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Rev. 1

Proposed Plan for Interim Remedial Measures at the 100-KR-1 Operable Unit

United States
Department of Energy
Richland, Washington

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Date Published
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United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

Approved for Public Release

PROPOSED PLAN FOR INTERIM REMEDIAL MEASURES AT THE 100-KR-1 OPERABLE UNIT

Hanford Site, Richland, Washington

DOE, EPA, AND ECOLOGY ANNOUNCE PROPOSED PLAN

This proposed plan identifies the preferred alternative for **interim remedial measures** for remedial action of radioactive liquid waste disposal sites that include contaminated soils and structures at the 100-KR-1 **Operable Unit**, located at the Hanford Site (Figure 1). It also summarizes other remedial alternatives evaluated for interim remedial measures in this Operable Unit. The intent of interim remedial measures is to speed up actions to address contaminated areas that pose potential threats to human health and the environment.

This proposed plan is being issued by the U.S. Environmental Protection Agency (EPA), the lead regulatory agency; the Washington State Department of Ecology (Ecology), the support regulatory agency; and the U.S. Department of Energy (DOE), the responsible agency. The EPA, Ecology, and the DOE are issuing this proposed plan as part of their public participation responsibilities under Section 117(a) of the **Comprehensive Environmental Response, Compensation and Liability Act** (CERCLA), commonly known as the "Superfund Law." The DOE is also issuing this proposed plan as part of its responsibilities under the National Environmental Policy Act. *National Environmental Policy Act* values are addressed in the *100 Area Source Operable Unit Focused Feasibility Study* (DOE/RL-94-61), which discusses the 100-KR-1 Operable Unit.

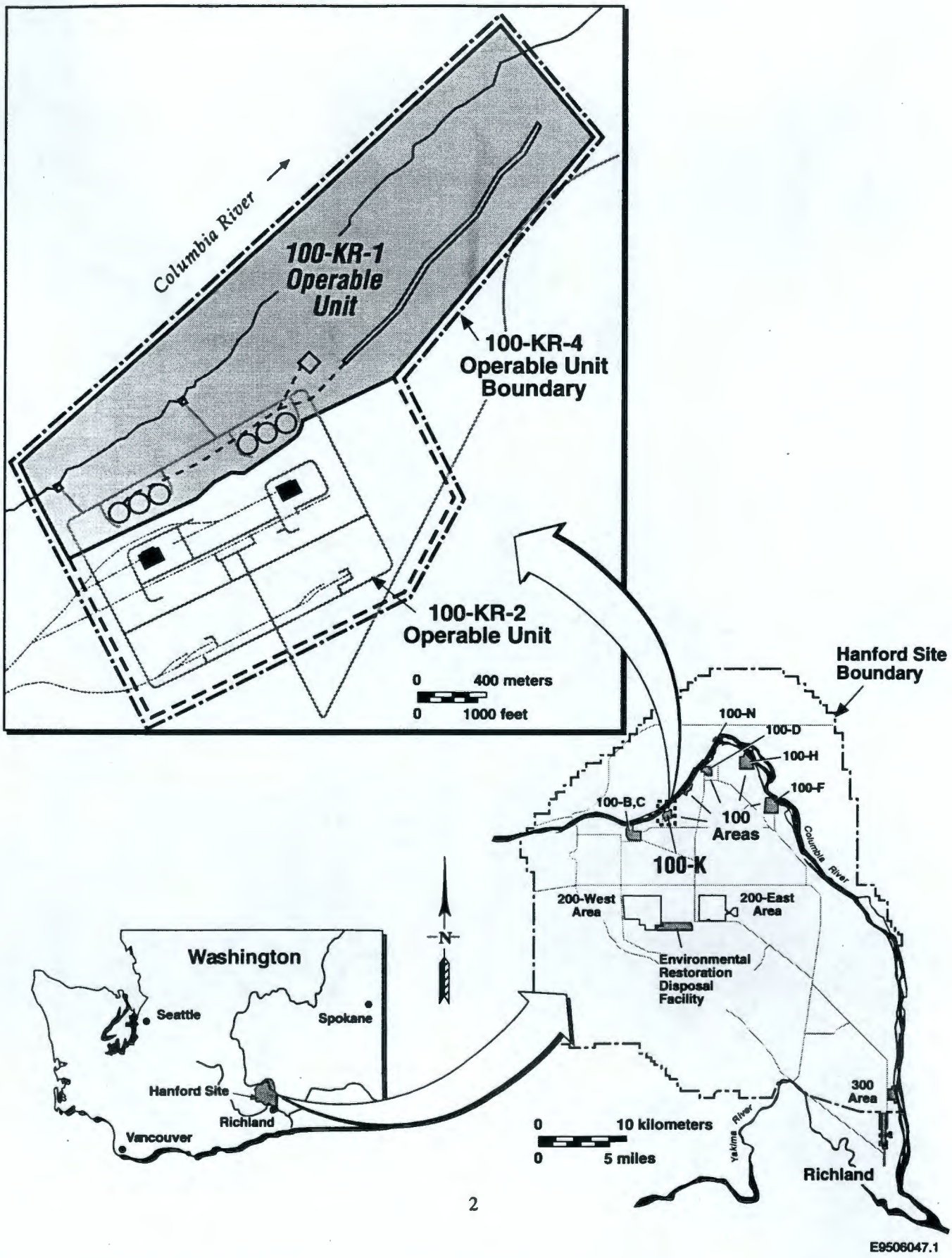
This proposed plan is intended to be a fact sheet for public review which briefly describes the remedial alternatives analyzed, identifies a preferred alternative, and summarizes the information relied upon to recommend the preferred alternative.

