D. Criterion 4: Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion evaluates the ability of the alternatives to significantly achieve reduction of the toxicity, mobility, or volume of the contaminants or wastes at the site, through treatment. The criterion is a principal statutory requirement of CERCLA. This analysis evaluates the quantity of contaminants treated and destroyed, the degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction, the degree to which the treatment will be irreversible, the type and quantity of residuals produced, and the manner in which the principal threat will be addressed through treatment. The risk posed by residuals will be considered in determining the adequacy of reduced toxicity and mobility achieved by each alternative.

Alternatives 2 and 3 would reduce the toxicity, mobility, or volume of landfill gas through extraction and treatment while landfill gas COC concentrations, mobility, and volume would likely increase under Alternative 1. Maintenance of the soil cover system would continue to reduce the mobility of landfill contents under Alternatives 2 and 3. The provision in Alternative 3 for modifications of the LFGES and the soil cover system, as required, ensures that reductions in toxicity, mobility and volume of landfill gas and reduction in the mobility of landfill contents would be maintained in the event of changing conditions at the Landfill. However, under present conditions, Alternatives 2 and 3 are essentially equivalent with respect to reducing toxicity, mobility, or volume.

Under Alternatives 2 and 3, the toxicity of landfill gas would be significantly reduced by the flare system, which incinerates the extracted gas. The mobility of landfill gas would be controlled through capture and extraction by the LFGES. Review of 1992 gas monitoring probe data indicates that the mobility of methane has been substantially reduced since operation of the LFGES began. The volume of landfill gas would be reduced through extraction and treatment by the LFGES. Currently, approximately 700,000 cubic feet of landfill gas per day are collected and treated by the LFGES.

The mobility of the landfill contents would be reduced through continued maintenance of the soil cover system and would thereby minimize the potential for direct contact with landfill contents. The soil cover system prevents transport of refuse by animals as well as by wind and erosion. The soil cover system does not contribute to a reduction in the toxicity or volume of the landfill contents. However, the toxicity of the landfill contents may be reduced by natural biodegradation.

Alternatives 2 and 3 would not provide a reduction in the toxicity, mobility, or volume of contaminated ground water beyond those processes occurring naturally. Reductions in toxicity as a result of natural attenuation and biodegradation processes may occur in ground water. Volatilization of organic compounds may result in a minor reduction in volume.

Alternative 1 would not reduce the toxicity, mobility, or volume of landfill gas, ground water, or landfill contents beyond what would occur through natural degradation and attenuation processes.

E. Criterion 5: Short-Term Effectiveness

The short-term effectiveness of each alternative was assessed based on the risk associated with the implementation of the remedial action to the community, workers, and environment and the time required to achieve the response objectives. Measures to mitigate releases and provide protection are central to this determination.

The evaluation of the alternatives indicate that all three are essentially equivalent with respect to short-term adverse environmental impacts and protection of the community and workers. With the exception of the groundwater monitoring program and additional institutional controls, as necessary, all remedial actions associated with Alternatives 2 and 3 have already been implemented. Alternative 3 may involve future improvements to the LFGES and soil cover system, but adverse short-term impacts should be minimized through standard engineering controls and adherence to standard health and safety practices. Because no remedial actions are proposed under Alternative 1, no potential short-term exposure to the community, construction workers, or additional impacts to the environment would occur as a result of implementing a remedial action.

F. Criterion 6: Implementability

This criterion analyzes technical feasibility, administrative feasibility, and the availability of services and materials. Technical feasibility assesses the difficulty of construction or operation of a particular alternative and unknowns associated with process technologies. The reliability of the technologies based on the likelihood of technical problems that would lead to project delays is critical in this determination. The ability to monitor the effectiveness of the alternative is also considered.

Administrative feasibility assesses the ease or difficulty of obtaining permits or rights-of-way for construction. Availability of services and materials evaluates the need for off-site treatment, storage, or disposal services, and the availability of such services. Necessary equipment, specialists, and additional resources are also evaluated in determining the ease by which these needs could fulfilled.

Each of the alternatives evaluated would be technically feasible. No additional construction, maintenance, or operations beyond those already existing would be required under any of the alternatives with the exception of Alternative 3, which may require improvements to existing systems. These improvements are expected to be readily implementable because no implementation difficulties were experienced during

the installation of the LFGES and improvement of the soil cover system. The groundwater monitoring program included in Alternatives 1, 2, and 3 is technically implementable because existing groundwater monitoring wells would be utilized to accomplish the proposed monitoring. The off-site monitoring of landfill gas included in Alternatives 2 and 3 is also technically implementable since existing monitoring probes would be used.

