DRAFT RESPONSES TO U.S. DOE COMMENTS ON DRAFT 881 HILLSIDE AREA FEASIBILITY STUDY VOLUME 1, DATED 1 MARCH 1988

GENERAL COMMENTS

Comment: Chapter 1

This introductory chapter should set the tone for the entire FS by presenting pertinent background data in a manner that makes clear the nature and extent of contamination and risks, as well as the remedial objectives.

This chapter presents considerable text, presumably derived from the Remedial Investigation (RI). However, it is not clear whether the information presented reflects the July 1987 RI report, or if it addresses subsequent changes to the RI report, which was resubmitted on March 1, 1988, the same date as the FS submittal.

The first chapter provides several pages of site background and contamination information, presumably from the RI. Chapter 1 tends to provide conclusive information without the benefit of supporting summary data tables and figures. Consequently, it gives the impression of being an incomplete account of the site situation. Comparisons to background are made and should be minimized. When used, background levels should be defined. In terms of remediation standards or objectives, however, emphasis should be placed on comparisons with Applicable or Relevant and Appropriate Requirements (ARARs). The present text should be revised to incorporate summary tables and to eliminate any conclusions (or opinions) that are not supported by information presented in the text. One approach may be to reprint the RI executive summary and conclusions, citing them as the basis for the remedial objectives. (The objectives themselves should be presented as clear, concise, site-specific action items.)

Response to Comment: Chapter 1

Due to time limitations imposed by the Compliance Agreement with the Colorado Department of Health, field work leading to revisions of the July 1987 Draft RI Report, preparation of the March Final 1988 Draft RI Report, and preparation of the March 1988 Draft FS Report were conducted concurrently. As a result, background characterization was inadequate at the time of FS preparation. Furthermore, the FS suffered because a preliminary ARAR analysis was not performed at the RI stage. The ability to develop specific remedial objectives based on the ARAR analysis was hindered by not incorporating the ARAR analysis into the FS at the appropriate time. The RFP is currently involved in the development and implementation of a comprehensive program for background characterization of both soil and groundwater. Additional soils data is expected to be available in four to six months from program authorization. Additional reliable and meaningful groundwater data will not be available for 18 months from program authorization.

However, because the 881 Hillside Area is currently in a remedial design phase, the RI/FS will be revised to address these comments as well as those of the

regulatory agencies without the benefit of this expanded background data. This means the data presented in the March 1988 report, and data collected to date, will be reevaluated to verify the soundness of our conclusions. Should reevaluation using new background data result in a change in our interpretation of the nature and extent of contamination, the need for an additional operable unit will be assessed at that time. In general, the introduction to the FS will be revised to more clearly present the nature and extent of contamination, compliance with ARARs, risks to the public health and environment, and remedial action objectives.

Comment: Chapter 2

This chapter on technology screening should be expanded to show how the screening was conducted and how the results will be used in remedial alternative development and evaluation. This would help not only in the reader's understanding of the process, but also in the consistent application of evaluation criteria during the screening process.

The present technology screening discussions are out of balance. Some technologies are retained or dismissed based on scant discussion; others, particularly groundwater treatment methods, go into extensive detail without apparent need. Also, cost seems to be inconsistently applied as a screening factor among the various technologies presented.

Response to Comment: Chapter 2

The presentation and screening of remedial action technologies and process options will be included as revisions to the Draft FS Report and will be performed using the most recent EPA guidance on conducting an RI/FS. Technologies associated with general response actions (e.g. chemical treatment technology types within ground water treatment response action) will be initially screened based on technical implementability. Those technology types passing initial screening will be assembled into process options that address the remedial action goals. These process options are then screened based on effectiveness, implementability and relative cost for input into the development of plausible remedial alternatives.

