hospital wastes, sewage sludge, coal ash, possibly live ordnance	VOCs, SVOCs, inorganics	**Remedy:** Capping (composite-low-permeability cover system), institutional controls. soil cover inspection, and ground water monitoring.
Pease AFB (OU1), NH, Region 1 9/27/93	LF-5, 23 acres	Domestic and industrial wastes, waste oils and solvents, and industrial wastewater treatment plant sludge	VOCs, PAHs, arsenic and other metals	**Remedy:** Excavation, dewatering and consolidation and regrading of waste under a composite-barrier type cap, institutional controls, and extraction and treatment of ground water with discharge to base wastewater treatment facility.
Fort Dix Landfill Site, NJ, Region 2 9/24/91	Main area, 126 acres	Domestic waste, paints and paint thinners, demolition debris, ash, and solvents	VOCs, metals	**Remedy:** Capping 50-acre portion (New Jersey Administrative Code 7:26 closure plan for hazardous waste), installing gas venting system and an air monitoring system, ground water, surface water, and air monitoring, and institutional controls.
Naval Air Engineering Center (OU3), NJ, Region 2 9/16/91	Site 26, 1500 sq. ft., volume not reported	Oil, roofing materials, building debris	No contamination was detected	**Remedy:** Source: No action.
Naval Air Engineering Center (OU3), NJ, Region 2 9/16/91	Site 27, 6.4 acres	Scrap steel cable	No contamination was detected	**Remedy:** Source: No action.

DATA SUMMARY TABLE FOR MILITARY LANDFILLS APPENDIX (CONT.)

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Naval Air Engineering Center (OU17), NJ, Region 2 9/26/94	Site 29, 20 acres	Construction debris, metal, asbestos, solvents, other miscellaneous wastes	VOCs, SVOCs, metals	**Remedy:** Source: No action.
Plattsburgh AFB, LF-022, NY, Region 2 9/30/92	LF-022, approx. 13.7 acres, approx. 524,000 cy	Household refuse	Metals, pesticides	**Remedy:** Capping (NY State requirements for solid waste landfills, 12 inch soil cap), and institutional controls.
Plattsburgh AFB, LF-023, NY, Region 2 9/30/92	LF-023, approx. 9 acres, approx. 406,000 cy	Household refuse, debris, car parts	Metals, VOCs, SVOCs, PCB, pesticides	**Remedy:** Capping (NY State requirements for solid waste landfills, low permeability cap), and institutional controls.
U.S. Army Aberdeen Proving Grounds (OU 1), MD, Region 3 6/30/92	Michaelsville Landfill, 20 acres, greater than 100,000 cy	Household refuse, limited quantities of industrial waste, burned sludges, pesticide containers, paint, asbestos shingles, solvents, waste motor oils, grease, PCB transformer oils, possible pesticides	Metals, pesticides, VOCs, PCBs, PAHs	**Remedy:** Capping (multi-layer cap in accordance with MDE requirements for sanitary landfills, using a geosynthetic membrane, 0-2 feet compacted earth material), surface water controls, and gas venting system.
Marine Corps Base, Camp Lejeune (OU1), NC, Region 4 9/15/94	Site 24, 100 acres, volume not reported	Fly ash, cinders, solvents, used paint stripping compounds, sewage sludge, spiractor sludge, construction debris	Pesticides, metals, SVOCs, PCBs	**Remedy:** Source: No action.
Robins AFB (OU1), GA, Region 4 6/25/91	Main area (Landfill No. 4), 45 acres, greater than 100,000 cy	Household refuse, industrial waste	VOCs, metals	**Remedy:** Capping (to maintain a minimum 2-foot cover over the waste materials), renovation of current soil cover including clearing, filling, regrading, adding soil and clay cover material and seeding to maintain a minimum 2-foot cover over the waste material.

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Twin Cities AFB Reserve, MN, Region 5 3/31/92	Main area, approx. 2 acres, volume not reported	Household refuse, small amounts of industrial; some burned waste	VOCs, metals	**Remedy:** Source: Institutional controls, natural attenuation, ground water and surface water monitoring.
Wright-Patterson AFB, (Source Control Operable Unit) OH, Region 5 7/15/93	LF-8, 11 acres, 187,300 cy	General refuse and hazardous materials	PAHs, pesticides, PCBs, VOCs, metals, inorganics	**Remedy:** Capping (low-permeability clay cap that complies with Ohio EPA regulations for sanitary landfills which meet or exceed RCRA Subtitle D requirements), institutional controls, ground water treatment and monitoring.
Wright-Patterson AFB, (Source Control Operable Unit) OH, Region 5 7/15/93	LF-10, 8 acres, 171,600 cy	General refuse and hazardous materials	PAHs, pesticides, PCBs, VOCs, metals, inorganics	**Remedy:** Capping (low-permeability clay cap that complies with Ohio EPA regulations for sanitary landfills which meet or exceed RCRA Subtitle D requirements), institutional controls, ground water treatment and monitoring.
Hill AFB (OU4), UT, Region 8 6/14/94	Landfill 1, 3.5 acres, 140,000 cy	Burned solid waste, small amounts of waste oils and solvents (from vehicle maintenance facility).	VOCs (TCE)	**Remedy:** Capping (clay or multi-media cap), pumping, treating, and discharging ground water to POTW, treating contaminated surface water, soil vapor extraction, implementing institutional controls and access restrictions.
Defense Depot, Ogden (OU1), UT, Region 8 6/26/92	Plain City Canal Backfill Area, 4,000 cy	Electrical wire, glass, ash, charcoal, asphalt, wood, concrete, plastic and metal fragments	Metals, PCBs, dioxins, furans, VOCs	**Remedy:** Excavation, sorting, and off-site disposal in a RCRA permitted facility.
Defense Depot, Ogden (OU3), UT, Region 8 9/28/92	Burial Site 3-A: Chemical Warfare Agent Identification Kit Burial Area, 100 cy	Vials of chemical surety agents, broken glass	Metals, chemical warfare agents	**Remedy:** Excavation, sorting, and off-site disposal in a RCRA permitted facility.
Defense Depot, Ogden (OU3), UT, Region 8 9/28/92	Burial Site 3-A: Riot Control and Smoke Grenade Burial Area, 90 cy	Unfused grenades and grenade fragments, as well as riot control grenades	No contaminants identified	**Remedy:** Excavation, sorting, and off-site disposal in a RCRA permitted facility.

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Defense Depot, Ogden (OU3), UT, Region 8 9/28/92	Burial Site 3-A: Compressed Gas Cylinder Reburial Area	Two compressed gas cylinders and four smaller steel tanks removed from the Chemical Warfare Agent Identification Kit and Riot Control and Smoke Grenade burial areas	Unknown, possible chemical warfare agents	**Remedy:** Excavation of compressed gas cylinders and disposal by a commercial operator.
Defense Depot, Ogden (OU3), UT, Region 8 9/28/92	Burial Site 3-A: Miscellaneous Items Burial Area, 230 cy	Chemical Warfare Agent Identification Kits containing no CWAs, World War II gas mask canisters, paint, broken glass, wooden boxes, and pieces of iron	No contaminants identified	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted hazardous waste landfill.
Defense Depot, Ogden (OU3), UT, Region 8 9/28/92	Water Purification Tablet Burial Area, 110 cy	Bottles containing halazone water purification tablets	No contaminants identified	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted industrial waste landfill.
Defense Depot, Ogden (OU4), UT, Region 8 9/28/92	4-A, 7500, sq. ft., 3000 cy	Wood, crating materials, paper, greases, debris, medical waste, oils, some burned waste	Pesticides, VOCs, PCBs	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted hazardous waste landfill.
Defense Depot, Ogden (OU4), UT, Region 8 9/28/92	4-B, (inside 4-E), less than 7,500, sq. ft.	Fluorescent tubes	No contaminants identified	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted landfill.
Defense Depot, Ogden (OU4), UT, Region 8 9/28/92	4-C, 6,000 sq. ft	Food products, sanitary landfill waste	Pesticides, VOCs, PCBs	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted landfill.

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Defense Depot, Ogden (OU4), UT, Region 8 9/28/92	4-D, 2,000 sq. ft.	Methyl bromide cylinders, halazone tablets (jars)	Possibly methyl bromide	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted industrial landfill.
Defense Depot, Ogden (OU4), UT, Region 8 9/28/92	4-E, 7,500 sq. ft., volume not reported	Oils, spent solvents, industrial waste	PCBs, VOCs, pesticides	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted hazardous landfill.
Rocky Mountain Arsenal, Shell Section 36 Trenches (OU23), CO, Region 8 5/3/90	Shell Trench Area, 8 acres	Rags, plastic and metal cans, glass jars, piping, pipe fittings, insulation, refuse, insulation, liquid and solid wastes generated from the manufacture of pesticides	VOCs, SVOCs, pesticides[2]	**Remedy:** Capping (physical barrier with a soil and vegetative cover).
Fort Ord Landfills (OU2), CA, Region 9 8/23/94	Landfills, 150 acres	Household and commercial refuse, dried sewage sludge, construction debris, small amounts of chemical waste including paint, oil, pesticides, and epoxy adhesive, electrical equipment	VOCs	**Remedy:** Capping (California Code of Regulations for non-hazardous waste), institutional controls, extraction, treatment, and recharge of ground water.
Riverbank Army Ammunition Plant Site, CA, Region 9 3/24/94	Landfill, 4.5 acres	Paper, oils, greases, solvents, hospital wastes, construction debris, and industrial sludges	Metals	**Remedy:** Capping (a multi-layer cap as specified in Dispute Resolution Agreement), pump and treat ground water, discharge treated water to on-site ponds.

[2] Contaminants identified as emanating from the trenches but not contaminants of concern

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Williams AFB (OU1), AZ, Region 9 5/18/94	Landfill LF-04, 90 acres, 59,000 cy	Dried sewage sludge, domestic trash and garbage, wood, metal, brush, construction debris, some solvents and chemicals	Soil, pesticides, SVOCs, inorganics, including beryllium, lead, zinc	**Remedy:** Capping (a permeable cap with a 24 inch soil cover), stormwater runoff controls, institutional actions, and soil and ground water monitoring.
Williams AFB (OU1), AZ, Region 9 5/18/94	Pesticide Burial Area (DP-13), 0.4 acre	Pesticides	Pesticides, VOCs, metals	**Remedy:** Source: No action.
Williams AFB (OU1), AZ, Region 9 5/18/94	Radioactive Instrumentation Burial Area (RW-11), 100 sq. ft.	Cement; radioactive instruments	Radium (background levels)	**Remedy:** Source: No action.
Elmendorf AFB (OU1), AK, Region 10 9/29/94	LF05, 17 acres	General refuse, scrap metal, used chemicals and other scrap material	VOCs, PCBs, metals, PAHs	**Remedy:** Source: No action.
Elmendorf AFB (OU1), AK, Region 10 9/29/94	LF07, 35 acres	Base generated refuse, scrap metal, construction rubble, drums of asphalt, empty pesticide containers, small amounts of shop wastes, and asbestos wastes	VOCs, PCBs, metals, PAHs	**Remedy:** Source: No action.
Elmendorf AFB (OU1), AK, Region 10 9/29/94	LF13, 2 acres	Empty drums, metal piping, drums of asphalt, and small quantities of quicklime	VOCs, PCBs, metals, PAHs	**Remedy:** Source: No action.

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Elmendorf AFB (OU1), AK, Region 10 9/29/94	LF59, 2 landfills (.5 acres each)	General refuse and construction debris, and tar seep	VOCs, PCBs, metals, PAHs	**Remedy:** Source: No action.
Fairchild AFB (OU1), WA, Region 10 2/13/93	Southwest area, 12.6 acres, 407,300 cy	Coal ash, solvents, dry cleaning filters, paints, thinners, possibly electrical transformers.	VOCs	**Remedy:** Capping (low-permeability cap designed to meet the closure requirements of Washington State's Minimum Functional Standards for Solid Waste handling and of federal RCRA Subtitle D), SVE/ treatment system, extracting contaminated ground water and treating by air stripping and granular activated carbon, disposal off-site, monitoring off-site water supply wells.
Fairchild AFB (OU1), WA, Region 10 2/13/93	Northeast area, 6 acres, 291,000 cy	Coal ash, solvents, dry cleaning filters, paints, thinners, possibly electrical transformers.	VOCs	**Remedy:** Capping (low-permeability cap designed to meet the closure requirements of Washington State's Minimum Functional Standards for Solid Waste handling and of federal RCRA Subtitle D), SVE/ treatment system, extracting contaminated ground water and treating by air stripping and granular activated carbon, disposal off-site, monitoring off-site water supply wells.
Fort Lewis Military Reservation, Landfill 4 and the Solvent Refined Coal Pilot Plant, WA, Region 10 9/24/93	LF4, 52 acres	Domestic and light industrial solid waste (no landfill records were maintained).	VOCs, metals	**Remedy:** Source: Institutional controls, treat ground water and soil using SVE and air sparging system.
Naval Air Station, Whidbey Island, Ault Field (OU1), WA, Region 10 12/20/93	Area 6 Landfill, 40 acres. Within Area 6 there are 2 distinct areas where wastes were disposed.	Household waste, construction debris, and yard waste	VOCs	**Remedy:** Capping (low-permeability cap to meet Washington State Minimum Functional Standards for non-hazardous closure), air stripping ground water, ground water monitoring, and institutional controls.
Naval Air Station, Whidbey Island, Ault Field (OU2), WA, Region 10 12/20/93	Area 2, 13 acres; Area 3, 1.5 acres. Both treated together due to close proximity.	Solid waste from the base, industrial wastes, and construction and demolition debris	Metals, PAHs	**Remedy:** Source: Institutional controls, ground water monitoring.

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Naval Reactor Facility, ID, Region 10 9/27/94	Landfill Unit 8-05-1, (350 ft. by 450 ft. by 4-25 ft.)	Construction debris, small quantities of paints, solvents, cafeteria wastes, and petroleum products	Metals, VOCs	**Remedy:** Capping (24-inch native soil cover), institutional controls.
Naval Reactor Facility, ID, Region 10 9/27/94	Landfill Unit 8-05-51, (450 ft. by 100 -175 ft. by 10-15 ft.)	Construction debris, small quantities of paints, solvents, cafeteria wastes, and petroleum products	Metals, VOCs	**Remedy:** Capping (24-inch native soil cover), institutional controls.
Naval Reactor Facility, ID, Region 10 9/27/94	Landfill Unit 8-06-53, (900 ft. by 1200 ft. by 7- 10 ft.)	Construction debris, small quantities of paints, solvents, cafeteria wastes, and petroleum products	Metals, VOCs	**Remedy:** Capping (24-inch native soil cover), institutional controls.

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Conducting Remedial Investigations/ Feasibility Studies for CERCLA Municipal Landfill Sites

Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, D.C. 20460

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EXECUTIVE SUMMARY

A broad framework for the Remedial Investigation/Feasibility Study (RI/FS) and selection of remedy process has been created through the National Contingency Plan (NCP) and the *U.S. EPA RI/FS Guidance* (U.S. EPA 1988d). With this framework now in place, the Office of Emergency and Remedial Response's efforts are being focused on streamlining the RI/FS and selection of remedy process for specific classes of sites with similar characteristics. One such class of sites is the municipal landfills which compose approximately 20 percent of the sites on the Superfund Program's National Priorities List (NPL). Landfill sites currently on the NPL typically contain a combination of principally municipal and to a lesser extent hazardous waste and range in size from 1 acre to 640 acres. Potential threats to human health and the environment resulting from municipal landfills may include:

- Leachate generation and groundwater contamination
- Soil contamination
- Landfill contents
- Landfill gas
- Contamination of surface waters, sediments, and adjacent wetlands

Because these sites share similar characteristics, they lend themselves to remediation by similar technologies. The NCP contains the expectation that containment technologies will generally be appropriate remedies for wastes that pose a relatively low low-level threat or where treatment is impracticable. Containment has been identified as the most likely response action at these sites because (1) CERCLA municipal landfills are primarily composed of municipal, and to a lesser extent hazardous wastes; therefore, they often pose a low-level threat rather than a principal threat; and (2) the volume and heterogeneity of waste within CERCLA municipal landfills will often make treatment impractical. The NCP also contains an expectation that treatment should be considered for identifiable areas of highly toxic and/or mobile material (hot spots) that pose potential principal threats. Treatment of hot spots within a landfill will therefore be considered and evaluated.

With these expectations in mind, a study of municipal landfills was conducted with the intent of developing methodologies and tools to assist in streamlining the RI/FS and selection of remedy process. Streamlining may be viewed as a mechanism to enhance the efficiency and effectiveness of decision-making at these sites. The goals of this study to meet this objective include: (1) developing tools to assist in scoping the RI/FS for municipal landfill sites, (2) defining strategies for characterizing municipal landfill sites that are on the NPL, and (3) identifying practicable remedial action alternatives for addressing these types of sites.

Streamlining Scoping

The primary purpose of scoping an RI/FS is to divide the broad project goals into manageable tasks that can be performed within a reasonable period of time. The broad project goals of any Superfund site are to provide the information necessary to characterize the site, define site dynamics, define risks, and develop a remedial program to mitigate current and potential threats to human health and the environment. Scoping of municipal landfill sites can be streamlined by focusing the RI/FS tasks on just the data required to evaluate alternatives that are most practicable for municipal landfill sites. Section 2 of this document describes the activities that must take place to plan an RI/FS and provides guidelines for establishing a project's scope. To summarize, scoping of the RI/FS tasks can be streamlined by:

- Developing preliminary remedial objectives and alternatives based on the NCP expectations and focusing on alternatives successfully implemented at other sites
- Using a conceptual site model (see Figure 2-4 for a generic model devel-

oped for municipal landfill sites based on their similarities) to help define site conditions and to scope future field tasks

- Conducting limited field investigations to assist in targeting future fieldwork

- Identifying clear, concise RI objectives in the form of field tasks to ensure sufficient data are collected to adequately characterize the site, perform the necessary risk assessment(s), and evaluate the practicable remedial action alternatives

- Identifying data quality objectives (DQOs) that result in a well-defined sampling and analysis plan, ensure the quality of the data collected, and integrate the information required in the RI/FS process

- Limiting the scope of the baseline risk assessment as discussed below

Streamlining the Baseline Risk Assessment

The baseline risk assessment may be used to determine whether a site poses risks to human health and the environment that are significant enough to warrant remedial action. Because options for remedial action at municipal landfill sites are limited, it may be possible to streamline or limit the scope of the baseline risk assessment by (1) using the conceptual site model and RI-generated data to perform a qualitative risk assessment that identifies the contaminants of concern in the affected media, their concentrations, and their hazardous properties that may pose a risk through the various routes of exposure and (2) identifying pathways that are an obvious threat to human health or the environment by comparing RI-derived contaminant concentration levels to standards that are potential chemical-specific applicable or relevant and appropriate requirements (ARARs) for the action. (When potential ARARs do not exist for a specific contaminant, risk-based chemical concentrations should be used.)

Where established standards for one or more contaminants in a given medium are clearly exceeded, the basis for taking remedial action is generally warranted (quantitative assessments that consider all chemicals, their potential additive effects, or additivity of multiple exposure pathways are not necessary to initiate remedial action). In cases where standards are not clearly exceeded, a more thorough risk assessment may be necessary before initiating remedial action.

This streamlined approach may facilitate early action on the most obvious landfill problems (groundwater and leachate, landfill gas, and the landfill contents) while analysis continues on other problems such as affected wetlands and stream sediments. Dividing a site into operable units and performing early or interim actions is often desirable for these types of sites. This is because performing certain early actions (e.g., capping a landfill) can reduce the impact to other parts of a site while the RI/FS continues. Additionally, early actions must be consistent with the site's final remedy and therefore help to speed up the clean-up process.

Ultimately, it will be necessary to demonstrate that the final remedy, once implemented, will in fact address all pathways and contaminants of concern, not just those that triggered the remedial action. The approach outlined above facilitates rapid implementation of protective remedial measures for the major problems at a municipal landfill site.

Streamlining Site Characterization

Site characterization for municipal landfills can be expedited by focusing field activities on the information needed to sufficiently assess risks posed by the site, and to evaluate practicable remedial actions. Recommendations to help streamline site characterization of media typically affected by landfills are discussed in Section 3 of this report. A summary of the site characterization strategies is presented below.

Leachate/Groundwater Contamination

Characterization of a site's geology and hydrogeology will affect decisions on capping options as well as on extraction and treatment systems for leachate and groundwater. Data gathered during the hydrogeologic investigation are similar to those gathered during investigations at other types of NPL sites. Groundwater contamination at municipal landfill sites may, however, vary in composition from that at other types of sites in that it often contains high levels of organic matter and metals.

Leachate generation is of special concern when characterizing municipal landfill sites. The main factors contributing to leachate quantity are precipitation and recharge from groundwater and surface water. Leachate is characteristically high in organic matter as measured by chemical oxygen demand (COD) or biochemical oxygen demand (BOD). In many landfills, leachate is perched within the landfill contents, above the water table. Placing a limited number of leachate wells in the landfill is an efficient means of gathering information regarding the depth, thickness, and types of the waste; the moisture content and degree of decomposition of the waste; leachate head levels and the composition of landfill leachate; and the elevation of the underlying natural soil layer. Additionally, leachate wells provide good locations for landfill gas sampling. It should be noted, however, that without the proper precautions, placing wells into the landfill contents may create health and safety risks. Also, installation of wells through the landfill base may create conduits through which leachate can migrate to lower geologic strata, and the installation of wells into landfill contents may make it difficult to ensure the reliability of the sampling locations.

