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Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

JUN 4 1996

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Mr. David L. Lundstrom
200 Area Section Manager
Nuclear Waste Program
State of Washington
Department of Ecology
1315 W. Fourth Avenue
Kennewick, Washington 99336-6018

Mr. Douglas R. Sherwood
Hanford Project Manager
U.S. Environmental Protection Agency
712 Swift Boulevard, Suite 5
Richland, Washington 99352-0539

Dear Messrs. Lundstrom and Sherwood:

TRANSMITTAL OF DOE/RL-93-33, REV. 0, FOCUSED FEASIBILITY STUDY (FFS) OF ENGINEERED BARRIERS FOR WASTE MANAGEMENT UNITS IN THE 200 AREAS

Please find attached the subject document (Attachment 6) for your information. This revision incorporates responses to comments provided by the U.S. Department of Energy (DOE), Richland Operations Office, DOE-Headquarters, the U.S. Environmental Protection Agency, and the State of Washington, Department of Ecology (Attachments 4, 5, 2, and 3, respectively) on Draft A and Draft B. A summary of the applicable or relevant and appropriate requirements and technical guidance changes is also provided as Attachment 1. 40464 42992

This FFS evaluates generic conceptual barrier designs for potential application at 200 Areas waste management units. These four designs are the Hanford Barrier, the Modified Resource Conservation and Recovery Act (RCRA) Subtitle C Barrier, the Standard RCRA Subtitle C Barrier, and the Modified RCRA Subtitle D Barrier. The decision logic is provided to determine which engineered barrier should be evaluated during waste site-specific evaluations of the various remedial alternatives. Also addressed are design issues to be considered during definitive design and recommendations for additional activities in support of barrier development and construction. This FFS also acknowledges that other barrier designs may be appropriate depending on the site-specific conditions. For example, a biointrusion barrier (not evaluated in this FFS) may be appropriate for consideration at waste sites containing contaminants that are strongly sorbed onto the soil column.

If you have any questions, please contact me at 376-7087.

Sincerely,

Bryan L. Foley, Project Manager
Remedial Actions Project

RAP:BLF

cc w/o attachs:
M. A. Buckmaster, BHI
G. R. Eidam, BHI
J. G. Woolard, BHI

cc w/attachs 1 and 2:
P. R. Beaver, EPA (2)

cc w/attachs 1 and 3:
N. T. Hepner, Ecology (2)

cc w/attachs 1 and 5:
R. L. Person, EM-442 (2)

Attachment 1

SUMMARY OF ARAR AND TECHNICAL GUIDANCE CHANGES

A requirement is applicable if the CERCLA action meets all the legal prerequisites of the requirement. A requirement is relevant and appropriate if does not meet the legal prerequisites to be applicable but addresses problems or situations that are sufficiently similar to those found at the CERCLA site. There is substantial flexibility in determining relevant and appropriate, and it is possible for only a portion of a requirement to be relevant and appropriate (OSWER Directive 9234.2-03/FS). Furthermore, EPA guidance suggests that performance standards rather than specific technical requirements are the key elements that are relevant and appropriate. If a requirement is either applicable or relevant and appropriate, it is enforceable under CERCLA. Technical guidance is not enforceable but may assist in developing a remedy.

The following describes modifications made to the ARARs and the rationale.

10 CFR Part 61

Modified to differentiate between performance standards (which are ARARs) and technical requirements (which provide technical guidance). 10 CFR 61 applies to NRC sites and is not legally applicable to DOE sites. However, 10 CFR 61 Subpart C, "Performance Objectives," contains performance standards that may be relevant and appropriate to 200 Area waste sites that are sufficiently similar to disposal sites addressed by 10 CFR 61. Technical requirements in 10 CFR 61 are used in the Barrier FFS as technical guidance.

40 CFR Part 191

Deleted as both an ARAR and technical guidance. 40 CFR 191 Subpart B - Environmental Standards for Disposal specifically does not apply to "wastes disposed of before November 18, 1985." The preamble clarifies that it is intended to apply to mined geologic repositories. 40 CFR 191 is not relevant and appropriate because it was intended for disposal of massive quantities of spent fuel and TRU waste (100,000 metric tons of spent fuel) and it relies heavily on siting criteria; the types and quantities of material at the 200 Area wastes sites and the reliance on siting criteria are not sufficiently similar to the conditions addressed by 40 CFR 191.

40 CFR Part 61

Deleted as ARAR for barrier design. 40 CFR 61 Subpart H limits doses of radiation that would be received by the public as a result of airborne emissions from DOE facilities. While they would be applicable during cleanup (e.g., during construction of a barrier), they would not be applicable or relevant and appropriate for airborne emissions from residual contamination after cleanup, when the site is no longer in operation (the standards were developed to limit radiation doses caused by operations that yield a beneficial product).

(EPA/540/G-89/009)

Chapter 173-460 WAC

Delete as an ARAR. WAC 173-460 applies to new sources of toxic air pollutants. It does not apply nor is it relevant and appropriate to the barrier designs because they will not involve new source of toxics.

Chapter 246-221 WAC

Reinstated.

40 CFR 192

40 CFR 192 is deleted as an ARAR. Subpart A of 40 CFR 192 addresses tailings found in unstable above-ground piles with relatively steep sideslopes. The piles typically range from 5 to 150 acres in size and from a few feet to as much as 230 feet in height, and contain anything from residual contamination to 2.7 million tons of contamination. The tailings are a sand-like material that is attractive for use in construction and soil conditioning. The tailings pose an immediate, but generally limited threat to human health, but more importantly, are vulnerable to human misuse and dispersal. The waste sites considered in the FFS are not comparable in size, aboveground location, material type, or accessibility, and therefore Subpart A is not relevant and appropriate. Subpart B applies to "...land and buildings that are part of any processing site...", and "land" is defined as "any surface or subsurface land that is not part of a disposal site..." This regulation is legally applicable only to inactive uranium mill tailing sites. In addition, this subpart of the regulation is designed for unrestricted use cleanup, not disposal of waste in place. It does not address leaving waste in place using barriers (note that the definition of land excludes disposal sites), and therefore is not relevant and appropriate in the Barrier FFS. This subpart would potentially be relevant and appropriate when all remedial options for 200 Area waste sites, including waste removal, are evaluated.

WAC 173-304-460

The solid waste sites in the 200 Area were closed before the effective date of this regulation and therefore it is not applicable. However, it is relevant and appropriate to sites containing solid waste. WAC 173-304-460(2) was retained as an ARAR because it specifically provides standards for performance. WAC 173-304-460(3) was moved to technical guidance because it provides specific technical requirements rather than performance standards.

40 CFR Part 258

Deleted as an ARAR. 40 CFR 258 applies to new and existing municipal waste landfills and expansions, and specifically states that all other solid waste landfills not regulated under

Subtitle C of RCRA are regulated under 40 CFR Part 257. The regulation also does not apply to municipal landfills that did not receive waste after October 9, 1991. None of the 200 Area sites are municipal waste landfills.

DOE Order 5820.2A

Deleted as an ARAR because (1) it is not a promulgated law or regulation and therefore cannot be an ARAR and (2) guidance from DOE headquarters indicates that it is not appropriate guidance for CERCLA remediation.

DOE Order 6430.1A, 5400.5

Deleted as an ARAR because (1) it is not a promulgated law or regulation and therefore cannot be an ARAR and (2) ARARs and other technical guidance provide standards that are sufficiently protective. Deletion of DOE Orders as ARAR/guidance for this FFS was discussed with Patrick Willison/RL Legal Counsel, on March 28, 1996. Mr. Willison fully endorsed this approach from a legal and regulatory standpoint.

Attachment 2

GENERAL COMMENTS FROM EPA

[Note: Responses as finalized following meeting on April 3, 1996.]

[1] The FFS does not clearly explain how the Hanford barrier and modified RCRA Subtitle C barrier will be evaluated against the 1,000-year and 500-year life expectancy objectives respectively. The approach for extrapolating data gathered during a 5-year (minimum) test on the prototype barrier (WHC 1992) to a 1,000-year time frame should be described. The approach should include the evaluation of long-term variances in environmental conditions such as climatic changes, long-term erosion from wind and water, revegetation, groundwater level changes, seismic conditions, and biointrusion.

Response: Accept. New subsections were added to Section 5.3 in Draft B summarizing monitoring and testing for the Hanford Barrier prototype. The new text explains how the mass wasting rate will be quantified and will read as follows:

"5.3.1 Prototype Testing

Plans for monitoring and testing of the Hanford Barrier prototype over 216-B-57 Crib are summarized in <u>Treatability Test Plan for the 200-BP-1 Prototype Surface Barrier</u> (DOE/RL 1993). After construction, the barrier is expected to take approximately 1 yr to stabilize. Barrier performance will be evaluated for an additional 2-yr period (i.e., active monitoring and testing are planned for 3 yrs). Because this time frame is limited compared to the barrier's 1,000-yr design life, the program emphasizes stress testing (i.e., imposition of harsher environmental conditions on the barrier than those that occur naturally). Monitoring and testing activities will focus on the following performance issues:

- ***Water infiltration control***
- ***Water erosion***
- ***Wind erosion***
- ***Biointrusion***
- ***Asphalt performance***

The barrier's ability to control moisture infiltration and to resist mass wasting will be evaluated from the data to be obtained."

Similar language was added in Section 5.3.2 for asphalt durability for the modified RCRA C Barrier, under the assumption that the asphalt is relied upon to provide the long-term protection for the Modified C (i.e., the upper silts don't withstand 500 years).

[Note: Response modified from original and incorporated into Draft B.]

[2] 1995 Comment: The text should also describe how 40 CFR Part 191.13 (releases of radionuclides to the accessible environment for 10,000 years...) will be met.

1996 Comment: The response did not address the comment.

Response: Reject. Reference to 40 CFR 191 as either an ARAR or technical guidance is being deleted. 40 CFR 191 Subpart B - Environmental Standards for Disposal does not apply to "wastes disposed of before November 18, 1985." (40 CFR 191 .11(b)(2)) In addition, the preamble states that this regulation was "developed primarily through consideration of mined geologic repositories," that the protectiveness requirements analysis was based on massive quantities of spent fuel (an assumed 100,000 metric tons of fuel) and TRU waste, and that the selection of a 10,00 year time frame relies heavily on the siting process. The waste sites in the 200 Area are near-surface (versus geologic repository), they do not contain "massive" quantities of radioactive material, and they are already sited. The problems and situations in the 200 Area are not sufficiently similar to those addressed by 40 CFR 191, and therefore the regulation is not relevant and appropriate.

[Note: Major modification of original response.]

[3] The surface of the barrier will be planted with perennial vegetation to control wind and water erosion. The types of perennial plants that will be used and the method of seed application that will enhance revegetation success are not described. The barrier covers should at least meet Environmental Protection Agency (EPA) recommendations found in the technical guidance (EPA 1989) for vegetative cover. Results of revegetation test plot studies in soil and pea-gravel admixtures similar to the top layer design for the barrier cover should be reported to demonstrate the cover's effectiveness as a protection against wind and water erosion.

Response: Accept. The omission of specific recommendations regarding the type(s) of perennial vegetation or the method of seeding to be utilized on any of

the barriers in the FFS was intentional. Efforts are ongoing to optimize seed mix selection for barrier applications, drawing upon on-site experience with mixes that have been used for various interim stabilization projects, performance of other seed mixes in lysimeters and test plots, evaluation of various mixtures that have been developed elsewhere (e.g., "highway mixes"), and data from other sources (e.g., vendor information). Because seed mix selection for Environmental Restoration projects is a "moving target", inclusion of detailed information in the FFS was considered counterproductive. Over the near term, it is expected that specific recommendations will be developed on a site-by-site basis as an aspect of definitive design. This item already is identified in Section 5.2 of the current draft as a definitive design issue. The specifications for seed, mulch and fertilizer for the Hanford Barrier prototype were based on a WSDOT highway specification (WSDOT M 41-10) which had not been used previously at Hanford (refer to Section 02935, Construction Specification for Prototype Surface Barrier at 200-BP-1 Operable Unit).

The following language will be added in Sections 3.1.2.1, 3.2.2.1, and 3.3.2.1:

> "*Cover vegetation will consist of a mixture of perennial grass species. Specifications for the seed mix, and the methods of seed application, fertilizing, and mulching will be developed during definitive design. Planting of cover vegetation will meet or exceed all applicable recommendations in EPA's technical guidance for final covers (EPA 1989).*"
>
> [Note: Modification to original response to show actual language added.]

[4] The FFS report states that the barriers (Hanford barrier and modified RCRA Subtitle C barrier) will isolate the waste from precipitation infiltration and inhibit erosion; prevent plant, animal, and inadvertent human intrusion; and control the release of noxious gases. A discussion of each barriers capabilities to prevent releases of radon and other radioactive gases such as tritium, which are expected to be released at some waste sites should be included. The FFS report should explain how releases of these radioactive gases through the barriers will be controlled.

Response: Accept in part. The FFS, does not (contrary to this comment) identify releases of noxious gases as a conceptual design issue for surface barriers for ER program sites. Radon-226 and Radon-228 releases are associated with radium and thorium sources. Other radioactive gases which might be encountered at Hanford are tritium (as tritiated water) and carbon-14. Neither of these

radionuclides is present at ER program sites in sufficient concentrations that releases are likely to impact air quality (with or without restrictions imposed by engineered barriers). Performance assessments for 200 Area sites generally have concluded that releases of radioactive gases are negligible dose contributors to the air pathway, according to WHC personnel familiar with PAs completed in recent years. Radioactive particulates generally are the contaminants of concern vis-a-vis the air pathway.

Low-permeability asphalt layers like the asphaltic concrete layer in the Hanford barrier and the Modified RCRA Subtitle C Barrier have been demonstrated to be highly effective in inhibiting the diffusion of radioactive gases with low partial pressures and short half lives, such as radon. This conclusion is supported by documentation from the UMTRA program, where multi-layer barriers including a low-permeability asphalt layer have been constructed and evaluated (see Wing 1994, PISB Development Plan, p. 53). This attribute may be useful in some non-ER programs applications at Hanford (e.g., tank farms -- a number of SSTs contain residuals from thorium separation that generate Radon-228).

Gas control requirements already are identified in Section 5.2 as site-specific design issues to be considered during definitive design. The following language will be added in Sections 3.1.2.6 and 3.2.2.4:

> "*Low-permeability asphalt layers like the asphaltic concrete layer in the Hanford barrier and the Modified RCRA Subtitle C Barrier have been demonstrated to be highly effective in inhibiting the diffusion of radioactive gases with low partial pressures and short half lives, such as radon. This conclusion is supported by documentation from the Uranium Mill Tailings Reclamation Act program, where multi-layer barriers including a low-permeability asphalt layer have been constructed and evaluated (see Wing 1994, p. 53).*"

[Note: Modification to original response to show actual text added.]

[5] Comment 1995: The text does not discuss how seismic activities may affect each barrier and each layer within the barrier. A discussion of how seismic activities are accounted for, or what its expected impact on the barrier will be should be included.

Comment 1996: Did not see response incorporated.

Response: Accept. Response was incorporated on age 5-2 of Draft B, last paragraph. Seismic susceptibility of the Hanford Barrier Prototype has been evaluated (Wing et al 1995). The results of the evaluation indicated that potential damage to the barrier from the design earthquake was confined to the 2:1 sideslope. The sideslope was susceptible to a sliding wedge failure mode, with sliding occurring on top of the fluid applied asphalt layer.

Seismic evaluations have not been carried out to date for the other two barrier designs described in the FFS. However, it is anticipated that the results would also demonstrate that seismic susceptibility is confined to the sideslopes and is readily controllable by design. Sideslope design is a site-specific design issue that will be considered during definitive design. Seismic evaluations will be carried out at that time. Seismic evaluations will be identified in Section 5.2.

Wing, N.R., F.M. Corpuz, K.L. Petersen, and A.M. Tallman, 1995, *Physical Stability of Long-Term Surface Barriers - Assessment of Potentially Disruptive Natural Events*, BHI-00145, Bechtel Hanford, Inc., Richland, Washington.

[Note: Modified to note where response was incorporated in Draft B.]

[6] The ways in which subsidence, surface erosion, and revegetation failure will be monitored and corrected should be described in the FFS. Elements of a site monitoring plan that should be described in the report include:

- General surface water and groundwater monitoring scheme
- Erosion markers (water and wind erosion)
- Settlement monuments to monitor subsidence
- Type and frequency of field surveys to detect development of nick-points and failure of revegetation

Potential actions that will be taken to correct erosion and gullying, subsidence, and revegetation failure should be described, also.

Response: Accept. These issues will be resolved through the initial implementation decision documents for various barriers. Policies concerning the issues listed above will be addressed in the initial RODs.

[Note: Response unchanged from original.]