Comment: Chapters 3-6

These chapters collectively deal with remedial alternative development and evaluation. While the overall presentation appears to be somewhat consistent with the June 1985 EPA FS guidance, several factors bear some consideration. First of all, the current National Contingency Plan (NCP) and FS guidance specify that at least one alternative representing each of five categories of remediation be developed. These categories are closely related to ARARs. Discussion early in the text explains how ARARs are defined by EPA, but it is not apparent how the ARARs are applied to the evaluation of the alternatives' acceptability. An extensive listing of ARARs and potential ARARs is presented in the appendices, but again, their application is unclear. In addition, the

effects of EPA Land Disposal Restrictions on the regulatory acceptability of the alternatives presented is not discussed.

Response to Paragraph 1:

We agree that the Draft FS Report is unclear in identifying how each of the remedial alternatives meet the NCP and SARA evaluation criteria, or how ARARs are attained by the alternative. We propose using a table in the revised Draft FS Report to label the alternative with a number that corresponds to the NCP and SARA category that best describes the alternative. A supplementary table will summarize an evaluation of the alternative's ability or inability to meet chemical, action, and location specific ARARs.

The applicability of EPA's Land Disposal Restrictions to potential remedial actions was presented in Appendix 2 under the screening of action specific ARARs. The Land Disposal Requirements were determined to be relevant and appropriate for remedial actions involving excavation and consolidation even though those actions do not constitute disposal.

It is noted that the NCP and 1985 guidance document do not reflect Superfund Amendments and Reauthorization Act (SARA) mandates. In particular, EPA now indicates that alternatives development should emphasize protection of human health and the environment (HH&E). They now suggest that meeting ARARs alone may not be fully protective of HH&E.

Response to Paragraph 2:

Your comment that former FS guidance and NCP mandates do not reflect current SARA mandates is correct. An example of SARA's impact on evaluation of alternatives is that formerly, SDWA Maximum Contaminant Levels (MCLs) were considered adequate to protect human health and the environment from contaminated ground water potentially used as a drinking water source. The most recent guidance on chemical specific ARARs states that FS preparers are obligated to consider other non-enforceable, non-promulgated criteria, guidance or advisories for certain contaminants under certain circumstances of release, such as multiple contaminants and/or multiple pathways of exposure to contaminated ground water. Revisions to the Draft FS Report will consider such criteria in the ARAR analysis.

In some instances, alternatives are rejected on the basis of technology uncertainties (e.g., Alternative 4), which suggests that the technology should not have passed the initial technology screen. This implies several possible considerations: remedial objectives may not have been defined so as to limit technology selection; technology screening may not have been sufficiently rigorous; alternatives development may not have been based on appropriate technologies; or alternative development may have been approached more randomly than systematically. Regardless, the general impression is that perhaps the incorrect set of alternatives is being evaluated in the first place. One way to improve that

apparent weakness is to present more objective or quantitative data (such as modeling and site data) in the evaluation.

Response to Paragraph 3:

The elimination of Alternative 4 was not based on the assessment that soil flushing was technically unsound. Soil flushing was included to meet the SARA criteria that alternatives be developed that include alternative or innovative technologies. Alternative 4 was subsequently eliminated under screening because the incremental benefit provided by soil flushing did not justify the increased cost of implementation. Note that the soil flushing technology was retained in the preferred alternative as an option to facilitate ground water remediation in the event remediation did not occur in a timely fashion. Revisions to the Draft FS Report will provide a more organized approach to technology and alternative screening, and provide more objective and quantitative analysis of alternatives to the extent possible.

It is not clear from the text that the provisions of SARA as applicable to the FS are entirely understood. While SARA does not encourage transporting wastes from one location to another as a solution, it does not prefer waste encapsulation or other passive source control measures over treatment measures. In fact, SARA emphasizes the need for measures that reduce volume, mobility, or toxicity of wastes. Yet in some cases, alternatives are evaluated as being in compliance with SARA because they control the source without treatment.

Response to Paragraph 4:

EPA's "Interim Guidance on Superfund Selection of Remedy," J. Winston Porter, December 24, 1986, provides guidance on the development of alternatives under SARA. These categories are as follows. Note category 3 in response to your comment that alternatives should not be evaluated as being in compliance with SARA because they control the source without treatment.