Landfill Contents

Characterization of a landfill's contents is generally not necessary because containment of the landfill contents, which is often the most practicable technology, does not require such information. Certain data, however, are necessary to evaluate capping alternatives and should be collected in the field. For instance, certain landfill properties such as the fill thickness, lateral extent, and age will influence landfill settlement and gas generation rates, which will thereby have an influence on the cover type at a site. Also, characterization of a landfill's contents may provide valuable information for PRP determination. A records review can also be valuable in gathering data concerning disposal history, thus reducing the need for field sampling of contents.

Hot Spots

More extensive characterization activities and development of remedial alternatives (such as thermal treatment or stabilization) may be appropriate for hot spots. Hot spots consist of highly toxic and/or highly mobile material and present a potential principal threat to human health or the environment. Excavation or treatment of hot spots is generally practicable where the waste type or mixture of wastes is in a discrete, accessible location of a landfill. A hot spot should be large enough that its remediation would significantly reduce the risk posed by the overall site, but small enough that it is reasonable to consider removal or treatment. It may generally be appropriate to consider excavation and/or treatment of the contents of a landfill where a low to moderate volume of toxic/mobile waste (for example, 100,000 cubic yards or less) poses a principal threat to human health and the environment.

Hot spots should be characterized if documentation and/or physical evidence exists to indicate the presence and approximate location of the hot spots. Hot spots may be delineated using geophysical techniques or soil gas surveys and typically are confirmed by excavating test pits or drilling exploratory borings. When characterizing hot spots, soil samples should be collected to determine the waste characteristics; treatability or pilot testing may be required to evaluate treatment alternatives.

Landfill Gas

Several gases typically are generated by decomposition of organic materials in a landfill. The composition, quantity, and generation rates of the gases depend on such factors as refuse quantity and composition, placement characteristics, landfill depth, refuse moisture content, and amount of oxygen present. The principal gases generated (by volume) are carbon dioxide, methane, trace thiols, and occasionally, hydrogen sulfide. Volatile organic compounds may also be present in landfill gases, particularly at co-disposal facilities. Data generated during the site characterization of landfill gas should include landfill gas characteristics as well as the role of onsite and offsite surface emissions, and the geologic and hydrologic conditions of the site.

Streamlining the Development of Alternatives

Section 4 of this document describes the remedial technologies that are generally appropriate to CERCLA landfill sites. Inclusion of these technologies is based on experience at landfill sites and expectations inherent in the NCP. To streamline the development of remedial action alternatives for landfill contents, hot spots, landfill gas, contaminated groundwater. and leachate, the following points should be considered:

- The most practicable remedial alternative for landfills is containment. Such containment may be achieved by installing a cap to prevent vertical infiltration of surface water. Lateral infiltration of water or gases into the landfill can be prevented by a perimeter trench-type barrier. Caps and perimeter barriers sometimes are used in combination. The type of cap would likely be either a native soil cover, single-barrier cap, or composite-barrier cap. The appropriate type of cap to be considered will be based on remedial objectives for the site. For example, a soil cover may be sufficient if the primary objective is to prevent direct contact and minimize erosion. A single barrier or composite cap may be necessary where infiltration is also a significant concern. Similarly, the type of trench will be dependent on the nature of the contaminant to be contained. Impermeable trenches may be constructed to contain liquids while permeable trenches may be used to collect gases. Compliance with ARARs may also affect the type of containment system to be considered.

- Treatment of soils and wastes may be practicable for hot spots. Consolidation of hot spot materials under a landfill cap is a potential alternative in cases when treatment is not practicable or necessary. Consolidation-related differential settlements may be large enough to require placement of an interim cap during the consolidation phase. Once the rate of settlement is observed to decrease, then a final cap can be placed over the waste.

- Extraction and treatment of contaminated groundwater and leachate may be required to control offsite migration of wastes. Additionally, extraction and treatment of leachate from landfill contents may be required. Collection and treatment may be necessary indefinitely because of continued contaminant loadings from the landfill.

- Constructing an active landfill gas collection and treatment system should be considered where (1) existing or planned homes or buildings may be adversely affected through either explosion or inhalation hazards, (2) final use of the site includes allowing public access, (3) the landfill produces excessive odors, or (4) it is necessary to comply with ARARs. Most landfills will require at least a passive gas collection system (that is, venting) to prevent buildup of pressure below the cap and to prevent damage to the vegetative cover.

Conclusions

Evaluation and selection of appropriate remedial action alternatives for CERCLA municipal landfill sites is a function of a number of factors including:

- Sources and pathways of potential risks to human health and the environment

- Potential ARARs for the site (significant ARARs might include RCRA and/or state closure requirements, and federal or state requirements pertaining to landfill gas emissions.)

- Waste characteristics

- Site characteristics (including surrounding area)

- Regional surface water (including wetlands) and groundwater characteristics and potential uses

Because these factors are similar for many CERCLA municipal landfill sites, it is possible to focus the RI/FS and selection of remedy process. In general, the remedial actions implemented at most CERCLA municipal landfill sites include:

- Containment of landfill contents (i.e., landfill cap)
- Remediation of hot spots
- Control and treatment of contaminated groundwater and leachate
- Control and treatment of landfill gas

Other areas that may require remediation include surface waters, sediments, and adjacent wetlands.

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Landfill Presumptive Remedy Saves Time and Cost

Office of Emergency and Remedial Response (5202G)

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Since Superfund's inception in 1980, the removal and remedial programs have found that certain categories of sites have similar characteristics, such as types of contaminants present, past industrial use, or environmental media affected. Based on a wealth of information acquired from evaluating and cleaning up these sites, Superfund undertook the presumptive remedy initiative to develop remedies that are appropriate for specific site types and/or contaminants. One site category for which EPA developed a presumptive remedy is municipal landfills. This bulletin summarizes the results of implementing the containment presumptive remedy at three CERCLA municipal landfill sites. At each of the sites, both time and costs were saved in conducting the RI/FS. When compared to similar "control" sites, EPA estimates time savings ranging from 36 to 56 percent, and cost savings up to 60 percent. In addition to demonstrating significant time and cost savings, the pilots also indicate that municipal landfill sites are good candidate sites for implementing the presumptive remedy as an early action, such as a non-time-critical removal. The combination of this presumptive remedy with an early action resulted in significant savings at one pilot site.

Introduction

EPA expects that the use of presumptive remedies will streamline removal actions, site studies, and cleanup actions while improving consistency, reducing costs, and increasing the speed with which hazardous waste sites are remediated. EPA has developed several presumptive remedies to date; a list of presumptive remedy directives is provided at the end of this document. The results of implementing the *containment presumptive remedy* at three CERCLA municipal landfill sites are discussed in this bulletin.

The Containment Presumptive Remedy

EPA established containment as the presumptive remedy for municipal landfills in September 1993. The containment presumptive remedy includes the following components, as appropriate on a site-specific basis:

- Landfill cap;
- Source area ground-water control to contain plume;
- Leachate collection and treatment;
- Landfill gas collection and treatment;
- Institutional controls to supplement engineering controls.

The presumptive remedy does not address exposure pathways outside the source area (landfill), nor does it include long-term ground-water response actions.

The Pilot Sites

Prior to establishing the presumptive remedy, EPA initiated a pilot project at three sites to assess the effectiveness of the containment remedy in streamlining the remedial investigation/feasibility study (RI/FS) process for municipal landfills. The pilots implemented the streamlining principles outlined in the document, "Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites," February 1991, Directive No. EPA/540/P-91001 (hereafter referred to as the "1991 MLF RI/FS guidance"). This 1991 MLF RI/FS guidance provides the implementation framework of the containment presumptive remedy.

EPA found the containment remedy to be a very effective tool for streamlining the RI/FS at municipal landfills. This bulletin describes the pilot sites, the ways in which each RI/FS was streamlined, and the time and cost savings realized at each of the sites. See Attachment A at the end of this bulletin for brief site summaries.

Who Can Use The Presumptive Remedy?

If you are the manager of a municipal landfill site, it is likely that **the presumptive remedy can help you save time and money on the RI/FS at your site.** Although the presumptive remedy is most beneficial when incorporated at the scoping stage of the RI/FS, if your site has progressed beyond that point, you may still be able to streamline your site characterization sampling strategy, baseline risk assessment, and/or feasibility study.

EPA piloted the containment remedy at the following municipal landfills beginning in the Spring of 1992:

- Albion-Sheridan Township Landfill, Michigan
- Lexington County Landfill, South Carolina
- BFI/Rockingham Landfill, Vermont

These sites were selected as pilots because they were in the scoping phase of the RI/FS at the time. The biggest savings in time and cost can be realized if streamlining is incorporated at the very beginning of the scoping phase of the RI/FS. All of these sites now have signed Records of Decision (RODs), with containment selected as part of the remedy at each of the sites.

EPA evaluated the impact of the containment remedy as a streamlining tool at the three pilot sites by estimating time and cost savings. The sites were evaluated in a paired analysis, comparing the pilot sites to the three "control" sites listed in Highlight 1. Remedy selection at the control sites was based on the results of conventional RI/FSs.

The factors considered in selecting the "control" sites included (listed in order of priority): (1) the state in which the landfill is located since State closure requirements often affect aspects of remedy selection; (2) the lead for the site (e.g., Fund-lead); and (3) the size of the landfill (in acres). Summary information on the pilot and control sites is provided in Highlight 1.

Highlight 1
Pilot/Control Site Characteristics

PILOT SITES				CORRESPONDING CONTROL SITES			
Name	State	Lead	Size	Name	State	Lead	Size
Albion-Sheridan	MI	F	30	West KL	MI	F	87
BFI	VT	PRP	19	Parker	VT	PRP	19
Lexington Co.	SC	PRP	70	Cedar-town LF	GA	PRP	6.8

Pilot Results

Two areas of the RI/FS process presented the greatest opportunity for streamlining at the pilot sites: 1) a phased approach to site characterization, and 2) streamlining the risk assessment.

Phased Approach to Site Characterization

The containment presumptive remedy emphasizes the use of existing data to the degree possible, and discourages characterization of landfill contents since it is presumed that the landfill will be contained, unless information is available indicating the need to investigate and potentially remove or treat hot spots. In keeping with these principles, a **phased approach** to sampling is recommended.

The phased approach to site characterization is a site-specific strategy that frames the data collection effort within the context of determining whether a risk is present at a site rather than characterizing the nature and extent of all contamination in a landfill.[1] A site-specific determination is made as to the environmental medium most likely to present a risk based upon any existing data available, and sampling of that pathway is conducted first.

At many landfill sites, ground-water contamination is likely to present a significant risk, and thus trigger the need for action.[2] At the pilot sites, ground water was the first medium sampled, and at each of the pilot sites, ground-water contamination supported the need for a response action. In two cases, soil sampling of the landfill source area was never conducted; sampling was limited to determining risk from the ground water. At one site, the State conducted additional sampling of the landfill area.

If ground-water data had not clearly demonstrated a risk at the pilot sites, additional sampling would have been conducted (in sequence) to determine whether a risk was present from other media or exposure pathways, such as contaminated soil and/or landfill gas. At the pilot sites, additional sampling was not necessary to determine risk, and since containment of the landfill was presumed, sampling and analysis was not required for the purpose of site characterization.

Streamlined Risk Assessment

For many landfill sites, it will be possible to streamline the risk assessment portion of the RI/FS. This is possible because the containment remedy addresses all migration pathways presented by the landfill source. The basis of the streamlined risk assessment process to be employed at MLFs is the conceptual site model (discussed in Section 2.5 of the 1991 RI/FS MLF guidance), which is used to identify all exposure pathways associated with the landfill source (i.e., direct contact with soil, exposure to contaminated ground water, contaminated

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[1]This phased approach applies to the landfill source only. Contamination that has migrated away from the landfill source must be characterized, and the associated risk estimated.

[2]See OSWER Directive 9355.0-30, "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions," April 22, 1991, which states that if MCLs or non-zero MCLGs are exceeded, [a response] action generally is warranted.

leachate, and/or landfill gas). The exposure pathways are then compared to those addressed by the containment remedy, as follows:

- direct contact with soil and/or debris prevented by landfill cap;
- exposure to contaminated ground water prevented by ground-water control;
- exposure to contaminated leachate prevented by leachate collection and treatment; and
- exposure to landfill gas addressed by gas collection and treatment, as appropriate.

This comparison reveals that the containment remedy addresses all pathways associated with the landfill source. The phased approach can be implemented at landfill sites using the conceptual site model because it demonstrates that all exposure pathways are addressed by the containment remedy, and field sampling is therefore not required to characterize the nature and extent of contamination once it has been demonstrated that the site presents a risk and warrants action.

A streamlined risk evaluation was successfully conducted at the three pilot sites, with contaminated ground water presenting the justification for a response action. Sampling, analysis, and a conventional risk assessment were required to characterize contamination, if any, that had migrated away from the source areas.

Quantitative Results

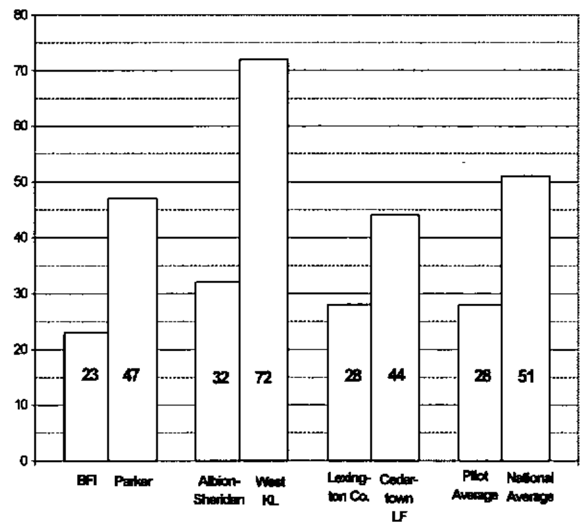
As illustrated in Highlight 2, the RI/FS durations for the pilot sites ranged from 23 to 32 months, compared to 44 to 72 months for the control sites. The average pilot RI/FS duration was 28 months, as compared to the national average of 51 months. The RI/FS durations for the pilot sites represent a time savings ranging from 16 to 40 months when compared to the control sites, and 23 months when compared to the national average. These results translate into an estimated time savings ranging from 36-56 percent when comparing the pilots to the control sites, and an estimated 45 percent when comparing the average pilot duration to the national average.

The figures for the BFI/Rockingham site include completion of an Engineering Evaluation/Cost Analysis (EE/CA) to support implementation of source control (i.e., cap, leachate and gas collection) as a non-time-critical removal action. The EE/CA was completed in 12 months, which is a subset of the 23 months indicated in Highlight 2. The 23 months was the time required to complete the RI/FS for the entire site, including ground-water contamination.

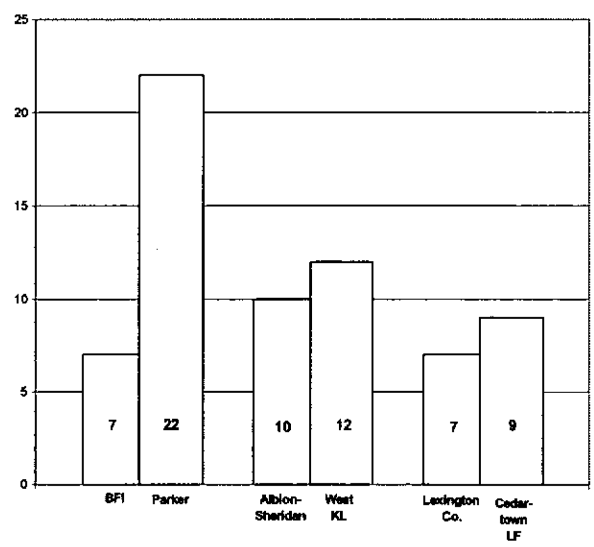
The pilot results for the BFI/Rockingham site are particularly noteworthy because the source control action was initiated just 12 months after the RI/FS start, and construction of the cap was completed in July 1995, just three years after the RI/FS start.

A savings in time was also realized as a result of the streamlined risk evaluations conducted at the pilot sites, as illustrated in Highlight 3. The time required to complete the risk assessments at the pilot sites ranged from 7 to 10 months, as compared to 9 to 22 months for the controls, which represents a savings ranging from 17 to 68 percent when compared to the control sites.

Highlight 2
RI/FS Durations (Months) for Pilot/Control Site and National Averages



Highlight 3
Risk Assessment Durations (Months) for Pilot/Control Sites



Cost savings were estimated in one of two ways for the pilot sites.

The RI/FS costs for Albion-Sheridan Landfill and Lexington County were compared to the national average RI/FS cost of $1 million, resulting in an estimated 10 percent and 1 percent savings, respectively, for those sites. The cost savings estimate for the BFI/Rockingham site was developed by the PRP, and was based upon a comparison with their costs for RI/FSs conducted at other similar sites. A savings of 60 percent was estimated for the RI/FS, which included the source area and areas of migration, and an engineering evaluation/cost analysis (EE/CA) to support the non-time-critical removal action on the landfill cap.

Conclusion

EPA found that the containment presumptive remedy resulted in a savings of time and costs at each of the pilot sites. The savings were the result of implementing a phased approach to site characterization and streamlining the risk assessment, both of which were possible because the landfill contents were contained.

The savings in time and costs were most significant at the BFI/Rockingham site, where the cap was completed three years after initiation of the RI/FS, and an estimated $3 million was saved. This significant savings was the result of combining the containment presumptive remedy with an early action accomplished as a non-time-critical removal action. Based on these results, municipal landfill sites appear to be well suited to the combined application of these streamlining and acceleration tools.

Next Steps

Since establishment of the presumptive remedy, EPA has tracked implementation at two additional landfill sites (demonstration sites): (1) Bennington Landfill, Vermont, and (2) Tomah Municipal Landfill, Wisconsin. EPA will summarize findings from the demonstration sites upon signature of their respective Records of Decision (RODs).

Presumptive Remedy Directives

To date, EPA has issued the following presumptive remedy directives:

(1) "Presumptive Remedies: Policy and Procedures," September 1993, Directive No. 9355.0-47FS;

(2) "Conducting Remedial Investigations/Feasibilities Studies for CERCLA Municipal Landfill Sites," EPA/540/P-91/001, February 1991.

(3) "Presumptive Remedy for CERCLA Municipal Landfill Sites," September 1993, Directive No. 9355.0-49FS;

(4) "CERCLA Landfill Caps RI/FS Data Collection Guide," August 1995, Directive No. 9355.3-18FS;

(5) "Site Characterization and Technology Selection for Volatile Organic Compounds in Soil/Sludge," September 1993, Directive No. 9355.4-048FS;

(6) "Presumptive Remedies for Soils, Sediments, and Sludges at Wood Treater Sites," December 1995, Directive No. 9200.5-162.

(7) "Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites," EPA/540/R-96/023, October 1996.

In addition, presumptive remedies directives for the following types of sites or contaminants are forthcoming:

(1) PCBs

(2) Manufactured gas plants

(3) Grain storage sites

(4) Metals in soils (in cooperation with the U.S. Department of Energy).

Additional Information

For additional information on the pilot sites or the presumptive remedy for municipal landfills, please call Andrea McLaughlin, Office of Emergency and Remedial Response, 703-603-8793.

Attachment A: Pilot Case Studies

Albion-Sheridan Landfill

Anecdotal evidence indicated that some quantity of industrial wastes were disposed of at the 30-acre Albion-Sheridan Landfill, but the location, volume and identity of wastes were unknown. No data were available for the site at the beginning of the RI/FS. EPA implemented the streamlining principles of the 1991 MLF RI/FS guidance, and scoped a phased approach to characterization of the Albion-Sheridan site with the goal of implementing the containment remedy. The draft work plan was revised to incorporate the phased investigation, focusing first on ground-water contamination to establish whether there was a basis for a response action.

Ground-water contamination did support the need for action at the site, so it was not necessary to quantify additional exposure pathways for this purpose. The remainder of the risk assessment was streamlined by using a conceptual site model to demonstrate that the other potential pathways of concern (e.g. direct contact) would be addressed by the components of the presumptive remedy (e.g. landfill cap).

EPA conducted a geophysical survey of the site to identify potential drum storage areas. Based on the results of the geophysics, EPA concluded that while there were anomalies in the results, there were no areas that appeared to consist of large numbers of drummed waste, thereby warranting further investigation. Because the State had remaining concerns with EPA's approach to hot spots, the State conducted its own geophysical survey and dug test pits at 12 locations. At one location approximately 300-400 drums were uncovered, and EPA reiterated its agreement to send any drums of hazardous waste off-site for disposal. Of the 300-400 drums, the number containing hazardous waste is unknown at this time.

Lexington County Landfill

Ground-water data were available for this 70-acre landfill prior to initiation of the RI, which indicated exceedences of MCLs, and therefore a basis for a response action. The strategy for the Lexington County Landfill RI was similar to the Albion-Sheridan Landfill, in that a phased approach was implemented. Sampling focused on further characterization of ground-water contamination, and the risk assessment was streamlined, focusing also on the ground-water pathway. Planned soil sampling and analysis to estimate direct contact threats was eliminated, and it was demonstrated (using a conceptual site model) that other potential pathways of concern would be addressed by components of the presumptive remedy.