[7] Comment 1995: A 2-percent slope from the crown of the barrier is proposed, but it is not clear whether this is the final top slope after allowance for settling and subsidence. This point should be clarified.

Also, it is not clear whether the proposed 2-percent slope from the crown is uniform in all directions throughout the barrier. In the *Engineering Report for Prototype Surface Barrier (PSB) of 200-BP-1 Operable Unit* (WHC 1992), it is proposed to tilt the entire barrier to the north at 2-percent, resulting in a 2.8 percent slope to the northwest and northeast corners of the test plot in order to minimize the barrier height and the complexity of the percolating water collection system. The text should explain whether a uniform 2-percent barrier slope will be used at all waste sites or if the crown slope will be site-specific.

Comment 1996: Acceptable subsidence tolerance - Page 3-3 (Draft B) 3rd paragraph, says Layer 1 will be constructed with a surface slope of 2% - was this before or after the barrier?

Response: Accept. Two percent is the final top slope after allowance for settlement and subsidence. This point will be clarified in Section 3.1.2.1, paragraph 1, where the last sentence will be deleted and replaced with the following:

"Layer 1 will be constructed to obtain a post-construction grade of approximately 2%. To establish this grade, overfilling toward the high point or crest of the barrier surface might be required to obtain a 2% final grade after post-construction settlement has occurred. Compression/settlement of the placed barrier materials and native subsurface materials is expected to occur during and directly after placement and can be estimated to obtain the desired grades. The specific slope requirements would be further evaluated during the site specific design for a waste site(s). Subsidence issues related to a particular waste site type will be addressed prior to construction of the barrier."

The FFS takes no position on slope lengths or slope geometry for purposes of conceptual design development. Crown slope geometry is a site-specific issue. This point will be reiterated in Section 5.2.

[Note: This response was modified to better respond following the second comment.]

[8] The Hanford barrier and RCRA Subtitle C barrier appear to meet RCRA guidelines. The only questionable equivalency concerns the layer of asphalt and concrete mixture. It is not clear that the 15-centimeter layer will not crack over time, thus allowing water to infiltrate the waste. The underlying layers are not designed to drain infiltrating water away from the waste. The durability and aging of asphalt concrete layers are important issues, especially when considering the time beyond the post-closure maintenance period for radioactive waste disposal sites. The FFS report should discuss and recommend testing and monitoring methods for large-scale permeability and stress-strain properties for three-dimensional deformation to demonstrate that design specifications for asphalt concrete are attainable.

Response: Reject. The FFS acknowledges design issues associated with the low-permeability asphalt layer (refer to Section 5.3.1). Additional investigations have been proposed to collect defensible data on long-term performance. Monitoring and testing activities are outside the scope of the FFS generally. However, text will be added within Section 5.3 summarizing monitoring and testing activities regarding the Hanford Barrier prototype (refer to response to general comment #1).

[Note: Response unchanged from original.]

ES-2, Executive Summary:
Provide a complete description of the design of each barrier alternative.

Response: Accept in part. The executive summary will be modified to read as follows:

- ***"Hanford Barrier. This design is recommended for implementation at sites with Greater-Than-Class-C (GTCC) Low-Level Waste (LLW) and/or GTCC-mixed waste and/or signficant inventories of TRU constituents. This barrier is designed to remain functional for a performance period of 1,000 years and to provide the maximum practicable degree of containment and hydrologic protection of the three proposed designs. The Hanford Barrier is composed of nine layers with a combined thickness of 4.5 m. The barrier layers are designed to maximize moisture retention and evapotranspiration capabilities, and to minimize moisture infiltration and biointrusion, taking into consideration long-term variations in Hanford Site climate.***

The primary structural differences between the Hanford Barrier and other barriers discussed in this report are increased thicknesses of individual layers and the inclusion of a coarse fractured basalt layer to control biointrusion and to limit inadvertent human intrusion.

* *Modified RCRA C Barrier. This barrier design is recommended for applications at sites containing hazardous waste, Category 3 LLW and/or Category 3-mixed LLW, and Category 1-mixed LLW. This barrier is designed to provide long-term containment and hydrologic protection for a performance period of 500 years. The performance period is based on radionuclide concentration and activity limits for Category 3 LLW. The Modified RCRA Subtitle C Barrier is composed of eight layers with a combined minimum thickness of 1.7 m. This design incorporates RCRA "minimum technology guidance" (MTG) (EPA 1989), with modifications for extended performance. One major change is the elimination of the clay layer which may desiccate and crack over time in an arid environment. Another change is the elimination of the geomembrane component, because of its uncertain long-term durability.*

  The Modified RCRA Subtitle C Barrier is similar in structure to the Hanford Barrier, but layer thicknesses are reduced and there is no fractured basalt layer. The design incorporates provisions for biointrusion and human intrusion control. However, the provisions are modest relative to the corresponding features in the Hanford Barrier design, reflecting the reduced toxicity of the subject waste and the reduced design life criterion.

* *Modified RCRA Subtitle D Barrier. This design is recommended for applications at nonradiological and nonhazardous solid waste sites, as well as Category 1 LLW sites where hazardous constituents are not present. The Modified RCRA Subtitle D Barrier is composed of four layers with a combined minimum thickness of 0.90 m. It is designed to provide limited biointrusion and limited hydrologic protection (relative to the other two barrier designs) for a performance period of 100 years. The performance period is consistent with the radionuclide concentrations and activity limits specified for Category 1 LLW."*

Detail beyond this level of information is not considered to be appropriate for inclusion in an executive summary.

[Note: Response modified from original after meeting to change wording on TRU constituents in Hanford Barrier description and modify basis for 100 year design life on RCRA Subtitle D Barrier.]

Page 2-4 through 2-28, Section 2.2:

The FFS should discuss whether the listed ARARs are applicable or relevant and appropriate.

Response: Reject. The determination of whether an ARAR is applicable or relevant and appropriate depends on the specific site. For example, at some sites, RCRA may be applicable depending on the type of waste and the date of disposal while at others, it may be relevant and appropriate or not an ARAR at all. Therefore, it seems more appropriate to leave the final determination of ARARS to the site-specific evaluation. See new table attached.

[Note: Response modified from original.]

Page 2-4 through 2-28, Section 2.2 (continued): Additional ARARs that should be considered for the FFS are:

* 40 CFR Part 50 - National Ambient Air Quality Standards.

Response: Reject. In the May 1 comment meeting, this item was withdrawn.

[Note: Response unchanged.]

* 40 CFR Part 191 - Environmental Radiation Protection Standards.

Response: Reject. Refer to response to comment [2].

[Note: Major modification of response.]

* 40 CFR Part 192 - Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings.

Response: Reject. Subpart A of 40 CFR 192 addresses tailings found in unstable above-ground piles with relatively steep sideslopes. The piles typically range from 5 to 150 acres in size and from a few feet to as much as 230 feet in height, and contain anything from residual contamination to 2.7 million tons of contamination. The tailings are a sand-like material that is attractive for use in construction and soil conditioning. The tailings pose an immediate, but generally limited threat to human health, but more importantly, are vulnerable to human misuse and dispersal. The waste sites considered in the FFS are not comparable in size, aboveground location, material type, or accessibility, and therefore Subpart A is

not relevant and appropriate. Subpart B applies to "...land and buildings that are part of any processing site...", and "land" is defined as "any surface or subsurface land that is not part of a disposal site..." This regulation is legally applicable only to inactive uranium mill tailing sites. In addition, this subpart of the regulation is designed for unrestricted use cleanup, not disposal of waste in place. It does not address leaving waste in place using barriers (note that the definition of land excludes disposal sites), and therefore is not relevant and appropriate in the Barrier FFS. This subpart would potentially be relevant and appropriate when all remedial options for 200 Area waste sites, including waste removal, are evaluated.

[Note: Modification from original response following meeting.]

* WAC 246-221 - Radiation Protection Standards.

Response: Accept. WAC 246-221-060 "Dose limits for individual members of the public" will be added as potential ARARs for TRU and LLW. The following text will be incorporated into Sections 2.2.1 and 2.2.2:

> *WAC 246-221-060(1): Each licensee or registrant shall conduct operations so that:*
> *(a) The total effective dose equivalent to individual members of the public does not exceed 100 mrem/yr, and*
> *(b) The dose in any unrestricted area from external sources does not exceed 2 mrem/hr.*
>
> [Note: This text was deleted in Draft B and will be reinstated.]

In addition, WAC 246-221-060(1) will be identified together with 40 CFR 61.192, WAC 173-480-040, WAC 173-480-50 and WAC 246-247-040, as a potential ARAR that was determined not to be pertinent to generic conceptual cover designs.

* WAC 246-247 - Radiation Protection - Air Emissions.

Response: Accept. WAC 246-247-040 Standards) is identified in Draft A of the FFS as a potential ARAR in Section 2.2.1.5 (re: TRU) and Section 2.2.2.4 (re: LLW). The standard is also identified in Table 2-1 as a potential ARAR for sites with TRU and LLW. These citations present the author's intended contextual interpretation of the regulation.

WAC 246-247 is not a potential ARAR for sites with hazardous or nonhazardous solid waste only. However, the Modified RCRA Subtitle D Barrier design is the baseline design for Category 1 LLW sites. Therefore, text in Section 2.2.1.5 (Draft A) needs to be reproduced under a Section 2.5.4 (Draft B) to further identify WAC 246-247-040 as a potential ARAR for the Modified RCRA Subtitle D Barrier.

[Note: Response modified to indicate where response appears in Draft B.]

Page 2-13, Section 2.2.4.3, (a)(iv):The text does not discuss what will happen to the collected run-off of surface waters and other liquid resulting from storms.

Response: Accept in part. As indicated at the top of p. 2-19, WAC 173-304-460(3)(a)(iv), surface runoff is not addressed because of the generic nature of the designs in the FFS. Edge fitup and terminations, perimeter grading and drainage, and collection of runoff are site-specific details to be developed as elements of definitive design for individual WMUs. As requested by EPA, the following text will be added to Section 4.2.3.2:

> *"The three barrier options described in this FFS are principally designed to maximize shallow infiltration, storage within the topsoil layers, and removal by evapotranspiration. The barriers are not optimized to maximize runoff. The design storm simulations indicate that runoff is not a significant design issue because precipitation events that produce surface runoff are infrequent and the volume of runoff is small. The barriers are all sloped at 2 percent to provide coherent drainage toward the perimeter of covered areas, where water would be permitted to infiltrate into the soil column at a distance from contaminated media. In certain applications, a runoff collection and diversion system may be provided at the margin of the barrier. This is a site-specific consideration to be addressed during definitive design."*

[Note: Response unchanged from original.]

Page 3-1, Section 3.0:

The FFS is not the appropriate place to "propose" an alternative for a specific waste type. A more appropriate wording would be "recommended for implementation...". Replacement of proposed should be carried throughout the FFS.

Response: Accept deletion of "proposed" throughout, but reject alternative language because of similar connotation. Suggest that the phrase "to be considered" would be more appropriate, or refer to barrier types as "baseline design" and define initially.

Additionally, these recommendations should be located after the evaluation section of the report.

Response: Reject. The current logical development is as follows:

-- ER Program waste types are identified in Chapter 1.0.
-- ARARs for each waste type are screened in Chapter 2.0.
-- Also in Chapter 2.0, applications for a limited number of surface barriers are distinguished based on the ARARs, and design criteria are derived for each barrier traceable to the ARARs.
-- Conceptual designs are developed in Chapter 3.0.
-- Conformance of the three designs to the respective design criteria is evaluated in Chapter 4.0.
-- Conformance of the three designs to EPA's nine criteria for remedial actions also is evaluated in Chapter 4.0.

It would be extremely awkward to attempt to evaluate conformance to criteria in advance of describing the proposed/recommended barrier designs.

[Note: Response unchanged from original.]

Page 3-1, Hanford Barrier: The text states that the Hanford Barrier is proposed for implementation at TRU-contaminated soil sites, sites with TRU or TRU mixed waste in nonretrievable configuration, and sites with Greater-Than-Class C LLW or mixed LLW. The text goes on to say that the Hanford Barrier has a design life of 1,000 years. The regulations contained in 40 CFR Part 191.13 state the disposal system must be protective for 10,000 years. The document is unclear how this criteria will be met. The text needs to further clarify this apparent discrepancy.

Response: Reject. See response to Comment #2.

9613448.1305

[Note: Major modification from original response.]

Page 3-4, Section 3.1.2.4:

The FFS specifies the use of basalt for the coarse biointrusion layer. The FFS should evaluate material availability as part of the implementability criterion. Alternate sources of similar material should also be evaluated.

Response: Accept in part. A separate engineering study recently was completed by BHI that evaluated on-site and off-site availability of basalt for barrier construction. A new citation for this document has been included in Section 3.1.2.3. The sentence "This material will be obtained from a quarry location to be determined" will be deleted from 3.1.2.3 and the following sentence will be added:

"An engineering study was completed to evaluate the suitability and availability of basalt quarry locations. Results of the study indicate that basalt in necessary quantities (rough order of magnitude) are available in the vicinity of the Hanford Site. The study did not select the final quarry site(s)."

The following document will be added to the reference for the FFS:

Duranceau, D.A., 1995, *Site Evaluation Report for Candidate Basalt Quarry Sites*, BHI-00005, Bechtel Hanford Inc., Richland, Washington.

[Note: Response modified to more completely address comment.]

Page 3-5, Section 3.1.2.6:

Hydraulic conductivity values determined in field test of the Hanford Prototype barrier should be included in the information provided on the asphalt layer.

Response: Accept. The following text will be eliminated:

'Tests have shown that this material can achieve in-field hydraulic conductivity values as low as 10^{-8} cm/s (Dunning 1990).'

Eliminated text will be replaced with the following:

'Laboratory permeability tests on asphaltic concrete cores from the 200-BP-1 Hanford Barrier Prototype yielded values on the order of 10^{-10} cm/s. In-field values, measured by falling-head permeameter testing, ranged between 10^{-7} and 10^{-9} cm/s (DOE/RL 1994).'

[Note: Response unchanged from original.]

Supporting documentation should be given for the permeability values of the fluid applied asphalt.

Response: Accept. The following text will be modified to reflect the most recent published information:

Current text:

'Permeability values as low as 10^{-11} cm/s have been demonstrated in tests of modified asphalt coatings (Romine 1992).' This reference also will be deleted from the reference list in Section 6.0.

Current text will be replaced with the following:

'Permeability values on the order of 10^{-11} cm/s have been demonstrated in tests of samples of polymer modified asphalt coating from the Hanford Barrier prototype constructed over 216-B-57 Crib (Freeman et al 1994).'

The Romine 1992 reference will be deleted from the reference list in Section 6.0 and replaced with the following:

Freeman, H.D., R.A. Romine, and A.H. Zacher, 1994, *Hanford Permanent Isolation Barrier Program: Asphalt Technology Data and Status Report - FY 1994*, PNL-10194, Pacific Northwest Laboratory, Richland, Washington.

[Note: Response unchanged from original.]

Additionally, alternatives to the fluid applied asphalt should be recommended.

Response: Reject. Alternatives have not been formally identified to date. BHI believes that recommendation of alternatives or substitutions for materials should be developed as an aspect of definitive designs for individual barriers.

[Note: Response unchanged from original.]

It is important to note that field tests will be required to assure that the hydraulic conductivity performance of the asphalt can be achieved.

Response: Accept. The following text will be inserted at the end of Section 3.1.2.6:

> ***'As individual barriers are constructed, field testing will be required as an aspect of construction quality assurance to assure that the design hydraulic conductivity performance of the asphalt layer is achieved.'***

The same text will be inserted at the end of Section 3.2.2.4.

[Note: Response unchanged from original.]

Page 3-6, Section 3.2: The standard RCRA Subtitle C Cover should be carried through the FFS evaluation and compared with the modified RCRA cover. This should include a comparison of the asphaltic concrete/ fluid applied asphalt layer to that of clay/HDPE layer.

Response: Accept. The FFS was modified to carry forward the RCRA MTG (Minimum Technology Guidance) barrier.

[Note: Response modified from original.]

Page 3-7. Section 3.2.2:

It is recommended that the text regarding the thickness of the Modified RCRA cover be changed to " a combined minimum thickness of 1.7 m." Site specific issues and land use scenarios may require increased thickness of the barrier.

Response: Accept.

[Note: Response unchanged from original.]

Page 3-9, Section 3.2.2.4:

As an alternative to placement of additional grading fill, increased thickness of the topsoil or graded filter layers should be evaluated. Placement of additional grading fill would likely increase the overall size requirements for the cover.