SARA CATEGORY	DESCRIPTION
1	Alternatives that, to the degree possible, would eliminate the need for long term management at the site.
2	Alternatives that would reduce toxicity, mobility, or volume.
3	A containment option involving little or no treatment.
4	No action alternative.
5	Alternatives that include alternative or innovative technologies.

Costs do not appear to be appropriately supported or utilized in the evaluations. SARA encourages cost-effective solutions, and the NCP and 1985 FS guidance specify that costs may be a screening factor within a particular category of remediation, but not

between categories. From the text, it is unclear which alternatives fit which of the five NCP categories. Some alternatives are screened out on a cost basis, even though other retained alternatives may have similar cost estimates. This prevents an effective cost comparison among all evaluated alternatives to assess relative costs and benefits. Moreover, it is not clear from the data presented how the costs were derived. Present worth estimates for each alternative in Chapter 3 differ from the present worth presented for four of the same alternatives in Chapter 4. Appendix 3 in Volume II provides costing details for capital costs only. The factors and assumptions built into the annual and present worth cost estimates do not appear to be presented in any detail. Based on Table 4-8 (Cyclic Costs Component Work Sheet for four alternatives), it is not apparent if labor and administrative costs are included in the annual cost estimates. If not, it is unlikely that the estimates will fall within the -30% to +50% required accuracy range.

Response to Paragraph 5:

Referring to our comment to Paragraph 1 of this section, the revised Draft FS Report will provide a summary table that identifies which alternatives meet which NCP and SARA category. The text of the Draft FS Report, Section 3, discusses the relative ability of the alternative in meeting the NCP and SARA categories, and the relative costs associated with the alternative. Although these assessments are summarized in Table 3-9, the table does not provide a clear definition of which alternatives meet which categories. Because this distinction is unclear, the decision process used to retain or eliminate an alternative based on costs is also unclear. Revisions to the Draft FS Report will provide a more thorough discussion of the categorization of the alternatives. Cost estimates will be included in the summary table to allow for direct cost comparison between alternatives within similar NCP categories. Additional detail on the assumptions used to arrive at cyclical costs will also be provided.

SARA requires that alternatives be cost effective. The intent of Congress in enacting SARA (Congressional Record, October 3, 1986, p. H9102) is clear. Here Congress indicates that "cost-effectiveness" means that one first determine the appropriate level of protection for HH&E to be achieved and then select a cost-effective means of achieving this goal. Only after ARARs are met is it appropriate to consider cost-effectiveness; it does not appear that the FS complies with SARA in this regard.

Response to Paragraph 6:

The June 1985 FS guidance mentions that alternatives should be developed that meet the following five NCP categories:

NCP CATEGORY	DESCRIPTION
1	Alternatives for treatment or disposal at an off-site facility approved by EPA, as appropriate.
2	Alternatives which attain applicable and relevant Federal public health or environmental standards:

NCP CATEGORY	DESCRIPTION
3	**As appropriate, alternatives which exceed applicable and relevant public health or environmental standards;**
4	**Alternatives which do not attain applicable or relevant public health or environmental standards but will reduce the likelihood of present or future threat from the hazardous substances. This must include an alternative which closely approaches the level of protection provided by the applicable or relevant standards and meets CERCLA's objective of adequately protecting public health, welfare, and environment.**
5	A no action alternative.

Although it is not documented clearly in the Draft FS Report, alternatives were developed using the above criteria as well as SARA criteria. Alternatives were then screened based first on their ability to meet or exceed ARARs followed by elimination of those alternatives that were an order of magnitude more costly than alternatives offering a similar level of protection. This procedure, outlined in the 1985 FS guidance manual, differs from the most recent guidance in that the first four categories are not specified per se. We feel that the alternatives were developed and screened in accordance with EPA guidance at the time of Draft FS Report preparation. Moreover, the screening was successful in eliminating those alternatives that were not protective of human health regardless of costs.