A planned drum search of the 70-acre landfill was eliminated based on the guidelines for hot spot characterization contained in the 1991 MLF RI/FS guidance. At Lexington County Landfill, as at Albion Sheridan Landfill, it is likely that some industrial waste was disposed of at the site, but the location, quantity and identity of the wastes were unknown. Because there was no evidence to guide such a search, EPA decided that the best approach was to contain the landfill, accounting for uncertainties in the nature of the wastes during the design.

The selected remedy includes consolidation and capping of the waste areas, landfill gas collection and venting; extraction of contaminated groundwater/leachate with discharge to POTW; additional sampling of surface water and sediment to characterize any off-site contamination; and monitoring of ground water, surface water, sediment and landfill gas. Additionally, to address a plume, a ground-water pump and treat remedy was put in place.

BFI/Rockingham

Extensive ground-water data were available for this site at the initiation of the RI, and the first step in implementation of the presumptive remedy was to evaluate the potential for using the data. The data were found to be useable to establish an initial basis for action, which allowed streamlining of the risk assessment and RI. Only confirmational ground-water sampling was conducted during the RI; characterization of the landfill surface soil and debris mass did not occur. Geotechnical information regarding settlement, cover quality, and stability was also collected. The knowledge that containment was the likely remedy allowed the RI to become primarily a design-related investigation. In addition, based on historical information, hot spots were not of concern at this site.

Levels of volatile organic compounds (VOCs) and certain metals clearly indicated that a ground-water risk was present. The existence of ground-water risk confirmed that a "No Action" decision was unlikely, and that a landfill cap would be a component of the source control action. The risk assessment was streamlined by quantifying the ground-water risk and qualitatively discussing the other pathways that would be addressed by the source control action. All pathways outside the landfill, which included off-site ground water and off-site soils, were fully quantified. An early action was conducted as a non-time-critical removal at this site in order to begin construction of the landfill cap. The combination of the presumptive remedy with the early action resulted in a significant time savings in the remedy selection and construction processes.

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Presumptive Remedies: CERCLA Landfill Caps RI/FS Data Collection Guide

Office of Emergency and Remedial Response
Hazardous Site Control Division (5203G)

Quick Reference Fact Sheet

Municipal landfills constitute approximately 20 percent of all sites on the Superfund National Priorities List. Approximately 75 percent of all CERCLA Municipal Solid Waste Landfill (MSWLF) Remedial Actions call for installation of a landfill cap. The remedy selection process for MSWLFs is the basis of a U.S. Environmental Protection Agency (EPA) guidance, *Conducting Remedial Investigation/Feasibility Studies for CERCLA Municipal Landfill Sites* (U.S. EPA, 1991), which establishes the framework for containment (including landfill cap construction, leachate collection and treatment, ground water treatment, and landfill gas collection and treatment) as the presumptive remedy for MSWLFs.

In 1992, EPA introduced the *Superfund Accelerated Cleanup Model (SACM)* to accelerate all phases of the remedial process. The presumptive remedy initiative is one tool for speeding up cleanups within SACM. One way that presumptive remedies can streamline the remedial process is through early identification of data collection needs for the remedial design. By collecting design data prior to issuance of the Record of Decision (ROD), the need for additional field investigations during the remedial design (RD) will be reduced, thereby accelerating the overall remedial process for these sites. Data needed for design also can be useful in better defining the scope of the remedy and in improving the accuracy of the cost estimate in the ROD. Since containment is the presumptive remedy for MSWLFs, the Remedial Project Manager (RPM) can begin making arrangements to collect landfill cap design data as soon as a basis for remedial action is established (e.g., ground water contaminant concentrations exceeding maximum contaminant levels [MCLs]).

This fact sheet identifies the data pertinent to landfill cap design that will be required for most sites. These data are organized within six categories: (1) waste area delineation; (2) slope stability and settlement; (3) gas generation/migration; (4) existing cover assessment; (5) surface water run-on/run-off management; and (6) clay sources. For reference, all data requirements and data collection methods discussed in this document are summarized in a table at the end of this document (Table 2). In addition to the following guidance provided in this fact sheet, RPMs should enlist the aid of technical experts familiar with landfill cap design in establishing data collection needs for specific sites.

TECHNICAL AREA 1: WASTE AREA DELINEATION

The area of a landfill cap is determined by the horizontal extent of previous waste disposal. One of the major causes of cost escalation for MSWLF sites has been the failure to establish the actual boundaries of the waste. Costly construction change orders have been required to increase the area of the cap because wastes have been found to extend well beyond the edges of the intended cap. Waste boundaries should be identified as accurately as practicable prior to initiation of the design.

Aerial photographs, maps, and a local newspaper subject search may provide a historical record of the extent and type of disposal activities conducted at the site. If appropriate, residents could be interviewed to confirm or supplement available information.

Field investigation should be used to confirm records and to collect data to delineate the outer boundaries of the waste. Field investigations normally include surface, subsurface, and noninvasive geophysical explorations. Field investigation methods that provide information on the surface and shallow subsurface extent of waste include excavating shallow test pits, using direct-push exploration techniques, and drilling bore-holes. Additional subsurface investigation methods are used to provide information on the vertical extent of waste.

Borings can be used to estimate waste thickness and condition of existing cover soils adjacent to or underlying the waste.

However, drilling into or through the waste and into the underlying soils and/or bedrock should be performed only if necessary, and only if the driller is experienced in the methods used to prevent cross-contamination. Additional health and safety concerns (especially exposure to methane gas) must be addressed in the health and safety plan when borings are located in the waste.

Visual evidence of the waste boundary or subsurface contamination from these field investigation activities should be recorded and, if necessary, verification samples should be collected and shipped for laboratory analyses.

Surface geophysical methods also may be useful in delineating the waste boundary. Each method has limitations, and the selection of an appropriate method should be based on landfill characteristics and data needs. The most commonly employed geophysical methods include:

- Magnetometry (measures minor changes in earth's magnetic field)--location of waste boundary and distribution of metallic waste
- Electromagnetic Conductivity (response to artificially induced magnetic field)--location of areas of contrasting conductivity, such as a landfill or natural deposits
- Ground-Penetrating Radar (reflection of electromagnetic waves)--determination of horizontal extent and depth of disturbed soils and buried objects (often used to confirm magnetometry)
- Electrical Resistivity (measures earth's response to electrical current)--determination of edge of landfill by subsurface resistivity difference
- Seismic Refraction (natural or induced compression waves)--estimation of depth to geologic strata and bedrock adjacent to the landfill.

These noninvasive surface geophysical methods should be performed prior to invasive explorations (e.g., borings or test pits). This will allow for the more limited intrusion activities to verify the findings of the noninvasive exploration methods.

TECHNICAL AREA 2: SLOPE STABILITY AND SETTLEMENT

Waste settlement and/or slope failure of the waste and existing cover soils can occur during construction of, or after completion of, the cap. Waste settlement or slope failure (see Figure 1) may expose waste and require costly repairs. Data are needed on degree of slope, existing cover materials, and existing cover soils to create cross-sectional diagrams for use in evaluating landfill slope stability and the potential for settlement damage.

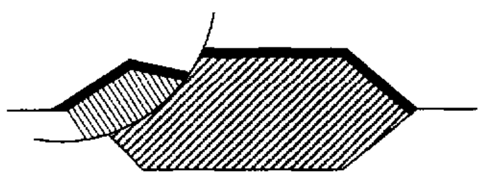

Figure 1. Typical slope failure at MSWLF site.

Settlement in a landfill can be caused by factors such as: biodegradation of wastes, consolidation of waste under the weight of waste material and cap, deterioration of partially filled containers (e.g., drums), or compaction of material during landfill operation or cap installations. Possible consequences of settlement include instability in the waste or cover soil, which can damage the cap. In fact, a recent article on cap design reports that "The center of a 20-foot diameter section of a landfill cover, for instance, could settle only 0.5 to 1.5 feet before significant cracking [of the composite clay liner] could be expected." (Koerner and Daniel, 1992) For this reason, settlement potential and stability of the landfill system should be evaluated concurrently.

The weight of the new cap can be significant enough to cause additional waste settlement and compaction. The effect of this additional weight may initiate differential settlement across the cap, thus compromising the integrity of the cap, or create stability problems such as slippage failures in the waste and/or existing cover soil. Differential settlement occurs when one area of waste settles more readily than another because of differences in moisture content, waste compaction, or waste composition. Settlement (magnitudes typically range from 5 to 25 percent of the initial waste thickness), and especially differential settlement, may create cracks in the cap and allow rainwater to reach the waste. Changes in the topography of the landfill because of settlement may also create areas on the cap surface where rainwater can pond.

In creating the conceptual landfill cap design, three separate calculations are conducted

- Stability of waste--largely depends on how well the waste was compacted when placed, waste layer thicknesses, and waste composition
- Stability of the cap (existing and proposed)
- Settlement of waste—largely depends on how well the waste was compacted when placed, waste layer thicknesses, age, rate of waste degradation, and waste composition.

Because of their heterogeneous nature, the settlement and stability of municipal wastes are difficult to predict. Settlement rates of selected areas of the waste can be measured by placing survey monuments on top of the waste and taking periodic measurements to determine the change in elevation of the monuments. Because settlement generally occurs slowly, it is important to begin measurement early, preferably during the remedial investigation.

The settlement of the waste depends on thickness and general composition of the waste and existing topography. Compressibility characteristics are derived from preload tests and empirical correlations to data in the published literature. Data from surveying monuments, settlement plates, and topographic surveys can be used to determine surface settlement rates across the landfill.

The stability of waste can be determined by evaluating the following:

- Potentiometric surface and perched water table information--can be determined using water level measurements from piezometers and monitoring wells
- Thickness of waste
- Existing topography-can be determined from site reconnaissance and topographic surveys.

Ground motions induced by earthquakes (seismic events) can also affect cap performance through a decrease in slope stability. This fact sheet does not address the additional data required for cap designs for landfills located in seismic impact zones.

The waste thickness and composition can be determined by observing and sampling (during completion of test pits, borings, and hand-augered holes with an experienced driller) and by searching through historical records.

The existing cover soil should also be evaluated to determine its stability and potential for settlement. Studies for the stability of the existing cover soil could include:

- Maximum Slope
- Soil classification
- Potentiometric surface
- Shear strength
- Thickness
- Density

Slope measurements and potentiometric surface derivations can be obtained using the same procedures used to determine waste characteristics. The remaining data can be obtained by boring, piezocone penetrometer (PCPT), geophysical techniques, and test pits. Existing cover soils should be classified by grain size and hydrometer analysis, as well as by Atterberg limits performed on borings and test pit samples. See the summary table at the end of this fact sheet (Table 2) for recommended tests to determine the shear strength for fine- and coarse-grained soils.

The stability and settlement estimates for existing cover soil depend largely on the complexity of the landfill site. Investigations necessary to evaluate physical properties of the existing cover soils will depend on the type(s) of soils encountered. If the existing cover soils are soft silts and clays, the settlement and stability evaluations will be more complex than for sands and gravels. These soil samples should be collected during drilling of monitoring wells to save time and money, usually during the remedial investigation (RI).

Additional slope stability evaluations will be performed during landfill cap design. Slopes greater than 3:1 (3 horizontal/1 vertical) and landfills that have been constructed within or adjacent to wetlands or low-strength soils are of particular concern. These areas of concern should be identified during RI/FS data collection to the extent possible.

TECHNICAL AREA 3: GAS GENERATION/MIGRATION

Assessment of the rate and composition of gas generated in the landfill will determine whether or not a gas collection layer should be included as a component of the cap. Dangers of gas generation and uncontrolled migration include vegetative kill, health risks from exposure, and explosive or lethal gas buildup within and outside of the landfill (see Figure 2). Field monitoring for the presence of landfill gases is also important in developing safety parameters and reducing health risks to personnel working on site.

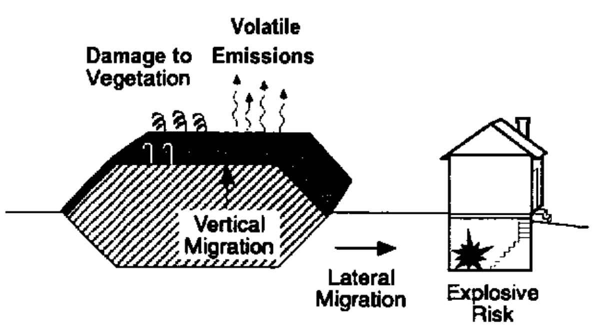

Figure 2. Vertical and lateral migration of generated gas from MSWLF site.

Generation of gas typically results from the biological decomposition of organic material in the wastes. The rate and process of gas generation are dependent on the availability of moisture, temperature, organic content of the waste, waste particle size, and waste compaction.

Data immediately available in the field for assessing gas generation are landfill gas composition and gas pressure. Gas composition in soils usually is evaluated in the field by monitoring or sampling through gas probes using a methane meter, explosimeter, or organic vapor analyzer. Air samples should be analyzed for the presence of volatile organic compounds (VOCs) or semivolatile organic compounds

(SVOCs). Moisture and heat content also can be determined by the laboratory or in the field with hand-held instruments. This information may be necessary to assess possible treatment alternatives for collected gas.

Gas migration is a function of site geology, chemical concentration, and pressure and density gradients. Gases migrate through the path of least resistance (e.g., coarse and porous soils, bedding stone along nearby water and sewer lines). Data for evaluating gas migration control and treatment methods include the composition of any existing landfill liners, soil stratigraphy, depth to water table, proximity of human/ecological receptors, and the locations of buried utilities and other backfilled excavations and structures.

Gas migration pathways may be identified based on knowledge of the site geology, hydrogeology, and surrounding soil characteristics and by review of water and sewer maps. Some of these data may be obtained by collecting and evaluating samples from test pits, borings, or hand-augered holes. Piezocone data also may be cost-effective for characterizing the surrounding subsurface soils at larger MSWLF sites.

Potential receptors of landfill gas emissions may be identified through site reconnaissance, and receptor locations should be monitored to assess possible accumulation of migrant landfill gases. Atmospheric monitoring at receptor locations may be done using a flame ionization detector (FID), a photoionization detector (PID), or a gas monitoring station; however, a PID will not detect methane and thus cannot be used to assess explosion risk. An oxygen meter using the Lower Explosive Limit (LEL) indicator may be used to detect explosive levels of gas.

Gas control is accomplished through either passive or active gas collection. Treatment of collected gas may be required depending on the concentration of hazardous constituents. The gas control system required will depend on the proximity of receptors, permeability of migration pathways, State and Federal regulations and guidelines, and level and rate of gas generation. Effective gas disposal methods include flaring, processing and sale, and/or sorption.

Active gas collection may be necessary to control gas migration when receptors are, or are expected to be, at risk. Active gas collection generally is required when measurements exceed either

- 5% methane at the property line or cap edge, or
- 25% methane LEL in/at on-site structures. (This subject is further addressed in the U.S. EPA Technology Brief *Data Requirements for Selecting Remedial Action Technology* [U.S. EPA, 1987].)

A gas pumping test can be used to improve the estimate of the gas permeability of the waste materials and unsaturated soils, number of collection wells required, piping size and configuration, and blower requirements. However, gas pumping tests should not be relied on without further measurement and adjustment during construction.

TECHNICAL AREA 4: EXISTING COVER ASSESSMENT

Existing landfill caps should be evaluated to determine whether or not any components can be reused in the construction of a new cap. Use of existing components could save both time and money.

Data on existing components can be readily collected because only materials above the waste need be sampled. Sampling locations and procedures that will minimize damage to geosynthetic materials should be used. Sampling holes should, at a minimum, be refilled with bentonite if the existing cap is composed of clay. Geosynthetics should be patched with materials of equal properties following manufacturer's guidelines.

Additionally, the site reconnaissance should be used to evaluate, in general, the need for regrading the landfill surface to achieve proper side slopes. Appropriate limits to the steepness of slopes can be determined from preliminary slope stability calculations. Excavation into landfill waste materials may be required to reduce slope steepness to acceptable limits.

Table 1 provides recommended guidelines for final cover designs. The assessment of the existing cover should include an evaluation of the potential for any components to meet final cover guidelines.

Table 1. Existing Cover Assessment Data Requirements and Recommended Guidelines

Data Requirements	Recommended Guidelines[a] (for Final Cover)
Slope (top)	3% to 5% minimum for drainage
Cap Area	Covers horizontal waste limits
Vegetative/Soil Layer	Vegetative soil supporting healthy low shrubs or grass, no erosion, gullies or deep-rooted plants, no unacceptable frost heaves or settlement
Drainage Layer	Permeability $>1 \times 10^{-2}$ cm/s (sand, gravel, or geosynthetic)
Barrier Layer	Two-component (geomembrane atop compacted clay[b]) composite liner below the frost zone
Gas Venting System	Either passive vents located at high points (not clogged, no settlement) or extraction and treatment system working properly

[a] Refer to EPA's Technical Guidance Document: *Final Covers on Hazardous Waste Landfills and Surface Impoundments* (U.S. EPA, 1989).

[b] Clay compacted to a permeability $\leq 1 \times 10^{-7}$ cm/s, geomembrane thickness $\geq$ 20 mil.

TECHNICAL AREA 5: SURFACE WATER RUN-ON/RUN-OFF MANAGEMENT

The surface area and gradient of landfill slopes will affect surface water control measures. For the protection of both the landfill cap and adjacent areas (see Figure 3), the design of the final remedy should ensure that the site layout will provide adequate space for surface water diversion and containment/retention impoundments.

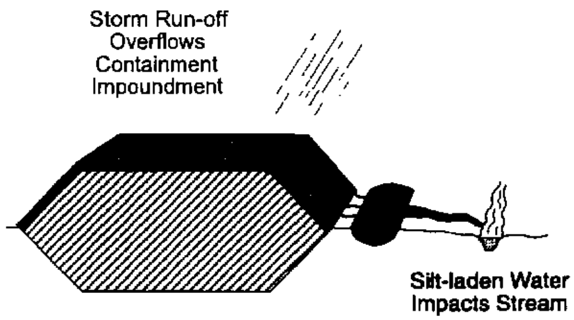

Figure 3. Storm run-off impact from an MSWLF site.

RCRA Subtitle D minimum requirements for MSWLFs (40 CFR Section 258.26) include providing a run-on control system capable of preventing flow onto the active portion of a landfill during the peak discharge from a 25-year rain storm. The regulation also requires providing run-off control systems to collect, at a minimum, the water volume resulting from a 24-hour, 25-year rainstorm. RCRA Subtitle D regulations apply to the closure of active MSWLFs and may be Applicable or Relevant and Appropriate Requirements (ARARs) for certain landfills at CERCLA sites as well.

The method for estimating run-on and run-off design discharges should be based on engineering judgment and on-site conditions (e.g., the Rational Method used by hydrologists to determine overland flow). Detailed storm flow calculations usually are done during the design phase. However, data for preliminary calculations should be collected early enough to prepare an estimate of the cost of run-on/run-off control measures as part of the remedy estimate for the ROD.

Because run-on and run-off control is required for operating landfills, some landfills may already have surface water diversion or containment impoundments that allow sediment to settle out of the run-off and that control discharge for a 25-year storm. Depending on when the landfill was designed (with respect to applicable Federal and State regulations), existing control structures may not have adequate capacity. In addition, the RI/FS should identify areas for temporary surface water controls for use during cap construction activities.

A review of the original design or site records available for a landfill may provide information on design criteria for the surface water control structures. Site reconnaissance should be conducted to evaluate the physical condition of the system. If there are no existing diversion or containment impoundments, adequate space should be located on or off site to accommodate them. Property acquisition may be necessary if on-site space is not available.

Prior to cap installation, collected or diverted run-on surface waters often can be discharged to a nearby surface waterbody or to a recharge basin. Discharge to surface water is considered a point source discharge and must comply with the National Pollution Discharge Elimination System (NPDES) requirements of the Clean Water Act. Because many States have jurisdiction for the discharge of pollutants to surface waters, permit requirements may vary depending on location, although an NPDES permit is always needed. Other factors to consider are the water quality and soil type, which can be determined by analysis of surface water samples, visual and sieve analyses of the soil, and review of NPDES compliance data (if applicable).

After the cover is installed, the collected or diverted surface water is not contaminated; therefore, diversion or containment impoundment maintenance usually is limited to control of vegetation and debris and sediment removal. Discharge to a recharge basin is not considered a point source discharge and, generally, regulators evaluate these basins for permit compliance on a case-by-case basis.

TECHNICAL AREA 6: CLAY SOURCES

A compacted clay layer is normally one of the primary components of an effective cap, provided that sources of clay (low-permeability soil) are available at or near the landfill. Data-gathering activities should include looking for potential on-site/local clay deposits for the cap construction. Manufactured geosynthetic clay liners should be considered if the required volume or physical properties are not available in nearby soils. A comparison of geosynthetic clay liner material cost versus clay excavation and transport cost should be completed before design commences.