Response: Accept. Text on p. 3-9 will be modified. Text in Section 3.2.2.4 which currently reads:

'In other cases, additional grading fill (Layer 8) could be placed at the site as an aspect of barrier construction in lieu of designating a layer within the barrier as a human intrusion layer.'

will be modified to read as follows:

'In other cases, the thicknesses of one or more of the barrier layers (e.g., grading fill (Layer 8) or topsoil (Layer 1 and/or 2)) could be modified (i.e., increased) to conform to requirement 1 in lieu of designating a human intrusion barrier layer.'

[Note: Response unchanged from original.]

Page 3T-1, Layer 3, specifications: The document should indicate the life expectancy of the geotextile fabric.

Response: Reject. Because the material is specified solely as a construction aid, its life expectancy is inconsequential. To resolve the discrepancy between the presence of the geotextile fabric in the Hanford Barrier design and the absence of the fabric in the Modified RCRA Subtitle C Barrier, the fabric layer will be deleted from the Hanford Barrier description in Section 3.0. (Section 3.1.2.2 and Figure 3F-1).

[Note: Response unchanged from original.]

Page 4-7, Table at Bottom of Page:
The table indicates deep infiltration being deepest for the Hanford Barrier with no discussion as to why this is so. Include a discussion for this.

Page 4-7, Water Balance Summary Table:
Explain the deep infiltration associated with the Hanford Barrier water balance summary under ambient conditions.

Response: Accept. One of the limitations inherent to the HELP Model is the unrealistic assumption that the depth of the evaporative zone is static through time. For the uncalibrated HELP simulations of the three barrier designs in Appendices C-1 through C-3 (summarized in the table on p 4-7), a constant 36-in. evaporative zone depth value was used. From HELP model calibration (see Appendix C-4, p. C4-53), it was determined that separate evaporative depth values should be specified for the three individual barriers. In the case of the Hanford Barrier simulation, the calibrated evaporative zone depth was 69.2 in.

(nearly double the value used in the uncalibrated simulation). This change had the effect of significantly improving performance predictions for the Hanford Barrier, as indicated on Line 12 of p. 4-8. Evaporative zone depth values were less affected by calibration for the other two designs.

[Note: Response unchanged from original.]

Page 4-13, Section 4.2.6

Use of basalt should be evaluated under the implementability criterion. An EIS has not been completed for basalt borrow sources. Significant comments have been received from the Indian Tribes concerning the cultural significance of the basalt outcrops located on the Hanford Site. Costs associated with off-site transport of basalt should also be evaluated.

Response: Accept in part. On-site sources of fractured basalt for environmental restoration projects will be addressed in the Hanford Restoration Activities EIS (in preparation). As noted in previous comment (ref: Page 3-4, Section 3.1.2.4), a separate engineering study recently was completed by BHI that evaluated potential on-site and off-site sources of basalt for barrier construction. A citation for this document will be included in Section 4.2.6.3. The document will be included in the references list in Section 6.0. This document includes an evaluation of costs associated with transportation of basalt from off-site sources.

Duranceau, D.A., 1995, *Site Evaluation Report for Candidate Basalt Quarry Sites*, BHI-00005, Bechtel Hanford Inc., Richland, Washington.

[Note: Response unchanged from original.]

Alternative sources of the silt loam should also be evaluated.

Response: Accept in part. As indicated in Section 3.1.2.1, a borrow site for silt loam has been formally selected following DOE's siting process, as documented in the reference cited (Skelly and Wing 1992). To date, no specific objections have been advanced by anyone regarding this action. Cultural and biological surveys of the area have been completed. No threatened or endangered species reside at McGee Ranch. Few cultural resources of any significance have been identified. Plans are being developed to mitigate impacts to these resources from borrow operations. The cite for the McGee Ranch site evaluation report (Skelly and Wing 1992) will be included in Section 4.2.6.3.

Skelly, W.A., and N.R. Wing, 1992, *Site Evaluation Report for a Borrow Site for Fine-Textured Soils*, WHC-SD-EN-SE-002, Westinghouse Hanford Company, Richland, Washington.

[Note: Response unchanged from original.]

Page 5-3, Section 5.3.4:

The covers may be used at a variety of sites, yet this FFS does not consider the effect of settlement or subsidence within WMUs on the proposed cover. Though site specific measures may be taken to mitigate settlement with the WMU, this FFS should evaluate the cover designs to establish subsidence limits which may impact the integrity of the cover. An additional FFS is not warranted. Established limits within this FFS would then be evaluated in the design phase of the remedial action for each waste site and appropriate subgrade settlement measures would be implemented.

Response: Accept. The following paragraph will be added to section 4.1, end of paragraph 8, following the sentence, " If slopes are limited to 2%, soil losses are predicted to be acceptable."

"Two percent is the desired long term slope of the barrier surface, after allowances for settlement and subsidence. Large area post-construction barrier settlement approaching or exceed 3% may result in excessive soil losses. In addition, localized differential settlement may impact the effectiveness of the barrier if the magnitude of the localized differential settlement exceeds the thickness of any of the layers (the asphalt layer is the thinnest layer, at six inches). However, the asphalt layer could retain function under substantially more than 6 inches of subsidence if the rate of displacement is low enough that strain could be relieved by creep (which would enable the material to deform without fracturing). An engineering study is planned to address subsidence issues that may be associated with a specific waste site type (see Section 5.3.5) and provide recommendation for eliminating subsidence potential in advance of barrier construction."

[Note: Response modified substantially to better respond to comment.]

Page A-3:

All references to WHC manuals describing low-level waste categories need to be removed. These waste categories are already described in 10 CFR and DOE orders.

Response: Accept in part. Text on p. A-3 will be modified as follows:

'Low-level waste is divided into three categories at the Hanford Site: Category 1 (analogous to NRC Classes A and B), Category 3 (analogous to NRC Class C), and Greater-Than-Class C as defined by NRC in 10 CFR 61.55(a)(2). DOE Category 1 and 3 wastes are defined according to the radiological constituents and corresponding

activity limits tabulated in Section 3.0 of WHC (1995). The information in this appendix is reproduced from that source. Wastes with multiple constituents are characterized according to a "sum-of-fractions" rule derived from 10 CFR 61.55(a)(7).'

The WHC manual reference is unique and essential to the text. The activity limit information in the manual is specific to the Hanford Site and does not appear in DOE Orders.

[Note: Response unchanged from original.]

Comments on Draft B

Page 2-5, Section 192.02, last sentence. "Because the standard is pertinent to design, monitoring after disposal is not required to demonstrate compliance." Delete this sentence.

Response: Accept. (40 CFR 192 was deleted as an ARAR).

[Note: Response modified following meeting.]

Page 2-11, Technical Guidance Requirements. Of the regulations appearing in this section, the following are ARARs: 40 CFR 191.15, 40 CFR 191.24, 10 CFR 61.52(a)(2), and possibly 10 CFR 61.51(a)(4).

Response: Reject. As described in Comment 2, 40 CFR 191 does not appear to be appropriate as either and ARAR or technical guidance. Those section of 10 CFR 61 that are called out under Subpart D, Technical Requirements, are believed to fit better as technical guidance, since "relevant and appropriate" normally refers to performance standards rather than technical requirements. However, the following statement will be added 2.1.1:

"The following ARARs evaluation was performed for generic baseline cover designs. The final determination of site-specific ARARs will be made in the Record(s) of Decision."

[Note: Response unchanged following meeting.]

Attachment 3

Washington State Department of Ecology Comments on the Focused Feasibility Study of Engineered Barriers for Waste Management Units in the 200 Areas (DOE/RL-93-33)

[Note: Responses as finalized following 4/3/96 meeting.]

Comments on Draft A

GENERAL COMMENTS:

1. Operable units should use this feasibility study to determine the acceptable barrier option for the contamination and risks present; however, they should not be constrained to examine only the barrier option(s) provided in this document. Operable units have the flexibility to assess site specific conditions and examine other barrier options which may or may not meet all ARARs, but are protective of human health and the environment.

Response: Accept. The purpose of the focused feasibility study (FFS) is to evaluate generic conceptual designs for different waste types. Waste site-specific evaluations will still be performed, both to examine barrier options and to consider nonbarrier options for remediation.

> **[Note: Initial response revised from reject to accept. Current Draft B is consistent with this revised response.]**

2. The report suggests basalt and McGee Ranch silt are easily and inexpensively obtained. The Indian Nations and wildlife agencies have voiced opposition to the continued use of these resources, and may demand significant mitigation/retribution for their use. The report should discuss the current climate and uncertainty surrounding these resources, the potential mitigation required, and consider other sources for basalt and silt.

Response: Accept in part. Refer to response to SPECIFIC COMMENT #6.

> **[Note: Response unchanged from original.]**

SPECIFIC COMMENTS:

3. Page 2T-3, Tables 2-4 and 2-5

COMMENT: The modified RCRA Subtitle C Barrier design differs from the Hanford Barrier in its intrusion protection and design life. It would appear the design life for the modified RCRA barrier could be established at 1,000 years with the addition of 6 inches of silt to the uppermost layer (erosion potential estimated page D-8), provided the asphalt durability tests prove satisfactory (this is also required for the Hanford Barrier). Intrusion protection is admittedly a subjective test; the basalt in the Hanford Barrier cannot prevent the drilling scenario, it only provides a deterrent to drilling and warning of a covered waste site. Since the basalt begins at an 8 foot depth and continues for only 5 feet, a backhoe could easily remove the basalt and allow drilling to proceed. Operable units could select the modified RCRA Subtitle C barrier for a TRU waste site, provided an alternative deterrent/warning to drilling is included. The alternative deterrent/warning should function similar to the basalt layer.

RECOMMENDATION: *(A)* Include a discussion in both the executive summary and body of the document stating the Modified RCRA Subtitle C Barrier can be enhanced with a deterrent layer, similar in function to basalt, which may make it acceptable for use at TRU waste sites. *(B)* Discuss at a minimum the performance expected from concrete rubble from demolition of the canyon and reactor facilities as a functional substitute for basalt.

Response: *(A)* Accept. Revised draft will include a new Section 3.2.2.7 reading as follows:

> **"Section 3.2.2.7 - Potential Modifications to Design and Application. The Modified RCRA Subtitle C Barrier design could be enhanced by increasing the thickness of the topsoil layers and by including some type of intrusion deterrence layer (similar in function to the fractured basalt layer of the Hanford Barrier) so that it would conform to barrier criteria for TRU waste sites. This is a potential evolutionary direction for the Subtitle C barrier."**

This information will be reiterated in the executive summary. Additionally, the following text regarding sensitive resources will be inserted on P. ES-3 of the executive summary after the second full paragraph:

"It is recognized that sources of some of the materials identified for barrier construction may be culturally and/or ecologically sensitive. Alternative

materials and sources have been considered and further evaluation of materials may be warranted."

[Note: This text insert was shown as a strike out in Draft B but will be restored.]

(B) Accept. This suggestion has been made by a number of program observers. The feasibility of utilizing concrete rubble as a substitute for basalt would depend on: (1) the technical feasibility of achieving effective size reduction of reinforced concrete (nearly all concrete from demolition of canyon and reactor buildings would be heavily reinforced); (2) the costs associated with size reduction; and (3) availability of sufficient quantities of concrete rubble on a schedule that would be compatible with barrier construction. There are existing and/or emerging technologies for rubblizing concrete. The cost and utility of these techniques, as applied to heavily reinforced concrete costs, are unknown. The bottom line is that, while the idea is intriguing, a factual basis has not been established.

The following information will be inserted at the end of Section 3.1.2.4 on Page 3-5:

"Concrete rubble from demolition of 200-Area canyon buildings and reactor facilities in the 100 Areas has been proposed as a substitute for basalt. Technologies for rubblizing concrete are available. The applicability of these technologies to heavily reinforced concrete and the associated cost consequences is being considered."

[Note: Response unchanged from original.]

4. Page 2-18, WAC 173-303-610(2)(a)(iii)

DEFICIENCY: The FFS rationalizes that this WAC citation is not pertinent to conceptual cover designs. The conceptual cover design should not exclude the ability of this land from being returned to likely future uses compatible with a barrier option.

RECOMMENDATION: Address the ability of this conceptual design to not exclude the land from being returned to, at a minimum, the following uses: native vegetation, industrial use, and Native American uses (grazing, crops, etc). This

should be addressed on page 2-23, 40 CFR 264.111 and WAC 173-303-610. The discussion of the WAC citation is incomplete. WAC 173-303-610 requires the land to be returned to the appearance and use of surrounding land areas to the degree possible, given the nature of the previous dangerous waste activity.

Response: Accept. The regulation clearly identifies this requirement as a performance standard, so the "appearance and use" requirement would be relevant and appropriate to the design. Surface barriers will be seeded with a mixture of perennial shrubs and/or grasses (which may include native and non-native species), such that barrier sites will resemble surrounding lands that support native shrub-steppe vegetation to some degree. All three of the recommended barriers are designed to retain moisture close to the surface in the topsoil layers, and to minimize moisture retention in the deeper layers. These strategies are intended to facilitate moisture removal by evapotranspiration and to prevent plant roots from accessing covered waste. Consequently, the barriers will preferentially support shallow-rooted vegetation. It is considered unlikely that deep-rooted native perennials will develop to maturity on surface barriers, except (perhaps) along the margins if there are discharges of lateral drainage. The degree of similarity that is achieved between vegetation patterns on barrier surfaces and surrounding land areas will be a subjective determination. The regulation gives no indication whether the appearance criterion would be evaluated from the perspective of the average citizen or the technical specialist.

The use requirement in WAC 173-303-610 does not specify whether the focus is to be placed on current uses of surrounding land or on projected future uses. Current use of the 200 Areas might be considered "waste management" although much of the land adjoining individual WMUs is actually undeveloped and relatively undisturbed. No final determination has been made to date regarding future use(s) of land in the 200 Areas, although some type of restricted use is probable. Surface barriers constructed to cover WMUs in the 200 Areas would impose some constraints on future uses of these unit areas. It is likely that DOE would impose certain land use restrictions on these sites similar to the deed restrictions that municipalities impose on closed landfill sites. Most industrial uses probably would be precluded by the restrictions. However, there may be some light industrial uses that would not conflict with the restrictions. There is no statement of record from Native Americans of their intentions concerning future land use objectives for the 200 Areas. However, the perception is that the intended uses by Native Americans would generally be agricultural in nature. Agricultural uses for crop production (particularly uses that would involve tilling or irrigating the barrier surface) would likely be precluded. However, grazing of livestock probably would be acceptable. Hunting and gathering uses would be

acceptable to the extent that the barriers would support native food plant and game resources.

Text on bottom of P. 2-22 will be modified to read as follows:

'40 CFR 264.111 and WAC 173-303-610.

These two performance ARARs require that a disposal facility for hazardous wastes be closed in a manner that (a) minimizes the need for further maintenance, (b) controls, minimizes or eliminates releases of hazardous constituents to the environment, and (c) returns land to the appearance and use of surrounding land to the degree possible, given the nature of previous waste handling activities. These requirements can best be met by developing a low-maintenance cover constructed of durable materials, that will support perennial vegetative cover similar to vegetation on surrounding land, and be highly effective in limiting moisture infiltration. The design criteria suggested by these ARARs are as follows: (1) minimize moisture infiltration through the cover, (2) design a multi-layer cover of materials that are resistant to natural degradation processes, and (3) design a durable cover that will require minimal maintenance during its design life and that will support perennial vegetation to the extent practicable (Criteria 1, 2 and 3, Table 2-4).'

Similar modifications will be made to text at the bottom of P. 2-23 and top of following page. Text on P. 2-18, sixth paragraph, will be eliminated.

[Note: Minor modifications to original response. Also, original response stated that the degree to which the barriers met this performance standard would be described in Section 4.2.3.4, "Long Term Effectiveness." This requirement is an ARAR compliance issue, not a long-term effectiveness issue, so the text will be removed from Section 4.2.3.4.]

5. Page 4-10, Section 4.2.3.3, Long Term Durability

COMMENT: The basis for the design lives of the barriers alternatives is not discussed. It is accepted the asphalt needs further study to determine its durability. It would appear the Hanford and modified RCRA subtitle C barrier

would have equivalent design lives.

RECOMMENDATION: Discuss briefly how the design lives were determined and state the limiting design feature of each barrier.

Response: Section 4.2.3.3 will be revised to read as follows:

'The principal issues associated with long-term durability of surface barriers are (1) potential changes in barrier morphology (thickness) due to erosion, and (2) potential chemical or physical alteration (weathering) of barrier materials.

If an excessive amount of topsoil material is removed from the barrier surface by erosion, hydrologic performance would be adversely affected. In all three barrier options, the topsoil system is designed to perform the key role in moisture management. As explained previously, the topsoil layers will serve as a storage medium for moisture received as precipitation. Storage will be enhanced by the development of a capillary barrier at the base of the topsoil system. Increasing the storage capacity and the residence time for soil moisture within the topsoil system will both facilitate evapotranspiration processes. Performance simulations in Appendix C indicate that, as designed, the topsoil systems of the three barriers can be expected to store and remove essentially 100 percent of average annual moisture receipts. Numerical sensitivity studies indicate that a minimum thickness of topsoil (on the order of 24 to 26 in.) is required to sustain moisture removal at this level of efficiency.