It should also be noted that the NCP and EPA FS guidance are in the process of changing. According to guidelines in current 1988 draft revisions to the NCP and to the FS guidance, nine principal criteria must be considered in the evaluation and comparison of remedial alternatives. These criteria, cited in EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-21 (July 24, 1987), are:

- *Compliance with ARARs*
- *Reduction of waste toxicity, mobility, or volume*
- *Short-term effectiveness*
- *Long-term effectiveness and permanence*
- *Implementability*
- *Cost (note Congressional intent)*
- *Community acceptance*
- *State acceptance*
- *Overall protection of HH&E*

Response to Paragraph 7

The criteria cited in this paragraph are noted and will be incorporated into revisions of the Draft FS Report.

SPECIFIC COMMENTS

Comment: Page 1-5, Paragraph 1

The "potential sources of environmental contamination" referred to here should be identified, at least those relevant to the 881 Hillside FS.

Response to Comment: Page 1-5, Paragraph 1

The statement on page 1-5 was intended as a general statement acknowledging sources of environmental contamination at Rocky Flats Plant. Section 1.1.2.4 presents details of source areas in the 881 Hillside Area.

Comment: Page 1-5, Paragraph 2

The text should characterize the "portions of this land" that have been converted to housing in terms of size, extent, population, and relationship to the Rocky Flats Plant (RFP) site.

Comment: Page 1-5, Paragraph 3

The text should address transient (i.e., worker or commuter) populations that could affect exposure concerns, both on and off the RFP.

Comment: Page 1-6, Paragraph 1

The locations of potentially-sensitive populations such as schools should be expressed more accurately than "in the same general area, but somewhat farther." Also, two reservoirs east of the RFP shown in Figure 1-2 are not mentioned in the text.

Response to Comments: Page 1-5, Paragraph 2; Page 1-5, Paragraph 3; Page 1-6, Paragraph 1

A demographic study will be performed to answer these three comments more thoroughly in the revised Draft FS Report.

Comment: Plate 1-4

Solid Waste Management Units (SWMUs) No. 104 and 177 are not shown on this drawing. If they have been purposely excluded, the text should provide an explanation.

Response to Comment: Plate 1-4

SWMU 104 was an area reported to be located east of Building 881. This area was used for disposal of unknown liquids prior to 1969. No evidence of the area was

found in review of historical air photos or in field investigations carried out by Rockwell (1987). Results are presented in the Draft RI Report and, because of their scope and depth, supercede observations of the CEARP Phase I program. Therefore, SWMU 104 was excluded from Plate 1-4.

Building 885 Drum Storage Area (SWMU Ref. No. 177) will be closed under RCRA Interim Status (6 CCR 1007-3). Complete information on this unit is provided in the RCRA Interim Status Closure Plan and therefore was not discussed in the RI/FS report. Location of SWMU 177 is identified on Figure 2-3 of the 881 Hillside RI report (page 2-7). These explanations will be added to the revised Draft FS Report.

Comment: Page 1-12, Paragraph 4

It seems that the description of SWMUs NO. 119.1 and .2 could be expanded. For example, data from the Comprehensive Environmental Assessment and Response Program (CEARP) Phases 1 and 2 may provide information regarding quantities stored, spills, areas affected, etc.

Response to Comment: Page 1-12, Paragraph 4

These SWMU descriptions given on pages 1-9 and 1-12 of the Draft FS Report are intended to be brief summaries of the more extensive Draft RI Report site descriptions. More detailed waste source characterizations are discussed in Section 4 of the Draft RI Report; specifically, SWMU 119 is discussed in Section 4.6 (page 4-27).

Comment: Page 1-12, Paragraph 5

It is unclear if the plutonium activity level reported for this area is the 1986 reported level or the level at time of disposal between 1969 and 1972. The current activity level should be provided if available.

Response to Comment: Page 1-12, Paragraph 5

We agree that it is unclear if the plutonium activity level reported is 1986 or 1969.

The average plutonium level of the material from the fire cleanup in 1969 was estimated to be seven disintegrations per minute per gram (dpm/g) (Rockwell International, 1986). Although soils containing low levels of plutonium were disposed of at this SWMU, no radionuclides were found in the soils based on our CEARP remedial investigation of the 881 Hillside area which began in March 1987. We intend to clarify this ambiguity in the revised Draft FS Report.