Investigation of potential sources for clay should be initiated prior to the preliminary conceptual cap design (which defines the components of the cover). For information on clay deposits, the Soil Conservation Service (SCS) of the U.S. Department of Agriculture (USDA) publishes soil maps and classifications by county. Additional information on the availability of clay soils may be obtained from State natural resource inventory programs; local contractors or engineering firms practicing in the area; State and local highway officials, shallow borings, test pits, and hand-augered holes; and geotechnical laboratory testing.

After potential sources of clay are identified, a site reconnaissance may be conducted. The site reconnaissance should include sample collection via hand-augered holes or shovels to verify the availability of clay over the site.

Subsurface soil samples of the source area should be collected later to determine resource quality (shear testing of layer interfaces) and quantity. Procedures used to characterize clay sources generally include:

- Excavation of at least one test pit for every 25,000 to 50,000 cubic yards
- Collection of soil samples from test pits for laboratory characterization
- Shallow borings to confirm soil type, volume, and, in certain instances, depth to ground water
- Laboratory testing of samples collected including: grain size analysis, Atterberg limits, permeability testing, moisture content, and compaction testing. Detailed compaction requirements to meet construction quality assurance objectives are provided in *Quality Assurance and Quality Control for Waste Containment Facilities* (U.S. EPA, 1993 b).

If sufficient quantities of soil cover materials with appropriate engineering properties are not available within an economically practicable distance from the project site, geosynthetics or processed natural materials should be considered. Geosynthetic clay liners are generally manufactured by either sandwiching bentonitic clays between geotextiles or affixing the bentonitic clay to the bottom surface of a membrane. Thus, if clay is not readily available, low-permeability layers of the cap may be comprised of either available soil that is processed by adding bentonite to reduce the permeability or geosynthetic clay liners. For cap drainage layers, geosynthetic drainage nets may also be used, in lieu of coarse sand and gravel, to meet performance requirements. Information on geosynthetic clay liners and drainage nets can be obtained from manufacturer catalogues.

CONCLUSION

For each MSWLF site where capping is clearly a preferred remedy, the RPM should assemble a technical review team to determine the design data to be collected. This team should include experienced RPMs and technical experts familiar with data collection needs for cap design. The team can help the RPM in defining the field work required and its timing and in reviewing the design data submitted by the contractor. In the event that the contractor is changed (i.e., the RI/FS is Fund-led and the design is switched to Potentially Responsible Party [PRP]-led), the technical review team can assist the RPM in transferring the pertinent collected design data to the new contractor.

Table 2 summarizes the data needs and collection methods presented in this fact sheet. This table should be used as a reference when determining necessary design data collection activities.

Table 2. Data Requirements and Collection Methods

Data Requirements	Data Collection Methods
Waste Area Delineation	
Design/historical information	Historical records, personal interviews
Horizontal extent of waste	Test pits, probes, hand-augered holes, magnetometry, electromagnetic conductivity, ground-penetrating radar, electrical resistivity, seismic refraction
Depth and thickness of waste	Borings, geophysical surveys
Slope Stability and Settlement*	
Waste Evaluation	
Slope measurement (A)	Slope inclinometers, topographic survey
Potentiometric surface (A)	Piezometers/monitoring wells
Compressibility characteristics (C)	Preload testing, empirical correlations to published literature
Settlement rate (C)	Survey monuments, settlement plates, topographic survey
Thickness of waste (A,C)	Observation and sampling during test pits, borings, hand-augered holes, historical records, geophysical surveys
General waste composition (A,C)	Observation and sampling during test pits, borings, hand-augered holes, historical records, geophysical surveys
Existing topography (A,C)	Site reconnaissance, topographic survey, historical photographs

(continued)

Table 2 (continued)

Data Requirements	Data Collation Methods
Existing Cover Soil Evaluation*	
Slope measurement (A,B)	Topographic survey, slope inclinometers
Soil classification (B)	Grain size analysis, hydrometer analysis, Atterberg limits performed on borings/test pit samples
Potentiometric surface (A,C)	Piezometers/monitoring wells
Shear strength (B)	Fine-grained soil (cohesion): Field and/or lab vane shear test, torvane, pocket penetrometer, piezocone penetrometer, unconfined compressive strength, empirical correlations to Standard Penetration Test (S-P-T) Coarse grained soil (friction angle): Empirical correlations to S-P-T, direct shear test, triaxial shear test, piezocone penetrometer
Compressibility characteristics (C)	Consolidation tests performed on undisturbed tube samples collected from borings. Empirical correlations to index properties (water content, plasticity).
Density (B)	Empirical correlations to S-P-T data, bulk density determination from undisturbed tube samples (fine-grained soils only)
Gas Generation/Migration	
Gas composition and gas pressure	Gas probes, monitoring wells, laboratory samples
Moisture and heat content	Laboratory samples or handheld instruments in the field
Migration pathways	Water and sewer maps, piezocone, test pits, borings, hand-augered holes
Receptors	Site reconnaissance, photoionization detector, flame ionization detector, air monitoring station, oxygen meter
Existing Cover Assessment	
Slope-top	Site reconnaissance, topographic survey
Cap area	Site reconnaissance, borings, test pits, geophysical survey
Vegetative/soil layer	Site reconnaissance, topographic survey, test pits
Drainage layer	Site reconnaissance, borings, test pits, hand-augered holes, field infiltrometer or laboratory samples for hydraulic conductivity
Barrier layer	Test pits, borings, hand-augered holes, Shelby tubes for permeability, laboratory samples/analysis for shear strength, compaction curve, atterberg limits, freeze/thaw cycling, water content
Gas venting system	Site reconnaissance, gas character sampling, gas pumping tests
Run-on/Run-off Management	
Estimated discharge, size of control structures, treatment requirements	Review of design records, National Pollutant Discharge Elimination System (NPDES) permit, detailed storm flow calculations
Climatic data	National Oceanographic and Atmospheric Administration (NOAA)
Run-on/run-off areas (% vegetated, % paved)	Site reconnaissance, topographic surveys, aerial photographs
Water quality	Surface water sampling and analysis
Soil types	Visual, aerial photographs, and soil maps from the Soil Conservation Service (SCS)
Clay Sources	
Soil properties	Soil maps from the SCS, local contractors or engineering firms, state/local transportation officials, natural resource inventory programs, shallow borings, hand-augered holes, test pits, and geotechnical laboratory testing
Subsurface resource adequacy and quantity (shear testing)	Grain size analysis, Atterberg limits, permeability test, moisture content, compaction test, shallow borings, test pits, laboratory testing
Geosynthetic clay liner properties	Manufacturer catalogs, literature, EPA studies/guidance

*The letters following the slope stability and settlement and existing cover soil evaluation data requirements are referenced to the data needed to perform the three separate calculations used to evaluate slope stability and settlement of the landfill cover (see Technical Area 2):

A = Stability of waste. B = Stability of cap components. C = Settlement of waste.

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EPA

Presumptive Remedy for CERCLA Municipal Landfill Sites

Office of Emergency and Remedial Response
Hazardous Site Control Division 5203G

Quick Reference Fact Sheet

Since Superfund's inception in 1980, the remedial and removal programs have found that certain categories of sites have similar characteristics, such as types of contaminants present, types of disposal practices, or how environmental media are affected. Based on information acquired from evaluating and cleaning up these sites, the Superfund program is undertaking an initiative to develop presumptive remedies to accelerate future cleanups at these types of sites. The presumptive remedy approach is one tool of acceleration within the **Superfund Accelerated Cleanup Model (SACM).**

Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation. The objective of the presumptive remedies initiative is to use the program's past experience to streamline site investigation and speed up selection of cleanup actions. Over time presumptive remedies are expected to ensure consistency in remedy selection and reduce the cost and time required to clean up similar types of sites. Presumptive remedies are expected to be used at all appropriate sites except under unusual site-specific circumstances.

This directive establishes **containment** as the presumptive remedy for CERCLA municipal landfills. The framework for the presumptive remedy for these sites is presented in a streamlining manual entitled *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites,* February 1991 (OSWER Directive 9355. 3-11). This directive highlights and emphasizes the importance of certain streamlining principles related to the scoping (planning) stages of the remedial investigation/feasibility study (RI/FS) that were identified in the manual. The directive also provides clarification of and additional guidance in the following areas: (1) the level of detail appropriate for risk assessment of source areas at municipal landfills and (2) the characterization of hot spots.

BACKGROUND

Superfund has conducted pilot projects at four municipal landfill sites[1] on the National Priorities List (NPL) to evaluate the effectiveness of the manual *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (hereafter referred to as "the manual") as a streamlining tool and as the framework for the municipal landfill presumptive remedy. Consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (or NCP), EPA's expectation was that containment technologies generally would be appropriate for municipal landfill waste because the volume and heterogeneity of the waste generally make treatment impracticable. The results of the pilots support this expectation and demonstrate that the manual is an effective tool for streamlining the RI/FS process for municipal landfills.

Since the manual's development, the expectation to contain wastes at municipal landfills has evolved into a presumptive remedy for these sites.[2] Implementation of the streamlining principles outlined in the manual at the four pilot sites helped to highlight issues requiring further clarification, such as the degree to which risk assessments can be streamlined for source areas and the characterization and remediation of hot spots. The pilots also demonstrated the value of focusing streamlining efforts at the scoping stage, recognizing that the biggest savings in time and money can be realized if streamlining is incorporated at the beginning of the RI/FS process. Accordingly, this directive addresses those issues identified during the pilots and highlights streamlining opportunities to be considered during the scoping component of the RI/FS.

[1] Municipal landfill sites typically contain a combination of principally municipal and to a lesser extent hazardous wastes.

[2] See EPA Publication 9203.1-02I, SACM Bulletins, *Presumptive Remedies for Municipal Landfill Sites,* April 1992, Vol. 1, No. 1, and February 1993, Vol. 2, No. 1, and SACM Bulletin *Presumptive Remedies,* August 1992, Vol. 1, No. 3.

Finally, while the primary focus of the municipal landfill manual is on streamlining the RI/FS, Superfund's goal under SACM is to accelerate the entire clean-up process. Other guidance issued under the municipal landfill presumptive remedy initiative identifies design data that may be collected during the RI/FS to streamline the overall response process for these sites (see Publication No. 9355.3-18FS, *Presumptive Remedies:* CERCLA *Landfill Caps Data Collection Guide,* to be published in October 1993).

CONTAINMENT AS A PRESUMPTIVE REMEDY

Section 300.430(a)(iii)(B) of the NCP contains the expectation that engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat where treatment is impracticable. The preamble to the NCP identifies municipal landfills as a type of site where treatment of the waste may be impracticable because of the size and heterogeneity of the contents (55 FR 8704). Waste in CERCLA landfills usually is present in large volumes and is a heterogeneous mixture of municipal waste frequently co-disposed with industrial and/or hazardous waste. Because treatment usually is impracticable, EPA generally considers containment to be the appropriate response action, or the "presumptive remedy," for the source areas of municipal landfill sites.

The presumptive remedy for CERCLA municipal landfill sites relates primarily to containment of the landfill mass and collection and/or treatment of landfill gas. In addition, measures to control landfill leachate, affected ground water at the perimeter of the landfill, and/or upgradient ground-water that is causing saturation of the landfill mass may be implemented as part of the presumptive remedy.

The presumptive remedy does not address exposure pathways outside the source area (landfill), nor does it include the long-term ground-water response action. Additional RI/FS activities, including a risk assessment, will need to be performed, as appropriate, to address those exposure pathways outside the source area. It is expected that RI/FS activities addressing exposure pathways outside the source generally will reconducted concurrently with the streamlined RI/FS for the landfill source presumptive remedy. A response action for exposure pathways outside the source (if any) may be selected together with the presumptive remedy (thereby developing a comprehensive site response), or as an operable unit separate from the presumptive remedy.

Highlight 1 identifies the components of the presumptive remedy. Response actions selected for individual sites will include only those components that are necessary, based on site-specific conditions.

Highlight 1: Components of the Presumptive Remedy: Source Containment

- Landfill cap;
- Source area ground-water control to contain plume;
- Leachate collection and treatment;
- Landfill gas collection and treatment; and/or
- Institutional controls to supplement engineering controls.

The EPA (or State) site manager will make the initial decision of whether a particular municipal landfill site is suitable for the presumptive remedy or whether a more comprehensive RI/FS is required. Generally, this determination will depend on whether the site is suitable for a streamlined risk evaluation, as described on page 4. The community, state, and potentially responsible parties (PRPs) should be notified that a presumptive remedy is being considered for the site before work on the RI/FS work plan is initiated. The notification may take the form of a fact sheet, a notoice in a local newspaper, and/or a public meeting.

Use of the presumptive remedy eliminates the need for the initial identification and screening of alternatives during the feasibility study (FS). Section 300.430(e)(1) of the NCP states that, "... the lead agency shall include art alternatives screening step, when needed, (emphasis added) to select a reasonable number of alternatives for detailed analysis."

EPA conducted an analysis of potentially available technologies for municipal landfills and found that certain technologies are routinely and appropriately screened out on the basis of effectiveness, feasibility, or cost (NCP Section 300.430(e)(7)). (See Appendix A to this directive and "Feasibility Study Analysis for CERCLA Municipal Landfills," September 1993 available at EPA Headquarters and Regional Offices.) Based on this analysis, the universe of alternatives that will be analyzed in detail may be limited to the components of the containment remedy identified in Highlight 1, unless site-specific conditions dictate otherwise or alternatives are considered that were not addressed in the FS analysis. The FS analysis document, together with this directive, must be included in the administrative record for each municipal landfill presumptive remedy site to support elimination of the initial identification and screening of site-specific alternatives. Further detailed and comprehensive supporting materials (e.g., FS reports included in analysis, technical reports) can be provided by Headquarters, as needed.

While the universe of alternatives to address the landfill source will be limited to those components identified in Highlight 1, potential alternatives that may exist for each component or combinations of components may be evaluated in the detailed analysis. For example, one component of the presumptive remedy is source area ground-water control. If appropriate, this component may be accomplished in a number of ways, including pump and treat, slurry walls, etc. These potential alternatives may then be combined with other components of the presumptive remedy to develop a range of containment alternatives suitable for site-specific conditions. Response alternatives must then be evaluated in detail against the nine criteria identified in Section 300.430(e)(g) of the NCP. The detailed analysis will identify site-specific ARARs and develop costs on the basis of the particular size and volume of the landfill.

EARLY ACTION AT MUNICIPAL LANDFILLS

EPA has identifies the presumptive remedy site categories as good candidates for early action under SACM. At municipal landfills, the upfront knowledge that the source area will be contained may facilitate such early actions as installation of a landfill cap or a ground-water containment system. Depending on the circumstances, early actions may be accomplished using either removal authority (e.g., non-time-critical removal actions) or remedial authority. In some cases, it may be appropriate for an Engineering Evaluation/Cost Analysis to replace part or all of the RI/FS if the source control component will be a non-time-critical removal action. Some factors may affect whether a specific response action would be better accomplished as a removal or remedial action including the size of the action, the associated state cost share, and/ or the scope of O&M. A discussion of these factors is contained in *Early Action and Long-term Action Under SACM - Interim Guidance,* Publication No. 9203.1-05I, December 1992.

SCOPING A STREAMLINED RI/FS UNDER THE PRESUMPTIVE REMEDY FRAMEWORK

The goal of an RI/FS is to provide the information necessary to: (1) adequately characterize the site; (2) define site dynamics; (3) define risks; and (4) develop the response action. As discussed in the following sections, the process for achieving each of these goals can be streamlined for CERCLA municipal landfill sites because of the upfront presumption that landfill contents will be contained. The strategy for streamlining each of these areas should be developed early (i.e., during the scoping phase of the RI/FS).

1. Characterizing the Site

The use of existing data is especially important in conducting a streamlined RI/FS for municipal landfills. Characterization of a landfill's contents is not necessary or appropriate for selecting a response action for these sites except in limited cases; rather, existing data are used to determine whether the containment presumption is appropriate. Subsequent sampling efforts should focus on characterizing areas where contaminant migration is suspected, such as leachate discharge areas or areas where surface water runoff has caused erosion. It is important to note that the decision to characterize hot spots should also be based on existing information, such as reliable anecdotal information, documentation, and/or physical evidence (see page 6).

In those limited cases where no information is available for a site, it may not be advisable to initiate use of the presumptive remedy until some data are collected. For example, if there is extensive migration of contaminants from a site located in an area with several sources, it will be necessary to have some information about the landfill source in order to make an association between on-site and off-site contamination.

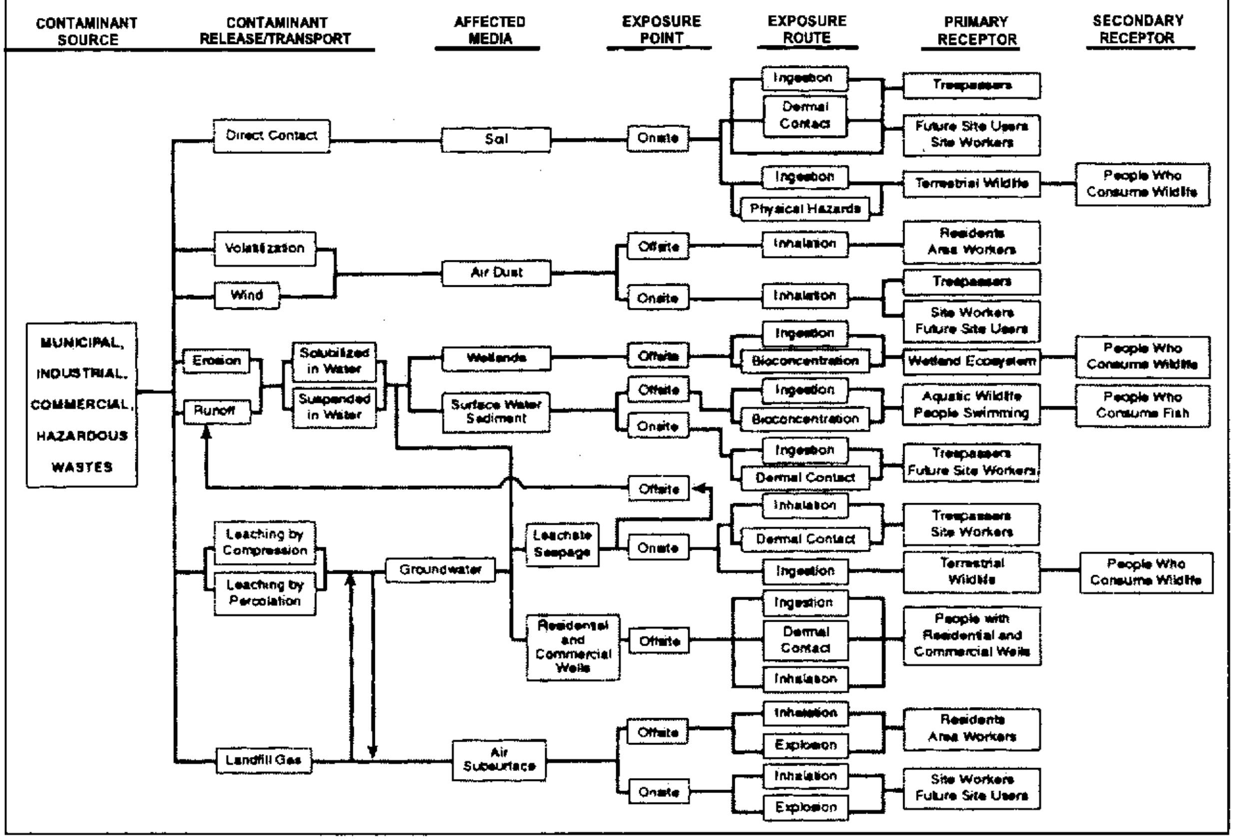
Sources of information of particular interest during scoping include records of previous ownership, state files, closure plans, etc., which may help to determine types and sources of hazardous materials present. In addition, a site visit is appropriate for several reasons, including the verification of existing data, the identification of existing site remediation systems, and to visually characterize wastes (e.g., leachate seeps). Specific information to be collected is provided in Sections 2.1 through 2.4 of the municipal landfill manual.

2. Defining Site Dynamics

The collected data are used to develop a conceptual site model, which is the key component of a streamlined RI/FS. The conceptual site model is an effective tool for defining the site dynamics, streamlining the risk evaluation, and developing the response action. Highlight 2 presents a generic conceptual site model for municipal landfill. The model is developed before any RI field activities are conducted, and its purpose is to aid in understanding and describing the site and to present hypotheses regarding:

- The suspected sources and types of contaminants present;
- Contaminant release and transport mechanisms;

Highlight 2: Generic Conceptual Site Model



- Rate of contaminant release and transport (where possible);
- Affected media;
- Known and potential routes of migration; and
- Known and potential human and environmental receptors.

After the data are evaluated and a site visit is completed, the contaminant release and transport mechanisms relevant to the site should be determined. The key element in developing the conceptual site model is to identify those aspects of the model that require more information to make a decision about response measures. Because containment of the landfill's contents is the presumed response action, the conceptual site model will be of most use in identifying areas beyond the landfill source itself that will require further study, thereby focusing site characterization away from the source area and on areas of potential contaminant migration (e.g., ground water or contaminated sediments).