Several provisions have been incorporated into the three barrier designs to protect the topsoil system from and/or otherwise compensate for the effects of erosion. The top layer of each barrier includes an admixture of pea gravel that will assist in armoring the barrier surface to protect it from wind erosion. Cover vegetation will be cultivated to further assist in reducing exposure of barrier surfaces to wind. Third, and perhaps most importantly, each barrier design includes excess thickness in the topsoil layers to provide performance margins against long-term wind erosion and long-term climate change. Sample calculations of potential wind and water erosion rates are provided in Appendix D, Sections 2.0 and 3.0. Projected soil losses for the three barrier options over their respective design lives are reported in Appendix D, Section 4.0. For the Hanford Barrier (1,000-year design life), the thickness allowance for wind erosion is 12.1 in. For the Modified RCRA Subtitle C Barrier (500-year design life), the allowance for wind erosion is 6.0 in. And for the Modified RCRA Subtitle D Barrier (100-year design life), the allowance for wind erosion is 1.2 in. These losses are all tolerable (i.e., soil losses of these magnitudes would not reduce the composite thickness of

topsoil components into the range of 24 to 26 in.). The beneficial effect of the pea gravel admixture in limiting wind erosion is not considered in the calculations in Appendix D, Section 4.0.

Aside from the low-permeability asphalt layer specified in the Hanford Barrier and the Modified RCRA Subtitle C Barrier, the three barriers will be constructed entirely of natural rock and soil materials. Chemical and physical weathering rates for these materials are low relative the performance periods of interest, and it is known that these materials will not experience any significant deterioration during the specified performance periods for the three barriers. The low-permeability asphalt layer also is expected to provide adequate durability based on studies of naturally occurring asphaltic materials. It is anticipated that additional studies of long-term durability of asphalt will be performed. The asphalt layer and lateral drainage layer in the Hanford Barrier and the Modified RCRA Subtitle C Barrier are both situated at sufficient depth below the surface to ensure permanent protection from frost damage.'

[Note: Response unchanged from original.]

6. Page 4-13, Section 4.2.6.3, Availability of Services and Materials

COMMENT: In discussing availability of McGee Ranch silt and basalt, the reader is not provided an indication of the existence of significant opposition to the use of these resources from the Hanford site.

RECOMMENDATION: Address and recognize the opposing viewpoints on use of these critical resources to the success of the barrier program. Discuss use of off-Hanford sources and substitution of these critical components with other materials. Acknowledge the potential need and cost of mitigation/retribution at the borrow sites.

Response: Accept in part. The existence of conflicting viewpoints regarding acquisition of borrow materials from on-site sources is acknowledged. It is also acknowledged that appropriate NEPA documentation for the proposed on-site borrow sites will have to be prepared. On-site sources of fractured basalt for environmental restoration projects will be addressed in the Hanford Restoration Activities EIS (in preparation). A separate engineering study recently was completed by BHI that evaluated potential on-site and off-site sources of basalt for barrier construction. A citation for this document will be included in Section 4.2.6.3. The document will be included in the references list in Section 6.0. The citation is as follows:

Duranceau, D.A., 1995, *Site Evaluation Report for Candidate Basalt Quarry Sites*, BHI-00005, Bechtel Hanford Inc., Richland, Washington.

This document includes an evaluation of costs associated with transportation of basalt from off-site sources. In the author's view, this comment should be directed toward the HRA EIS rather than the FFS.

As indicated in Section 3.1.2.1, a borrow site for silt loam has been formally selected following DOE's siting process, as documented in the reference cited (Skelly and Wing 1992). To date, the author is unaware of any specific objections regarding this action. Cultural and biological surveys of the area have been completed. No threatened or endangered species reside at McGee Ranch. Few cultural resources of any significance have been identified. Plans are being developed to mitigate impacts to these resources from borrow operations. The cite for the McGee Ranch site evaluation report (Skelly and Wing 1992) will be included in Section 4.2.6.3.

Skelly, W.A., and N.R. Wing, 1992, *Site Evaluation Report for a Borrow Site for Fine-Textured Soils*, WHC-SD-EN-SE-002, Westinghouse Hanford Company, Richland, Washington.

Additionally, the following text regarding sensitive resources will be inserted on P. ES-3 of the executive summary after the second full paragraph:

> ***"It is recognized that sources of some of the materials identified for barrier construction may be culturally and/or ecologically sensitive. Alternative materials and sources have been considered and further evaluation of materials may be warranted."***

[Note: Response unchanged from original.]

7. Page 3-4, Section 3.1.2.3, Graded Filter Components

COMMENT: *Ecology 1987* is cited as a reference for establishing criteria for the design of the graded filter, however, it is not listed in the reference section on page 6-2. The reference cited was updated in July 1993 and is titled "Dam Safety Guidelines, Part IV: Dam Design and Construction."

RECOMMENDATION: Ecology's newly updated guidelines provide a more thorough approach to choosing a filter. Review and change the design accordingly and list Ecology 1993 in the reference.

Response: The reference is to Ecology's *Solid Waste Landfill Design Manual (Pub 87-13)*, not *Dam Safety Guidelines*. The omission in Section 6.0 will be corrected in the next revision. The full reference should read as follows:

> **Parametrix, 1987, *Solid Waste Landfill Design Manual,* by Parametrix, Inc., Belleview, Washington, Publication No. 87-13, for Washington State Department of Ecology, Olympia, Washington.**

The new filter criteria in *Dam Safety Guidelines* have been reviewed. In cases where the base soil is a fine-textured material like McGee Ranch silt loam, the new criteria will produce a coarser filter media specification than the old criteria. For coarser textured materials the new criteria and the old criteria are essentially the same. Based on this insight, BHI prefers to retain the existing specifications developed with reference to the old criteria because they are conservative (i.e., smaller particle size contrasts are identified across the filter boundaries). Additional physical testing may be needed to verify that significantly coarser filter materials would be appropriate.

> **[Note: Response unchanged from original.]**

Comments on Draft B

1) pg ES-3, para 3: Restore strikeout. Paragraph had been agreed to for insertion into the executive summary during last review cycle.

Response: Accept. Text is in main body of document (Draft B, 3.2.2.7) and will be restored in Executive Summary.

2) pg 2-4, section 2.2.1: Ecology disagrees that 40 CFR 191 is not ARAR; Ecology would like to understand why DOE considers 40 CFR 191 a TBC.

Response: DOE does not consider 40 CFR 191 either an ARAR or technical guidance and proposes to remove reference to it from the FFS. 40 CFR 191 Subpart B - Environmental Standards for Disposal does not apply to "wastes disposed of before November 18, 1985." (40 CFR 191 .11(b)(2)) In addition, the preamble states that this regulation was "developed primarily through consideration of mined geologic repositories," that the protectiveness requirements analysis was based on massive quantities of spent fuel (an assumed 100,000 metric tons of fuel) and TRU waste, and that the selection of a 10,000 year time frame relies heavily on the siting process. The waste sites in the 200 Area are near-surface (versus geologic repository), they do not contain "massive" quantities of radioactive material, and they are already sited. The problems and situations in the 200 Area are not sufficiently similar to those addressed by 40 CFR 191, and therefore the regulation is not relevant and appropriate nor is it useful for technical guidance.

3) pg 2-33, para 1: Ecology does not understand or agree that an additional 6" of topsoil would significantly delay the design process and have negligible benefit.

Response: Text on page 2-33 will be revised as follows:

> **"This criterion would add 15 cm (6 in.) to the previous 46-cm (18-in.) topsoil layer (see Section 3.0 for details.). ~~This incremental increase in design is considered negligible, and the benefits of a streamlined design exceeds the impact of adding this thickness~~. The site specific evaluation that is needed for all waste sites could further address this issue and evaluate the appropriateness of incorporating this criterion. ~~eliminate the 15 cm (6 in.) of additional topsoil if it is deemed cost effective for that waste site.~~**

4) pg 3-4, para 1: The discussion in the paragraph suggests that a decision to use McGee Ranch silt has been made. Change discussion appropriately.

Response: Section 3.1.2.1, paragraph 5, will be modified to say "...the recommended topsoil for the Hanford Barrier *could be* obtained from the McGee Ranch..."

5) pg 3-7, para 1: The discussion claims that asphalt could "remain functional for a period of 5,000 years or more ..." However, a draft proposal was submitted to the Site Technology Coordination Group to seek funding for continued research of the Hanford Barrier. The proposal was described as "this task will establish a defensible data set to address questions regarding the longevity of asphaltic barrier and cap material." Please clarify.

Response: The above full passage from the text reads, "Natural analog studies (Waugh et al. 1994; Freeman and Romine 1994) estimate that asphalt could remain functional for a period of 5,000 years or more ..." The following clarifying paragraph will be added:

> **"The natural analogs noted above, were from asphalt specimens from museum collections that range in age from 150 to 5,000 years. This is limited sampling, testing and information for defensibility purposes. Currently, heat accelerated aging tests are proposed on asphaltic samples fabricated from specifications for the asphalt layer in the barriers; these tests would be more defensible than current analog projections."**

6)General Comment: The document contains substantial revisions to the ARARS section. Draft A of this document had been previously reviewed and appropriate revisions agreed to by all parties. Ecology did not attend the Dec 19, 1995 meeting between DOE and EPA to discuss ARARs and would like to meet separately with DOE to understand the ARAR revisions.

Response: See ARARs writeup (attached) addressing modifications.

Comment provided at April 4, 1996 meeting

Comment: Delete use of WAC 173-304 as an ARAR and substitute WAC 173-351-500.

Response: Rejected. FFS will continue to cite WAC 173-304 "Minimum Functional Standards for Solid Waste Handling," rather than change to WAC 173-351 "Municipal Solid Waste Landfills." The basis for this is that WAC 173-351-010(2)(b) states "MSWLF units that stopped receiving waste prior to October 9, 1991, are subject to closure and post-closure rules under chapter 173-304 WAC, the Minimum Functional Standards for Solid Waste Handling." All of the units considered in the FFS stopped receiving waste prior to October 9, 1991. The barrier design criteria are unaffected by this.

Attachment 4

COMMENTS FROM RL ON THE FOCUSED FEASIBILITY STUDY OF ENGINEERED BARRIERS FOR WASTE MANAGEMENT UNITS IN THE 200 AREAS (DOE/RL-93-33) GENERAL COMMENTS

1. The document is well written and easy to follow even though it contains technical information that is difficult to explain.

Response: Noted.

[Note: Response essentially unchanged from original.]

2. The report cites 40 CFR Part 191.15 for individual protection requirements for allowable dose exposure from the disposal system to any member of the public in the accessible environment. The allowable exposure levels are currently being assessed by the Department of Health, EPA and DOE. The current discussion suggests 10 to 15 mrem as the maximum annual dose limit to the whole body. Suggest including a statement that the current requirement levels will change.

Response: Rejected. All of the regulations identified in Section 2.2 are subject to periodic review and revision. Regulatory reviews are all, of necessity, snapshots in effect. The indicated revision above probably would not be consequential to the subject matter in this FFS, which is developed to a generic conceptual design level of detail, as opposed to site-specific definitive design and, therefore, is not considered to warrant special reference.

In addition, reference to 40 CFR 191.14 has been deleted because it is no longer considered an applicable or relevant and appropriate requirement (ARAR) or technical guidance. 40 CFR 191 Subpart B - Environmental Standards for Disposal specifically does not apply to "wastes disposed of before November 18, 1985." The preamble clarifies that it is intended to apply to mined geologic repositories. 40 CFR 191 is not relevant and appropriate because it was intended for disposal of massive quantities of spent fuel and transuranic (TRU) waste (100,000 metric tons of spent fuel) and it relies heavily on siting criteria; the types and quantities of material at the 200 Area waste sites and the reliance on siting criteria are not sufficiently similar to the conditions addressed by 40 CFR 191.

[Note: Comment modified slightly to delete reference to 40 CFR 191 which is no longer considered an ARAR.]

1. This Focused Feasibility Study (FFS) of the engineered barriers is destined to become part of the Interim Record of Decision (IROD) for the surface treatment of a range of high priority source waste management units. In appendices C through C4, it presents performance evaluation of the three barrier designs using model simulations generated by HELP and UNSAT-H computer codes. As indicated in those appendices, the model simulations are based on measured, calculated and default parameter values of the various soils layers and the asphalt layer of the three barriers. These brief introductory remarks form the basis for the following questions that need to be address in this study.

a) RL/ER is conducting a field test and collecting data on a prototype barrier cap over 200-BP-5. The infiltration and the drainage data collected to date should be used to calibrate the two models and should be used to evaluate how reasonable the other parameters used in the two models.

b) Provide a write up about these barrier tests that are being conducted. This will allow the decision makers to determine:

1) How these tests will be used to provide a level of confidence in the proposed cap designs,

2) How the tests will interface with the IROD, and

3) How they will be used support the 100, 500 and 1,000 years design requirements to win regulatory support.

Response: A monitoring and testing program for the B-57 prototype is in progress to develop this information. However, it is not within the intended scope of this document to status ongoing prototype testing activities.

[Note: Response essentially unchanged from original.]

4. At many places in Section 1 [see page 1-1, ¶4; §1.2, pages 1-4 and 1-5] the FFS explains that the proposed design of the three caps are to support the IM path and cites the Hanford Site Past-Practice Strategy for the IRM path justification. At a quick glance and within the Past Practice Strategy it may be a sound and reasonable strategy to do an IRM leading to IROD. However, after a careful evaluation of the permanence of the three barriers it is reasonable to presume that these barriers will not be modified, changed, or upgraded once constructed. This leads GSSC to believe that the IRM path is not an appropriate process for these permanent capping technologies. The effective path for these technologies is not

through the IRM, but through direct RM to a ROD which leads to a permanent solution, instead of an interim solution. The barrier caps are developed for permanent and long term (100 to 1,000 years) solutions. Placing two feet of soil cover to reduce an immediate exposure hazard would be an IRM, followed by a permanent solution (ROD). Please modify the referenced sections and restate the actual RM path for permanent remedies.

Response: Accept. This comment is similar to one made by U.S. Department of Energy-Headquarters (DOE-HQ) contractors. The proposed disposition is as follows:

The last two paragraphs in Section 1.2 (which appear on Page 1-5) will be modified to read as follows:

> **'Waste management units in the 200 Areas that have been identified as candidates for remediation with surface barriers (including both high- and low-priority sites) are listed in Appendix B. Covers may be selected as interim remedial measures (IRM) for high-priority (i.e., IRM and limited field investigation (LFI) candidate) sites, or as final remedies for low-priority sites (FRS candidates). The decision logic for selecting the appropriate cover option for a given site (presented in Section 5.0) is not dependent on the remediation path. Where covers are selected initially as IRMs, it is generally expected that they would also be designated as final remedies.**
>
> **This focused feasibility study (FFS) report must also provide recommendations for any additional studies that may be required to facilitate the near-term implementation of the conceptual designs described in this report. These recommendations are provided in Section 5.0. This FFS report is to provide a limited number of preengineered cover options to support the IRM path. Decision logic for determining the appropriate cover alternative to be evaluated for specific types of sites is provided in Section 5.0.**
>
> **[Note: The response in the second paragraph has been modified to reflect the text as it will be in Rev. 0.]**

5. The conceptual design of the cap is incomplete: Though Figures 3-1 through 3-3 provide profiles for the three barrier caps; it does not provide a cross section of a barrier cap over an assumed waste site that should show basic design parameters such as slope angles for the various layers, areal toe lines and their

offsets from the edges of the waste site and, side slopes and the protective riprap layer. Provide a cross section and discussion in the relevant section.

Response: Reject. The recommended slope angle is 2% on all internal and external layer surfaces. The mode of termination around the perimeter (i.e., toe lines, side slopes, and protective riprap) of a barrier is a site-specific design issue that does not require or benefit from standardization or uniformity. This issue is identified in Section 5.2 to be considered during definitive designs for individual waste management units.

[Note: Response essentially unchanged from original.]

6. Continuing with comment 3, the side slopes and the protective riprap layer is missing from the discussion in § 3.0. The design is flawed and incomplete without such protective layer, and would not last long without a protection. The riprap and its transition into the adjacent layer needs to be properly graded and designed to eliminate piping and erosion. Provide a discussion and a drawing. A properly designed slope atop the asphalt layer is essential to the barrier function and it should include long term settlement/subsidence considerations to eliminate any potential sagging. Provide a discussion and a drawing.

Response: Refer to comment response #5.