Comment: Page 1-13, Paragraph 3

The Fountain Formation is not shown in Figure 1-5 as stated.

Response to Comment: Page 1-13, Paragraph 3

The Fountain Formation is not shown on Figure 1-5. The following figures are a generalized east-west cross section and stratigraphic section which will replace Figure 1-5 in the revised FS report. These illustrations are more applicable for the discussion which follows in the Report.

Comment: Page 1-14, Figure 1-5

There are 2 Upper Laramie Formations indicated. Perhaps one should be the Arapahoe Formation, which is not shown here; Laramie is misspelled.

Response to Comment: Page 1-14, Figure 1-5

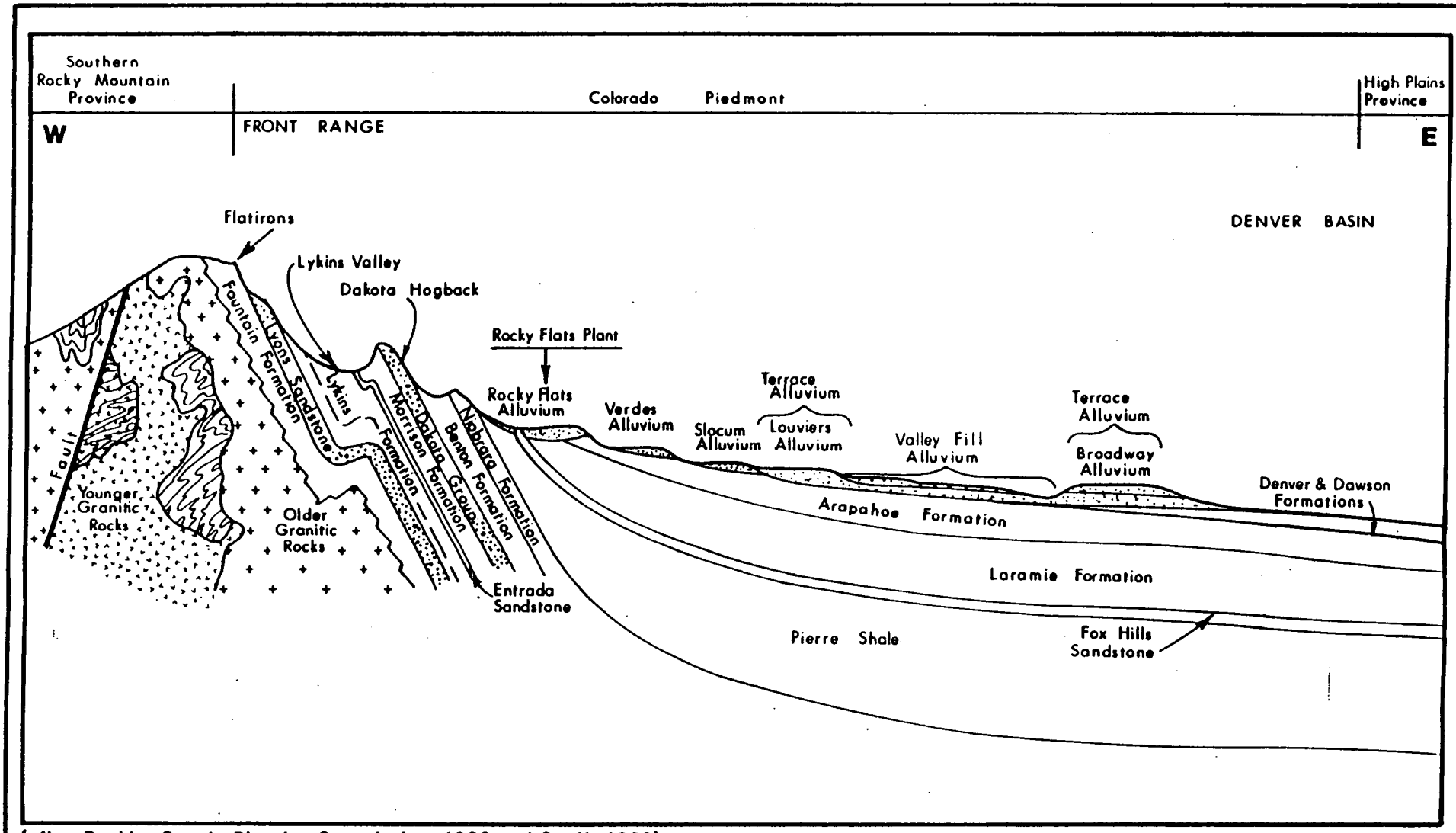
Yes, there are two Upper Laramie Formations indicated in Figure 1-5. Ka should be the Cretaceous Arapahoe and Laramie is misspelled. We intend to replace this cross section with the illustrations indicated for the previous response.