The preferred alternative presented in this proposed plan is to remove, treat (as appropriate or required), and dispose of the contaminated soil and associated structures from five waste sites within the 100-KR-1 Operable Unit. These are the 116-K-1 Crib, the 116-K-2 Process Effluent Trench, the 116-KW-3 and 116-KE-4 Retention Basins, and the 100-KR-1 Buried Process Effluent Pipelines. Treatment would be conducted as necessary or appropriate for cost effective operations (e.g., to reduce the size of the **Environmental Restoration Disposal Facility** or to reduce overall costs). Treatment may also be necessary prior to disposal to meet land disposal restrictions. The preferred alternative will reduce potential threats to human health and the environment at 100-KR-1 Operable Unit radioactive liquid waste disposal sites. The remedial actions described are intended to reduce potential human health and ecological risks, to ensure that contaminants present at these waste sites will not adversely impact **groundwater** beneath the sites or the Columbia River, and to leave the site suitable for future site uses.

The preferred alternative is the initial recommendation of the EPA, Ecology, and the DOE. The cleanup alternative will be selected only after the public has had the opportunity to comment on this recommendation and all comments have been reviewed and considered. The agencies are seeking comments on each alternative presented, not just the preferred alternative. Written comments must be submitted by DATE 1995. Response to comments will be presented in a responsiveness summary that will be part of the **record of decision** (ROD), which is the legal decision document that selects the cleanup remedy. The public is encouraged to review Appendix M of the *100 Area Source Operable Unit Focused Feasibility Study* (DOE/RL-94-61), which discusses the 100-KR-1 Operable Unit. This and other documents listed at the end of this proposed plan provide greater detail about this Operable Unit.

Technical terms and other text in bold are defined in the glossary at the end of this document.

Figure 1. 100-KR-1, 100-KR-2, and 100-KR-4 Operable Units.



MARK YOUR CALENDAR

A 45-day public comment period for the 100-KR-1 Proposed Plan will be from DATE, 1995, to DATE, 1995.

A public meeting on this proposed plan will be held upon public request. Send written comments or a request for a public meeting to:

Larry Gadbois
U.S. Environmental Protection Agency
712 Swift Boulevard, Suite 5
Richland, WA 99352

SITE BACKGROUND

The Hanford Site is located in southeastern Washington (Figure 1). The 100 Area of the Hanford Site is located along the Columbia River and includes nine DOE nuclear reactors previously used for plutonium production, two of which are the 105-KE and 105-KW Reactors. In November 1989, the EPA placed the 100 Area on the **National Priorities List** because of soil and groundwater contamination resulting from the past operation of nuclear facilities.

The 105-KE Reactor operated between 1955 and 1971, and the 105-KW Reactor operated between 1955 and 1970. Reactor operations and former waste handling practices have caused contamination around the KE and KW Reactors and support facilities, adjacent soil, and groundwater. To organize cleanup efforts under the Superfund Law, contaminated areas at the 100-K Area were subdivided into three geographic areas called "operable units." The three 100-K Operable Units are designated 100-KR-1, 100-KR-2, and 100-KR-4 (Figure 1).

The 100-KR-1 Operable Unit (Figure 2) encompasses an area of approximately 155 hectares (384 acres). It includes former radioactive liquid waste disposal sites and buried debris resulting from demolition of some reactor support facilities. Sites fall into two general categories; shallow sites where both soil exposure and groundwater impacts may be a concern; and deep sites where groundwater impact is the primary concern. The 100-KR-2 Operable Unit comprises solid waste burial grounds, cribs, french drains, and other types of waste sites. Groundwater beneath the 100-KR-1 and 100-KR-2 Operable Units and vicinity is being addressed in the 100-KR-4 Operable Unit.

The 100-KR-1 Operable Unit includes six waste sites that have been designated by Ecology, the EPA, and the DOE as high priority for interim remedial measures (Figure 2). High priority waste sites are distinguished from low priority sites based on the results of remedial investigation activities, assessment of potential impacts to human health and the environment, and local community concerns. All six high priority sites within the 100-KR-1 Operable Unit are radioactive liquid waste disposal sites. This proposed plan presents interim cleanup actions for five of these sites (Table 1). The sixth site (116-K-3 Outfall) is being addressed as part of the river pipeline Expedited Response Action. The 100-KR-2 and 100-KR-4 Operable Units will be addressed separately in future proposed plans. Table 1 summarizes information on the former use, waste site dimensions, and **contaminants of potential concern**, and is based on historical process knowledge, previous investigations, and the limited field investigation undertaken by the DOE. The waste site locations are shown in Figure 2.

SUMMARY OF SITE RISK

Potential risks to human health and ecological receptors were evaluated in the *Qualitative Risk Assessment Report*. The results of the **qualitative risk assessment** are summarized in Table 2 and described in the following sections. These results indicate that interim remedial measures are warranted at these five high priority sites.

In the Superfund process, potential risks to human health and the environment are evaluated to determine whether significant risks exist due to site contaminants. Two types of potential human health effects due to contact with site contaminants are evaluated at Superfund sites. The first is the potential increase in cancer risks. This potential increase is expressed exponentially as 1×10^{-4}, 1×10^{-5}, 1×10^{-6} (one in ten thousand, one in one hundred thousand, one in a million, respectively). This means that for a 1×10^{-4} risk, if 10,000 people were exposed to a contaminant of concern for some period of time, one additional person could be expected to be diagnosed with cancer in his/her lifetime. Based on current national cancer rates, 2,500 people out of 10,000 are expected to be diagnosed with cancer. Under a 1×10^{-4} risk, 2,501 cancer diagnoses could be expected. Remedial actions generally are not required at risk levels below

Figure 2. Location of 100-KR-1 Waste Sites.