[Note: Response essentially unchanged from original.]

7. Design and Construction costs shown in Tables E-1 and E-2 appear to be high and inconsistent, and not representative of industry standards. For example, Table E-1 (Hanford Barrier Conceptual Cost Estimate) shows a cost of $ 10,199 to spread a 6-inch layer of gravel and a cost of $3,307 to spread a 4-inch layer of base material. It is not clear why the cost to spread a 6-inch layer is over three times that required to spread a 4-inch layer. An other example of excessive cost is the quote from Kaiser Engineers Hanford (KEH) for $1,176,120 for a fluid applied asphalt coat (nearly $40 per square yard). **The cost of this thin coat represents over 20 percent of the total cost for the project** and there is no evidence that this fluid coat is necessary since the text states that the asphaltic concrete (without the fluid top coat) exceeds design requirements. These examples, indicate that a closer inspection of the costs and design of what is necessary to meet design requirements should be done by the private sector.

Response: The indicated costs and quantities of material in Table E-1 are correct. However, the "6-inch layer" of drainage gravel should read "12-inch". The typographical error will be corrected. Since this FFS was prepared, an independent construction cost estimate has been developed for the Modified RCRA

Subtitle C design. Industry standard estimating methods, along with actual cost history data from construction of the Hanford Barrier prototype over 216-B-57 Crib in the 200-BP-1 Operable Unit, were used to prepare this estimate. The results of the two estimates are comparable. For discussion of the fluid-applied asphalt layer, refer to comment response #32.

[Note: Response essentially unchanged from original.]

8. Hanford Barrier Cap in particular and RCRA Title Cap (in general) may be considered as NRC Category 1 structures. This requires that tests for slope stability and internal integrity of the layers be performed under Hanford seismic design earthquake. The vulnerability of the barriers to seismic hazard has not been addressed in this FFS. GSSC recommends an assessment of seismic loading for the barriers.

Response: Noted. The Hanford Barrier has been evaluated with regard to seismic susceptibility (see Wing et al. 1995, Physical Stability of Long-Term Surface Barriers - Assessment of Potentially Disruptive Natural Events, BHI-00145). The Bechtel Hanford, Inc. (BHI) document has been released since the FFS was issued for review, and contains information that was not available for reference in the FFS. Seismic hazards for the other two designs have not been evaluated at all. Generally, the work to date indicates that susceptibility is confined to the sideslope area, and because the sideslope design is expected to vary from site to site, the issue of susceptibility may be site specific. In the FFS, this issue is identified in Section 5.2 as to be considered during definitive designs for individual waste management units.

[Note: Response essentially unchanged from original.]

SPECIFIC COMMENTS

(No comments #9 or #10)

11. Page ES-1, Line 26; Page ES-3, Line 6; Page 1-5, Lines 35 and 36; Page 2-1, Line 25; Page 2-18, Line 1; Page 5-1, Line 32: Delete the word "all". It is unnecessary and implies a level of perfection which is unattainable.

Response: Accept.

[Note: Response essentially unchanged from original.]

12. Page ES-3, Line 14:Replace the word "ensure" with "verify" or some other suitable word that does not imply a guarantee.

Response: Accept.

[Note: Response essentially unchanged from original.]

13. Page ES-3, Line 8: Delete words "determined to be" as unnecessary.

Response: Accept.

[Note: Response essentially unchanged from original.]

14. § 2.0 and Table 2T-1Page 2-17, Line 5; Page 2-19, Line 41; Page 4-6, Lines 30-4: Your attention is directed to the many performance based ARARs mentioned in this section that minimize moisture infiltration, minimize erosion, accommodate settlement, and eliminates release of hazardous constituents to the environment. The three barrier caps are designed to meet these ARARs, but they have not been tested in actual field condition. A prototype barrier is being tested to develop data that will validate the performance and satisfy the above ARARs and allow the regulatory acceptance. Therefore, it is imperative to discuss the testing program and its utilization in this context. Provide such a narrative that will make a positive connection between the testing, validation and the performance of barrier caps. Please clarify how the barriers will meet technical acceptance without support of such specific data?

Response: Reject. It is agreed that there is a need for a high-level program plan that will establish clear connections between the outstanding barrier performance issues; the corresponding data needs to be resolved by specific monitoring and testing activities, definitions of specific results, and conclusions that will be required by the various stakeholders to reach consensus on validation, and multiyear budget and schedule commitments. It is not the intended purpose of the FFS to provide this program plan, nor is it likely that such a plan could be provided at this time. Presently, consensus is lacking among the stakeholders regarding the specific monitoring and testing issues that need to be addressed, the data needs, sufficiency of proof, and funding levels that are necessary and appropriate to resolve issues in a timely manner. DOE and BHI currently are looking to the regulators and other stakeholders to identify issues, data needs, and sufficiency requirements for barrier performance. This approach might be workable if the regulators were operating with a clear vision of their roles and requirements in the validation process. However, that is not the case so far. Lacking clarity and leadership, funding commitments by DOE have been restrained. Given the politics

of the situation, it may be some time before a comprehensive program plan for barrier performance monitoring and testing can be developed.

[Note: Response essentially unchanged from original.]

15. Page 2-17, Line 5; Page 2-19, Line 41; Page 4-6, Lines 30-41

There is a new version of the HELP model. Recommend rerunning analyses using this new version. The new code may resolve limitations existing in the version used in Draft A.

Response: Reject. The FFS authors are aware of HELP Version 3.0. Rerunning the HELP simulations with the new version was considered. However, it was agreed, in consultation with the U.S. Environmental Protection Agency (EPA), that any improvements in performance predictions with the new version probably would be minimal compared to the cost of doing the work.

[Note: Response essentially unchanged from original.]

16. Page 2-20, Lines 12-15: UNSAT-H is referred to as a "model" and as a "code". Choose one and be consistent.

Response: Accept.

[Note: Response essentially unchanged from original.]

17. Page 2-27, Line 42: GSSC believes "Subtitle C" should read "Subtitle D".

Response: Accept.

[Note: Response essentially unchanged from original.]

18. Page 3-2, § 3.1.2.1. Please indicate if the top two layers will be placed at its natural (borrow pit) water content, or if the inplace water content will be modified? Also, indicate if the top two layers of the barriers and/or asphalt layer would be flat or pitched at a certain angle to facilitate drainage.

Response: Accept. The following information will be included in Section 3.1.2.1 in response to this comment:

Insert at the end of the first paragraph:

"Layer 1 will be constructed with a surface slope of 2%."

Insert at the end of the second paragraph:

"The water content of the topsoil material in Layers 1 and 2 will be essentially the same as the in-place value at the borrow site. A minimal amount of moisture will be added at the borrow site for dust control."

[Note: Response essentially unchanged from original.]

19. Page 3-3, ¶ 3, line 18. Check and correct the density value of 1.38 g/cc (86.3 lb/ft). It is the density of layer 2, not of layer 1 that will suffer wind erosion. The density of layer 1 is 1.46 g/cc.

Response: Accept. The following change will be made to resolve the inaccurate statement in the third paragraph:

Statement did read:

"Assuming that the topsoil layers are constructed at a bulk density of about 1.38 g/cc (86.3 lb/ft^3), which is approximately the same as the in-place value at the borrow site, and projecting a soil erosion rate of 2 tons per acre per year, the thickness of soil loss over the barrier's 1,000-year design life would be approximately 33 cm (13 in.)."

Statement will be modified to read:

"Assuming that the topsoil layers are constructed at a bulk density that is approximately the same as the in-place value at the borrow site, and projecting a soil erosion rate of 2 tons per acre per year, the thickness of soil loss over the barrier's 1,000-year design life would be approximately 33 cm (13 in.)."

[Note: Response essentially unchanged from original.]

20. Page 3-4, § 3.1.2.4, Par. 2; Page 3-5, Par. 3: Please note that Layer 6 (Coarse Fractured Basalt) should not be considered an impediment to any kind of human activity, especially drilling. Industry drilling methods commonly make several hundred feet of hole per day and four of five feet of fractured basalt will not even be noticed by off-site, serious, and non-Hanford drillers. Delete the reference that Layer 6 somehow is a viable obstacle to human intrusion.

Requirement 40 CFR 191 may require some mention that human intrusion be considered in the design; however, a thin layer of fractured basalt is not a design to prevent human intrusion since it will not be felt by a serious driller intent upon making hole. A fine gray-black mist will be seen for about five seconds as the drill rig penetrates this so-called impediment using an air-rotary drill rig or any number of drilling methods.
If the intent is to seriously prevent human intrusion via drilling methods then this reviewer recommends that a five or ten foot thick layer of old rubber tires be considered and studied to prevent penetration. This idea came to mind while conducting RI drilling in the Greenacres Landfill (east of Spokane) in 1988 when the drill string encountered several disposed tires approximately 15 feet below grade. Penetration and drilling immediately stopped once the tires were encountered since the transmission of the drill rig burned out (drill string is still in place anchored into the old tires since it could not be retrieved once a new transmission was installed).

Layer 6 is adequate as a biointrusion barrier but should not be considered as an obstacle to inadvertent and real drilling.

Response. Accept in concept. It is conceded that some of the discussion appearing in the third paragraph of Page 3-5 may be overgeneralized. If all potential drilling methods (current and future) are considered, one or several methods probably exist that could successfully penetrate virtually any type of layer or system of layers that might be incorporated into a surface barrier design for the purpose of intrusion control. BHI declines to act on the recommendation in the comment to broaden the discussion to include the range of potential drilling techniques, insofar as we are dealing with future intervention scenarios, and a future state of the art in drilling technology that is speculative. Alternatively, the following modification is proposed in place of the third paragraph:

> **The coarse, fractured basalt in Layer 6 is designed to <u>present</u> an impediment to <u>human intrusion</u>. A subsurface layer consisting of loose, <u>coarse</u> fractured rock represents an adverse <u>ground condition for many types of drilling methods</u>, typically because circulation cannot be maintained, cuttings cannot be removed from the hole, the drill bit does not receive adequate lubrication, and firm contact cannot be maintained between the bit and the rock, all of which contribute to high bit wear and minimal advance of the hole. However, drilling methods exist today that would be minimally affected by the composition of Layer 6, and more effective technologies are likely to be available in the future. Therefore, the effectiveness of Layer 6 as a deterrent to drilling intrusion is likely to decrease over time.**

However, EPA indicates that 'passive institutional controls or the intruders' own exploratory procedures (would be) adequate for the intruders to soon detect, or be warned of, the incompatibility of the area with (exploratory drilling) activities.' The composition and construction of Layer 6 should be sufficiently unique as to be immediately recognizable to knowledgeable persons engaged in resource exploration as engineered-fill material, as opposed to a natural soil deposit of normal geologic origins. Thus, Layer 6 may function either as an impediment to drilling intrusion or as a warning/marker horizon. In either case, Layer 6 will serve to alert intruders to the existence of anomalous subsurface conditions at covered waste sites.

In addition, reference to 40 CFR 191.14 has been deleted because it is no longer considered an ARAR or technical guidance. 40 CFR 191 Subpart B - Environmental Standards for Disposal specifically does not apply to "wastes disposed of before November 18, 1985." The preamble clarifies that it is intended to apply to mined geologic repositories. 40 CFR 191 is not relevant and appropriate because it was intended for disposal of massive quantities of spent fuel and TRU waste (100,000 metric tons of spent fuel) and it relies heavily on siting criteria; the types and quantities of material at the 200 Area waste sites and the reliance on siting criteria are not sufficiently similar to the conditions addressed by 40 CFR 191.

[Note: Response modified from original to delete text that refers to refers to 40 CFR 191.]

21. Page 3-5, § 3.1.2.6, Par. 1: Mention the biodegradation potential of the asphalt layer; no discussion of this is mentioned in the analog study. Ecology has expressed concerns regarding this issue. Acceptable ASTM tests exist to address their concerns: The following ASTM Test Methods should be applied:

- G21-70
- G22-76

Response: Reject. Biological attack as a capable degradation mechanism was evaluated some time ago by the Pacific Northwest National Laboratory (PNNL) in studies conducted in support of the UMTRA Program and the Hanford Grout Vaults Project. These studies showed that biodegradation was highly dependent on the available surface area, and that biodegradation generally became self-limiting as microbial waste products accumulate on the surface. Consequently, biodegradation has not been considered in the recently proposed activity plans for asphalt aging and durability testing.

Reference: Luey, J., and S.W. Li, 1993, Determination of the Biodegradation Rate of Asphalt for the Hanford Grout Vaults, PNL-8599, Pacific Northwest Laboratory, Richland, Washington.

[Note: Response essentially unchanged from original.]

22. Page 3-7, §3.2.1, ¶3: One of the significant design changes that was incorporated in the Modified RCRA Subtitle C was to eliminate the geosynthetic layer. The main function of the geotextile filter fabric incorporated in the Hanford barrier is to prevent mixing of fine-texture soil (silt) and migration to a lower layer during construction activities. The same concern exists for the construction of the Modified RCRA Subtitle C barrier. Suggest including the geotextile filter fabric particularly when its cost is relatively insignificant (approximately one percent) compared to the total cost of constructing the barrier as indicated in Appendix E.

Response: Reject. The geotextile filter fabric in the Hanford Barrier is nonessential. If the two-layer graded filter performs as designed, there is no significant mixing or migration potential. In comments from EPA, the design life of the filter fabric was called into question. To disposition that comment, it was agreed that the fabric would be deleted from the Hanford Barrier design in the final revision. This was the preferred course of action because the fabric provides no essential contribution (other than as a "feelgood" type of thing) and because its durability is indeterminate.

[Note: Response essentially unchanged from original.]

23. Page 3-11, 4th Paragraph; Page 3T-5, Layer No. 3, Function; Page 4T-8, Criteria 7, Assessment: In assessing the ability of layer 3 to retard the migration of moisture, a target value for a minimum permeability should be included from which the retention capacity can be determined as well as the extension of residence time. Otherwise the paragraph sounds evasive, as if it is skirting the issue. Double ring infiltrometer tests should be run on test lifts.

Response: Accept. The text will be modified to include compaction test results as follows:

> **'Compaction of Layer 3 during construction will decrease its saturated hydraulic conductivity by three to four orders of magnitude (i.e., from values in the range of 10^{-3} to 10^{-4} cm/s down to values between 10^{-6} to 10^{-7} cm/s). The indicated reduction in conductivity is readily achievable by compacting McGee Ranch silt loam soil to densities in the range of 1.68 to 1.84 (105 to 115 lb/ft^3). Laboratory testing indicates that these results can be accomplished with**

moderate compactive effort (Skelly et al. 1994). Compaction will retard moisture migration through Layer 3. Moisture retention and evapotranspiration within the topsoil system also will be enhanced by formation of a capillary barrier at the base of Layer 3. Numerical performance assessments using HELP and UNSAT-H predict that essentially 100% of average annual precipitation will be removed from the barrier by evapotranspiration (Appendices C-3 and C-4).'

BHI believes that compaction can be adequately evaluated by typical field QA/QC methods (nuclear density measurements), which would be preferable to SDRI testing on the basis of cost benefit.

[Note: Response essentially unchanged from original.]

24. Page 3T-3, Table 3-2, Layer No. 1, Specifications: The fill material for the first layer is specified at a bulk density of approximately 1.46 g/cc. The text (Page 3-8, ¶0) includes specification of 1.38 g/cc. Please revise.

Response: Accept. The information on Page 3-8 was incorrect. The difference in these values is attributable to the higher bulk density of the pea gravel component.

[Note: Response essentially unchanged from original.]

25. Page 4-2, Line 21: The "three criteria" should read "eight criteria".

Response: Accept.
[Note: Response essentially unchanged from original.]

26. Page 4-5, Lines 5-8: Need to back up these claims analytically elsewhere in this report.

Response: Accept. Refer to comment response #23.

[Note: Response essentially unchanged from original.]

27. Page 4-6, Line 13: The statement that the "design is considered to provide sufficient control" needs backup.

Response: The sentence with this statement has been deleted as a result of revising the ARARs discussion throughout the document.

[Note: Response has been modified from the original.]

28. Page 4-6, Line 25: Refers to institutional control will last for 100 years. Is this from start of first closure or after final closure?

Response: This sentence with this statement has been deleted as a result of revising the ARARs discussion throughout the document. The document now states that The Subtitle D Barrier has a design life of 100 years, and that control of inadvertent human intrusion will be placed on existing institutional controls.

[Note: Response has been modified from the original.]

29. Page 4-12, § 4.2.6. The integrity of all three barrier caps are dependent on the foundation conditions. Such integrity can be compromised if the cap's foundation under goes settlement due to loss of volume within the waste site. It is important for this document to recognize this situation and it should suggest a few measures to preconsolidate waste sites and improve foundation stability.

Response: Refer to comment response #35.