3. Defining Risks

The municipal landfill manual states that a streamlined or limited baseline risk assessment will be sufficient to initiate response action on the most obvious problems at a municipal landfill (e.g., ground water, leachate, landfill contents, and landfill gas). One method for establishing risk using a streamlined approach is to compare contaminant concentration levels (if available) to standards that are potential chemical-specific applicable or relevant and appropriate requirements (ARARs) for the action. The manual states that where established standards for one or more contaminants in a given medium are clearly exceeded, remedial action generally is warranted.[1]

It is important to note, however, that based on site-specific conditions, an active response is not required if ground-water contaminant concentrations exceed chemical-specific standards but the site risk is within the Agency's acceptable risk range (10^{-4} to 10^{-6}). For example, if it is determined that the release of

[1]See also OSWER Directive 9355.0-30, *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, April 22, 1991, which states that if MCLs or non-zero MCLGs are exceeded, [a response] action generally is warranted.

contaminants from a particular landfill is declining, and concentrations of one or more ground-water contaminants are at or barely exceed chemical-specific standards, the Agency may decide not to implement an active response. Such a decision might be based on the understanding that the landfill is no longer acting as a source of ground-water contamination, and that the landfill does not present an unacceptable risk from any other exposure pathway.

A site generally will not be eligible for a streamlined risk evaluation if ground-water contaminant concentrations do not clearly exceed chemical-specific standards or the Agency's accepted level of risk, or other conditions do not exist that provide a clear justification for action (e.g., direct contact with landfill contents resulting from unstable slopes). Under these circumstances, a quantitative risk assessment that addresses all exposure pathways will be necessary to determine whether action is needed.

Ultimately, it is necessary to demonstrate that the final remedy addresses all pathways and contaminants of concern, not just those that triggered the remedial action. As described in the following sections, the conceptual site model is an effective tool for identifying those pathways and illustrating that they have been addressed by the containment remedy.

Streamlined Risk Evaluation Of The Landfill Source

Experience from the presumptive remedy pilots supports the usefulness of a streamlined risk evaluation to initiate an early response action under certain circumstances. As a matter of policy, for the source area of municipal landfills, a quantitative risk assessment that considers all chemicals, their potential additive effects, etc., is not necessary to establish a basis for action if ground-water data are available to demonstrate that contaminants clearly exceed established standards or if other conditions exist that provide a clear justification for action.

A quantitative risk assessment also is not necessary to evaluate whether the containment remedy addresses all pathways and contaminants of concern associated with the source. Rather, all potential exposure pathways can be identified using the conceptual site model and compared to the pathways addressed by the containment presumptive remedy. Highlight 3 illustrates that the containment remedy addresses all exposure pathways associated with the source at municipal landfill sites.

Finally, a quantitative risk assessment is not required to determine clean-up levels because the type of cap will be determined by closure ARARs, and ground water that is extracted as a component of the presumptive remedy will be required to meet discharge limits, or other standards for its disposal. Calculation of clean-up levels for ground-water contamination that has migrated away from the source will not be accomplished under the presumptive remedy, since such contamination will require a conventional investigation and a risk assessment.

Highlight 3: Source Contaminant Exposure Pathways Addressed by Presumptive Remedy

1. Direct contact with soil and/or debris prevented by landfill cap;
2. Exposure to contaminated ground water within the landfill area prevented by ground-water control;
3. Exposure to contaminated leachate prevented by leachate collection and treatment; and
4. Exposure to landfill gas addressed by gas collection and treatment, as appropriate.

Streamlining the risk assessment of the source area eliminates the need for sampling and analysis to support the calculation of current or potential future risk associated with direct contact. It is important to note that because the continued effectiveness of the containment remedy depends on the integrity of the containment system, it is likely that institutional controls will be necessary to restrict future activities at a CERCLA municipal landfill after construction of the cap and associated systems. EPA has thus determined that it is not appropriate or necessary to estimate the risk associated with future residential use of the landfill source, as such use would be incompatible with the need to maintain the integrity of the containment system. (Long-term waste management areas, such as municipal landfills, may be appropriate, however, for recreational or other limited uses on a site-specific basis.) The availability and efficacy of institutional controls should be evaluated in the FS. Decision documents should include measures such as institutional controls to ensure the continued integrity of such containment systems whenever possible.

Areas of Contaminant Migration

Almost every municipal landfill site has some characteristic that may require additional study, such as leachate discharge to a wetland or significant surface water run-off caused by drainage problems. These migration pathways, as well as ground-water contamination that has migrated away from the source, generally will require characterization and a more comprehensive risk assessment to determine whether action is warranted beyond the source area and, if so, the type of action that is appropriate.

While future residential use of the landfill source area itself is not considered appropriate, the land adjacent to landfills is frequently used for residential purposes. Therefore, based on site-specific circumstances, it may be appropriate to consider future residential use for ground water and other exposure pathways when assessing risk from areas of **contaminant migration.**

4. Developing the Response Action

As a first step in developing containment alternatives, response action objectives should be developed on the basis of the pathways identified for action in the conceptual site model. Typically, the primary response action objectives for municipal landfill sites include:

<u>Presumptive Remedy</u>

- Preventing direct contact with landfill contents;
- Minimizing infiltration and resulting contaminant leaching to ground water;
- Controlling surface water runoff and erosion;
- Collecting and treating contaminated ground water and leachate to contain the contaminant plume and prevent further migration from source area; and
- Controlling and treating landfill gas.

<u>Non-Presumptive Remedy</u>

- Remediating ground water;
- Remediating contaminated surface water and sediments; and
- Remediating contaminated wetland areas.

As discussed in Section 3, "Defining Risks," the containment presumptive remedy accomplishes all but the last three of these objectives by addressing all pathways associated with the source. Therefore, the focus of the RI/FS can be shifted to characterizing the media addressed in the last three objectives (contaminated ground water, surface water and sediments, and wetland areas) and on collecting data to support design of the containment remedy.

Treatment of Hot Spots

The decision to characterize and/or treat hot spots is a site-specific judgement that should be based on the consideration of a standard set of factors. Highlight 4 lists questions that should be answered before making the decision to characterize and/or treat hot spots. The overriding question is whether the combination of the waste's physical and chemical characteristics and volume is such that the integrity of the new containment system will be threatened if the waste is left in place. This question should be answered on the basis of what is <u>known</u> about a site (e.g., from operating records or other reliable information). An answer in the affirmative to all of the questions listed in Highlight 4 would indicate that it is likely that the integrity of the containment system would be threatened, or that excavation and treatment of hot spots would be practicable, and that a significant reduction in risk at the site would occur as a result of treating hot spots. EPA expects that few CERCLA municipal landfills will fall into this category; rather, based on the Agency's experience, the majority of sites are expected to be suitable for containment only, based on the heterogeneity of the waste, the lack of reliable information concerning disposal history, and the problems associated with excavating through refuse.

The volume of industrial and/or hazardous waste co-disposed with municipal waste at CERCLA municipal landfills varies from site to site, as does the amount of information available concerning disposal history. It is impossible to fully characterize, excavate, and/or treat the source area of municipal landfills, so uncertainty about the landfill contents is expected. Uncertainty by itself does not call into question the containment approach. However, containment remedies must be designed to take into account the possibility that hot spots are present in addition to those that have been identified and characterized. The presumptive remedy must be relied upon to contain landfill contents and prevent migration of comtaminants. This is accomplished by a combination of measures, such as a landfill cap combined with a leachate collection system. Monitoring will further ensure the continued effectiveness of the remedy.

The following examples illustrate site-specific decision making and show how these factors affect the decision whether to characterize and/or treat hot spots.

Examples of Site-Specific Decision Making Concerning Hot Spot Characterization/ Treatment

<u>**Site A**</u>

There is anecdotal information that approximately 200 drums of hazardous waste were disposed of at this 70-acre former municipal landfill, but their location and contents are unknown. The remedy includes a landfill cap and ground-water and landfill gas treatment.

A search for and characterization of hot spots is not supported at Site A based on the questions listed in

Highlight 4: Characterization of Hot Spots

If all of the following questions can be answered in the affirmative, it is likely that characterization and/or treatment of hot spots is warranted:

1. Does evidence exist to indicate the presence and approximate location of waste?
2. Is the hot spot known to be principal threat waste?*
3. Is the waste in a discrete, accessible part of the landfill?
4. Is the hot spot known to be large enough that its remediation will reduce the threat posed by the overall site but small enough that it is reasonable to consider removal (e.g., 100,000 cubic yards or less)?

*See *A Guide to Principal Threat and Low Level Threat Wastes,* November 1991, Superfund Publication No. 9380.3-06FS.

Highlight 4: (1) no reliable information exists to indicate the location of the waste; (2) the determination of whether the waste is principal threat waste cannot be made since the physical/chemical characteristics of the wastes are unknown; (3) since the location of the waste is unknown, the determination of whether the waste is in a discrete accessible location cannot be made; (4) in this ease, the presence of 200 drums in a 70-acre landfill is not considered to significantly affect the threat posed by the overall site. Rather, the containment system will include measures to ensure its continued effectiveness (e.g., monitoring and/or leachate collection) given the uncertainty associated with the landfill contents and suspected drums.

Site B

Approximately 35,000 drums, many containing hazardous wastes, were disposed of in two drum disposal units at this privately owned 80-acre inactive landfill, which was licensed to receive general refuse. The site is divided into two operable units. The remedy for Operable Unit 1 (OU 1) is incineration of drummed wastes in the two drum disposal units. The remedy for OU 2 consists of treatment of contaminated ground water and leachate and containment of treatment residuals (from OU 1) and remaining landfill contents, including passive gas collection and flaring.

Treatment of landfill contents is supported at Site B because all of the questions in Highlight 4 can be answered in the affirmative: (1) existing evidence from previous investigations and sampling conducted by the state (prior to the RI) indicated the presence and approximate location of wastes; (2) the wastes were considered principal threat wastes because they were liquids and (based on sampling) were believed to contain contaminants of concern; (3) the waste is located in discrete accessible parts of the landfill; and (4) the waste volume is large enough that its remediation will significantly reduce the threat posed by the overall site.

CLOSURE REQUIREMENTS

Subtitle D

In the absence of Federal Subtitle D closure regulations, State Subtitle D closure requirements generally have governed CERCLA response actions at municipal landfills as applicable or relevant and appropriate requirements (ARARs). New Federal Subtitle D closure and post-closure care regulations will be in effect on October 9, 1993 (56 FR 50978 and 40 CFR 258).[4] State closure requirements that are ARARs and that are more stringent than the Federal requirements must be attained or waived.

The new Federal regulations contain requirements related to construction and maintenance of the final cover, and leachate collection, ground-water monitoring, and gas monitoring systems. The final cover regulations will be applicable requirements for landfills that received household waste after October 9,1991. EPA expects that the final cover requirements will be applicable to few, if any, CERCLA municipal landfills, since the receipt of household wastes ceased at most CERCLA landfills before October 1991. Rather, the substantive requirements of the new Subtitle D regulations generally will be considered relevant and approptiate requirements for CERCLA response actions that occur after the effective date.

Subtitle C

RCRA Subtitle C closure requirements may be applicable or relevant and appropriate in certain circumstances. RCRA Subtitle C is applicable if the landfill received waste that is a listed or characteristic waste under RCRA, and:

1. The waste was disposed of after November 19,1980 (effective date of RCRA), or

[4] An extension of the effective date has been proposed but not finalized at this time.

2. The new response action constitutes disposal under RCRA (i.e., disposal back into the original landfill).[5]

The decision about whether a Subtitle C closure requirement is relevant and appropriate is based on a variety of factors, including the nature of the waste and its hazardous properties, the date on which it was disposed, and the nature of the requirement itself. For more information on RCRA Subtitle C closure requirements, see *RCRA ARARs:Focus on Closure Requirements,* Directive No. 9234.2-04FS, October 1989.

[5]Note that disposal of only small quantity hazardous waste and household hazardous waste does not make Subtitle C applicable.

Notice:

The policies set out in this document are intended solely as guidance to the U.S. Environmental Protection Agency (EPA) personnel; they are not final EPA actions and do not constitute rulemaking. These policies are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this document, or to act at variance with the guidance, based on an analysis of specific site circumstances. EPA also reserves the right to change the guidance at any time without public notice.

APPENDIX A
TECHNICAL BASIS FOR PRESUMPTIVE REMEDIES

This Appendix summarizes the analysis that EPA conducted of feasibility study (FS) and Record of Decision (ROD) data from CERCLA municipal landfill sites which led to the establishment of containment as the presumptive remedy for these sites. The objective of the study was to identify those technologies that are consistently included in the remedies selected, those that are consistently screened out, and to identify the basis for their elimination. Results of this analysis support the decision to eliminate the initial technology identification and screening steps on a site-specific basis for this site type. The technical review found that certain technologies are appropriately screened out based on effectiveness, implementability, or excessive costs.

The methodology for this analysis entailed reviewing the technology identification and screening components of the remedy selection process for a representative sample of municipal landfill sites. The number of times each technology was either screened out or selected in each remedy was compiled. A detailed discussion of the methodology used is provided below.

METHODOLOGY

Identification of Sites for Feasibility Study Analysis

Of the 230 municipal landfill sites on the NPL, 149 sites have had a remedy selected for at least one operable unit. Of the 149 sites, 30 were selected for this study on a random basis, or slightly greater than 20 percent. The sites range in size from 8.5 acres to over 200 acres and are located primarily in Regions 1,2,3, and 5. This geographical distribution approximates the distribution of municipal landfills on the NPL.

Technology Secrning and Remedial Alternative Analysis

The FS analysis involved a review of the technology identification and screening phase, including any pre-screening steps, followed by a review of the detailed analysis and comparative analysis phases. Information derived from each review was documented on site-specific data collection forms, which are available for evaluation as part of the Administrative Record for this presumptive remedy directive. The review focused on the landfill source contamination only; ground-water technologies and alternatives were not included in the analysis.

For the screening phase, the full range of technologies considered was listed on the data collection forms, along with the key reasons given for eliminating technologies from further consideration. These reasons were categorized according to the screening criteria: cost, effectiveness, or implementability. The frequency with which specific reasons were given for eliminating a technology from further consideration was then tallied and compiled into a screening phase summary table.

For the detailed analysis and comparative analysis, information on the relative performance of each technology/alternative with respect to the seven NCP criteria was documented on the site-specific data collection forms. The advantages and disadvantages associated with each clean-up option were highlighted. In some cases, a technology was combined with one or more technologies into one or more alternatives. The disadvantages of a technology/alternative were then compiled into a detailed analysis/comparative analysis summary table, under the assumption that these disadvantages contributed to non-selection. All summary tables are available for review as part of the Administrative Record.

APPENDIX A
TECHNICAL BASIS FOR PRESUMPTIVE REMEDIES (continued)

RESULTS

The information from the technology screening and remedial alternative analyses is provided in Table 1. It demonstrates that containment (the presumptive remedy), was chosen as a component of the selected remedy at all thirty of the sites analyzed. No other technologies or treatments were consistently selected as a remedy or retained for consideration in a remedial alternative. However, at eight of the thirty sites, there were circumstances where technologies were included in the selected remedy to address a site-specific concern, such as principal threat wastes. These technologies are included in the column entitled "Tech. Not Primary Component of Alternative"[1] in Table 1 and include incineration at two sites, waste removal and off-site disposal at two sites, soil vapor extraction at two sites, and bioreclamation at one site.

Leachate collection and gas collection systems were also tracked as part of the detailed analysis and comparison of remedial alternatives. These types of systems generally were not considered as remediation technologies during the screening phases. At fifteen sites, leachate collection was selected as part of the overall containment remedy. At seventeen sites, gas collection systems were selected as part of the overall containment remedy.

This analysis supports the decision to eliminate the initial technology identification and screening step for municipal landfill sites. On a site-specific basis, consideration of remediation technologies may be retained as needed.

[1] This column title is used for record-keeping purposes only and is not meant to imply that these treatment technologies are not considered important components of the selected remedies.

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

Technology[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out[3]			# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-Selection							
					Cost	Effectiveness	Implement			Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns[4]	Community Concerns[4]
Multi-layer Cap	28	25	3	0	2	2	0	18	7	1	0	0	1	3	5	3	---	---
Clay Cap	16	8	8	0	1	8	0	4	4	2	2	1	2	1	0	1	---	---
Asphalt Cap	17	0	17	0	2	14	5	0	0	0	0	0	0	0	0	0	---	---
Concrete Cap	17	0	17	0	3	14	5	0	0	0	0	0	0	0	0	0	---	---
Soil Cover	16	7	5	4	0	5	1	5	2	1	0	0	0	0	0	0	---	---
Synthetic Cap	13	3	10	0	0	10	1	2	1	1	1	1	1	1	1	1	---	---
Chemical Seal	5	0	5	0	0	4	0	0	0	0	0	0	0	0	0	0	---	---
Slurry Wall	22	5	14	3	2	8	6	2	3	3	2	2	1	2	0	2	---	---
Grout Curtain	18	0	18	0	3	15	9	0	0	0	0	0	0	0	0	0	---	---
Sheet Piling	17	1	16	0	0	13	5	0	1	0	0	0	0	0	0	0	---	---
Grout Injection	8	0	8	0	0	8	2	0	0	0	0	0	0	0	0	0	---	---
Block Displacement	5	0	5	0	0	3	3	0	0	0	0	0	0	0	0	0	---	---
Bottom Sealing	5	0	5	0	0	3	4	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out 3: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-Selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns[4]	Community Concerns[4]
Vibrating Beam	5	0	5	0	0	3	3	0	0	0	0	0	0	0	0	0	---	---
Liners	2	0	2	0	0	1	2	0	0	0	0	0	0	0	0	0	---	---
Offsite Nonhazardous Landfill	3	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	---	---
Offsite RCRA Landfill	17	0	13	4	8	3	12	0	0	0	0	0	0	0	0	0	---	---
Offsite Landfill (unspecified)	9	1	8	0	5	3	5	1	0	0	0	0	0	0	0	0	---	---
Onsite Nonhazardous Landfill	2	0	2	0	1	1	1	0	0	0	0	0	0	0	0	0	---	---
Onsite RCRA Landfill	14	1	11	2	3	2	10	0	1	0	0	0	0	0	0	1	---	---
Onsite Landfill (unspecified)	7	0	6	1	3	3	6	0	0	0	0	0	0	0	0	0	---	---
Bioremediation (unspecified)	13	0	13	0	0	13	1	0	0	0	0	0	0	0	0	0	---	---
Bioremediation Ex-situ	10	0	10	0	0	7	7	0	0	0	0	0	0	0	0	0	---	---
Bioremediation In-situ	15	1	14	0	1	13	7	1	0	0	0	0	0	0	0	0	---	---
Dechlorinization/ APEG	6	0	5	1	1	4	2	0	0	0	0	0	0	0	0	0	---	---
Oxidation/ Reduction	12	0	12	0	1	8	5	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out[3]: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-Selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns[4]	Community Concerns[4]
Neutralization	4	0	3	1	0	2	1	0	0	0	0	0	0	0	0	0	---	---
Thermal Destruction (unspecified)	6	0	6	0	0	3	4	0	0	0	0	0	0	0	0	0	---	---
Offsite Incineration (unspecified)	19	2	14	3	9	5	10	1	1	0	0	0	0	1	1	0	---	---
Onsite Incineration (unspecified)	12	0	8	3	5	5	6	0	1	0	0	0	0	1	1	1	---	---
Fluidized Bed	9	0	9	0	5	6	4	0	0	0	0	0	0	0	0	0	---	---
Infrared	8	0	7	1	6	3	3	0	0	0	0	0	0	0	0	0	---	---
Pyrolysis	5	2	3	1	2	2	1	0	1	0	1	0	0	1	1	1	---	---
Multiple Hearth	4	0	4	0	2	2	1	0	0	0	0	0	0	0	0	0	---	---
Rotary Kiln	10	0	9	1	6	5	4	0	0	0	0	0	0	0	0	0	---	---
Vitrification	21	0	21	0	8	15	11	0	0	0	0	0	0	0	0	0	---	---
Low Temperature Thermal Desorp/ Stripping	13	1	11	1	2	9	3	0	1	0	0	0	0	0	1	0	---	---
In-situ Steam Stripping	5	0	5	0	1	4	2	0	0	0	0	0	0	0	0	0	---	---
Soil Flushing	16	2	14	0	2	9	10	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out[3]			# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs WHERE CRITERION CONTRIBUTED TO NON-SELECTION								
					Cost	Effectiveness	Implement			Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns[4]	Community Concerns[4]
Soil Washing	12	2	9	1	1	8	6	0	0	0	0	0	0	0	0	0	---	---
Soil Vapor Extraction (SVE)	14	1	11	2	2	9	5	1	0	0	0	0	0	0	0	0	---	---
Fixation	7	1	5	1	0	4	2	2	0	0	0	0	0	0	0	0	---	---
Stabilization/ Solidification	20	0	19	2	1	13	6	0	0	0	0	0	0	0	0	0	---	---
Aeration	7	0	7	0	0	5	3	0	0	0	0	0	0	0	0	0	---	---

[1] The study was conducted on 30 RODs and their corresponding FSs.

[2] This does not include the no-action or institutional control only alternatives. No RODs selected either of these as remedies.

[3] FSs and RODs may contain more than one criterion for screening or non-selection of technology. Also, some FSs did not fully explain the criteria for screening out a technology. Thus, the totals for screening and non-selection criteria are not equal to the number of FSs and RODs considered.