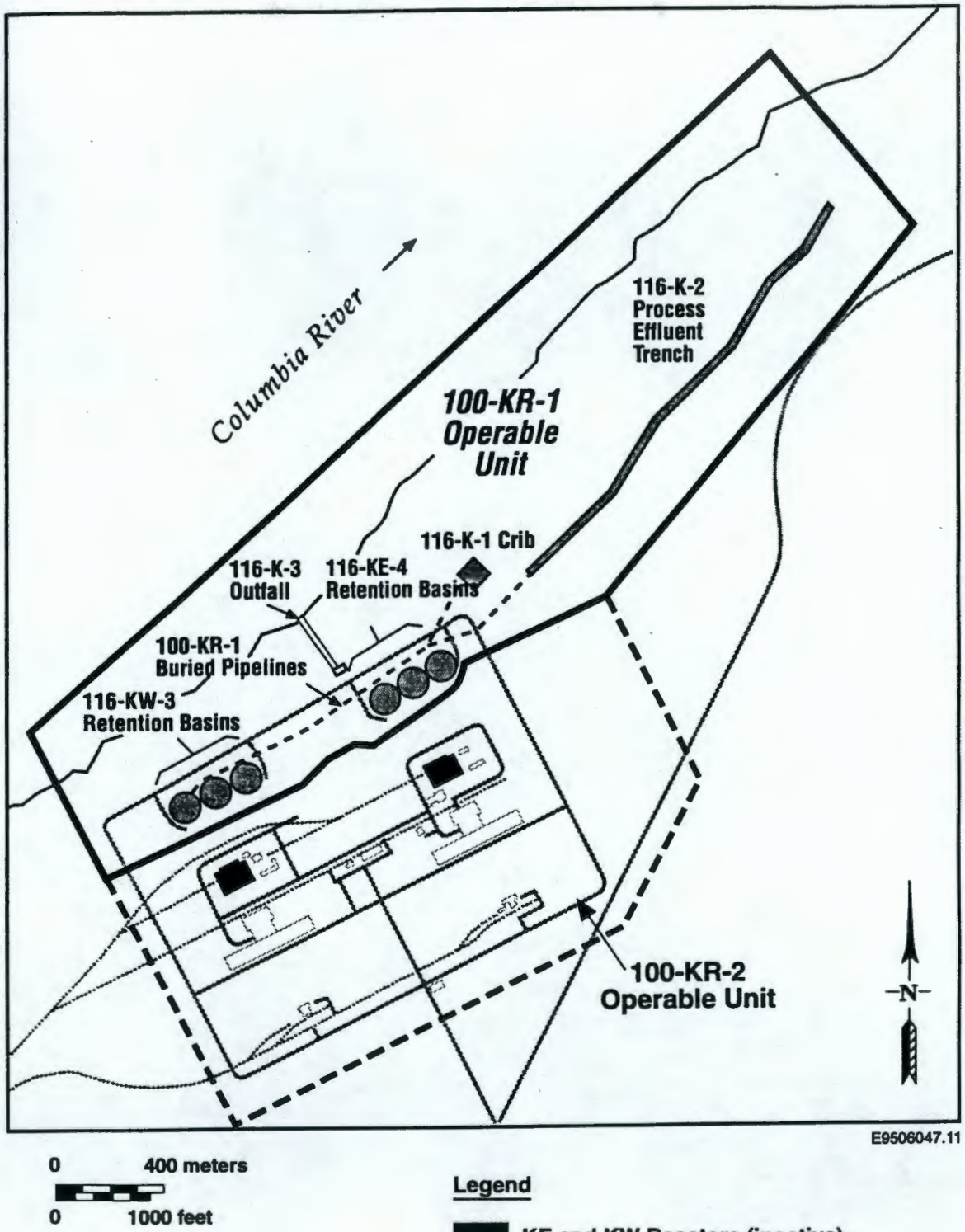


Table 1. Description of 100-KR-1 Operable Unit High Priority Radioactive Liquid Waste Sites.

Waste Site Number/Name	Former Waste Site Use	Physical Waste Site Description	[1]Contaminants of Potential Concern
116-K-1 Crib	Received 40 million liters of radioactive reactor cooling effluent wastes contaminated by fuel cladding ruptures.	Crib area is 61 m x 61 m. Crib surrounded by earthen embankment extending 6.1 m above crib bottom. Outer edge of embankment encompasses area 122 m x 122 m.	Cs-137, Co-60, Eu-152, Eu-154, Pu-239/240
116-K-2 Process Effluent Trench	Received 300 billion liters of contaminated effluent that included radioactive reactor cooling effluent and contaminated water from floor drains in 105-KE and 105-KW Reactors. Also buried in the trench is a construction tractor and all "hydride" tanks from the 100-K Area.	Open trench 1249.7 m long, 13.7 m wide, and 7.6 m deep. Trench was excavated 5.3 m below grade and surrounded by a berm 2.3 m high. About 6.6 m of fill placed in trench in 1971, except at inlet end of trench. First 290 m of trench, the inlet end, now contains about 6.8 m of fill.	Cs-137, Co-60, Eu-152, Eu-154, Pu-239/240, Sr-90, Th-228, chromium, mercury
116-KW-3 Retention Basins	Held cooling water effluent from 105-KW Reactor for cooling/decay before release to the Columbia River.	Three open-topped welded carbon steel tanks 76.2 m dia. x 8.8 m high. Approximately 3/4 of the tank walls have been removed.	Cs-137, Co-60, Eu-152, Eu-154, Pu-239/240, Th-228, Th-232, U-233/234, U-238
116-KE-4 Retention Basins	Held cooling water effluent from 105-KE Reactor for cooling/decay before release to the Columbia River.	Three open-topped welded carbon steel tanks 76.2 m dia. x 7.62 m high. Approximately 3/4 of the tank walls have been removed.	Cs-137, Co-60, Eu-152, Eu-154, Pu-239/240, Th-228, Th-232
100-KR-1 Buried Process Effluent Pipelines	Transported reactor cooling water to retention basins, 116-K-3 outfall structure, 116-K-1 crib, and 116-K-2 trench. Contains contaminated sludge and scale.	Lines are 183 cm, 168 cm, 152 cm, 107 cm, 91 cm, and 30 cm in diameter; buried 1.9 m to 5.2 m below grade.	Cs-137, Co-60, Eu-152, Eu-154, Eu-155, Pu-239/240

