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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 or 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 be conducted 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 notice 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 an 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 identified 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.

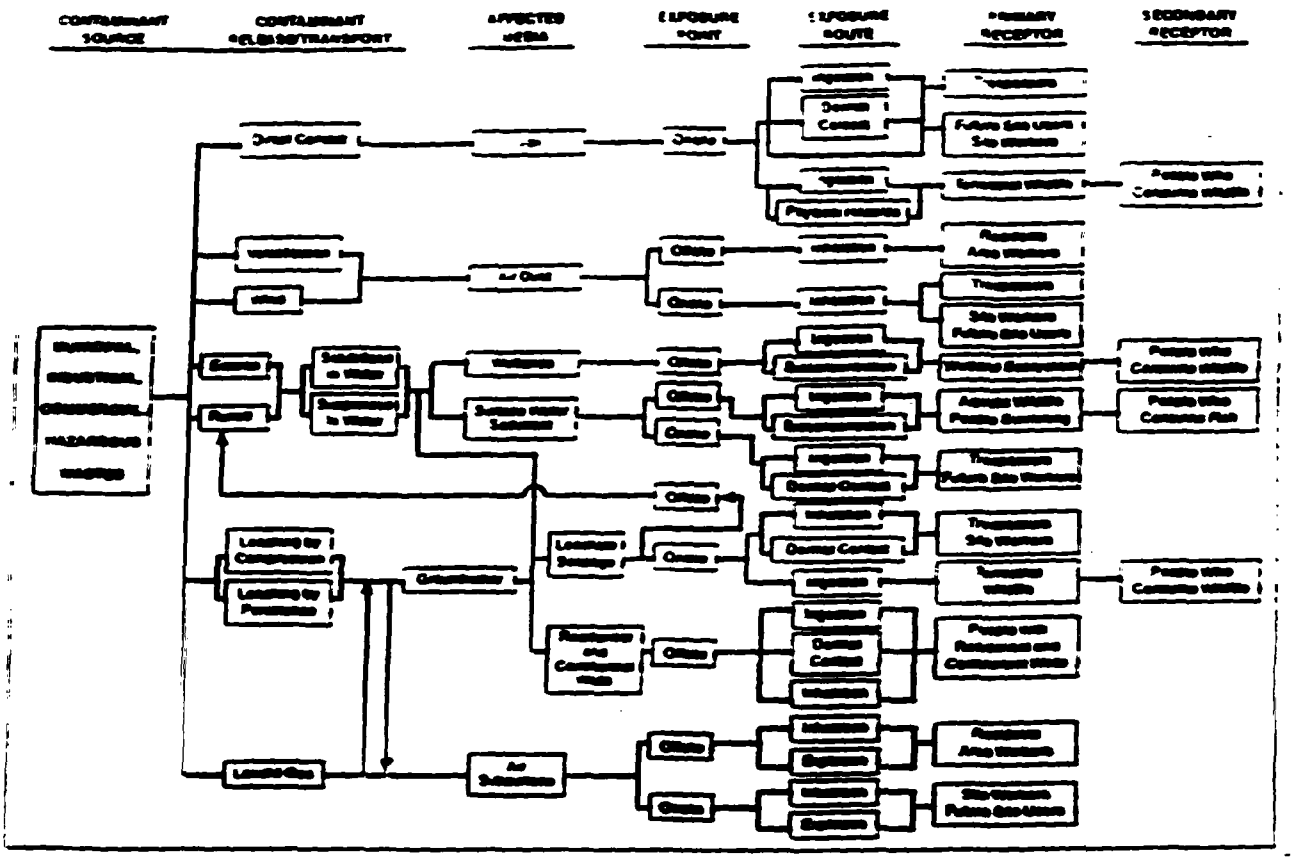
Sources of information of particular interest during scoping include records of previous ownership, state files, closure plans, etc., which may help to determine types and sources of hazardous materials present. In addition, a site visit is appropriate for several reasons, including the verification 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 landfills. 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.[3]

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

[3] 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

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.

remedy, since such contamination will require a conventional investigation and a risk assessment.

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:

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- 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 potential 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 contaminants. 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

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 case, 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 appropriate 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).[3]

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.

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

Notice:

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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 Screening 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	Implem.			Protect.	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concern [4]	Community Concern [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 (Continued) [1]

Technology [2]	# FSs Where Technology Considered	# FSs Text: Passed Screening	# FSs Text: Screened Out	# FSs Where Criterion Contributed To Screening Out [3]: Text Not Primary Component of Alternative	Cost	Effectiveness	Implement	# RODs Text: Selected	# RODs Text: Not Selected	# RODs Where Criterion Contributed to Non-Selection: Protect	ARARs	Short-Term Effects	Long-Term Effects	Reduction of Toxicity	Cost	Implem	State Concern [4]	Community Concern [5]
Vitrifying 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	6	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 (Continued)[1]

Technology[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# RODs 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	Community Concerns
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 (Continued)[1]

Technology[2]	# FSs Where Technology Considered	# FSs Text, Passed Screening	# FSs Text, Screened Out	# FSs Where Criterion(s) Contributed To Screening Out[3]			# RODs Text, Selected	# RODs Text, Not Selected	# RODs Where Criterion Contributed to Non-Selection								
				Text, Not Passed Component of Alternative	Cost	Effectiveness	Implement			Preference	ARARs	Time Frame	Long-term Effect	Short-term Effect	Cost	Implem	State Concerns[4]	Community Concerns[4]
Soil Washing	12	2	9	1	1	8	5	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	6	3	0	0	0	0	0	0	0	0	0		

[1] This study was conducted on 20 RODs and their corresponding FSs.
[2] This does not the 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).