It is unlikely that the regulatory agencies or the public would accept shutdown of the LFGES as proposed under Alternative 1. Alternative 2 would be administratively feasible. Institutional controls, as necessary, in Alternative 3 would require additional legal effort to be implemented and would be dependent in certain instances on cooperation of property owners and municipalities or other governmental entities, and satisfaction of legal requirements. Alternative 2 would likely be the easiest to implement with respect to administrative feasibility because no additional actions would be required.

G. Criterion 7: Cost

Alternatives are evaluated for cost in terms of both capital costs and long-term O&M costs necessary to ensure continued effectiveness of the alternatives. Capital costs include the sum of the direct capital costs (materials, equipment, labor, land purchases) and indirect capital costs (engineering, licenses, or permits). Long-term O&M costs include labor, materials, energy, equipment replacement, disposal, and sampling necessary to implement the alternative. The objective of the cost analysis is to eliminate those alternatives that (1) do not provide measurably greater protection of human health and the environment, and (2) include costs that are substantially greater than those of other alternatives.

The present worth analysis is used to evaluate expenditures that would occur during different time periods. By discounting all costs to a common base year (i.e., 1992), the costs could be compared on the basis of a single figure for each alternative. Total present worth costs were calculated by multiplying the capital and O&M cost incurred during each year by the present worth factor. An interest rate of 5 % and a project duration of 30 years was used in accordance with EPA guidance.

The total present worth costs are identical ($7,283,000) for Alternatives 2 and 3 since the additional expenditures required for Alternative 3 (i.e., additional institutional controls and required improvements to the LFGES and soil cover system, as necessary) cannot be estimated. A total present worth cost of $4,316,000 is estimated for Alternative 1. Operation and maintenance costs incurred to date were included for Alternative 1, but future O&M for the LFGES and soil cover system were excluded since this alternative proposed discontinuation of these systems. Total annual O&M costs for Alternative 1 include only the implementation of a groundwater monitoring program and periodic site reviews and are estimated at $47,000. For both Alternatives 2 and 3, total

estimated capital costs and annual O&M costs are $3,170,000 and $240,000, respectively. However, capital costs for Alternative 3 are likely to be somewhat higher than indicated due to costs associated with additional institutional controls, if necessary.

H. Criterion 8: State Acceptance

This modifying criterion evaluates technical and administrative issues that may be raised by the State. EPA has involved CDH throughout the RI/FS and remedy selection process. The State of Colorado concurs with EPA's selected alternative, as presented in Section IX.

I. Criterion 9: Community Acceptance

This modifying criterion evaluates questions and comments on the Proposed Plan received from members of the community. It appears that the community supports EPA's selected remedy, as presented in Section IX. No comments on the Proposed Plan were received by EPA during the public comment period. Therefore, preparation of a Responsiveness Summary for this ROD was not necessary.

IX. SELECTED REMEDY

Based on consideration of the requirements of CERCLA and the detailed analysis of alternatives, EPA with the concurrence of the State of Colorado has determined that Alternative 3, Engineering and Institutional Controls, is the most appropriate remedy for OU3/OU6 of the Sand Creek Industrial Superfund Site. This remedy includes extraction and treatment of landfill gas; maintenance of the soil cover system and LFGES with improvements, as required; maintenance of the perimeter fence and warning signs; implementation of additional institutional controls, as necessary; implementation of a monitoring program and site reviews; and additional remedial action, as necessary, if monitoring indicates that the Landfill contributes to unacceptable contamination of ground water. The PRPs will be responsible for maintenance of each component of the remedy.

The detailed analysis of alternatives shows that for overall protection of human health and the environment; effectiveness; and reduction of toxicity, mobility or volume, the selected alternative is superior to Alternatives 1 and 2. The selected remedy and Alternative 2 are essentially equivalent in terms of technical and administrative feasibility, although cooperation of landowners or governmental entities may be necessary for implementation of certain additional institutional controls under the selected alternative. Costs for the selected remedy and Alternative 2 are also similar, however, there may be additional costs for the selected alternative due to costs

associated with additional institutional control implementation, if necessary, and any improvements required to the LFGES and soil cover system during the normal course of O&M activities.

The selected remedy incorporates removal, treatment, and containment technologies. The principal components of the selected alternative are described below in greater detail. Capital and annual O&M costs for these components are presented in Table 5.