[4] Information on State and community concerns was not included in this analysis because FSs do not contain this information and RODs generally only reference supporting documentation (i.e., State concurrence letter and responsiveness summary).

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out[3]: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-Selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns[4]	Community Concerns[4]
Multi-layer Cap	28	25	3	0	2	2	0	18	7	1	0	0	1	3	5	3	---	---
Clay Cap	16	8	8	0	1	8	0	4	4	2	2	1	2	1	0	1	---	---
Asphalt Cap	17	0	17	0	2	14	5	0	0	0	0	0	0	0	0	0	---	---
Concrete Cap	17	0	17	0	3	14	5	0	0	0	0	0	0	0	0	0	---	---
Soil Cover	16	7	5	4	0	5	1	5	2	1	0	0	0	0	0	0	---	---
Synthetic Cap	13	3	10	0	0	10	1	2	1	1	1	1	1	1	1	1	---	---
Chemical Seal	5	0	5	0	0	4	0	0	0	0	0	0	0	0	0	0	---	---
Slurry Wall	22	5	14	3	2	8	6	2	3	3	2	2	1	2	0	2	---	---
Grout Curtain	18	0	18	0	3	15	9	0	0	0	0	0	0	0	0	0	---	---
Sheet Piling	17	1	16	0	0	13	5	0	1	0	0	0	0	0	0	0	---	---
Grout Injection	8	0	8	0	0	8	2	0	0	0	0	0	0	0	0	0	---	---
Block Displacement	5	0	5	0	0	3	3	0	0	0	0	0	0	0	0	0	---	---
Bottom Sealing	5	0	5	0	0	3	4	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out[3] Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-Selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns[4]	Community Concerns[4]
Vibrating Beam	5	0	5	0	0	3	3	0	0	0	0	0	0	0	0	0	---	---
Liners	2	0	2	0	0	1	2	0	0	0	0	0	0	0	0	0	---	---
Offsite Nonhazardous Landfill	3	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	---	---
Offsite RCRA Landfill	17	0	13	4	8	3	12	0	0	0	0	0	0	0	0	0	---	---
Offsite Landfill (unspecified)	9	1	8	0	5	3	5	1	0	0	0	0	0	0	0	0	---	---
Onsite Nonhazardous Landfill	2	0	2	0	1	1	1	0	0	0	0	0	0	0	0	0	---	---
Onsite RCRA Landfill	14	1	11	2	3	2	10	0	1	0	0	0	0	0	0	1	---	---
Onsite Landfill (unspecified)	7	0	6	1	3	3	6	0	0	0	0	0	0	0	0	0	---	---
Bioremediation (unspecified)	13	0	13	0	0	13	1	0	0	0	0	0	0	0	0	0	---	---
Bioremediation Ex-situ	10	0	10	0	0	7	7	0	0	0	0	0	0	0	0	0	---	---
Bioremediation In-situ	15	1	14	0	1	13	7	1	0	0	0	0	0	0	0	0	---	---
Dechlorinization/ APEG	6	0	5	1	1	4	2	0	0	0	0	0	0	0	0	0	---	---
Oxidation/ Reduction	12	0	12	0	1	8	5	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out 3: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-Selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns 4	Community Concerns 4
Neutralization	4	0	3	1	0	2	1	0	0	0	0	0	0	0	0	0	---	---
Thermal Destruction (unspecified)	6	0	6	0	0	3	4	0	0	0	0	0	0	0	0	0	---	---
Offsite Incineration (unspecified)	19	2	14	3	9	5	10	1	1	0	0	0	0	1	1	0	---	---
Onsite Incineration (unspecified)	12	0	8	3	5	5	6	0	1	0	0	0	0	1	1	1	---	---
Fluidized Bed	9	0	9	0	5	6	4	0	0	0	0	0	0	0	0	0	---	---
Infrared	8	0	7	1	6	3	3	0	0	0	0	0	0	0	0	0	---	---
Pyrolysis	5	2	3	1	2	2	1	0	1	0	1	0	0	1	1	1	---	---
Multiple Hearth	4	0	4	0	2	2	1	0	0	0	0	0	0	0	0	0	---	---
Rotary Kiln	10	0	9	1	6	5	4	0	0	0	0	0	0	0	0	0	---	---
Vitrification	21	0	21	0	8	15	11	0	0	0	0	0	0	0	0	0	---	---
Low Temperature Thermal Desorp/ Stripping	13	1	11	1	2	9	3	0	1	0	0	0	0	0	1	0	---	---
In-situ Steam Stripping	5	0	5	0	1	4	2	0	0	0	0	0	0	0	0	0	---	---
Soil Flushing	16	2	14	0	2	9	10	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out[3]: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-Selection: Protect	ARARs	TMV Through Treatment	Long-term Effect	Short-term Effect	Cost	Implem.	State Concerns[4]	Community Concerns[4]
Soil Washing	12	2	9	1	1	8	6	0	0	0	0	0	0	0	0	0	---	---
Soil Vapor Extraction (SVE)	14	1	11	2	2	9	5	1	0	0	0	0	0	0	0	0	---	---
Fixation	7	1	5	1	0	4	2	2	0	0	0	0	0	0	0	0	---	---
Stabilization/ Solidification	20	0	19	2	1	13	6	0	0	0	0	0	0	0	0	0	---	---
Aeration	7	0	7	0	0	5	3	0	0	0	0	0	0	0	0	0	---	---

[1] The study was conducted on 30 RODs and their corresponding FSs.

[2] This does not include the no-action or institutional control only alternatives. No RODs selected either of these as remedies.

[3] FSs and RODs may contain more than one criterion for screening or non-selection of technology. Also, some FSs did not fully explain the criteria for screening out a technology. Thus, the totals for screening and non-selection criteria are not equal to the number of FSs and RODs considered.

[4] Information on State and community concerns was not included in this analysis because FSs do not contain this information and RODs generally only reference supporting documentation (i.e., State concurrence letter and responsiveness summary).

United States Environmental Protection Agency

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Reuse of CERCLA Landfill and Containment Sites

Through the "Superfund Redevelopment Initiative," EPA is helping communities restore properties, once restricted from use due to risk to human health and the environment, to productive uses. These uses may include a range of activities, such as commercial businesses, recreational facilities, and ecologically enhanced areas. This fact sheet is designed to assist Remedial Project Managers (RPMs), On-Scene Coordinators (OSCs), and State agencies in working with communities to incorporate reuse options into on-site containment remedies, such as the municipal landfill presumptive remedy, when possible. The fact sheet does not establish new policy, but rather illustrates how reuse of property has been accomplished successfully under the existing program at several sites. In addition, the fact sheet describes design considerations that were creatively implemented at the sites, identifies techniques to facilitate land use, and discusses potential reuse limitations.

Softball is played at an outdoor recreation complex developed at the Chisman Creek Superfund Site.

INTRODUCTION

For over eighteen years EPA has characterized and remediated municipal landfills under its Superfund program. Based on the wealth of information acquired and the lessons learned from evaluating and cleaning up these sites, the Agency developed a presumptive remedy for CERCLA municipal landfill sites (see OSWER Directive No. 9355.0-49FS). This presumptive remedy calls for containment of the landfill mass, and collection or treatment of landfill gas and/or leachate, as appropriate. The effectiveness of the remedy is dependent on a containment system that is properly operated and maintained, and institutional controls that provide for the continued integrity of the containment system, thereby ensuring long-term protection of future site users. EPA uses similar containment strategies at other sites where a decision is made to leave some contaminated material onsite. In either case, the containment system used at the site is designed to provide protection of human health and the environment for both current and future users of the site.

The Superfund Redevelopment Initiative reflects the Agency's belief that EPA's responsibility to local communities to clean up contaminated properties in a manner that protects human health and the environment, generally should be carried out such that cleanups are protective for reasonably anticipated future land use. Superfund sites can be recycled in a variety of forms, including redevelopment of the site (e.g., construction of a new facility), reuse of existing resources on the site (e.g., a new business in pre-existing buildings), or enhancing the ecosystem on and around the site. **EPA does not favor one type of reuse over another, as land use is a local decision.** Instead, EPA is working with community leaders to determine remedial action objectives for cleanups that will allow for reasonably anticipated future land uses, where possible. Although the landfill presumptive remedy and other containment requirements may limit future uses, EPA believes that a significant number of sites using containment strategies may be appropriate for future ecological, recreational, or commercial/industrial reuse. EPA believes that reuse should help to ensure proper maintenance of the remedy while providing tangible benefits to key stakeholders, especially the surrounding community. The possible benefits of reuse include:

- Positive economic impacts for communities living around the site including new employment opportunities, increased property values, and catalysts for additional redevelopment activities;
- Stakeholder acceptance of the municipal landfill presumptive remedy because of potential time and cost savings, and increased involvement in the restoration and redevelopment process;
- Enhanced day-to-day attention, potentially resulting in improved maintenance of remedy integrity and institutional controls; and
- Improved aesthetic quality of the area through discouragement of illegal waste disposal or trespassing on restricted portions of the site, as well as increased upkeep of the site by future site occupants.

This fact sheet provides information on reuse projects that have been implemented successfully at landfills and other sites using similar containment remedies. It identifies features to be considered during the design phase, and highlights examples of project designs that incorporated creative solutions to facilitate reuse. In addition, this fact sheet addresses reuse issues—such as transfer of operation and maintenance (O&M) responsibilities and implementation of institutional controls—that are crucial to the continued protection of human health and the environment. Finally, the fact sheet delineates EPA guidance and tools for stakeholders interested in reusing a landfill site.

IDENTIFYING REASONABLY ANTICIPATED FUTURE LAND USE

To ensure that a containment remedy is protective for the reasonably anticipated use(s) of a site, RPMs and/or OSCs should involve stakeholders as early in the Superfund decision-making process as possible. Discussions with local land use planning authorities, appropriate State and local officials, property owners, and the public, as appropriate, should be conducted as early as possible in the scoping phase of the Remedial Investigation/Feasibility Study (RI/FS).

To identify reasonably anticipated future land uses, the following types of information, much of which typically is available from local planning authorities, may be evaluated: current land use; zoning laws; zoning maps; comprehensive community master plans; population growth patterns and projections (e.g., Bureau of Census projections); accessibility of site to existing infrastructure (e.g., transportation and public utilities); institutional controls currently in place; site location in relation to urban, residential, commercial, industrial, agricultural and recreational areas; Federal/State land use designation (Federal/State control over designated lands range from established uses for the general public, such as national parks or State recreational areas, to governmental facilities, which often have extensive site access restrictions, such as Department of Defense facilities); historical or recent development patterns; cultural factors (e.g., historical sites, Native American religious sites); natural resources information; potential vulnerability of groundwater to contaminants that might migrate from soil; environmental justice issues; location of on-site or nearby wetlands; proximity of site to a floodplain; proximity of site to critical habitats of endangered or threatened species; geographic and geologic information; and location of Wellhead Protection areas, recharge areas, and other areas identified in a State's Comprehensive Groundwater Protection Program.

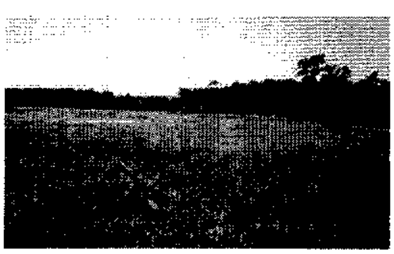
Early discussions with stakeholders will assist EPA in understanding the reasonably anticipated future uses of the site and in identifying specific institutional and engineering controls that may be necessary. Three categories of land reuse have been employed at former municipal landfills—ecological enhancement, recreational reuse, and commercial/industrial reuse. Each of these categories is discussed in the sections that follow. Case studies are used throughout this fact sheet to illustrate engineering and policy considerations, and protective, feasible solutions for integrating site reuse with a containment remedy. Exhibit One summarizes key characteristics of the case studies included in this fact sheet. Detailed case studies of these sites are available on the Superfund homepage located at http://www.epa.gov/superfund.

Ecological Enhancement

The historical practice of siting landfills in remote areas often allows all or part of a landfill site to be used for future ecological use. Wildlife enhancement areas and wetlands provide green space and habitat for indigenous species, and often serve as a cost-effective and design-friendly means of returning landfills to beneficial use. Historically, EPA has accommodated restoration of ecologically significant areas, when possible, including landfills located in areas with significant, existing habitat. The first step is to consult with other Federal and State agencies, such as the U.S. Fish and Wildlife Service, to target specific indigenous birds and wildlife that are in need of habitat. Once this information has been gathered, it may be possible to conduct the cleanup in a manner that will support plant and animal species while ensuring that the selected vegetation and engineering controls will protect the landfill cover and maintain the effectiveness of the remedy.

Army Creek Landfill Superfund Site before cleanup and ecological restoration.

One example of ecological restoration is at the Army Creek Landfill in New Castle County, Delaware. At this site, EPA and the potentially responsible parties (PRPs) turned a sixty-acre abandoned landfill into a wildlife enhancement area. This remedy and reuse project provided protective habitat for various native terrestrial and aquatic wildlife species. Additionally, various grains, wildflowers, and custom vegetation were planted on the site cap to encourage migratory birds to stop, nest, and feed on the land. Revegetation of the site and reconstruction of the wetlands were completed at no additional cost to the Agency.

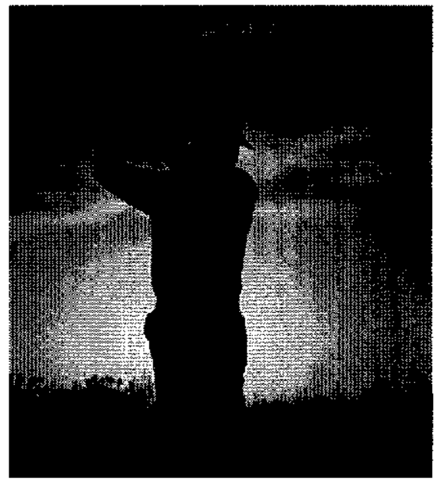


The Army Creek Landfill Superfund Site after cleanup and ecological restoration. Today the area supports various terrestrial and aquatic species of wildlife.

Another example of ecological restoration is the remedy implemented at the Bower's Landfill site in Pickaway County, Ohio. Knowing that part of the site was flooded an average of 29 days a year, EPA determined that converting a portion of the site into a wetlands would be both cost-effective and beneficial to the surrounding ecosystem. To make ecological restoration a reality, the RPM consulted with the Ohio Division of Wildlife and the U.S. Fish and Wildlife Service to design the wetlands area. EPA used clay from a portion of the site to build the cap over the landfill. The area that was excavated was then graded to provide waterways and retention ponds and to promote the growth of plants and wildlife with minimal maintenance. The seven-acre wetlands that were constructed now effectively control flooding of the landfill source, and provide food, shelter, and habitat for a variety of plants and animals.

Recreational Reuse

Former municipal landfills can also find new life as low-impact recreational areas. Landfills are a natural fit for this type of activity because they typically have a large surface area and the cap can be contoured to meet the specifications for ball fields or golf courses. In addition, communities are generally hospitable to new recreational areas because they have a tendency to increase property values and enhance the quality of life in the immediate area.



Sunset at the Old Works Golf Course, Deer Lodge County, Montana. In 1997, 25,000 rounds of golf were played at the course.

For instance, at the Chisman Creek Landfill in York County, Virginia, the cleanup plan developed by EPA and the PRPs was based on local residents' desire for a sports complex in the community. The site cap was engineered to serve as a foundation for future playing fields and graded to allow for park structures such as bleachers and fences. The Chisman Creek site is now a 41-acre complex that contains two lighted softball fields, four soccer fields, parking, vending facilities, and facility equipment storage.

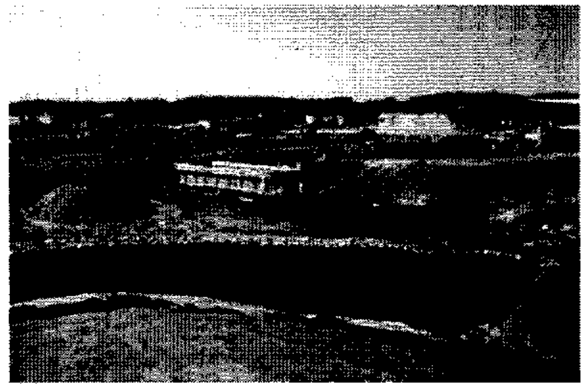
Another case of recreational reuse at a site implementing a containment remedy is the Old Works/East Anaconda Smelter Superfund Site in Deer Lodge County, Montana. After extensive discussions with both the PRP and the local community, EPA approved a cleanup plan that accommodated the development of a golf course over a portion of the property. In order to construct the golf course, the PRPs utilized many unique design features that not only facilitated redevelopment, but also allowed for the protection of future golfers and a nearby trout stream, and future development around the golf course.

For landfills and other sites with mounds or sloped areas, the DuPage County Landfill/Blackwell Forest Preserve illustrates a recreational use that makes the most of this fairly common feature. Solid waste materials at the former landfill were deposited to a height of over 188 feet above ground level. After the site was closed, the town saw a need for a recreational resource, and decided to convert the former landfill and surrounding area into a multi-use area featuring hiking trails, camping facilities, and picnic areas for warmer months and a sledding/toboggan hill in winter months.

Industrial/Commercial Reuse

Some landfills, because of their locale or surroundings, may not be suitable for ecological or recreational reuse. These sites are generally located in industrialized areas that lack significant wildlife and/or habitat acreage. However, other factors, such as proximity to major transportation routes and suppliers or customers make these sites a potential setting for industrial or commercial redevelopment.

The remediation of the Raymark site in Fairfield County, Connecticut, is one of the first cases in which effective consideration of the reasonably anticipated future land use in developing a cleanup plan helped reuse occur. From 1995 through 1997, Region 1 and the Connecticut Department of Environmental Protection (CDEP) decontaminated and demolished all site buildings and structures, consolidated contaminated soils, addressed highly concentrated pockets of contaminated groundwater, installed a gas collection system, and capped the entire 33-acre property so that future development could occur. A partnership was formed among EPA, CDEP, the Town of Stratford, and a local developer, which ultimately will allow for the construction of a 300,000 square foot retail shopping complex on the site.



Remediation underway at the Raymark Superfund Site. The site will support a 300,000 square foot shopping complex.

The Delaware Sand and Gravel site in New Castle County, Delaware, is another example of industrial redevelopment of a former landfill. Although construction of a low-permeability landfill cap was required, the owner was interested in reusing a portion of the site for temporary storage of heavy equipment. Region 3 allowed PRP construction of a "wear surface" over a 5-acre portion of the RCRA landfill cap. The wear surface was designed and constructed to withstand daily use by a sixteen-ton load—the weight of the heaviest piece of equipment that was going to be used on the site in its new capacity. Similarly, the containment remedy at the Mid-Atlantic Wood Preserver site in Anne Arundel County, Maryland, allowed the site to be paved as a parking lot for the use of the adjacent business.

Another example of commercial/industrial redevelopment is the Industri-Plex site, which is located in a dense commercial and industrial area in Middlesex County, Massachusetts. Remediation of the site included PRP construction of permeable and/or impermeable caps and other covers (e.g., concrete foundations, asphalt parking lots, etc.) over approximately 110 acres of contaminated soils. Development projects planned or underway include construction of a Regional Transportation Center (RTC), a retail store on 19 acres, and up to 750,000 square feet of office and hotel space.

REMEDY CONSIDERATIONS

Pursuant to Section 121(d)(2) of CERCLA, remedial actions must meet or waive all applicable or relevant and appropriate requirements (ARARs) identified for a response. For landfills, ARARs generally include closure requirements in compliance with Subtitle D or Subtitle C of the Resource Conservation and Recovery Act (RCRA) (for more information on closure requirements as ARARs, see "Presumptive Remedy for CERCLA Municipal Landfill Sites, September 1993, Directive No. 9355.0-49FS). Whatever the intended future use of the site, the integrity of the cap and other components of the containment remedy must be protected and maintained. The following sections identify remedy considerations that have been addressed at sites where it has been possible to accommodate reasonably anticipated land uses in the remedy. These considerations include design components for the containment remedies, implementation of appropriate institutional controls, and ongoing O&M activities.

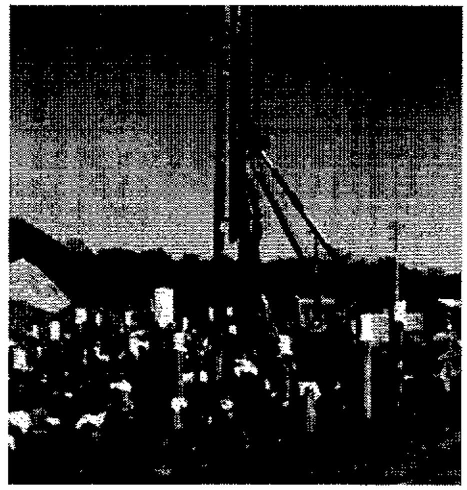
Design Components

Plans and specifications for a landfill or other containment cap system generally provide the following components, regardless of the intended future use of the site: cap design and integrity; runoff collection system design and safety; monitoring well location and design; leachate/gas collection system design and safety; and vegetative choices. When a particular reuse of a site is anticipated, in general, EPA will attempt to conduct site activities in a manner that will be protective for the anticipated future use. The following sections provide examples of sites where remedial actions were conducted in such a way that desired future uses were successfully incorporated into the remedial design.