Comment: Page 1-15, Paragraph 1

The "low permeability" of the Upper Laramie Formation mentioned in line one is not defined. The statement that this formation is the base of the hydrologic system beneath the plant needs more support. The hydrogeologic characteristics of the Lower Laramie should be described including the presence of fractures, joints, and structures beneath and neighboring the RFP.

Response to Comment: Page 1-15, Paragraph 1

The Upper Laramie claystone at Rocky Flats Plant has a low hydraulic conductivity of $4x10^{-8}$ centimeters per second (cm/s) based on packer test data from the West Spray Field (Rockwell, 1983). The low permeability of the Laramie claystones is also documented by Robson (1987). Based on computer modeling of the Denver Basin, he predicts the Upper Laramie to hydraulically separate the sandstones of the Arapahoe aquifer from the Laramie-Fox Hills sandstones (Robson, 1987). These data will be incorporated into the Draft FS Report.



(after: Boulder County Planning Commission, 1983 and Scott, 1960)

Not To Scale

Figure 3-3:
Generalized East-West Cross Section
Front Range to Denver Basin

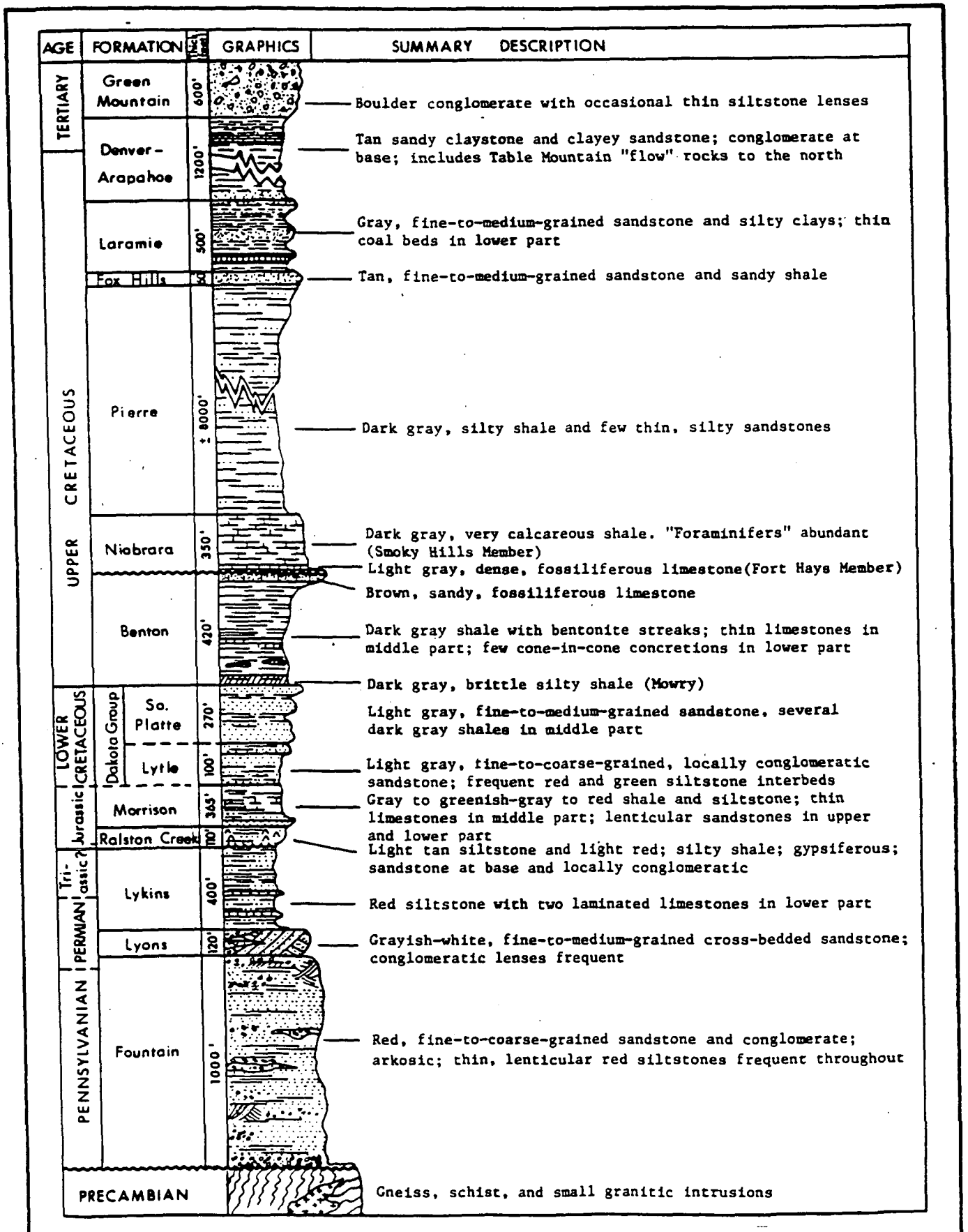


Figure 3-5: Generalized Stratigraphic Section, Golden-Morrison Area

(after: LeRoy and Weimer, 1971)

Comment: Page 1-17, Paragraph 2

While gravel layers may be significant, the properties of the alluvial, colluvial, and fill materials that also contribute to contaminant transport should be summarized.

Response to Comment: Page 1-17, Paragraph 2

The properties of hydraulic conductivity, effective porosity, and hydraulic gradient control contaminant transport in surficial materials. These properties are discussed in Section 1.1.4.2 of the Draft FS Report for valley fill alluvium and colluvial materials. In addition, presented below are geologic descriptions of alluvial, colluvial, and fill materials which will be added to the revised Draft FS Report.