Landfill Gas-Extraction System: The LFGES was installed within the boundaries of the Landfill during the spring of 1991 as part of the OU6 landfill gas Removal Action. The LFGES has the following primary components: seventy-five landfill gas-extraction wells; gas collection piping, consisting of a main header and 13 subheaders; four condensate sumps, piping, and a knockout pot; a 10,000-gallon condensate storage tank; two gas-extraction blowers and ancillary equipment; an enclosed gas flare system and a blower building; and 22 gas monitoring probes. Condensate collected in the storage tank is discharged via a sanitary sewer to the Denver Metro Central Treatment Plant. The LFGES is designed to capture as much of the landfill gas within the Landfill as possible and minimize its vertical and lateral migration via the extraction wells and gas collection piping. The enclosed flare system destroys odors and toxic components of the landfill gas. The gas monitoring probe network monitors the LFGES performance. Based on results from the gas monitoring probes and extraction wells sampled weekly and evaluated quarterly, the LFGES is adequately capturing methane and mitigating off-site gas migration. The preferred alternative provides for improvements or upgrades to the LFGES, as required.

Soil Cover System: Site improvements were undertaken at the Landfill during the spring of 1992 to enhance the integrity of the soil cover system and improve general erosion control and site appearance. The site improvements were also expected to improve O&M of the LFGES by reducing infiltration of ambient air into the Landfill. The site improvements consisted of: (1) the placement, grading, and compaction of approximately 62,000 cubic yards of fill material; (2) the placement of fill in low/eroded areas and the construction of terraces and straw bale dikes to control surface-water runoff; and (3) the revegetation of approximately 30 acres and interseeding of 8 acres of the Landfill. Under the preferred alternative, the soil cover system will be maintained (i.e., mowing the grass and spot reseeding as necessary) and improved as conditions at the Landfill warrant. The need for additional improvements to the soil cover system will be based on visual indications, such as surface erosion or a lack of vegetation.

Fencing: The Landfill is currently fenced with a 3-strand smooth wire fence that was installed in August 1991. Warning signs are posted around the entire perimeter of the fence. Maintaining the wooden fence posts, repairing broken strands of wire, and replacing warning signs as required will ensure that the fence will continue to be an effective deterrent to public access to the Landfill.

Table 5. Cost Summary for the Selected Remedy[a]

Capital Costs:	
• Landfill Gas Extraction System	- $2,470,000
• Landfill Soil Cover System	- $ 673,000
• Perimeter Fence	- $ 16,000
• Groundwater Monitoring Program Design	- $ 11,000
TOTAL CAPITAL COSTS	- $3,170,000
Estimated Annual O&M Costs:	
• Landfill Gas Extraction System	- $ 152,000
• Landfill Soil Cover System	- $ 40,000
• Groundwater Monitoring Program	- $ 36,000
• Periodic Site Assessment	- $ 11,400
TOTAL ANNUAL O&M COSTS	- $ 240,000 (rounded)
TOTAL PRESENT WORTH (1992 $)[b]	- $7,283,000 (rounded)

[a] The capital costs of the selected remedy are likely to be higher than indicated due to costs associated with implementation of additional institutional controls, as necessary. However, these costs were not included because of uncertainties in estimating costs associated with negotiating and implementing the additional institutional controls.

[b] Total present worth costs assume an annual discount rate of 5% and a project duration of 30 years.

Source: OU3 FFS (HLA, 1993).

Institutional Controls: The purposes of the institutional controls component of the selected alternative are (1) to protect the integrity of the soil cover system to prevent dermal or direct contact with the landfill contents, (2) to prevent the use of ground water underlying the Landfill as a drinking water source, and (3) to protect the LFGES operating at the Landfill. These objectives are already achieved in part through EPA oversight of the response action; state restrictions on permitting and constructing water wells in areas of known contamination; and maintenance of the existing controls under the OU6 Order, the CPC Access Order, and the Consent for Access on CERC property. Additional institutional controls that may be implemented as necessary include further EPA Orders issued pursuant to CERCLA § 106, judicial Consent Decrees under CERCLA § 122, zoning and subdivision regulations, building permits, recording requirements, state statutes, and local ordinances. Institutional controls currently in place at OU3/OU6 as well as available and potential supplemental institutional controls are summarized in Appendix A.