Exhibit One: Case Study Site Characteristics					
Site Name	**Land Use**	**Design Considerations**	**Operation & Maintenance**	**Objectives of Institutional Controls**	**RPM Information**
Army Creek Landfill, DE Region 3 PRP lead	Wildlife refuge	Vegetative cover (species); O&M Schedule Burrowing animal control	PRP inspects and mows cap on rotating schedule; removes penetrating trees and other plants; monitors gas vents; removes nuisance reeds from wetlands; runs humane capture and release program; collects and treats groundwater and monitors air and groundwater	Ensure that any future use is consistent with, and protective of, the site remedy. Any activities performed at the site must be done in an environmentally and otherwise acceptable manner consistent with all laws, regulations, ordinances, zoning requirements, or other rules imposed by Federal, State, County, or Local government bodies.	Debra Rossi (215) 814-3228 rossi.debra@epa.gov
Bower's Landfill Site, OH Region 5 Fund lead	Wetlands habitat creation	Flood and erosion control Monitoring well integrity	State O&M program includes quarterly inspection for leachate and gas formation, groundwater monitoring, mowing cap vegetation, inspecting and repairing the cap, and repairing the fencing.	Prohibit groundwater extraction in west field and restricting disturbance of the landfill surface. If necessary, farming will be prohibited on land west of site.	David Wilson (312) 886-1476 wilson.david@epa.gov
Chisman Creek Site, VA Region 3 PRP lead	Soccer and softball fields	Wetlands preservation Prevention future direct contact	Routine O&M transferred to York County Parks and Recreation; PRP responsible for O&M of engineering control equipment. Post closure monitoring program for ground and surface water down gradient of the fly ash pits.	Prohibit excavation of soil, restrict building, and restrict groundwater use under and down gradient of the pits.	Andrew C. Palestini, (215) 814-3233 palestini.andrew@epa.go v
Anaconda Smelter Site, MT Region 8 PRP lead	18-hole golf course	Runoff and irrigation control Materials recycling	O&M and monitoring transferred to Deer Lodge County; O&M requirements include monitoring and maintenance of the vegetative cover and installation and maintenance of a fence around the perimeter of the site; Future transfer of site ownership will transfer O&M responsibilities.	Short-term institutional controls to control access and land use will be implemented throughout the area of the site. County responsible for land use decisions and issuing redevelopment permits.	Charles Coleman (406) 441-1150 Ext. 261 coleman.charles@epa.go v

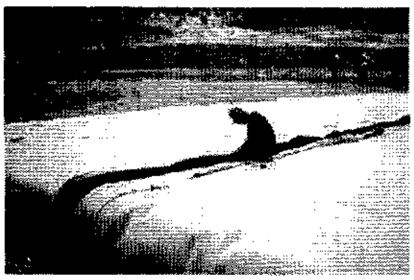
Exhibit One: Case Study Site Characteristics					
Site Name	**Land Use**	**Design Considerations**	**Operation & Maintenance**	**Objectives of Institutional Controls**	**RPM Information**
Raymark Site, CT Region 1 Fund lead	Retail shopping plaza	Designed to allow future development on top of cap such that no penetration of cap will be necessary	O&M program includes conducting routine monitoring of groundwater and surface water, O&M of DNAPL collection system, O&M of soil gas collection system, and O&M of enhanced gas collection system.	Some use restrictions on types of businesses that can operate on property and restrictions on excavating below impermeable layer.	Mike Hill (617) 918-1398 hill.michael@epa.gov
Delaware Sand & Gravel Site, DE Region 3 PRP lead	Storage facility for light industrial equipment	Load bearing; gas collection with vents located outside work area	Owner inspects RCRA cap; monitors gas vents; mows	Use of the surface area barrier is restricted by weight, spillage, storage, excavation, and other measures.	Phil Rotstein (215) 814-3232 rotstein.phil@epa.gov
Mid-Atlantic Wood Preserver Site, MD Region 3 PRP Lead	Parking lot for adjacent business	Wear surface over cap	Developer inspects and maintains asphalt paving and carries out environmental (air, surface water, sediments, & groundwater) monitoring.	Ensure the integrity of containment structure is not compromised by future use of the property.	Eric Newman (215) 814-3237 newman.eric@.epa.gov
Industri-Plex Site, MA Region 1 PRP lead	Transportation center; retail store; office and hotel space	Design permeable and impermeable covers to prevent direct contact with soils contaminated with heavy metals. The design considers long-term protectiveness/ effectiveness and freeze-thaw action.	Air, surface, and ground-water quality monitoring and post-closure care consistent with RCRA regulations.	Under development. The institutional controls will preserve the continued effectiveness of the remedy, which ensures the protection of human health and the environment, while allowing property owners greatest possible use of the site.	Joseph LeMay, P.E. (617) 918-1323 lemay.joe@epa.gov
DuPage County Landfill/Blackwell Forest Preserve, IL Region 5 PRP Lead	Natural recreation area; hiking and camping facilities; sledding hill; lake	Minimized tree removal over footprint of site. If existing landfill gas system is incapable of meeting recreational uses, system will go from passive to active (designed to be upgraded), additional gas collection wells will be added, and/or thermal treatment device will be added.	Forest Preserve District will handle all operation and maintenance. Rigorous inspections of cap integrity (i.e., after weather events, look for excessive wear in recreational areas).	Prohibit excavation of soil, restricting building and ground-water use. However, have petition flexibility to accommodate non-invasive improvements	Michael Bellot Region 5 312-353-6425 bellot.michael@epa.gov

Cap design and integrity



At the Raymark Superfund Site in Connecticut, foundation pilings were engineered into the protective cap, which will support a 300,000 square foot retail complex.

Basic considerations in cap design include material, thickness, permeability and slope stability. However, the future use of the site may require design components that incorporate specific reuse considerations. At the Chisman Creek site, the cap was engineered to serve as a foundation for future playing fields and graded to allow for park structures such as bleachers and fences. Precautions, such as placing underground utilities in oversized clay trenches, were taken to protect future workers from coming into contact with fly ash. At the Delaware Sand and Gravel site, the wear surface was constructed to withstand daily use by a sixteen-ton load—the weight of the heaviest piece of equipment onsite, an eight-ton forklift with a maximum front-end load of eight tons. Other design considerations may take into account unique site characteristics; for example, sledding at the DuPage Landfill site slope is limited to days during which there are at least three inches of snow on the ground. Caps can also be designed to accommodate large commercial buildings. For example, underlying soils and waste were compacted through surcharging and dynamic compaction, and in one area of the site, steel pilings were installed below the protective cap at the Raymark Industries site to support the loads of the cap, parking lot, and a 300,000 square foot retail shopping complex. Through a Prospective Purchaser Agreement (PPA) (see page 13 for a discussion of PPAs), the developer agreed to reimburse EPA for the additional costs associated with the soil stabilization techniques implemented in preparation for the future shopping complex, and agreed to avoid actions that could disrupt the protective cover.



Capping underway at the Summitville Mine Superfund Site, Rio Grande County, Colorado.

Runoff collection system design and safety

Surface water runoff controls typically are used to prevent the migration of leachate or contaminant plumes with lateral drainage features. Again, site reuse may entail modifications of system designs to contain or treat the flow prior to release. Under EPA supervision, the PRP installed a state-of- the-art drainage system at the Old Works/East Anaconda Smelter site. This system directs runoff from the hills which surround the course into a large holding pond. The design of this unit protects the overall integrity of the cap, minimizes stormwater runoff to a nearby trout stream, and allows the water to be used as an irrigation source. At the Army Creek Landfill site, concerns of flooding in low lying areas where treated water feeds into the adjacent Army Creek resulted in modifications to the slope and discharge layout of several existing onsite sediment basins to create a standing wetlands area. One of the sediment basins, already colonized with native wetland plant species, was left in its natural state. The second basin was replanted with plant species typical to riparian wetlands in the area. At the Chisman Creek Landfill site, the surface water collection system was so efficient that the York County Parks and Recreation Department had to re-sod the support layer to slow rainwater drainage in order to maintain grass on the fields.

Monitoring well location and design

Containment remedies generally include monitoring wells to ensure that leachate from the contained mass does not migrate to underlying groundwater. The location and design of these wells can be planned so that site reuse does not affect use of the wells. At the Bower's Landfill site, monitoring wells in the constructed wetland area were fitted with risers and the surrounding earth was mounded to minimize water intrusion through the wells and to make access easier during flood conditions.

Leachate/Gas collection system design and safety

Leachate and gas collection and treatment systems are also design considerations that may be integrated with future land use. Both the placement of collection equipment and treatment options (e.g., vents and flares) can be planned to accommodate future reuse. Gas vents at the Delaware Sand and Gravel site were installed horizontally, away from the reuse area, and towards an unobstructed five acres. This portion of the property will not be reused due to unsuitable slope. Engineers at the Chisman Creek site discovered that the original design of the groundwater collection system would significantly impact the stability of the land under the highway bisecting the site and several nearby homes. To avoid these impacts, a series of horizontal drains were drilled laterally into the base of the ash pit. This lower-cost and more efficient design was adapted from highway construction projects and required the use of a specially constructed drill rig. At the Army Creek site, gooseberry was planted around the gas vents to provide a food source for animals as well as visual cover of the vent pipes. At the DuPage County Landfill site, the Forest Preserve District agreed to conduct breathing zone ambient monitoring that includes different seasonal variations and atmospheric changes. If the existing landfill gas system does not meet recreational use safety requirements, the Record of Decision is written to change the gas collection system from passive to active (the system was designed to be upgraded), to add additional gas collection wells, and/or to add a thermal treatment device.

Vegetation Choice

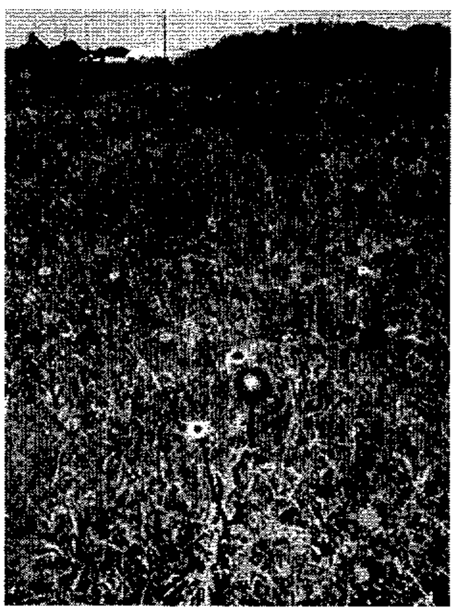
The vegetation selected for containment remedies generally will help reduce erosion and water penetration and enhance evapotranspiration. Vegetative support layers usually are organic silty loam topsoil, and vegetation generally has shallow roots and may be selected based on a low possibility of bioaccumulation. At the DuPage County Landfill site, the Forest Preserve District conducted an Arboreal Study to determine if the trees and brush were detrimental to the cap. Although some trees were eliminated to allow for the footprint of the planned site cap, every effort was made to remove as few trees as possible. At the Army Creek landfill site, EPA consulted with ecologists to identify specific grains, wildflowers, and vegetation that would attract migratory birds. The selected seed mixture provided the land coverage and erosion control needed to maintain the integrity of the cap, while providing food and habitat to a variety of plant and animal species. A similar revegetation strategy was used at the Delaware Sand and Gravel site for those portions of the property that were unusable for redevelopment because of slope or other terrain-related factors. One significant change in the seed mix used to revegetate the Delaware Sand and Gravel site was the absence of red clover seed, as previous experience at the Army Creek site indicated that this plant attracted unwanted burrowing animals.

Institutional Controls

Remedies that involve on-site containment of waste often incorporate institutional controls to prevent an unanticipated change in land use that could result in unacceptable exposures to contamination, or at a minimum, alert future users to the residual risks and monitor for any changes in use. Examples of institutional controls include land use regulations imposed by local governments, property law devices such as easements and covenants that restrict future land or resource use, and informational devices such as deed notices that inform prospective purchasers of residual on-site contamination. For example, a local ordinance might prohibit the use of contaminated groundwater or require periodic maintenance of a parking lot or other engineered barrier.

Jack Nicklaus testing out a sand trap at the Old Works Golf Course developed over a 120-acre capped area at the Anaconda Superfund Site. The 14,000 cubic yards of black sand in the course sand traps is finely ground inert smelting slag.

Institutional controls play a key role in ensuring long-term protectiveness, and should be evaluated and implemented with the same degree of care as is given to other elements of a remedy. In developing remedial alternatives that include institutional controls, EPA determines the type of institutional control to be used, the existence of the authority to implement the institutional control, and the appropriate entity's resolve and ability to implement the institutional control. An alternative may anticipate two or more options for establishing institutional controls, but should fully evaluate all such options. Because of their importance in restricting future land uses, it is best to identify the need for institutional controls as early in the remedy selection process as possible to identify implementation and long-term enforcement issues. It also is vital that stakeholders be informed whenever institutional controls are added or modified so that future development can accommodate existing or altered land-use restrictions.



Native grasses and flowers at the restored Army Creek Landfill Site.

EPA personnel working at the Old Works/East Anaconda site crafted a creative solution for ensuring compliance with institutional controls while allowing for continued redevelopment at the site. Citizens, the PRP, and local, state, and federal government officials formed the Old Works/East Anaconda Development Area (OW/EADA) to promote redevelopment of a 1,300 acre area of the site. The Anaconda-Deer Lodge County Comprehensive Master Plan was then prepared to provide guidance for accommodating future development and its possible effects on the environment and surrounding land uses. The Master Plan incorporates a Development Permit System (DPS), which regulates proposed development activity or land use located anywhere on the site, such as drilling wells, excavation, or new construction, irrespective of land ownership, to ensure it is consistent with environmental and safety guidelines. Other institutional controls such as land use and groundwater restrictions, private land ownership controls, dedicated developments, covenants, and easements, will be implemented to complement the DPS and ensure overall compliance with the Master Plan.

The DuPage Landfill site has institutional controls in place that prohibit construction of buildings on the site; however, language does provide the flexibility to petition for non-invasive improvements. For example, the Forest Preserve District successfully petitioned to put a temporary building at the top of the hill during the winter months for the purpose of renting toboggans.

Operation and Maintenance

Operation and Maintenance (O&M) activities protect the integrity of the selected remedy for a site. O&M measures are initiated after the remedy has achieved the action objectives and goals outlined in the Record of Decision (ROD), and after the remedy is determined to be operational and functional (O&F) based on State and Federal agreement. Typically, remedies are considered O&F either one year after construction is complete or when the remedy is functioning properly and performing as designed—whichever is earlier. Remedies requiring O&M measures include landfill caps, gas collection systems, groundwater extraction/treatment systems, groundwater monitoring, and/or surface water treatment. Once the O&M period begins, the State or PRP is responsible for maintaining the protectiveness of the remedy in perpetuity. O&M monitoring typically includes four components: inspection; sampling and analysis; routine maintenance; and reporting. Although O&M activities may be transferred through a rental or purchase agreement to a new owner, the State or PRP is still ultimately responsible for the protectiveness of O&M activities. However, the costs for O&M activities can often be offset through reuse or redevelopment at a site.

For example, the softball fields and recreational sports complex created as part of the redevelopment of the Chisman Creek Superfund site are operated by York County. The O&M activities at the site, such as mowing the grass, preventing cap deterioration, and routine repairs, are now handled by the County as part of their normal park operations. This has, in effect, eliminated the costs for O&M at the site. Another example is the result of the redevelopment that took place at the Army Creek Landfill site. EPA determined that converting the site into a wildlife enhancement area would provide a much needed protective habitat for various birds and wildlife. Various grains, wildflowers and custom vegetation were planted on the site cap to encourage migratory birds to stop and feed on the land. Bird boxes also were installed along the riparian wetlands of Army Creek to encourage nesting. The site is mowed once a year before the nesting season to provide food and shelter for migratory birds. Additionally, the site is mowed on alternating years in vertical or horizontal grids that leave straight stands of protective, vegetative cover for terrestrial animals. Gooseberry was planted around the gas vents to provide a food source for animals as well as visual cover of the vent pipes. Cap integrity is maintained through removal of deep-rooting, woody plants from the capped area and a humane trapping and relocation of woodchucks that may burrow into the cap. O&M at this site also includes activities to minimize invasion of non-native reeds into the wetlands area. Revegetation of the site and reconstruction of the wetlands was completed at no additional cost to the Agency, has not significantly increased operation activities at the site, and has decreased some maintenance activities, such as mowing the site, to once per year.

REUSE CONSIDERATIONS

The following sections summarize select EPA guidance and tools for stakeholders interested in reusing a site at which containment is part of the remedy. These sections include discussions on early involvement of stakeholders, confirmation of reuse viability, and use of redevelopment tools that are available in the event that reuse is desired.

Solicit Input from Stakeholders

The actual reuse of a site is driven by many factors, including the local business climate, real estate and land prices, and natural site features. However, the most important aspect when determining the reasonably anticipated future land reuse is the early involvement of all interested parties. Throughout the cleanup process, from site discovery to construction completion, EPA encourages open dialogue with the community to determine the reasonably anticipated future land reuse. Reuse can create many benefits that productively impact local communities, including new jobs, higher property values, and better quality of life through the preservation of open space and recreational areas. If all stakeholders, including the community, state, and, if applicable, PRPs, should reach an agreement on what they believe reuse may be as early as possible in the RI/FS process if a containment remedy is being considered for the site, EPA can be reasonably confident about the future use. For municipal landfill sites, the presumptive remedy allows for an up-front assumption regarding the appropriate remedial alternatives in the RI/FS process (i.e., scoping).

Fact sheets, notices in local newspapers and/or public meetings are appropriate notification tools for beginning the dialogue concerning reasonably anticipated future uses of the site. In addition, a letter, phone call or other appropriate communication to the local land use planning authority associated with the site may be made prior to such notifications. More focused communications, such as letters or fact sheets may be mailed or hand delivered to adjacent property owners, especially when a residential neighborhood is situated in close proximity to the site. This is especially important because in some instances the local residents near the Superfund site may feel disenfranchised from the local land use planning and development process. Also, if the site is located in a community that is likely to have environmental justice concerns, extra efforts may be made to reach out to and confer with segments of the community that are not necessarily reached by conventional communication vehicles or through local officials and planning commissions.

A critical component of the notification and discussion process is a clear explanation of the limits of reasonably anticipated future land uses. For example, reuse of municipal landfills as residential developments is discouraged. In addition, site managers should begin a dialogue with PRPs so that they continue the process if they assume responsibility for the RI/FS and future site remediation activities. Through early and open dialogue with stakeholders, EPA believes that realistic land-use scenarios can be developed that will facilitate the RI/FS, and expedite the cleanup and ultimately the redevelopment of the site.

Confirm Reuse Viability during RI/FS Process

Once the reasonably anticipated future land use(s) of a site is identified, it is important to confirm the viability of planned uses by analyzing data collected during the RI/FS, such as the nature and extent of contamination, containment alternatives, site topography, and other factors presented previously. Any combination of unrestricted uses, restricted uses, or use for long-term waste management may result, but it is important to confirm that the reuse options desired by the community are viable given the characteristics of the site. By maintaining an active role in site planning, EPA can attempt to accommodate site reuse, where possible, ensure that reuse options are consistent with the presumptive remedy or other containment design, and verify that any institutional controls ensure protection of human health and the environment and enforce limitations on reuse.

Redevelopment Tools

Once community outreach has been initiated and EPA has gathered information on possible reuse options, the Agency can attempt to ensure that the remedy is protective for the reasonably anticipated reuse. EPA has worked with States and localities to develop and issue guidance that will clarify the liability of prospective purchasers, lenders, property owners, and others regarding their association with activities at a site. These guidance documents state EPA's decision to use its enforcement discretion not to pursue such parties in specific situations. EPA anticipates that these clear statements will alleviate concerns these parties may have, and will facilitate their involvement in cleanup and redevelopment. Three guidance documents of particular interest are described in greater detail below.

Prospective Purchaser Agreements

The prospective purchaser agreement (PPA) is a tool that EPA may use to facilitate cleanup and redevelopment of contaminated property, with over 90 PPAs signed through the end of fiscal year (FY) 1998. Through PPAs, EPA provides parties interested in acquiring contaminated property with CERCLA covenants not to sue for cleanup of preexisting environmental conditions. PPAs also shield purchasers from contribution claims by liable parties who may seek to recover some of their cleanup expenses from purchasers. PPAs may relieve the liability concerns of prospective purchasers, and, therefore, facilitate the cleanup and reuse of contaminated properties.

In 1995, EPA issued guidance expanding the circumstances under which the Agency will provide covenants not to sue to prospective purchasers of contaminated properties. The *Guidance on Agreements with Prospective Purchasers of Contaminated Property* gives the Agency greater flexibility to enter into agreements under which EPA agrees not to sue the purchaser for contamination that existed at the time of the purchase. Included in the guidance is a model PPA to streamline and facilitate negotiations with prospective purchasers.

PPAs ensure continued protection of the site after it is passed along to a purchaser. Through PPAs, a prospective purchaser must commit that the continued operation of the facility or redevelopment will not aggravate or contribute to the existing contamination or interfere with EPA's response action. The prospective purchaser also must agree that the future use of the property will not pose health risks to the community and those persons likely to be present at the site. Under the appropriate sections of the settlement document, EPA can include provisions to ensure that the remedy design specifications are not violated; that long-term O&M activities at the site are attended to; and that there is compliance with institutional controls. EPA and developers have entered into PPAs at the Anaconda Smelter, Mid-Atlantic Wood Preservers, Raymark, and Industri-Plex sites.