[1] The contaminants of potential concern were identified from the qualitative risk assessment.

Cs-137 = ^{137}Cesium
Co-60 = ^{60}Cobalt
Eu-152 = ^{152}Europium
Eu-154 = ^{154}Europium
Eu-155 = ^{155}Europium
Pu-239/240 = $^{239/240}$Plutonium
Sr-90 = ^{90}Strontium
Th-228 = ^{228}Thorium
Th-232 = ^{232} Thorium
U-233/234 = $^{233/234}$ Uranium
U-238 = ^{238}Uranium

Table 2. Qualitative Risk Assessment Summary[a] for 100-KR-1 Interim Remedial Measure Sites.

Waste Site	Human Health Risk Estimates[b]				Ecological Risk Estimates[b] (Environmental Hazard Quotient)	
	Residential Land Use[c]		Recreational Land Use[d]			
	Increased Cancer Risk[e]	NonCancer Hazard Index[f]	Increased Cancer Risk[e]	NonCancer Hazard Index[f]	Radionuclides	Inorganics or Organics
116-K-1 Crib	$>1 \times 10^{-2}$	<1.0	3×10^{-4}	<1.0	<1.0	<1.0
116-K-2 Process Effluent Trench	$>1 \times 10^{-2}$	<1.0	1×10^{-2}	<1.0	>1.0	<1.0
116-KW-3 Retention Basins	1×10^{-2}	<1.0	5×10^{-4}	<1.0	>1.0	<1.0
116-KE-4 Retention Basins	1×10^{-2}	<1.0	1×10^{-2}[j]	<1.0	<1.0	<1.0
100-KR-1 Buried Process Effluent Pipelines	$>1 \times 10^{-2}$[g]	NA[h]	$>1 \times 10^{-2}$[g]	NA[h]	ND[i]	ND[i]

[a] A qualitative risk assessment provides an evaluation of the need for interim remedial measures at 100-KR-1 sites.
[b] Human health and ecological risks estimated in the qualitative risk assessment are based on conservative assumptions that may overstate the level of potential risks. Actual risks associated with the 100-KR-1 sites are likely to be lower than presented here.
[c] Corresponds to a frequent use scenario.
[d] Corresponds to an occasional use scenario.
[e] Based on soils within the waste site and assuming radioactive decay through the year 2018.
[f] Based on soils within the waste site.
[g] Rating is qualitative, based on process information and analogous site information from 100-BC-1 Operable Unit. QRA rates this risk "medium" to account for uncertainty associated with using analogous site.
[h] NA = Not applicable.
[i] ND = No data available.
[j] Risks based on contaminants in inlet chute scale.

1×10^{-4} unless there are other considerations such as adverse environmental impacts, potential for future migration, or uncertainty regarding future land use. For the second type of potential human health effect, non-carcinogenic health impacts, a **Hazard Index** (HI) is calculated. An HI greater than or equal to 1.0 may pose a potential adverse human health risk.

Human Health Risk - Human health risks were evaluated for 100-KR-1 waste sites in order to select sites that should be addressed by interim remedial measures. Human health risks were evaluated using a qualitative risk assessment. The qualitative risk assessment used a limited set of exposure assumptions and pathways to estimate health risks. Contaminants detected in soils at the 100-KR-1 Operable Unit high priority radioactive liquid waste disposal sites pose a potential increased health risk to future users of the site (Table 2). The level of potential health risk posed by these contaminants differs depending upon the future site use. Two scenarios were evaluated; an occasional use scenario which corresponds to a recreational use, and a frequent use scenario which corresponds to a residential use. In either case, future users could be exposed to contaminants in soil through ingestion of soil, inhalation of wind-blown dust, use of contaminated groundwater, or external exposure to radiation.

Based on the qualitative risk assessment, the contaminants in soil providing the highest contribution to potential increased cancer risks included the radionuclides cesium-137, cobalt-60, europium-152, and europium-154. Noncancer hazard indices at 100-KR-1 Operable Unit sites were all less than 1.0. The risk estimates presented in Table 2 represent potential

future risks if the area were to be used for recreational or residential purposes. These risks are outside of the EPA's acceptable risk range and show that remedial actions should be taken at these sites.

Past disposal of radioactive liquid wastes to the soils at the 100-KR-1 Operable Unit has resulted in impacts to the underlying groundwater. Should groundwater under the site be used, future users could be exposed to contaminants by drinking the groundwater. The existing groundwater contamination that resulted from these source operable units is part of the 100-KR-4 Operable Unit, and will be addressed in a future proposed plan for groundwater.