OU3 Monitoring Program: The OU3 monitoring program consists of groundwater and landfill gas monitoring components. Under the preferred alternative, both components will be implemented or continued. The duration of the OU3 monitoring program will be established in a Unilateral Order. The groundwater monitoring component is designed to assess changing conditions in Aquifers 0 and 2, and to continue evaluation of the Landfill's impact on groundwater quality. Key elements of the monitoring program include: annual sampling of 3 existing upgradient wells, annual sampling of 6 existing downgradient wells, annual sampling of one location at the spring discharge area, and proposed target analytes based on the results of the OU3 RI.

The landfill gas monitoring component was implemented with the startup of the LFGES in the spring of 1991. The perimeter network of 22 gas monitoring probes will continue to be monitored to evaluate the performance of the LFGES. In addition, six gas monitoring probes existing on the northwest perimeter of the Landfill prior to the OU6 Removal Action will also continue to be monitored to provide additional information regarding system performance and the migration of landfill gas. The LFGES is operated so that the concentration of methane within the monitoring probes does not exceed 5% by volume.

Data from both components of the OU3 monitoring program will support assessment of landfill conditions and LFGES performance as well as the need for improvements as provided for under the selected remedy. In addition, the data will be used to assess the site and ongoing activities during the periodic site review. In the future, if it is determined that the Landfill is responsible for unacceptable groundwater contamination, the remediation of ground water at the Landfill will be addressed under OU3.

X. STATUTORY DETERMINATIONS

EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for a site must comply with applicable or relevant and appropriate environmental standards established under federal and state environmental laws unless a statutory waiver is justified. The selected remedy must also be cost effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatments that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following discussion addresses how the selected remedy meets these statutory requirements.

A. Protection of Human Health and the Environment

EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (1988) indicates that protectiveness may be achieved by reducing exposure through actions such as containment, limiting access, or providing an alternate water supply. The remedial actions described for the selected remedy will permanently address the principal threats to human health and the environment for OU3/OU6 through treatment to reduce the toxicity, mobility, and volume of landfill gas and containment of landfill contents. Concentrations of contaminants of concern in the spring discharge area do not exceed preliminary remediation goals, so remedial action objectives for aquatic life have been achieved. The risks associated with potential future activities at the Landfill will be addressed by the implementation of additional institutional controls, if necessary.

Though CERCLA favors active remediation, institutional controls may be implemented under CERCLA in appropriate circumstances. As provided by the Preamble to the NCP (55 Federal Register 8666, 8706 [March 8, 1990]):

> Examples of institutional controls, which generally limit human activities at or near facilities where hazardous substances, pollutants, or contaminants exist or will remain onsite, include land and resource use and deed restrictions, well drilling prohibitions, building permits, and well use advisories and deed notices. EPA believes ...that institutional controls have a valid role in remediation and are allowed under CERCLA (e.g., Section 121(d)(2)(B)(ii) appears to contemplate such controls). Institutional controls are a necessary supplement when some waste is left in place, as it is in most response actions. Also, in some instances where the balancing of tradeoffs among alternatives during selection of remedy process indicates no practicable way to actively remediate a site, institutional controls such as deed restrictions or well-drilling prohibitions are the only means available to provide protection of human health.

Institutional controls are particularly suited for application at municipal landfills. For example, as provided in EPA's *Conducting Remedial Investigation/Feasibility Studies for CERCLA Municipal Landfill Sites* (1991):

> For municipal landfill sites, the major purpose of deed restrictions is to protect the integrity of the cap. The restrictive covenant should limit subsurface development (excavation), excessive vehicular traffic (including off-road vehicles), and groundwater use. Additional deed restrictions may be required for effective implementation of other technologies. The permissible uses/limitations for the specific landfill property should be identified based on the risk the site poses and the remedial actions likely to be implemented.

B. Compliance with ARARs

All federal and state ARARs will be met by the selected remedy. Federal and state ARARs which must be considered include those that are: chemical-specific, location-specific, and action-specific. Potential ARARs identified for OU3/OU6 are provided below.

Chemical-Specific ARARs:

- Colorado Interim Organic Pollutant Standards (CIOPS) for Stream Segments Classified for Aquatic Life.

Sampling data from OU3 indicates that none of these standards are exceeded. Therefore, the selected alternative complies with this potential ARAR.

Location-Specific ARARs:

- Archeological and Historic Preservation Act, 16 USC § 469;40 CFR § 6.301(c).

The investigations of OU3 have not revealed any data that would trigger the effect of the Act or its regulations. The selected remedy will comply with this potential ARAR.

- National Historic Preservation Act (NHPA), 16 USC § 470; 40 CFR § 6.301(b); 36 CFR Part 800.