[Note: Response essentially unchanged from original.]

30. Page 4-14, §4.2.7, ¶1: Reads "126 m by 1,739 m (415 ft by 530 ft)...", please revise.

Response: Accept. "126 m by 1,739 m (415 ft by 530 ft)..." should read "126 m by <u>162</u> m (415 ft by 530 ft)..."

[Note: Response essentially unchanged from original.]

31. Page 4-14, Line 14: With the recent construction of the B-57 prototype barrier, aren't more precise costs available?

Response: Refer to comment response #7.

[Note: Response essentially unchanged from original.]

32. Page 5-2, §5.3.2: The text discusses difficulties in implementing the "seal coating of spray-applied polymer-modified asphalt". In addition, the text raises the concern of the cost associated with the fluid-applied asphalt. Later, the text states that during initial permeability tests, the asphaltic concrete layer (without the coating layer) exceeded design requirements. It is unclear why the text does not recommend eliminating the coating layer particularly when the design requirements were met on the basis of asphaltic concrete layer only. In addition,

the cost for the coating material is 20 or 40 percent of the cost for construction of the Hanford and Modified RCRA C barriers, respectively. Please clarify.

Response: Noted. For information, one purpose served by the polymer-modified asphalt coating is as a direct analog to the geomembrane in the RCRA minimum technology guidance. If the coating is eliminated from the design, the issue of RCRA equivalence may reappear. As this is a politically sensitive issue with the regulators, the issue is being worked slowly so as not to exceed the stakeholders' comfort levels.

[Note: Response essentially unchanged from original.]

33. Page 5-2, Line 9: References field demonstration tests described in "Section 5.3.1". However, Section 5.3.1 does not describe any field demonstration tests.

Response: Accept. The sentence on Line 9 will be modified as follows:

Sentence did read:

> **"These activities include work associated with the Hanford Barrier Development Program and the field demonstration tests described in Section 5.3.1 associated with the cover remedy selected for units within the 200-BP-1 Operable Unit."**

Sentence will read as follows:

> **"These activities include work associated with monitoring and testing of the Hanford Barrier prototype and the work described in Sections 5.3.1 and 5.3.2 below, which is related to the selected remedial actions for units within the 200-BP-1 Operable Unit."**

[Note: Response essentially unchanged from original.]

34. Page 5-3, §5.3.3: The text discusses the biointrusion barrier with its limitation including waivers requirement for several key ARARs. Suggest including a "rough" cost estimate for construction of the barrier in order to assess the cost benefit of pursuing the alternative.

Response: Reject. This comment presupposes that a conceptual design exists as a basis for comment response. At an early stage of preparing this FFS, one such design was produced and a "rough" cost estimate was developed for it. For

information, the estimated cost was roughly the same as the Modified RCRA Subtitle C Barrier. Largely based on cost benefit, the design was concluded to be unacceptable. However, many internal and external reviewers suggested at the time that other designs might be developed that would be much less costly yet achieve the desired result. That remains to be determined. What ultimately stalled the effort was (as indicated in text) the lack of a candidate waste site where this approach to remediation might be appropriate as a test case for developing better definition of all potential design issues and requirements.

[Note: Response essentially unchanged from original.]

35. Page 5-3, § 5.3.4. The integrity, hence the long term performance of the three barrier caps depends upon the settlement and subsidence characteristics of the waste sites. In particular, the foundation treatment of burial grounds to eliminate the geotechnical hazard has not been addressed in this FFS document. Instead, it has been left for a second proposed FFS. In GSSC's considered view stable foundations are integral parts of barrier caps, and foundation modification methods should be part of this FFS. Without a discussion on foundation, this FFS is incomplete for a decision making process. Furthermore, the FFS should discuss and provide estimates of tolerance of the barrier caps, in particular the asphalt layer, to short and long term settlement/subsidence, differential settlement and potential for cracking and displacements for the preconsolidated and unconsolidated waste sites. As indicated, the 2% slope for drainage does not have any room for settlement and may sag due to waste consolidation.

Response: Agree in concept. As it is currently structured, the FFS requires the assumption that satisfactory subgrade modification methods will be identified and implemented. With that assumption, the FFS is considered by BHI to be a sufficiently complete conceptual design document to develop consensus on the graded approach to surface barriers for the 200 Areas. However, it is agreed that the concerns expressed in this comment are significant issues and, as indicated in Section 5.3.4, a significant (albeit separate) effort is envisioned to address these concerns in appropriate detail.

[Note: Response essentially unchanged from original.]

36. Page 5-3 § 5.3.4, ¶ last. Eliminate the last sentence. It does not add any value.

Response: Accept.

[Note: Response essentially unchanged from original.]

37. Page 5-4, Lines 7-13: References should be provided which address settlement estimates.

Response: Reject. There are no known references that include settlement estimates for structures with the extremely wide footprints analogous to surface barriers, with one exception. ICF KH did estimate settlement for the Hanford Barrier prototype over 216-B-57 Crib. The predicted settlement was about 1 in. (reference: KEH Letter #WD-94-001). Actual settlement is to be determined. It would appear to be inappropriate to provide one settlement value in a section concerned with programmatic recommendations. It is likely that subsidence will prove to be a much larger issue than settlement at many or most WMUs listed in Appendix B.

[Note: Response essentially unchanged from original.]

38. Appendix E, Table E-1, Site Grading, Compaction & Fill:

A. The first item lists the cost for load, haul and dump soil. It is not clear if the cost includes tipping fee for the fill material. Please clarify.

Response: It does not.

[Note: Response essentially unchanged from original.]

B. The second item does not include labor cost for the ten man crew for 97 days of work. This cost item was not included in any of the barrier design. The cost should be included to provide a realistic cost estimate for each of the barrier designs. Please clarify.

Response: Labor is included in the $359,312. The second hyphen and the $0 are typographical errors introduced during transcription. They will be eliminated.

[Note: Response essentially unchanged from original.]

C. The specification of the grading fill calls for variable thickness in the barrier design. In addition, a 4-inch asphalt base course layer is designed to be constructed on top. The thickness used for the cost estimate is almost a foot. Suggest modifying the cost estimate for a 6-inch layer of fill material.

Response: Reject. The quantity of grading fill identified for the estimate is the amount required to establish a uniform grade for an actual 5-acre waste site

(216-B-43 through B-50 cribs), determined from sections and volumetric calculations developed from site topography.

[Note: Response essentially unchanged from original.]

39. Appendix E, § 1.0 and 2.0, Sealed Double-Ring Infiltrometer Test: Estimated costs for each infiltrometer test appear to be at least $15,000 dollars too high, especially if a private subcontractor is to be used. Clarify, why over $25,000 is required to perform each test. An equivalent test in Industry should cost less than $5,000.

Response: Accept. For information, the $25 thousand figure was from a 1993 vendor letter proposal. However, the information was obtained at a time when there were few vendors who had experience with this test and the necessary test equipment. Since then, much has changed. The Environmental Restoration (ER) program has acquired the apparatus, SDRI testing has been conducted on the asphalt layer of the Hanford Barrier prototype, and current proposals to conduct individual tests with the ER-owned apparatus are running about $9 thousand. The costs in Appendix E will be revised accordingly.

[Note: Response essentially unchanged from original.]

Attachment 5

COMMENTS FROM DOE-HQ

ON THE FOCUSED FEASIBILITY STUDY OF
ENGINEERED BARRIERS FOR WASTE MANAGEMENT UNITS IN
THE 200 AREAS (DOE/RL-93-33)

PREPARED BY BOOZ-ALLEN & HAMILTON, INC.

1. The document, for the most part, is well prepared and presents the required FFS material in a logical and clear manner.

Response: Noted.

2. The basis for the barrier performance design periods should be more thoroughly presented and documented. In addition, a more detailed and thorough discussion should be presented in support of the claim that the barrier designs, as presented, meet the performance design period criteria.

Response: Washington State Department of Ecology (Ecology) reviewers had a similar comment. Their recommendation was that Bechtel Hanford, Inc. (BHI) "discuss briefly how the design lives were determined and identify the limiting design feature of each barrier. To disposition the comment from Ecology, BHI agreed to do the following:

Section 4.2.3.3 will be revised to read as follows:

'The principal issues associated with long-term durability of surface barriers are (1) potential changes in barrier morphology (thickness) due to erosion, and (2) potential chemical or physical alteration (weathering) of barrier materials.

If an excessive amount of topsoil material is removed from the barrier surface by erosion, hydrologic performance would be adversely affected. In all three barrier options, the topsoil system is designed to perform the key role in moisture management. As explained previously, the topsoil layers will serve as a storage medium for moisture received as precipitation. Storage will be enhanced by the development of a capillary barrier at the base of the topsoil system. Increasing the storage capacity and the residence time for soil moisture within the topsoil system will both facilitate moisture removal by evapotranspiration processes. Performance simulations in Appendix C indicate that, as designed, the topsoil systems of the three barriers can be expected to store and remove essentially 100% of average annual

moisture receipts. Numerical sensitivity studies indicate that a minimum thickness of topsoil (on the order of 24 to 26 in.) is required to sustain moisture removal at this level of efficiency.

Several provisions have been incorporated into the three barrier designs to protect the topsoil system from and/or otherwise compensate for the effects of erosion. The top layer of each barrier includes an admixture of pea gravel that will assist in armoring the barrier surface to protect it from wind erosion. Cover vegetation will be cultivated to further assist in reducing exposure of barrier surfaces to wind. Third, and perhaps most importantly, each barrier design includes excess thickness in the topsoil layers to provide performance margins against long-term wind erosion and long-term climate change. Sample calculations of potential wind and water erosion rates are provided in Appendix D, Sections 2.0 and 3.0. Projected soil losses for the three barrier options over their respective design lives are reported in Appendix D, Section 4.0. For the Hanford Barrier (1,000-year design life), the thickness allowance for wind erosion is 12.1 in. For the Modified RCRA Subtitle C Barrier (500-year design life), the allowance for wind erosion is 6.0 in. And for the Modified RCRA Subtitle D Barrier (100-year design life), the allowance for wind erosion is 1.2 in. These losses are all tolerable (i.e., soil losses of these magnitudes would not reduce the composite thickness of topsoil components into the range of 24 to 26 in.). The beneficial effect of the pea gravel admixture in limiting wind erosion is not considered in the calculations in Appendix D, Section 4.0.

Aside from the low-permeability asphalt layer specified in the Hanford Barrier and the Modified RCRA Subtitle C Barrier, the three barriers will be constructed entirely of natural rock and soil materials. Chemical and physical weathering rates for these materials are low relative to the performance periods of interest, and it is known that these materials will not experience any significant deterioration during the respective performance periods. The low-permeability asphalt layer also is expected to provide adequate durability based on studies of naturally occurring asphaltic materials. It is anticipated that additional studies of long-term durability of asphalt will be performed. The asphalt layer and lateral drainage layer in the Hanford Barrier and the Modified RCRA Subtitle C Barrier are both situated at sufficient depth below the surface to ensure permanent protection from frost damage.'

[Note: Response essentially unchanged from original.]

3. The basis for barrier design, as presented in this FFS, lies principally in selected regulatory requirements and appropriate guidance. These tools are, however, based upon a technical consensus that relates to the environmental fate properties of real contaminants. It is, therefore, recommended that the FFS contain a discussion regarding the types of contaminants (not just waste types) and environmental fate properties (e.g., volatilization, leaching potential, etc.) that are and are not be addressed by the barriers.

Response: Accept in principle. It is agreed that information regarding the types of contaminants involved (specifically their chemical and physical properties and environmental fate and transport characteristics) is crucial for developing barrier implementation rationale. In addition, the AAMS reports provide extensive documentation on various media of concern, contaminant inventories, release mechanisms, transport pathways, contaminant characteristics, and conceptual models of the individual areas (refer to Chapter 4.0 of specific AAMS reports). These reports also present screening criteria for remedial action objectives and technologies, and identify technologies applicable to individual waste management units (refer to Chapter 7.0 of specific AAMS reports). The focused feasibility study (FFS) uses the AAMS reports as a point of departure for evaluating covers as one category of remedial alternatives. Waste management units identified in the AAMS reports as candidates for remediation with covers are summarized in Appendix B. The contents of Chapters 4.0 and 7.0 of all eight source AAMS reports are far too voluminous to reproduce in this document. Therefore, it is necessary to identify this information by reference. The underlined portion of this explanation will be included at the end of the first paragraph under Section 1.1.3.

[Note: Response essentially unchanged from original.]

4. The document does not accurately account for subsidence and settlement, yet proceeds to draw conclusions relative to the feasibility of barrier designs. A 2% slope is contemplated on pages 2-13 and 4-4. And on page 5-3 it is stated that: "This FFS does not address settlement and subsidence issues as they relate to covers. This omission reflects the view that there is relatively little an engineer can do to design a barrier to minimize or eliminate its vulnerability to large, uneven settlement. To deal with this issue, the engineering focus must be redirected from the barrier to the subgrade." See the 16-page waste settlement analysis by Golder Associates (Golder) appearing in Construction of W-296 Environmental Restoration Disposal Facility at the Hanford Site, Richland, Washington, 60% Design Analysis, Volume 1, December 19, 1994. The analysis, dated December 2, 1994, predates this FFS by approximately 3 months. The analysis was performed to see if the cap had to be built with a steeper slope to accommodate settlement in the event that high enough compaction densities could not be achieved. The analysis begins with the statement that: "If the waste is highly compacted, the potential for...settlement is reduced. A previous study on the load/deformation characteristics of ERDF waste soil indicated that compaction to 95% of Modified Proctor (ASTM D1557) dry density would be required to limit the change in slope to 1 percent...The purpose of this analysis is to determine whether a lower degree of compaction is feasible if steeper initial cover slopes are allowed." The study concludes that: "The results show that for an initial cover slope of 5% compaction should be in the range of 89% to

92% of Modified Proctor density. For an initial cover slope of 4%, compaction should be in the range of 91% to 94% of Modified Proctor density" and "With steeper cover slopes, moderate compaction of waste is expected to adequately limit settlements." Please incorporate this settlement analysis into the FFS. Contact Golder to determine the current status of the settlement design first.

Response: Reject. The FFS author's position is, as indicated above, that surface barriers are not rigid structures and, therefore, cannot feasibly be designed to resist distortions and volume changes that may occur within the subgrade in response to the surcharge loading represented by the weight of the cover materials. To eliminate unacceptable settlement and subsidence effects on the cover, some type of subgrade modification generally will be necessary so that the subgrade response is predictable when the cover is built. It will be practical to develop a reliable settlement estimate for the cover only after the appropriate engineering had been done on the subgrade. Because subgrade conditions are fundamentally different between the various types of waste management units, various forms of subgrade modification will be required to address individual site conditions. Therefore, there is no appropriate generalized method of analysis for this problem.

The settlement analysis for the Environmental Restoration Disposal Facility (ERDF) (referenced in the comment) has been reviewed. The approach taken by the engineers who performed the settlement estimate for the ERDF cover is consistent with the position advanced by the FFS author. Compaction effort for the fill material was evaluated to determine the extent of subgrade improvement required to limit settlement effects on the cover. To develop specifications for construction, this was done in an iterative fashion (which would not necessarily be required in other cases).

Relative to other waste management units in the Environmental Restoration (ER) program at the Hanford Site (see Appendix B), ERDF is an extremely atypical unit. From a foundation engineering perspective, the unique feature of ERDF is the great thickness (70 to 90 ft) of fill to be placed. Other ER sites contain fill material in various amounts ranging from a few ft to maybe 20 ft. However, the sites in Appendix B are all existing facilities (where there is no opportunity to control the properties of the fill as it is placed). Therefore, the settlement analysis for ERDF, and the conclusions regarding settlement for that facility, are not regarded as typical for other ER waste sites (i.e., the analysis has relatively little applicability to the sites listed in Appendix B). However, there is broad agreement that settlement and subsidence are important concerns, and should be evaluated, either in a follow-on engineering study, or during definitive designs for individual covers. Some of these analyses would be similar to the one referenced above in this comment.

[Note: Response essentially unchanged from original.]

5. It seems that the issues of radiation-over-the-top (ROT) and gamma

skyshine have not been accounted for in the cap designs. Please refer to 1301-N LWDF Skyshine Dose Reduction, WHC-SD-NR-ES-009, September 18, 1990. Skyshine from that trench was an issue even though that trench was covered with concrete planking and several feet of soil. There are three barrier designs deemed feasible in this FFS: the Hanford Barrier, the Modified RCRA Subtitle C Barrier, and the Modified RCRA Subtitle D Barrier. The Modified RCRA Subtitle D Barrier is only 3 feet thick, and as such we would expect it to offer a minimum of resistance to radiation passage. The Modified RCRA Subtitle C Barrier is only 5.7' thick, and contains two 6"-thick gravel drainage layers that we would expect would present little or no obstacle to radiation. The Hanford Barrier is 15 feet thick, but is comprised of a 5-foot thick gravel capillary break and two 1-foot thick gravel filter layers, leaving only 8 feet of resistance to radiation. Please provide calculations proving that these designs, deemed "feasible" by this feasibility study, will be protective with respect to ROT, skyshine, and future uses of these areas once capped.