Ecological Risk - Ecological risks for the waste sites within the 100-KR-1 Operable Unit were estimated by evaluating potential impacts to the Great Basin pocket mouse. Risks to the mouse were estimated assuming the food pathway was the primary route of exposure to both radionuclides and inorganic/organic contaminants. An **Environmental Hazard Quotient** (EHQ) equal to or greater than 1.0 was considered to indicate a potential ecological risk.

Radiological risks to the mouse exceeded an EHQ of 1.0 at two of the five high priority waste sites. Nearly all of the radiological risks (EHQ > 1.0) to the mouse at this Operable Unit were attributable to strontium-90. Exposure to inorganic and organic chemical contaminants did not exceed an EHQ of 1.0 at any of the interim remedial measure sites. Table 2 summarizes the risk estimates to the Great Basin pocket mouse due to exposure to contaminants at the 100-KR-1 Operable Unit waste sites.

SCOPE AND ROLE OF ACTION

This proposed plan presents interim remedial measures at five high priority radioactive liquid waste disposal sites, with associated contaminated soil and structures, at the 100-KR-1 Operable Unit. The objective of the proposed interim remedial measures is to reduce potential future threats to human health and the environment from these waste sites. It is expected that no additional remedial measures will be required at these sites.

The public has provided input to the DOE on the future use of the 100 Area through various forums, including the **Hanford Future Site Uses Working Group**. However, the final land use for the 100 Area of the Hanford Site has not been established. Remedial action objectives and cleanup goals may be revisited if future land use and groundwater use determinations are inconsistent with the goals presented in this plan. For the purposes of this proposed plan, the EPA, Ecology, and the DOE have agreed to cleanup goals that, to the extent practicable, would support a goal to not limit future uses of the 100 Area land due to contaminants resulting from Hanford operations. This would be accomplished through remediation of the sites to address the potential direct effects of exposure, and potential releases to air and groundwater. Cleanup would be planned to minimize ecological and cultural impacts. The development of mitigation plans to address site-specific ecological and cultural resources will occur during the remedial design phase that follows after the ROD is signed.

INTERIM REMEDIAL ACTION GOALS

Interim remedial action goals represent contaminant concentrations in soils that are considered protective of human health and the environment. Cleanup goals for the proposed actions are based on the three laws and the draft regulation listed below.

- State of Washington *Model Toxics Control Act* for organic and inorganic chemical constituents in soil to support unrestricted (residential) use.

- Draft EPA and Nuclear Regulatory Commission proposed standard of 15 mrem/yr in soils above background for radionuclides for the protection of human health.

- Protection of groundwater such that contaminants remaining in the soil after remediation do not result in an impact to groundwater that could exceed **Maximum Contaminant Levels** under the *Safe Drinking Water Act*. This applies to waste sites where groundwater has not been impacted.

- Protection of the Columbia River such that contaminants remaining in the soil after remediation do not result in an impact to groundwater and, therefore, the Columbia River that could exceed the Ambient Water Quality Criteria under the *Clean Water Act* for protection of aquatic organisms. This applies to sites where groundwater has already been impacted.

For deep sites, such as the buried process effluent pipelines that are 1.9m to 5.2m below the surface, the extent of remediation may be balanced against

several factors including reduction of risk by decay of radionuclides, protection of human health and the environment, costs, sizing of the Environmental Restoration Disposal Facility, worker safety, presence of ecological and cultural resources, the use of institutional controls, and long term monitoring costs. In the event that contaminated soil above cleanup goals are left in place, additional public comment may be requested.

SUMMARY OF ALTERNATIVES CONSIDERED

The *100 Area Source Operable Unit Focused Feasibility Study (DOE/RL-94-61)* identified six general response actions that could be applied to waste sites in the 100 Areas, including the 100-KR-1 Operable Unit. The alternatives evaluated for interim remediation are as follows:

- No action
- Institutional Controls
- Containment
- Remove/Dispose
- In Situ Treatment
- Remove/Treat/Dispose.

NOTE: The No Action, Institutional Controls, Containment and In Situ Treatment alternatives would limit the future uses of the 100 Area. A summary of alternatives considered is provided below.

No Action - The "no action" alternative was evaluated to provide a baseline for comparison to the other alternatives. It represents a hypothetical scenario where no additional restrictions, controls, or active remedial measures other than those currently existing are applied to a site.

Institutional Controls - This alternative involves the following:

- deed and/or access restrictions
- groundwater monitoring.

Deed restrictions would consist of limitations on certain types of land-uses (e.g., prohibiting drilling or excavation) at an individual waste site. Access restrictions would include fences or signs. Groundwater monitoring would include sampling for potential changes in groundwater contaminant concentrations underlying the waste sites. These institutional controls would limit exposure to humans and would monitor changes in groundwater quality until a final response action could be evaluated and implemented.

Containment - This alternative includes the following elements:

- institutional controls
- groundwater monitoring
- surface water controls
- installation of a surface barrier at the surface.

As described under the institutional control alternative, deed restrictions and/or access restrictions, combined with groundwater monitoring, would be implemented along with surface water controls during and after installation of a surface barrier, such as the Hanford Barrier.

Remove/Dispose - This alternative applies to contaminated soils and structures and includes the following:

- remove contaminated media
- dispose media at an approved disposal facility
- backfill excavated areas and revegetate.