Studies of OU3 have not revealed any historic properties that would trigger the effect of this Act or its regulations. The selected alternative will comply with this potential ARAR.

- Colorado Register of Historic Places, Colo. Rev. Stat. § 24-80.1.101, et seq., 8 CCR 1504-5.

Studies of OU3 have not revealed any historic properties that would trigger the effect of this Act or its regulations. The selected alternative will comply with this potential ARAR.

- Endangered Species Act, 16 USC § 1531, et seq.; 50 CFR Part 17; 40 CFR § 6.302(h).

Studies of OU3 have not indicated the presence of any listed species that would trigger the effect of this Act or its regulations. The selected alternative will comply with this potential ARAR.

- Non-Game Endangered or Threatened Species Conservation Act, Colo. Rev. Stat. § 32.101, et seq.; 2 CCR 406-8.

Studies of OU3 have not indicated the presence of any listed species that would trigger the effect of this Act or its regulations. The selected alternative will comply with this potential ARAR.

- Executive Order on Protection of Wetlands, Executive Order No. 11990; 40 CFR § 6.302(a).

The U.S. Fish and Wildlife Service does not believe that the remedial activities associated with OU3 will adversely impact any wetland that may be present at or near the Landfill (letter dated June 6, 1991 from the U.S. Department of the Interior). Therefore, the Executive Order and its regulations are not ARARs for OU3. In the event that the OU3 remedial activities adversely impact any wetlands at OU3, the Executive Order and regulations may be ARARs.

Action-Specific ARARs and Guidance To Be Considered (TBC):

- Conducting Remedial Investigation/Feasibility Studies for CERCLA Municipal Landfill Sites (EPA, 1991).

EPA has provided guidance specifically intended to address the remediation of municipal landfills. In particular, the guidance addresses the type of cover suggested for municipal landfills and recognizes a soil

cover as sufficient to prevent dermal contact with landfill contents. It is apparent that EPA's municipal landfill guidance is not an ARAR (see NCP, 40 CFR § 300.400(g)(3)). However, as an Agency guidance, it may be a TBC for OU3.

- Potential Action-Specific ARARs Pertinent to Operation of the Gas Collection System at OU6, as set forth in the Sand Creek Industrial Superfund Site OU6 EE/CA (HLA, 1990).

  Gas Collection System:

  - Clean Air Act, 42 USC §§ 7401 et seq., National Ambient Air Quality Standards (NAAQS).

  NAAQS are ARARs for the Landfill. The landfill area is an attainment area for sulfur dioxide, nitrogen dioxide, and lead, and a non-attainment area for particulates, carbon monoxide, and ozone. However, since the gas collection system is not expected to exceed NAAQS levels during the remedial action, this requirement is relevant and appropriate.

  - Colorado Air Pollution Control Regulations, 5 CCR 1001-1 et seq.

  Based on experience with other similar gas removal systems and the performance of the OU6 LFGES to date, it is not expected that the LFGES will qualify as a major stationary source. However, if the gas collection system should ever qualify as a major stationary source, the pertinent substantive requirements applicable to major stationary sources in the Colorado Air Pollution Control Regulations would be potential ARARs.

  - Colorado Solid Waste Disposal Sites and Facilities Regulations, 6 CCR 1007-2, Section 2.

  These regulations include requirements concerning explosive gas concentrations at solid waste disposal facilities. Section 2.2.5 requires that explosive gas concentrations be monitored regularly. Section 2.2.6 limits explosive gas concentrations for solid waste facilities and requires that the concentration of explosive gases must not exceed 1% by volume of air within facility structures or 5% by volume of air at the site boundary. Section 2.4.4 provides that concentrations of explosive gases generated by the facility for solid waste disposal shall not exceed 5% in

the air at the site boundary after closure. These requirements are potential ARARs for the gas collection system.

Condensate Management:

- RCRA Subtitle C Requirements, 6 CCR 1007-3.

The condensate generated from operation of the LFGES should not be a hazardous waste because it is not a listed waste and it is not derived from a listed hazardous waste. Based on sampling of condensate from the LFGES and past experience with landfill condensate, it is not expected that concentration limits set forth in the TCLP rule will be exceeded or that the condensate will otherwise exhibit a characteristic of hazardous waste. Therefore, RCRA Subtitle C requirements should not be ARARs for the management of condensate. In the unlikely event that (1) the condensate exhibits a characteristic of a hazardous waste, and (2) the condensate is not managed in a manner excluded from RCRA Subtitle C regulation, requirements pertinent to the management of the condensate would be potential ARARs.