Response: Some form of interim stabilization already has been performed at many or most of the WMUs listed in Appendix B to limit exposures to onsite workers. Surface dose rates at stabilized sites currently are low enough generally that it is not anticipated that people near the WMUs would need to have "radiation worker" certification. Consequently, the three barrier options described in this FFS are not expected to provide any essential contribution to dose reduction (i.e., no design criteria for shielding were identified in Section 2.0 of the FFS). An explanation of the foregoing rationale has been incorporated in Section 4.2.5.

Some ER program sites may exist where exposure rates are high enough that the shielding contribution of the barriers may have to be taken into consideration. In those cases, the identities of specific radionuclides present in the soil column, and their respective concentrations and distributions would have to be known to do the shielding calculations (because attenuation is a function of the energy associated with gamma emissions from the individual radionuclides and because the soil column itself contributes significant self-shielding unless all contamination is confined to within 2 to 3 ft of the surface). Because this information is site specific, shielding is necessarily a definitive design issue. Shielding will be added to the list of bullets in Section 5.1.

[Note: Response modified slightly to reference 4.2.5, where the rationale has been provided.]

6. Page i: It is recommended that a list of acronyms be provided.

Response: Accept.

[Note: Response essentially unchanged from original.]

7. Page 1-4, First Paragraph: The words "reduction of" should be eliminated from item (5) of the third sentence.

Response: Accept.

[Note: Response essentially unchanged from original.]

8. Page 1-4, Section 1.2: It is recommended that "waste units" replace the phrase "for source IRMs and LFIs" in the first sentence.

Response: Accept in part. The reference to source interim remedial measures (IRM) and limited field investigations (LFI) has been deleted. This sentence has been modified to read, "The scope of this FFS is to develop and evaluate a limited number of conceptual cover designs that could be applied to waste sites in the 200 Areas."

[Note: Response changed from original to reflect current wording.]

9. Page 1-5, Third Paragraph: The first sentence states that "the primary objective of this FFS report is to provide a limited number of preengineered cover options to support the IRM path". This does not seem completely accurate. While, many, if not most, IRMs may end up as final remedies, this is not necessarily a given. Design lives of 100, 500 and 1,000 years are not interim. It would seem that the FFS supports both IRM paths and final remedy selection.

Response: Accept. The last two paragraphs in Section 1.2 (which appear on Page 1-5) will be modified to read as follows:

'Waste management units in the 200 Areas that have been identified as candidates for remediation with surface barriers (including both high- and low-priority sites) are listed in Appendix B. Covers may be selected as IRMs for high-priority (i.e., IRM and LFI candidate) sites, or as final remedies for low-priority sites (FRS candidates). The decision logic for selecting the appropriate cover option for a given site (presented in Section 5.0) is not dependent on the remediation path. Where covers are selected initially as IRMs, it is generally expected that they would also be designated as final remedies.

A secondary objective of this FFS report is to provide recommendations for any additional studies that may be required to facilitate the near-term implementation of the conceptual designs described in this report. These recommendations are provided in Section

5.0.'

[Note: Response essentially unchanged from original.]

10. Page 1-6, First Paragraph, Item #7: The statement made appears to limit cover use to IRMs. See previous comment, #9, above.

Response: Accept. Item #7 will be modified to read as follows:

'The final chapter of this report will summarize the results of the design process, identify design issues to be resolved during definitive design, and provide recommendations for additional engineering studies needed to support timely implementation of barrier technology. A logic chart for barrier selection will be included relating the cover options developed in this FFS to applicable waste categories.'

[Note: Response essentially unchanged from original.]

11. Page 2-2, First Paragraph: The second sentence states that "it is anticipated that any refinements required because of contaminant-specific ARARs will not require significant modification of the generic conceptual cover designs." It is recommended that the reasons/rationale for this "anticipation" be presented and discussed.

Response: Accept. First paragraph on Page 2-2 will be modified to read as follows:

'Contaminant-specific ARARs were evaluated on a preliminary basis in Section 6.2 of the source AAMS reports (refer to Table 6-1 of individual reports). Based on that evaluation, it is considered unlikely that significant modifications would be required to any of the generic conceptual cover designs developed in this FFS to properly account for contaminant-specific ARARs. However, this group of potential ARARs will be reconsidered during definitive designs of covers for individual sites to verify that contaminants will be appropriately isolated and immobilized.'

[Note: Response essentially unchanged from original.]

12. Page 2-18, Subsection headed, WAC 173-304-407 (3)(b): The first sentence states that "...the 200 Areas rarely, if ever, received putrescible solid waste". This statement should be appropriately referenced.

Response: Accept in principle. It was determined by the regulator that this regulation was not an ARAR for the barrier design. Ecology requested that WAC 173-351-500,

"Closure/Post-Closure Care Requirements for Municipal Solid Waste Landfills" be cited instead. Reference to putrescible waste has been deleted.

[Note: Response changed from original.]

13. Page 2-19, Subsection headed, WAS 173-304-460 (3)(a)(iv): The subsection should be concluded with a statement indicating how the topic will or will not be addressed in this document.

Response: Accept. Text on P. 2-19 will be modified as follows:

'It is impractical to provide designs of systems for run-on and run-off collection as part of a generic conceptual design study. A variety of factors at individual sites, such as areal extent, adjoining topography, and vegetation, will have a significant effect on the volume of surface water to be managed from the design storm. However, run-off from the design storm can be estimated on a per-acre basis at the conceptual design stage. Design storm analyses for all three barrier options are provided in Appendix C-4 of this FFS. Complete designs of systems for collection and routing of surface water will be deferred to definitive design.'

[Note: Response essentially unchanged from original.]

14. Page 2-19, Fourth Paragraph: The paragraph provides a discussion that summarizes the relevance of TBCs. The first sentence states that "few of the TBCs listed in Section 2.2.5 were determined to be directly relevant,..." while the second sentence states that "two notable TBCs are....". It is not clear whether the "notable TBCs" are, in fact, considered relevant. This should be clarified.

Response: Accept in part. This paragraph has been deleted in the rewrite. The FFS no longer has any TBCs. It was determined that the applicable or relevant and appropriate requirements (ARAR) are sufficient to establish the requirements for barrier design. Regulations and guidance that are not ARARs, but that are useful to consider in cover designs, are now included in a section titled 2.3 TECHNICAL GUIDANCE REQUIREMENTS. The opening paragraph states:

"There are documents that provide design criteria that are not considered an ARAR, but contains technical guidance that are considered pertinent. These technical guidance criteria are contained in sections of promulgated statutes that are not considered applicable or relevant and appropriate, state or federal statutes that are not promulgated, state or federal guidance documents, or industry document generated to document good engineering practices to be followed. Technical guidance will be integrated with the ARAR requirements discussed in Section 2.2 to

develop design criteria for the cover designs. Technical guidance and their associated source, that are contained in federal, state, or DOE documents that relate to cover designs, are provided below."

[Note: Response significantly modified from original.]

15. Page 2-21, Subsection headed, 40 CFR 191.14: The citation appears to be limited to describing concerns/criteria regarding "inadvertent human intrusion. The fifth sentence, however, states that "exploratory drilling for resources is the most severe intrusion scenario envisioned by EPA." Is this to be considered "inadvertent human intrusion"? The paragraph concludes by indicating design criteria that claim to address inadvertent human intrusion. Is the EPA scenario covered? This should be clarified.

Response: 40 CFR 191.14 is no longer considered an ARAR or technical guidance. 40 CFR 191 Subpart B - Environmental Standards for Disposal specifically does not apply to "wastes disposed of before November 18, 1985." The preamble clarifies that it is intended to apply to mined geologic repositories. 40 CFR 191 is not relevant and appropriate because it was intended for disposal of massive quantities of spent fuel and TRU waste (100,000 metric tons of spent fuel) and it relies heavily on siting criteria; the types and quantities of material at the 200 Area waste sites and the reliance on siting criteria are not sufficiently similar to the conditions addressed by 40 CFR 191.

[Note: Response modified substantially from original.]

16. Page 2T-3 and 2T-4, Tables 2-4, 2-5, and 2-6: The tables list design functional lives for the three barrier designs: Hanford - 1,000 years; Modified RCRA C - 500 years; and Modified RCRA D - 100 years. The determination of these design lives is somewhat confusing. While the discussion of 40 CFR 191.15 on page 2-5 indicates a 1,000 year exposure requirement for SNF, HLW and TRU wastes, the discussion on page 2-4, under the listing for 40 CFR 191.13, cites 10,000 year exposure requirements for these wastes. Performance life requirements do not seem to be indicated in the subsequent subsections regarding regulatory requirements for LLW, Subtitle C Hazardous Wastes, or subtitle D Solid Wastes. It is recommended that a summary discussion be provided that presents the rationale for the performance life determinations.

Response: As noted in the response above, 40 CFR 191 has been deleted as an ARAR. The design life requirements for the various classes of waste will be clarified in the text.

[Note: Response has been significantly modified].

17. Page 3-1, First Paragraph: The discussion presents performance periods for the three barriers. See comment #16 above.

Response: See response to comment #16. With the changes indicated in response to comment #16, no additional change should be required on Page 3-1.

[Note: Response essentially unchanged from original.]

18. Page 3-2, Second Paragraph: The first sentence mentions the "Hanford Barrier Development Team." No further identification of this organization is provided. It is recommended that this information be presented.

Response: Accept. This organization has been effectively disbanded. Consequently, it appears that the best resolution for this comment is to delete the sentence that identifies the "Hanford Barrier Development Team." The remainder of the second paragraph on Page 3-2 will be combined with the first paragraph.

[Note: Response essentially unchanged from original.]

19. Page 3-2, Section 3.1.2.1: This section offers an good extensive description of the design of the topsoil components of the Hanford Barrier. It is recommended, however, that the design discussion indicate recommendations for soil organic and nutrient content and their relevance to effective soil field capacity and to establishment and maintenance of a good plant cover.

Response: Accept. The omission of specific recommendations regarding the type(s) of perennial vegetation or the method of seeding to be utilized on any of the barriers in the FFS was intentional. Efforts are ongoing to optimize seed mix selection for barrier applications, drawing upon onsite experience with mixes that have been used for various interim stabilization projects, performance of other seed mixes in lysimeters and test plots, evaluation of various mixtures that have been developed elsewhere (e.g., "highway mixes"), and data from other sources (e.g., vendor information). Because seed mix selection for ER projects is a "moving target," inclusion of detailed information in the FFS was considered counterproductive. Over the near term, it is expected that specific recommendations will be developed on a site-by-site basis as an aspect of definitive design. This item already is identified in Section 5.2 of the current draft as a definitive design issue. The specifications for seed, mulch, and fertilizer for the Hanford Barrier prototype were based on a WSDOT highway specification (WSDOT M 41-10) that had not been used previously at the Hanford Site (refer to Section 02935, Construction Specification for Prototype Surface Barrier at 200-BP-1 Operable Unit).

The revised draft will include statements in Sections 3.1.2.1, 3.2.2.1, and 3.3.2.1 to the effect that establishment of vegetative cover will meet or exceed the U.S. Environmental Protection Agency (EPA) recommendations found in the technical guidance (EPA 1989) for vegetative cover.

[Note: Response essentially unchanged from original.]

20. Page 3-3, First Paragraph: It is recommended that the words "clean coarse" be placed between "(e.g.," and "sand" in the second sentence.

Response: Accept. The word "clean" will be inserted between "(e.g.," and "sand" in the second sentence. It is unnecessary for the sand to be coarse.

[Note: Response essentially unchanged from original.]

21. Page 3-3, Third Paragraph: It is recommended that the word "native" be placed between "with" and "perennial" in the eighth sentence.

Response: Reject. There is no commitment to cultivate cover vegetation consisting exclusively of native perennials. Some candidate seed mixes (including some commercially available "highway" mixes) include nonnative species.

[Note: Response essentially unchanged from original.]

22. Page 3-4, Section 3.1.2.3: It is recommended that the specific particle size designations mentioned in the text (e.g., D15) be defined.

Response: Accept. This information will be provided in Section 3.1.2.3.

[Note: Response essentially unchanged from original.]

23. Page 3-5, Third Paragraph: The discussion addresses the design of layer 6 as an impediment to exploratory drilling. It is recommended that the discussion be broadened to discuss the wide range of potential drilling techniques.

Response. Accept in concept. It is conceded that some of the discussion appearing in the third paragraph of Page 3-5 may be overgeneralized. If all potential drilling methods (current and future) are considered, one or several methods probably exist that could successfully penetrate virtually any type of layer or system of layers that might be incorporated into a surface barrier design for the purpose of intrusion control. In concept, this may be a problem with applications of surface barriers. BHI declines to act on the recommendation in the comment to broaden the discussion to include the range of potential drilling techniques, insofar as we are dealing with future intervention scenarios, and a future state of the art in drilling technology that is

speculative. Alternatively, the following modification is proposed in place of the third paragraph:

> The coarse, fractured basalt in Layer 6 is designed to present an impediment to human intrusion. A subsurface layer consisting of loose, coarse fractured rock represents an adverse ground condition for many types of drilling methods, typically because circulation cannot be maintained, cuttings cannot be removed from the hole, the drill bit does not receive adequate lubrication, and firm contact cannot be maintained between the bit and the rock, all of which contribute to high bit wear and minimal advance of the hole. However, drilling methods exist today that would be minimally affected by the composition of Layer 6, and more effective technologies are likely to be available in the future. Therefore, the effectiveness of Layer 6 as a deterrent to drilling intrusion is likely to decrease over time.
>
> However, 'passive institutional controls or the intruders' own exploratory procedures (would be) adequate for the intruders to soon detect, or be warned of, the incompatibility of the area with (exploratory drilling) activities.' The composition and construction of Layer 6 should be sufficiently unique as to be immediately recognizable to knowledgeable persons engaged in resource exploration as engineered fill material, as opposed to a natural soil deposit of normal geologic origins. Thus, Layer 6 may function either as an impediment to drilling intrusion or as a warning/marker horizon. In either case, Layer 6 will serve to alert intruders to the existence of anomalous subsurface conditions at covered waste sites.
>
> [Note: Comment modified to delete reference to 40 CFR 191 as this is not an ARAR. See response to comment #15.]

24. Pages 3-5 and 3-6, Sections 3.1.2.6, 3.1.2.7 and 3.1.2.8: It is recommended that references to materials and conformance standards specifically identify the material and/or standard.

Response: Accept. Text will be modified as follows (changes underlined):

> '3.1.2.6 Layer 8 - Asphalt Layer. This layer will function as a low-permeability barrier layer and as a redundant biointrusion barrier. Layer 8 will be 15 cm (6 in.) thick and will be constructed of a durable asphaltic concrete mixture consisting of double-tar asphalt (i.e., twice the tar content of normal highway asphalt) with added sand as binder material, conforming to WSDOT M41-10, Section 9-02.1(4), Grade AR-4000W (WDOT 1991). Laboratory permeability tests on asphaltic concrete cores from the 200-BP-1 Hanford Barrier Prototype yielded

values on the order of 10^{-10} cm/s. In-field values, measured by falling-head permeameter testing, ranged between 10^{-7} and 10^{-9} cm/s (DOE/RL 1994). Based on studies of natural analogs (Waugh et al. 1994; Freeman and Romine 1994), it is estimated that asphalt could remain functional for a period of 5,000 years or more, as long as the layer remains covered and protected from ultraviolet radiation and freeze/thaw activity. The top of Layer 8 will be approximately 4.3 m (14 ft) below final grade, well below the design frost depth of 2 ft 6 in.

To provide additional assurance against leakage through the asphalt layer, the asphaltic concrete will be coated with a spray-applied asphaltic coating material. This material has gained wide acceptance based on its excellent puncture resistance, retained flexibility, and favorable constructability attributes. Permeability values on the order of 10^{-11} cm/s have been demonstrated in tests of samples of polymer modified asphalt coating from the Hanford Barrier prototype constructed over 216-B-57 Crib (Freeman et al. 1994).

As individual barriers are constructed, field testing will be required as an aspect of construction quality assurance to assure that the design hydraulic conductivity performance of the asphalt layer is achieved.'

3.1.2.7 Layer 9 - Asphalt Base Course. This layer will provide a stable base for placement of the overlying asphalt layer. The base course will consist of screened, crushed surfacing material, with 100% passing the 32 mm (1-1/4 in.) sieve, conforming to WSDOT M 41-10, Section 9-03.9(3) (WDOT 1991).