Under this alternative, contaminated media would be excavated, transported, and disposed at an appropriate facility (e.g., the Environmental Restoration Disposal Facility or 218-W-5 Burial Ground, Trench 31 [W025]), in accordance with waste acceptance criteria established for the disposal facility. Any material that exceeds the disposal facility acceptance criteria would be stored onsite consistent with requirements until treated to meet acceptance criteria, or a treatability variance is approved. As the contaminated material is excavated, it would be characterized and segregated prior to transportation. Excavation would continue until all contaminated material exceeding the cleanup goal is removed. The site would then be backfilled and the area would be revegetated. Site specific revegetation plans will be developed during remedial design with input from affected stakeholders such as the Natural Resource Trustees.

In Situ Treatment (for soil) - This alternative applies to contaminated soil and includes the following elements:

- institutional controls
- groundwater monitoring
- surface water controls
- **in situ vitrification.**

Institutional controls such as deed restrictions and/or access restrictions, groundwater monitoring, and

surface water controls would be implemented as discussed under the institutional control and containment alternatives after completion of the in situ vitrification process. Under this alternative, the contaminated soil would be vitrified in place and covered with a minimum of one meter of soil. The disturbed area would then be revegetated.

In Situ Treatment (for Buried Process Effluent Pipelines) - This alternative applies to buried process effluent pipelines and contaminated soils. It includes the following elements:

- institutional controls
- groundwater monitoring
- void grouting
- installation of a surface barrier, if needed.

Under this alternative, deed and/or access restrictions, groundwater monitoring, and surface water controls would be implemented as previously described. The buried process effluent pipelines would be pressure injected in place with grout that would immobilize contamination in the pipeline (i.e., the contaminated metal, scale, and sediments in the pipe) through encapsulation. A surface barrier would be installed (as described in the containment alternative) over soils and buried pipelines if needed to reduce infiltration of rainwater.

Remove/Treat/Dispose - This alternative applies to sites with contaminated soil and structures, and includes the following elements:

- remove contaminated media
- **thermal desorption**, if required, for soil
- **soil washing**, as appropriate
- disposal at an approved facility
- backfill excavated areas and revegetate.

Under this alternative, the contaminated soils would be excavated as described under the remove/dispose alternative. Soils contaminated with organic chemicals at levels exceeding waste disposal acceptance criteria would be treated by thermal desorption, then recombined with the remaining contaminated soils prior to soil washing.

Soil washing could reduce the volume of contaminated soil for disposal. The application of soil washing to a waste site will depend on several factors including soil conditions, contaminant specific cleanup goals, and the level of contaminants present. Soil washing is a desirable treatment only when significant volume reduction can be achieved. It would only be performed when such volume reduction could be achieved in a cost-effective manner. The greatest cost benefit would be achieved at large volume sites with low levels of contaminants. Treatability studies are currently in progress to evaluate the applicability of soil washing in the 100 Areas.

Following removal and treatment, contaminated soil and/or contaminated products resulting from treatment technologies would be disposed of in the same manner as the remove/dispose alternative. The excavation would be backfilled with washed soils and other soils as needed and revegetated.

PREFERRED INTERIM REMEDIAL MEASURES

The preferred alternative proposed for the 116-K-1 Crib, 116-K-2 Process Effluent Trench, 116-KW-3 Retention Basins, and the 116-KE-4 Retention Basins is remove, treat (where appropriate or required), and dispose. For the 100-KR-1 Buried Process Effluent Pipelines it is remove/dispose since there are no known contaminated media that would benefit from treatment. The preferred alternatives meet the remedial action objectives under the future land use assumptions, provide long-term effectiveness and permanence, and overall protectiveness. They are implementable, utilize proven technologies and equipment to complete the action, and are cost effective.

EVALUATION OF ALTERNATIVES

The preferred alternatives are believed to provide the best balance of tradeoffs among the alternatives with respect to the nine evaluation criteria used to evaluate remedies. Descriptions of the criteria are presented below. The criteria fall into three categories: The first two (Overall Protection of Human Health and the Environment, and Compliance with **Applicable or Relevant and Appropriate Requirements [ARARs]**) are considered *threshold* criteria and, in general, must be met. ARARs may be waived in accordance with CERCLA Section 121. The next five are considered *balancing* criteria and are used to compare technical and cost aspects of the alternatives. The final two criteria (State and Community Acceptance) are considered *modifying* criteria. Modifications to remedial actions may be made based upon state and local comments and concerns. Community acceptance will be evaluated after all public comments have

EXPLANATION OF CERCLA EVALUATION CRITERIA

1. *Overall Protection of Human Health and the Environment* addresses whether or not a remedial action provides adequate protection and describes how potential risks posed through each exposure route are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. *Compliance with Applicable or Relevant and Appropriate Requirements* addresses whether or not a remedial action will meet all of the applicable or relevant and appropriate requirements and other federal and state environmental statutes or provide grounds for invoking a treatability variance of the requirements.

3. *Long-Term Effectiveness and Permanence* refers to the magnitude of residual risk and the ability of a remedial action to maintain reliable protection of human health and the environment after remedial goals have been met.

4. *Reduction of Toxicity, Mobility, or Volume Through Treatment* evaluates the anticipated performance of the treatment technologies that may be employed in a remedy.

5. *Short-Term Effectiveness* refers to the speed with which the remedial action achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment that may result during the construction and implementation period.

6. *Implementability* refers to the technical and administrative feasibility of a remedial action, including the availability of materials and services needed to implement the selected solution.

7. *Cost* evaluates capital, operation and maintenance costs for each alternative by performing present worth cost analyses.

8. *State Acceptance* is based on review of the remedial investigation and focused feasibility study reports, and the proposed plan. It also indicates whether the state concurs with, opposes, or has no comment on the preferred interim alternative.