- Compliance with Colorado Discharge Permit System Regulations, 5 CCR 1002-2.

Substantive provisions of these regulations would be potential ARARs in the event that management of the condensate involved a point source discharge to Sand Creek. However, condensate will be stored in a 10,000-gallon storage tank and discharged to a POTW.

- Federal Pretreatment Regulations

Colorado has adopted the federal General Pretreatment Regulations for Existing and New Sources of Pollution, 40 CFR Part 403, as amended 55 Fed. Reg. 30082 (July 24, 1990). Therefore, Colorado regulations will not be more stringent than federal regulations, which are potential ARARs since the condensate will be discharged to a POTW.

- Local Pretreatment Rules

Section 121(d) of CERCLA does not require CERCLA response actions to comply with local laws (i.e., local laws by themselves are not

ARARs). While local pretreatment requirements technically are not considered to be ARARs, the LFGES is expected to comply with applicable provisions of these requirements.

C. Cost Effectiveness

The selected alternative is cost-effective in its approach to remediating landfill gas, containment of landfill contents, and restricting access to the site. The OU3 monitoring program will allow assessment of the conditions at the Landfill relative to (1) groundwater contamination attributable to the site and (2) accumulation and migration of landfill gas. The analysis of sampling data collected will allow for cost-effective decisions regarding any future improvements that may be required for the remedial systems. Total capital, annual O&M, and present worth costs for the selected remedy are $3,170,000; $240,000; and $7,283,000; respectively. However, if implementation of additional institutional controls are necessary, capital costs for the selected remedy are likely to be higher than indicated.

D. Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

The selected remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable for the 48th and Holly Landfill. Specifically, the use of the LFGES to extract and treat landfill gas results in a permanent reduction in methane and concentrations of COCs in landfill gas through thermal destruction. Condensate generated by the operation of the LFGES will be treated by a POTW. Because no hot spots were located within the Landfill, it was considered impractical and unnecessary to remediate landfill contents. Direct contact with landfill contents will be eliminated by containing the refuse beneath the landfill cap.

Of the alternatives that are protective of human health and the environment and comply with ARARs, EPA believes that the selected remedy provides the best balance in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; short-term effectiveness; implementability; cost; and the statutory preference for treatment as a principal element. Overall protection of human health and the environment, and long-term effectiveness and permanence were the most decisive criteria in selecting Alternative 3 as the preferred remedy.

The selected remedy offers greater overall protection of human health and the environment than afforded by Alternatives 1 or 2 because future potential exposure pathways for ground water are addressed through additional institutional controls, as necessary. Alternative 1 would not be protective of human health or the environment. The preferred alternative provides the greatest long-term effectiveness by including

provisions for future modifications and improvements to the LFGES and soil cover system as required during the normal course of O&M activities. The selected remedy and Alternative 2 are essentially equivalent with respect to the evaluation of compliance with ARARs; reduction of toxicity, mobility, or volume; short-term effectiveness; and implementability. Alternative 1 would not reduce residual risk associated with landfill gas, landfill contents, or groundwater exposure pathways; nor would it employ any treatment options that would reduce the toxicity, mobility, or volume of contaminants in the media of concern. Alternative 1 is also not likely to be administratively feasible. The additional capital expenditure for the selected alternative associated with implementation of additional institutional controls, as necessary, is not expected to be significant in comparison to Alternative 2.

E. Preference for Treatment as a Principal Element

The selected remedy satisfies the statutory preference for treatment as a principal element and is fully consistent with the NCP. Operation of the LFGES to extract and treat landfill gas addresses the principal threat posed by landfill gas. The LFGES will reduce the potential for explosion and inhalation hazards by mitigating the migration and accumulation of landfill gases. Combustible and toxic components of the landfill gas will be permanently destroyed through thermal destruction by the flare system. Condensate generated from the extraction of landfill gas will be treated by the Denver Metro POTW.

The size of the Landfill and the fact that there are no on-site hot spots that represent the major sources of contamination preclude a remedy in which contaminants could be excavated and treated effectively. However, hazards associated with exposure to landfill contents will be minimized through containment by maintaining the soil cover system. Groundwater contamination attributable to the Landfill is not considered to be a principal threat, and potential exposure pathways for ground water have been addressed to the extent practicable.

Because this remedy will result in hazardous substances remaining on-site, a review will be conducted every five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.