3.1.2.8 Layer 10 - Grading Fill. Grading fill will be placed, as necessary, to establish a smooth, planar-base surface for construction of the overlying layers. The preexisting site surface will be contoured and graded to create uniform surfaces sloped at 2%, as required for internal lateral drainage and surface run-off control. Grading the site before construction will facilitate accurate and controlled placement of soil lifts and layers. Grading fill will consist of a well-graded granular soil mixture, which may include as much as 20% by volume of cobbles measuring no more than 75 mm (3 in.) in the greatest dimension.'

[Note: Response essentially unchanged from original.]

25. Page 3-6, Section 3.2.1: The last sentence of the second paragraph states that "the barrier is designed to provide containment and hydrologic protection for a performance period of 500 years." This should be shown. Also, see comment #16 above.

Response: Reject. Conformance to design criteria is addressed in Section 4.1. Specifically, refer to Table 4-2.

[Note: Response essentially unchanged from original.]

26A. Page 3-8, Third Paragraph: The discussion of compaction should indicate the actual range of reduction in hydraulic conductivity. This should then be supported by indicating the corresponding soil density changes and showing that this can be feasibly attained given the designated soil characteristics.

Response: Accept. The text will be modified to include compaction test results as follows (changes underlined):

'Compaction of Layer 2 during construction will decrease its saturated hydraulic conductivity by three to four orders of magnitude (i.e., from values in the range of 10^{-3} - 10^{-4} cm/s down to values between 10^{-6} - 10^{-7} cm/s). The indicated reduction in conductivity is readily achievable by compacting McGee Ranch silt loam soil to densities in the range of 1.68 to 1.84 (105 to 115 lb/ft^3). Laboratory testing indicates that these results can be accomplished with moderate compactive effort (Skelly et al. 1994). Compaction will retard moisture migration through Layer 2. Moisture retention and evapotranspiration within Layer 1 and Layer 2 also will be enhanced by formation of a capillary barrier at the base of Layer 2, as explained in Section 3.1.2.1. Numerical performance assessments using HELP and UNSAT-H predict that essentially 100% of average annual precipitation will be removed from the barrier by evapotranspiration (Appendices C-2 and C-4).'

[Note: Response essentially unchanged from original.]

26B. Page 3-9, Section 3.2.2.4, 3.2.2.5, and 3.2.2.6: Materials and testing methods mentioned should be more specifically identified.

Response: Accept. Text will be modified as follows (changes underlined):

'3.2.2.4 Layer 6 - Asphalt Layer. This layer will function as a low-permeability barrier layer and as a biointrusion barrier. Layer 6 will be constructed of a durable asphaltic concrete mixture consisting of double-tar asphalt (i.e., twice the tar content of normal highway asphalt) with added sand as binder material, conforming to WSDOT M41-10, Section 9-02.1(4), Grade AR-4000W (WDOT 1991). Laboratory permeability tests on asphaltic concrete cores from the 200-BP-1 Hanford Barrier Prototype yielded values on the order of 10^{-10} cm/s. In-field values, measured by falling-head permeameter testing, ranged

between 10^{-7} and 10^{-9} cm/s (DOE/RL 1994). The same asphalt layer design is incorporated into the Hanford Barrier and the Modified RCRA Subtitle C Barrier. As noted in Section 3.1.2.6, hydraulic conductivity testing will be performed on the asphalt layer in situ to determine the actual in-field value at the time of construction.

The low-permeability asphalt layer is expected to be a highly effective deterrent to intrusion by plant roots and burrowing animals. As necessary, it will also function as a human intrusion barrier. The strength of the asphaltic concrete material, the thickness of Layer 6, and its deliberate construction should serve to advise inadvertent intruders that this layer is an intentional barrier. Layer 6 can be breached with mechanical excavation equipment, but intrusion scenarios involving the use of heavy equipment probably would be considered advertent rather than inadvertent.

10 CFR 61.42 requires protecting individuals from inadvertent human intrusion into radioactive waste. The guidance contained in 10 CFR 61.52 was used for Class C (DOE Category 3) low-level waste (LLW) specifically. This guidance states that protection may take either of the following forms:

1. The site may be capped with a combination of earth fill and engineered barrier materials such that the top of the waste zone is at least 5 m (16.4 ft) below the surface of the cover.

2. The engineered barrier must be designed to protect against inadvertent intrusion for the design life of 500 years.

Many radiological sites in the 200 Areas where the Modified RCRA Subtitle C Barrier may be constructed already have been covered with sufficient fill to satisfy requirement 1 or would meet requirement 1 with the additional 1.7 m (5.6 ft) of cover materials in the Modified RCRA Subtitle C Barrier. In other cases, additional grading fill (Layer 8) could be placed at the site as an aspect of barrier construction in lieu of designating a layer within the barrier as a human intrusion layer.'

3.2.2.5 Layer 7 - Asphalt Base Course. This layer will provide a stable base for placement of the overlying asphalt layer. The base course will consist of screened, crushed surfacing material, with 100% passing the 32-mm (1-1/4 in.) sieve, conforming to WSDOT M 41-10, Section 9-03.9(3) (WDOT 1991).

3.2.2.6 Layer 8 - Grading Fill. Grading fill will be placed, as necessary,

to establish a smooth, planar-base surface for construction of the overlying layers. The preexisting site surface will be contoured and graded to create uniform surfaces sloped at 2%, as required for internal lateral drainage and surface run-off control. Grading the site before construction will facilitate accurate and controlled placement of soil lifts and layers. Grading fill will consist of a well-graded granular soil mixture, which may include as much as 20% by volume of cobbles measuring no more than 75 mm (3 in.) in the greatest dimension.'

[Note: Response modified slightly. The third paragraph under 3.2.2.4 above has been modified slightly. The intent has not been changed.]

27. Page 4-3, Second Paragraph: The second and third sentences state that "all of the designs comply with the applicable ARARs as identified in Section 2.5" and "the designs all conform to their respective criteria." These statements should be shown to be true.

Response: Accept. Second paragraph on Page 4-3 will be modified to read as follows:

'Each barrier design described in Section 3.0 has been evaluated for conformance to design criteria in Section 4.1. The criteria were related to individual ARARs and technical guidance sources in Section 2.5 and Tables 2.4, 2.5, 2.6, and 2.7. Based on this information, it is established that the barrier designs comply with ARARs and conform to their respective criteria.

[Note: Response modified slightly; however, the intent has not been changed.]

28. Pages 4-5 and 4-5, Section 4.2.3.1: The discussion of barrier intrusion control should be more clearly and definitively presented. For example, the specific relevant regulations and/or criteria should be restated or referenced and the summary requirements clearly identified. It is also noted that the use of phrases such as "is expected to be" presents insufficient evidence or rationale. More definitive explanations and statements should be used.

Response: Reject. This section should address long-term protectiveness, as based on the CERCLA definition of that criterion, not based on whether an alternative meets regulatory requirements. Compliance with ARARs is discussed in section 4.2.2. The following additional information will be inserted at the beginning of Section 4.2.3.1:

The Hanford Barrier is a baseline design for sites containing transuranic (TRU) and Greater Than Class C (GTCC) waste (if any). In these

applications, the Hanford Barrier includes provisions for control of biointrusion and inadvertent human intrusion. The Modified RCRA Subtitle C Design, which is the baseline design for sites containing Category 3 LLW, also provides intrusion control.

[Note: Comment significantly modified.]

(NO COMMENT #29)

30. Pages 4-7. 4-8 and 4-9, Insert Tables: The specific meanings of the column headings (relative to a unit mass of barrier) should be presented in the text.

Response: Accept. The following text will be inserted at the end of line 29 on Page 4-7.

'Run-off refers to the percentage of precipitation that drains off of the barrier surface without being absorbed. Evaporation and transpiration, also shown collectively as evapotranspiration, are the percentages of precipitation that are absorbed into storage in the topsoil layers of the barrier, where they are subsequently removed by direct evaporation and plant transpiration. Lateral drainage is the percentage of precipitation that infiltrates to the level of the lateral drainage layer of the barrier, where it is intercepted and diverted to the perimeter of the barrier. Deep infiltration represents the percentage of precipitation that is able to infiltrate completely through the barrier system, such that it could come into contact with buried waste or contaminated soil.'

The following text will be inserted at the end of line 27 on Page 4-9.

'The design storm is the maximum precipitation event that would be expected to occur during the design life of each barrier. The design storm amount is based on a storm of maximum intensity and given duration occurring once within a specified return period and is determined from statistical analysis of historic precipitation data for a given locale.

[Note: Response essentially unchanged from original.]

31. Page 4-10, First Paragraph: The fourth sentence states that "...run-off is less than 1 in. in each case, which is not particularly adverse in terms of erosion potential." The use of the words "not particularly" is unconvincing. A more definitive statement should be provided.

Response: Accept. Text will be modified as follows (changes underlined):

> **'The design storm is the worst-case precipitation event that can be expected to occur during the functional life of each barrier. Reflecting the Hanford Site's arid climate, the storm amounts themselves are comparatively small. In more humid parts of the United States, storms of this magnitude are likely to have return periods on the order of two to five years. The design storm simulations predict that run-off would be less than 1 in. in all cases. Because this amount of run-off takes place over a 24-hr period, it is unlikely that the design storm would induce significant erosion of the barrier surface. The simulations also show indirectly that during even the largest storm events at the Hanford Site, the majority of precipitation (60% or more) would infiltrate into the topsoil layers of the barrier, where moisture would be retained in storage until it is removed by the combined action of evapotranspiration processes.'**
>
> **[Note: Response essentially unchanged from original.]**

32. Page 4-10, First Paragraph: The fifth sentence states that "these data also show indirectly that during even the largest storm events at the Hanford Site, the majority (60 percent or more) of precipitation will infiltrate." Does infiltration indicate that all barrier layers have been penetrated? If so, what are the consequences? If not, where does the water go? This should be provided additional explanation.

Response: Accept. Refer to comment response #31.

> **[Note: Response essentially unchanged from original.]**

33. Page 4-11, Section 4.2.5: It is recommended that specific safety and health and construction quality assurance procedures/guidance be cited.

Response: Reject. Based on the way the Hanford Barrier Prototype construction project was handled, it is not envisioned that a health and safety plan would be prepared for each project. For the prototype construction, health and safety issues were addressed in a Job Safety Analysis, which is basically an unpublished white paper that is circulated and reviewed by all project participants. QA/QC procedures and protocols were published with the construction specifications document (i.e., they were a project-specific product of definitive design). It is envisioned that QA/QC matters would be handled in a similar manner on other future projects.

> **[Note: Response essentially unchanged from original.]**

34. Page 4-12, lines 3 to 7: The following appears: "At any site scheduled

to receive a surface barrier where unacceptable levels of surface contamination are still present, the surface will be stabilized with grading fill as an initial aspect of barrier construction. The risk of physically contacting subsurface waste or releasing contaminants into the air during barrier construction is considered low." We would think there is a very real potential for risk. Please provide full justification for the statement.

Response: Accept. The following modifications will be made to the paragraph beginning at the bottom of Page 4-11:

'Barrier construction activities at 200 Area waste sites will be performed on surfaces where radiological contamination is demonstrably below levels of concern with regard to worker health and safety. Most waste sites identified in Appendix B already have undergone surface stabilization. This practice involves placing a blanket of a few to several feet of clean fill over a radiological site. The fill provides shielding which eliminates direct exposure hazards to workers and reduces short-term problems associated with biointrusion. Radiological surveys are used to verify that surface contamination has been reduced to acceptably low levels as a result of stabilization activities. In any case where a surface barrier is to be built at a site with residual surface radiological contamination, the site would be stabilized with grading fill before barrier construction activities are initiated. Once a site has been stabilized, the risk of coming into contact with subsurface waste or releasing contaminants into the air during barrier construction activities is considered low. Radiological monitoring will be performed during construction to verify that contamination is not disturbed or released.'

[Note: Response essentially unchanged from original.]

35. Page 4-12, First Paragraph: The fifth sentence states that certain risks associated with barrier construction are "considered low." The reasons for this conclusion should be stated.

Response: Accept. Refer to response to comment #34.

[Note: Response essentially unchanged from original.]

36. Page 4-12, Third Paragraph: The third sentence states that "...the FS report....concluded that the worst-case air release scenario.....would not exceed 10-6 to any offsite community." The specific risk (e.g., life-time cancer risk) should be indicated.

Response: Accept. The highest specific risk factor reported was 10^{-7}. However, in

the FFS, the results are compared to 10^{-6} because that is EPA's criterion in determining whether projected risks are significant or not. The third paragraph will be modified as follows (changes underlined):

> 'The exposure pathway of any significance to the offsite public related to construction of surface barriers is the air pathway. Barrier construction activities are not expected to generate contaminated particulate in rates or quantities of any consequence to the offsite public. For example, the RI report for the 200-BP-1 Operable Unit (DOE-RL 1993) concluded that the worst-case air release scenario (assuming direct surface exposure of all subsurface contaminated soils within the operable unit) would result in an incremental life-time cancer risk (for the residential or agricultural land-use cases) at the site of less than 10^{-6}. Risk factors were not reported for offsite locations because of the low onsite risk and the dispersion that would necessarily occur between the onsite location and the nearest offsite receptor. Based on the RI results, it is expected that baseline risk assessments for other 200 Area waste sites will also show that risk to the offsite public from barrier construction is low in relation to onsite worker risk and low in absolute terms.'

The reference is:

> DOE-RL, 1993, *Phase 1 Remedial Investigation Report for 200-BP-1 Operable Unit, Volume 1*, DOE/RL-92-70, Revision 0, U.S. Department of Energy, Richland, Washington.
>
> [Note: Response modified slightly].

37. Page 4-12, Third Paragraph: The last sentence is somewhat confusing. It is recommended that it be rewritten to improve clarity. The explicit conditions upon which the statement is made should also be presented.

Response: Accept. Refer to proposed disposition for comment #36.

> [Note: Response essentially unchanged from original.]

38. Page 4-13, Section 4.2.6.1: The last part of the second bulleted item states that "the likelihood of encountering significant technical problems, schedule delays, or cost overruns during construction is relatively low." The basis for each element of the statement should be provided.

Response: Accept. The text will be rearranged and supplemented as follows.

> 'One surface barrier already has been built at the Hanford Site (the

Hanford Barrier prototype at the 200-BP-1 Operable Unit). Design, materials, and construction issues that were identified during that project have been summarized and evaluated for future reference (DOE-RL 1994). Monitoring and testing activities are ongoing to identify and evaluate any unresolved issues relating to barrier performance. Most materials of construction consist of natural soil and rock materials that are available on the Hanford Site. Asphalt is the only essential material that must be brought to the site. Consequently, it is not likely that significant schedule impacts would be experienced due to nonavailability of materials. As experience with barrier construction accumulates, the likelihood of encountering significant technical problems, schedule delays, or cost overruns will be reduced.'

[Note: Response essentially unchanged from original.]

39. Page 4-14, First Paragraph: It is recommended that "40 million yards" cited in the second sentence be changed to indicate that the value is "40 million cubic yards."

Response. Accept.

[Note: Response essentially unchanged from original.]

40. Page 4-14, Second Paragraph: It is recommended that the words "parallel activities" in the first sentence be replaced with the word "efforts."

Response. Accept.

[Note: Response essentially unchanged from original.]

41. Page 5-1, lines 23 to 25: As stated, "From an implementability perspective, the barriers are readily constructable, are viewed as reliable remedial measures, and do not appear to be constrained by administrative issues or the availability of materials." Sections 4.2.6.2 and 4.2.6.3 indicate that administrative feasibility and availability of services and materials, respectively, are definitively not of concern. These statements should be amended for consistency.

Response. Accept. Subject statement will be modified as follows (changes underlined).

"From an implementability perspective, <u>surface</u> barriers are readily constructable, are viewed as reliable remedial measures, and <u>are not</u> constrained by administrative issues or the availability of <u>labor or</u>

materials."

[Note: Response essentially unchanged from original.]

42. Page 5-1, lines 47 and 48: The text indicates that site-specific requirements and criteria include "Settlement and subsidence issues and control measures, including void reduction and subgrade compaction specifications." Please see the above discussion on cap slope and update this sentence accordingly.

Response: Reject. Refer to comment response #4.

[Note: Response essentially unchanged from original.]

43. Page 5F-1, Figure 5-1: Decision box (6) which involves the question; does the category 1 rad waste also contain hazardous waste? follows illogically along the flow path (through decision box #4) which has already determined that there is no hazardous waste. This contradiction should be resolved. Perhaps a second C1 decision box should be placed off of the "yes" path from the #4 decision box.

Response: Accept. Figure 5-1 will be modified to eliminate the logic problem.

[Note: Response essentially unchanged from original.]