9. *Community Acceptance* is an assessment of the general public response to the proposed plan following a review of the public comments received on the remedial investigation, focused feasibility study, and proposed plan during the public comment period and open community meetings.

been received. The following paragraphs discuss how the alternatives address the criteria for the 116-K-1 Crib, 116-K-2 Process Effluent Trench, 116-KW-3 Retention Basins, 116-KE-4 Retention Basins, and the 100-KR-1 Buried Process Effluent Pipelines.

OVERALL PROTECTION

The no action alternative does not meet this criteria. Institutional controls alone cannot be relied on to indefinitely provide protection, and therefore does not meet this criteria. The containment alternative would provide protection by encapsulating wastes for the 100-KR-1 Buried Pipelines, the 116-KW-3 Retention Basins, or the 116-K-1 Crib, but would not provide adequate protection for the 116-K-2 Process Effluent Trench. The in situ alternative would provide overall protection for the 116-K-1 Crib, 116-KE-4 Retention Basins, and buried pipelines, but would not adequately address the 116-K-2 Process Effluent Trench or the 116-KW-3 Retention Basins. The remove/dispose and remove/treat/dispose alternatives would provide overall protection of human health and the environment for all five waste sites.

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The no action, institutional controls, containment and in-situ treatment alternatives would not meet all of the principal ARARs identified for all of the sites. The remove/dispose and the remove/treat/dispose alternatives would meet the ARARs, with the potential exception of Land Disposal Restricted contaminants under the *Resource Conservation and Recovery Act*. If Land Disposal Restricted contaminants are encountered, contaminated soil would be treated or a treatability variance could be requested.

LONG-TERM EFFECTIVENESS AND PERMANENCE

The no action and institutional controls alternatives would not meet cleanup goals and, therefore, would not provide for long-term effectiveness. Containment and in-situ treatment would provide a greater degree of long term effectiveness by stabilizing and isolating the wastes in place, but could limit future land uses. The remove/dispose and remove/treat/dispose alternatives would provide the greatest long-term effectiveness and permanence.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

The no action and institutional controls alternatives do not reduce the mobility, toxicity, or volume of the contaminants. The containment and institutional controls alternatives do not include treatment. The containment, in-situ treatment, and remove/dispose alternatives would reduce the mobility of contaminants but not the toxicity or volume. The remove/treat/dispose alternative provides the most significant level of treatment and would reduce volume and mobility.

SHORT-TERM EFFECTIVENESS

The no action and institutional controls alternative could be in place very quickly and would have minimal adverse impacts on human health or the environment. The containment and in-situ treatment options require technology that is readily available. The remove/dispose alternative would provide a greater degree of short-term protectiveness than the remove/treat/dispose alternative because it requires less time to implement, utilizes standard technologies, and presents less short-term risk to workers and the environment.

IMPLEMENTABILITY

The no action and institutional controls alternatives require minimal effort to implement. The institutional controls alternative, however, would require administrative actions such as deed restrictions. The containment and in situ treatment alternatives are implementable with existing technologies, but would require land use restrictions. The remove/dispose alternative is easier to implement than the remove/treat/dispose alternative.

COSTS

Table 3 provides a summary of costs for the alternatives for the five waste sites. Costs were not developed for containment at 116-K-2 and 116-KE-4, or for in situ treatment at 116-K-2 and 116-KW-3 since the alternatives would not adequately meet the threshold evaluation criteria as discussed above. Costs were not developed for the remove/treat/dispose alternative for the buried pipelines because there is no known contamination that would benefit from treatment.

> The Tri-Parties are working together to implement a demonstration project this summer in the 100-BC Area to address a number of concerns related to cleanup, including the incorporation of actual cost into the cost models. It is expected that contaminated materials from those actions will be disposed of at the 218-W-5 Burial Ground, Trench 31 (W025) in the 200 Area, or stored for future disposal at the Environmental Restoration Disposal Facility.

EVALUATION OF POTENTIAL ENVIRONMENTAL IMPACTS

In addition to evaluating whether the alternatives pose a risk to human and ecological receptors, the different remedial alternatives were compared relative to the potential impacts the action might have on cultural and natural resources, transportation, and regional socioeconomics. The evaluation of alternatives also considered avoidance and mitigation of the above impacts, what commitment of resources may be necessary, and how the actions at this operable unit relate to actions being planned or executed at other operable units (cumulative impacts).

The levels of impact from the alternatives will vary depending on requirements (such as equipment and services), the need for borrow materials, and people that are needed to support each alternative. Significant impacts are expected to be limited to potential exposure of remediation workers to hazardous or radioactive substances, short-term indirect impact to wildlife from construction noise, and the commitment of land area used for disposal. The extent of physical disturbance caused by the action was also evaluated because this has a direct relationship to the potential for impacting cultural and natural resources.

The development of avoidance and mitigation measures will be initiated as soon as the remedial alternative is selected. The waste sites to be remediated occur within areas previously disturbed by reactor operations and agricultural activities, so remediation and revegetation actions will likely result in improving rather than degrading ecological conditions in the area.

Table 3. Summary of Estimated Costs for 100-KR-1 Operable Unit Remedial Alternatives.