Partial Deletion from the National Priorities List (NPL)

Where there is substantial agreement among local residents, land use planning agencies, owners, and developers, EPA can be reasonably confident about the future use of the site. In such cases, site managers may consider the feasibility of deleting a parcel of land from the NPL. Site size and the extent of contamination are factors to consider in a decision to partially delete. If the site can realistically accommodate the entire remedial footprint, an appropriate buffer zone and the planned reuse option, then partial deletion of the site may be possible. EPA has used its partial deletion authority at 14 sites through the end of FY98.

The National Contingency Plan (NCP) establishes the criteria that EPA uses to delete sites from the National Priorities List. In accordance with 40 CFR § 300.425(e), sites may be deleted from the NPL where no further response is appropriate to protect public health or the environment. In making such a determination, EPA considers, in consultation with the State, whether any of the following criteria have been met:

- Section 300.425(e)(1)(I). Responsible parties or other persons have implemented all appropriate response actions required;

- Section 300.425(e)(1)(ii). All appropriate Fund-financed response under CERCLA has been implemented, and no further response action by responsible parties is appropriate; and

- Section 300.425(e)(1)(iii). The remedial investigation has shown that the release poses no significant threat to public health or the environment and, therefore, taking of remedial measures is not appropriate.

Partial deletion of an NPL site is initiated when EPA prepares and publishes relevant documents, which are made available in the Deletion Docket at an official information repository. The State, with respect to the NPL site and applicable operable units, is asked to concur on EPA's final determination regarding the partial deletion. Concurrent with a Notice of Intent in the *Federal Register,* a notice is published in a newspaper of record and is distributed to appropriate Federal, Tribal, State, and local government officials, and other interested parties. These notices announce a thirty (30) day public comment period on the deletion package, which commences on the date of publication of the notice in the Federal Register and the newspaper of record. If, after review of all public comments, EPA determines that the partial deletion from the NPL is appropriate, EPA will publish a final notice of partial deletion in the *Federal Register*. Site managers should explicitly state from the initiation of this scenario that EPA cannot participate in any activities associated with the deleted portion of the site.

Comfort/Status Letters

In order to minimize stakeholder liability concerns associated with a potentially reusable site, Regional staff may issue a comfort letter. These letters provide potential buyers with as much information as possible from which to draw their own conclusions of the potential risk of Superfund liability. Three types of letters can be issued to parties who purchase, develop or operate a restored property:

- *No Current Federal Superfund Interest Letter* - a letter sent at a site that EPA deleted from the NPL or that EPA no longer includes on its list of potential Superfund sites;

- *Federal Interest Letter* - a letter indicating the status of EPA's involvement, where EPA anticipates or has already begun a response at the site; and

- *State Action Letter* - a letter stating that the corresponding state has assumed response action at the site.

By establishing early contact with potential stakeholders, defining realistic beneficial reuse options, and using the full range of redevelopment tools, site managers may be able to accommodate reasonably anticipated land uses at municipal landfills and other sites using containment remedies.

Limits to Betterment Activities

At sites with reuse potential, stakeholders may propose an action that is beyond the authority of the Agency. EPA may modify a remedial action if EPA finds that the proposed change or expansion is necessary and appropriate to the EPA-selected remedial action. In this case, any additional costs would be paid as part of the remedial action. If EPA finds that the proposed change or expansion is not necessary to the selected remedial action, but would not conflict or be inconsistent with the EPA-selected remedy, EPA may agree to integrate the proposed change or expansion into the planned CERCLA remedial work if:

- The state, PRP, or developer agrees to fund the entire additional cost associated with the change or expansion; and

- The state, PRP, or developer agrees to assume the lead for supervising that component of the remedy, or if EPA determines that component cannot be conducted as a separate phase or activity, for supervising the remedial design and construction of the entire remedy.

- If a state does not concur in a remedial action selected by EPA, and the state desires to have the remedial action conform to an ARAR that has been waived under § 300.430(f)(1)(ii)(C), a state may seek to have that remedial action so conform in accordance with the procedures set out in CERCLA section 121(f)(2).

The Raymark site is an example of a remedy that included an enhancement. EPA worked closely with the developer to incorporate redevelopment plans into the containment strategy for the site. The developer requested that a series of soil stabilization techniques be used, including the installation of steel pilings below the cap to support the planned retail shopping complex. EPA signed a PPA with the developer that ensured that the company paid for the installation of the steel pilings and other enhancements.

CONCLUSIONS

The Superfund Redevelopment Initiative, which is aimed at choosing cleanups consistent with reasonably anticipated reuse where possible, is a program that can yield positive economic, environmental, and social benefits for communities with Superfund sites. The keys to a successful reuse effort are: remedies that are protective for reasonably anticipated future land uses, institutional controls that impose necessary reuse limitations, early and active participation from all stakeholders, and appropriate enforcement tools for redevelopment.

The essential step to success is to incorporate the plan to reuse the site with the plan to clean up the site. With the municipal landfill presumptive remedy, it may be possible to accommodate ecological, recreational, or commercial/industrial reuses in the cleanup plan. Whatever the intended future use of the site, all landfill remedies must first be designed to protect the integrity of the cap. EPA must maintain an active role in reuse planning to ensure that reasonably anticipated future reuse options are consistent with the presumptive remedy or other containment design, and that institutional controls and O&M activities are managed properly. Additional keys to success require the early and active participation of all stakeholders, including EPA, the appropriate state and local authorities, any PRPs, and the site neighbors and surrounding community. EPA can help facilitate the reuse of a site, but cannot accomplish this goal on its own. Therefore, it is imperative that site managers take the appropriate steps to involve these stakeholders as early as possible in the process. Early discussions with stakeholders will help ensure that the interests of all involved and affected parties are properly represented. Also, if the need arises based on these discussions, it may be appropriate for EPA to use legal tools like PPAs and model comfort letters to clarify potential issues of liability. By following these steps, EPA believes that realistic land-use scenarios may be accommodated in cleanup and redevelopment of sites, where possible.

FOR FURTHER INFORMATION

- Presumptive Remedy for CERCLA Municipal Landfill Sites. September 1993. 14 pp. (EPA) U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/F-93/035, OSWER-9355.0-49FS, PB93-963339. Washington, DC. Quick Reference Fact Sheet.

- Presumptive Remedies: CERCLA Landfill Caps RI/FS Data Collection Guide. 1995. 8 pp. (EPA) U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/F-95/009, OSWER-9355.3-18FS, PB95-963412.

- Presumptive Remedies and NCP Compliance. June 14, 1995. 12 pp. (EPA) U.S. Environmental Protection Agency, CERCLA Administrative Records Workgroup ORC Region IV, Solid Waste and Emergency Response Division. Washington, DC.

- Rules of Thumb for Superfund Remedy Selection. 1997. 23 pp. (EPA) U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/R-97/013, OSWER 9355.0-69, PB97-963301. Washington, DC.

- Land Use in the CERCLA Remedy Selection Process. 1995. 13 pp. (EPA) U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. EPA 540/R-95/052, OSWER 9355.7-04, PB95-963234/HDM. Directive. Washington, DC.

- Procedures for Partial Deletions at NPL Sites. 1996. 9 pp. (EPA) U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/R-96/014, OERR Directive 9320.2-11, PB96-963222. Washington, DC.

- Guidance on Settlements with Prospective Purchasers of Contaminated Property. 1995. 24 pp. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. PB96-105044. Washington, DC.

- Policy on the Issuance of Comfort/Status Letters. PB97-123921. November, 1997.

- Handbook of Tools for Managing Federal Superfund Liability Risks at Brownfields and Other Sites, November 1998, EPA330-B-98-001, Office of Enforcement and Compliance Assurance.

landfills is frequently used for residential purposes. Therefore, based on site-specific circumstances, it may be appropriate to consider future residential use for ground water and other exposure pathways when assessing risk from areas of **contaminant migration.**

4. Developing the Response Action

As a first step in developing containment alternatives, response action objectives should be developed on the basis of the pathways identified for action in the conceptual site model. Typically, the primary response action objectives for municipal landfill sites include:

Presumptive Remedy

- Preventing direct contact with landfill contents;
- Minimizing infiltration and resulting contaminant leaching to ground water;
- Controlling surface water runoff and erosion;
- Collecting and treating contaminated ground water and leachate to contain the contaminant plume and prevent further migration from source area; and
- Controlling and treating landfill gas.

Non-Presumptive Remedy

- Remediating ground water;
- Remediating contaminated surface water and sediments; and
- Remediating contaminated wetland areas.

As discussed in Section 3, "Defining Risks," the containment presumptive remedy accomplishes all but the last three of these objectives by addressing all pathways associated with the source. Therefore, the focus of the RI/FS can be shifted to characterizing the media addressed in the last three objectives (contaminated ground water, surface water and sediments, and wetland areas) and on collecting data to support design of the containment remedy.

Treatment of Hot Spots

The decision to characterize and/or treat hot spots is a site-specific judgement that should be based on the consideration of a standard set of factors. Highlight 4 lists questions that should be answered before making the decision to characterize and/or treat hot spots. The overriding question is whether the combination of the waste's physical and chemical characteristics and volume is such that the integrity of the new containment system will be threatened if the waste is left in place. This question should be answered on the basis of what is known about a site (e.g., from operating records or other reliable information). An answer in the affirmative to all of the questions listed in Highlight 4 would indicate that it is likely that the integrity of the containment system would be threatened, or that excavation and treatment of hot spots would be practicable, and that a significant reduction in risk at the site would occur as a result of treating hot spots. EPA expects that few CERCLA municipal landfills will fall into this category; rather, based on the Agency's experience, the majority of sites are expected to be suitable for containment only, based on the heterogeneity of the waste, the lack of reliable information concerning disposal history, and the problems associated with excavating through refuse.

The volume of industrial and/or hazardous waste co-disposed with municipal waste at CERCLA municipal landfills varies from site to site, as does the amount of information available concerning disposal history. It is impossible to fully characterize, excavate, and/or treat the source area of municipal landfills, so uncertainty about the landfill contents is expected. Uncertainty by itself does not call into question the containment approach. However, containment remedies must be designed to take into account the possibility that hot spots are present in addition to those that have been identified and characterized. The presumptive remedy must be relied upon to contain landfill contents and prevent migration of comtaminants. This is accomplished by a combination of measures, such as a landfill cap combined with a leachate collection system. Monitoring will further ensure the continued effectiveness of the remedy.

The following examples illustrate site-specific decision making and show how these factors affect the decision whether to characterize and/or treat hot spots.

Examples of Site-Specific Decision Making Concerning Hot Spot Characterization/ Treatment

Site A

There is anecdotal information that approximately 200 drums of hazardous waste were disposed of at this 70-acre former municipal landfill, but their location and contents are unknown. The remedy includes a landfill cap and ground-water and landfill gas treatment.

A search for and characterization of hot spots is not supported at Site A based on the questions listed in

(8) The lead agency shall notify the support agency of the alternatives that will be evaluated in detail to facilitate the identification of ARARs and, as appropriate, pertinent advisories, criteria, or guidance to be considered.

(9) *Detailed analysis of alternatives.* (i) A detailed analysis shall be conducted on the limited number of alternatives that represent viable approaches to remedial action after evaluation in the screening stage. The lead and support agencies must identify their ARARs related to specific actions in a timely manner and no later than the early stages of the comparative analysis. The lead and support agencies may also, as appropriate, identify other pertinent advisories, criteria, or guidance in a timely manner.

(ii) The detailed analysis consists of an assessment of individual alternatives against each of nine evaluation criteria and a comparative analysis that focuses upon the relative performance of each alternative against those criteria.

(iii) *Nine criteria for evaluation.* The analysis of alternatives under review shall reflect the scope and complexity of site problems and alternatives being evaluated and consider the relative significance of the factors within each criteria. The nine evaluation criteria are as follows:

(A) *Overall protection of human health and the environment.* Alternatives shall be assessed to determine whether they can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remediation goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

(B) *Compliance with ARARs.* The alternatives shall be assessed to determine whether they attain applicable or relevant and appropriate requirements under federal environmental laws and state environmental or facility siting laws or provide grounds for invoking one of the waivers under paragraph (f)(1)(ii)(C) of this section.

(C) *Long-term effectiveness and permanence.* Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following:

(*1*) Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. The characteristics of the residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

(*2*) Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risks posed should the remedial action need replacement.

(D) *Reduction of toxicity, mobility, or volume through treatment.* The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following:

(*1*) The treatment or recycling processes the alternatives employ and materials they will treat;

(*2*) The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled;

(*3*) The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment or recycling and the specification of which reduction(s) are occurring;

(*4*) The degree to which the treatment is irreversible;

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Presumptive Remedies for Municipal Landfill Sites

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The Presumptive Remedy Selection Initiative

Since Superfund's inception in 1980, the removal and remedial programs have found that certain categories of sites have similar characteristics, such as the types of contaminants present, past industrial use, or the environmental media that are affected. Based on a wealth of information acquired from evaluating and cleaning up these sites, Superfund is undertaking an initiative to develop **presumptive remedies** that are appropriate for specific types of sites, contaminants, or both. This initiative is part of a larger program, known as the **Superfund Accelerated Cleanup Model (SACM)**, which is designed to speed all aspects of the Superfund clean-up process.

The objective of the presumptive remedies initiative is to use clean-up techniques shown to be effective in the past at similar sites in the future. The use of presumptive remedies will streamline removal actions, site studies, and clean-up actions, thereby improving consistency, reducing costs, and increasing the speed with which hazardous waste sites are remediated

The Municipal Landfill Pilot Project

Superfund kicked off a new pilot project designed to expedite the site investigation and remedy selection process for municipal landfills with a visit to Region V on March 18-20, 1992. Superfund anticipates that remedy selection may be streamlined for municipal landfills because they typically share similar characteristics and because containment and ground water cleanup frequently is the appropriate remedy for these sites.

An existing EPA manual, *Conducting Remedial Investigations/ Feasibility Studies for* CERCLA *Municipal Landfill Sites*, outlines streamlining techniques for municipal landfills. The goal of the initiative is to aid the Regions in implementing the manual, so that site characterization, the baseline risk assessment, and the number of alternatives considered will be streamlined at every municipal landfill site.

Albion Sheridan Township landfill, a municipal landfill in Michigan, was the first site to participate in the pilot Project. A team of Remedial Project Managers (RPMs) from several Regions and experts on landfill construction met with the site RPM in Grand Rapids, Michigan to develop the site strategy. As a result of the meeting, site characterization will be conducted in a phased approach, with criteria established for when additional sampling will occur. Streamlining of the baseline risk assessment will depend upon data obtained in the first phase of sampling.

Four other Superfund municipal landfill sites have been identified as candidates for participation in the project: Lexington County Landfill, Lexington County, South Carolina (Region IV); BFI/ Rockingham, Rockingham, Vermont (Region I); Sparta Landfill, Sparta Township, Michigan (Region V); and Beulah Landfill, Pensacola, Florida (Region IV). The review team anticipates meeting with the RPMs for these sites during April, May, and June 1992.

RPMs who participate in the project and implement the municipal landfill manual at their sites will become members of the team and will be available to assist other RPMs in developing streamlined RI/FSs. These RPMs will be a resource for their Regions, providing assistance in streamlining remedy selection at all future municipal landfill sites.

Questions should be addressed to Andrea McLaughlin at FTS 678-8365.

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Presumptive Remedies for Municipal Landfill Sites

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Office of Waste Programs Enforcement
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Purpose

The Superfund Municipal Landfill Expert Team has completed four site visits under the Municipal Landfill Pilot Project.[1] The pilot project implements a 1991 streamlining manual, "Conducting Remedial Investigations /Feasibility Studies for CERCLA Municipal Landfill Sites" (hereafter referred to as "the manual"). This bulletin presents key findings from the pilots completed to date, particularly with respect to the level of detail that was appropriate for establishing risk, and therefore a basis for remedial action, at two of the sites.

Background

The preamble to the National Contingency Plan (NCP) identifies municipal landfills as a type of site where treatment of the waste may be impracticable due to the size and heterogeneity of the contents. Because of this, containment will often be the appropriate response action for the source area of municipal landfill sites. Such containment remedies are likely to include a landfill cap; ground-water treatment or control; leachate collection and treatment; and landfill gas collection and treatment, as appropriate.

The municipal landfill manual states that baseline risk assessments at municipal landfill sites may be streamlined or limited in order to initiate early remedial action on the most obvious landfill problems (e.g., ground water/ leachate, landfill contents, and landfill gas). One method for establishing risk using a streamlined approach is to compare contaminant concentration levels (if available) to standards that are potential chemical-specific applicable or relevant and appropriate requirements (ARARs) for the action. The manual states that where established standards for one or more contaminants in a given medium are clearly exceeded, remedial action is generally warranted.[2] The manual further states that ultimately it is necessary to demonstrate that the final remedy addresses all pathways and contaminants of concern, not just those that triggered the remedial action.

Pilot Project Findings

The experience of the expert team supports the usefulness of a limited risk assessment to initiate early action at two of the pilot sites. Specifically, for the source area of these two sites (i.e., the discrete landfill area), a quantitative risk assessment that considered all chemicals, their potential additive effects, etc., was not necessary,

[1] See "Superfund Accelerated Cleanup Bulletin, Presumptive Remedies for Municipal Landfill Sites," Publication 9203.1-02I, Volume 1, Number 1, April 1992.
[2] See also OSWER Directive 9355.0-30, "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions," April 22, 1991, which states that if MCLs or non-zero MCLGs are exceeded, [remedial] action generally is warranted.

either to establish a basis for action or to establish clean-up levels. For these two sites, the justification for early remedial action was based on existing ground-water data. Ground-water data are not available for the other two sites.

Sites with Ground-water Data

For the source areas of the two sites with existing ground-water data, the basis for action was ground-water contamination at levels exceeding non-zero MCLGs or MCLs; therefore, a complete quantitative risk assessment was not necessary to establish risk (and therefore a basis for action) at these sites. Furthermore, a quantitative risk assessment was not needed to evaluate whether the containment remedy addressed all pathways and contaminants of concern associated with the source. Rather, all potential migration pathways were identified (using the conceptual site model) and compared to those addressed by the containment remedy as follows:

- direct contact threat and surface water run-off addressed by capping;
- exposure to contaminated ground water (including any contaminated ground water moving off-site) addressed by ground-water treatment/control (including assessment of current exposure); and
- exposure to landfill gas addressed by gas collection and treatment, as appropriate.

This comparison revealed that the containment remedy addressed all pathways associated with the sources at these sites.

Finally, a quantitative risk assessment was not required to determine clean-up levels for the source areas, since the type of cap will be determined by closure ARARs and ground-water clean-up levels may be based on MCLs, non-zero MCLGs, or more-stringent, promulgated, state levels.

NOTE: In some cases, a risk assessment may be required to determine the risk associated with contaminants in landfill gas. Landfill gas collection will frequently be a necessary component of the remedy to insure cap integrity. There may be an additional need for treatment of the collected gas based upon the contaminants present. In some cases, state ARARs may identify clean-up levels for such contaminants, and in some cases health-based levels will be appropriate. This issue will be addressed in further detail in future guidance.

Sites with No Existing Ground-water Data

Ground-water data are not yet available for two of the pilot sites; for these sites, the following tiered approach was recommended. Once ground-water data are obtained, a clear basis for action may be established, and the remedy selection may be streamlined as described for the two sites with available ground-water data. If contaminants are not identified above MCLs or non-zero MCLGs however, additional pathways, such as surface contamination and landfill gas, will be characterized next, and a focused quantitative risk assessment conducted to establish basis for remedial action.

Areas of Contaminant Migration

One of the expert team's key findings is that almost every municipal landfill site has some unique characteristic that may require additional study. Unique characteristics encountered during the pilot visits include leachate discharge to a wetland at one site and significant surface water run-off due to drainage problems at another. These pathways will require characterization and conventional risk assessment to determine whether remedial action is warranted beyond the source area, and if so, the type of action that is appropriate.

Pilot Study Findings and Conclusions

The expert team's conclusions from the four pilots, then, are that:

(1) a quantative risk assessment was not warranted for the source areas of the two pilot sites where ground-water data were available and contamiants exceeded chemical-specific standards; justification for action was the exceedance of the standards;

Further, streamlining the risk assessment eliminated the need for sampling and analysis of these source areas to support the calculation of current or future risk;

(2) a focused risk assessment generally will be necessary for areas other than the landfill source itself (such as areas where contaminants have migrated from the source) to determine the need for additional remedial action beyond areas normally addressed by the cap; and

(3) a focused risk assessment generally will be necessary to determine the need for remedial action at sites where ground-water concentrations do not exceed MCLs or non-zero MCLGs unless other conditions provide a clear justification (e.g. unstable slopes).

These conclusions are directly applicable to the four pilot sites only; however, based on these findings, the municipal landfill expert team is developing an Agency directive that will provide additional guidance on conducting baseline risk assessments at municipal landfill sites. For additional information on the directive or the municipal landfill pilot project, please call Andrea McLaughlin at 703-603-8793.