	Containment			Remove/Dispose			In Situ Treatment			Remove/Treat/Dispose		
WASTE SITE	CAP	O&M	PW	CAP	O&M	PW	CAP	O&M	PW	CAP	O&M	PW
116-K-1	$7.5	$2.4	$8.5	$3.3	$0.0	$3.2	$8.0	$6.2	$13.6	$3.3	$0.0	$3.2
116-K-2	NA	NA	NA	$68.5	$0.0	$63.4	NA	NA	NA	$68.2	$9.7	$71.1
116-KW-3	$36.9	$17.6	$43.8	$90.5	$0.0	$84.9	NA	NA	NA	$86.6	$27.4	$102.6
116-KE-4	NA	NA	NA	$22.7	$0.0	$21.7	$64.6	$50.4	$87.6	$22.5	$4.8	$26.1
100-KR-1 Buried Effluent Pipelines	$37.3	$18.0	$44.6	$42.7	$0.0	$39.8	$8.3	$0.0	$7.9	NA	NA	NA

NOTES:

- Costs are in millions of dollars.
- CAP - Capital Costs
- O&M - Operation and Maintenance.
- PW - Present Worth.
- NA - Not Applicable to the Waste Site (see FFS Report).
- Costs presented are based on a different exposure scenario than the selected scenario, but the relative differences between alternatives are similar (see FFS Report for detailed cost analysis).
- Costs presented are preliminary, and are presented for comparison purposes only. It is expected that actual costs will be significantly lower.

SUPPORTING DOCUMENTS

The public is encouraged to review the following documents at the Administrative Record Locations.

- *Remedial Investigation/Feasibility Study Work Plan for the 100-KR-1 Operable Unit* (DOE/RL-90-20)
- *Limited Field Investigation Report for the 100-KR-1 Operable Unit* (DOE/RL-93-78)
- *Qualitative Risk Assessment for the 100-KR-1 Operable Unit Report* (WHC-SD-EN-RA-009)
- *100-Area Source Operable Unit Focused Feasibility Study Report* (DOE/RL-94-61)
- *100-KR-1 Operable Unit Focused Feasibility Study* (DOE/RL-94-61, Appendix M)
- *100 Areas Feasibility Study, Phases 1 and 2* (DOE/RL-92-11)
- *100-K Area Technical Baseline Report* (WHC-SD-EN-TI-239)

ADMINISTRATIVE RECORD

The Administrative Record can be reviewed at the following locations:

U. S. Department of Energy - Richland Operations
Administrative Record
2440 Stevens Center Place; Room 1101
Richland, Washington 99352
509/376-2530
ATTN: Debbie Isom

Lobat-Anderson Inc.
c/o U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101
206/553-4494
ATTN: Karen Prater

Washington State Department of Ecology
Nuclear Waste Library
300 Desmond Drive S.E.
Lacey, Washington 98503
206/407-7097
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100 Sprout Road, Room 130 West
Richland, Washington 99352
509/376-8583
ATTN: Terri Traub

GLOSSARY

Applicable or Relevant and Appropriate Requirements (ARARs) - These are requirements promulgated under federal or state law that specifically address the circumstances of a CERCLA cleanup action.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - This is a federal law that establishes a program that enables the Environmental Protection Agency to identify hazardous waste sites, ensure that they are cleaned up, and allow other government entities to evaluate damages to natural resources. CERCLA is also known as the "Superfund law." CERCLA applies to the 100-KR-1 Operable Unit.

Contaminants of Potential Concern - These are chemical and radioactive constituents that must be addressed by remedial action.

Environmental Hazard Quotient - The ratio of exposure toxicity for ecological receptors of contaminants. When the Environmental Hazard Quotient exceeds 1.0, a possible ecological risk is assumed to exist.

Environmental Restoration Disposal Facility - A disposal facility for contaminated soils and solid waste that will be available in October 1996 at the Hanford Site to support interim remedial measures.

Focused Feasibility Study (FFS) - An engineering study on a waste site that evaluates a limited number of remedial alternatives for cleaning up environmental contaminants.

Groundwater - Underground water that fills the spaces between particles of soil, sand, gravel, or fractures in rocks.

Hanford Future Site Uses Working Group - A working group made up of representatives of interested parties concerned with the cleanup and possible future uses of the Hanford Site. The group produced a report in 1992 identifying possible future site uses and an examination of the cleanup necessary to make those uses possible.

Hazard Index - The ratio of exposure to toxicity for receptors of contaminants. When the Hazard Index exceeds 1.0, a possible human health risk is assumed to exist.

In Situ Vitrification - A treatment process that converts soil and other material into stable glass or glass-like crystalline substances and stabilizes the contaminants in-place.

Interim Remedial Measure - A remedial action that is taken at a site to address one or more of the contamination problems, but not necessarily all of the contamination problems. The remedial action is based on a Limited Field Investigation/Focused Feasibility Study, and is selected in a record of decision.

Maximum Contaminant Level (MCL) - The maximum concentration of a particular contaminant allowable in drinking water under the *Safe Drinking Water Act* of 1974, as amended.

National Priorities List - A list of top-priority hazardous waste sites in the United States that are eligible for investigation and cleanup under the Superfund law.

Operable Unit - This is a subset of a larger CERCLA site; it is typically the subject of Operable Unit-specific investigations and remedial actions.

Qualitative Risk Assessment - An evaluation of risk for a predefined set of human and environmental exposure scenarios that assists Tri-Party signatories in making decisions on the necessity of interim remedial measures.

Record of Decision - The formal document in which the lead regulatory agency sets forth the selected remedial measure and the reasons for its selection.

Soil Washing - A means to reduce the volume of contaminated soil by physically or chemically separating the clean and contaminated soil fractions (i.e., clay, silt, and sand). Only the contaminated fraction, rather than the entire range of particle sizes, is disposed of at an approved waste disposal facility. The uncontaminated fraction can be used as clean fill or for other purposes.

Thermal Desorption - A process that uses indirect low temperatures to thermally remove volatile and semi-volatile organic compounds from contaminated soil, sediment, or sludge.

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