The Rocky Flats Alluvium is topographically the highest elevation and the oldest of the alluvial deposits and consists of a series of laterally coalescing alluvial fans deposited by streams (Hurr, 1976). The alluvium consists of sand, clay, silt, gravel, cobble, and occasional boulder deposits. Locally, the alluvium is cemented with calcium carbonate in the form of caliche. The sands range from very fine-grained to medium-grained and poorly to moderately sorted. The alluvium is thickest to the west of the RFP, where less has been eroded, and thinnest to the east of the plant (Rockwell International, 1986a).

Various alluvial deposits occur topographically below the Rocky Flats Alluvium in the drainages and are primarily composed of reworked Rocky Flats Alluvium, with the addition of some bedrock material.

Valley fill alluvium occurs in the bottom of the present stream valleys around the plant. The valley fill ranges from sandy, clayey silt to moderately sorted cobbles and small boulders, recently reworked from previously deposited alluvium. Where valley fill is deposited on bedrock, 0.5 to 2 feet of cobbly sand and gravel commonly is overlain by several feet of sandy, clayey silt (Rockwell International, 1986a). Subsequent erosion and deposition locally may have added more sand, gravel, and cobbles on top of the silt, or cut through the valley fill to expose bedrock along the channel bottom (Hurr, 1976).

Colluvium, produced by mass wasting and downslope creep, collects on the sides and at the base of hills and slopes. These deposits are a poorly sorted mixture of soil and debris from bedrock clay and sand mixed with gravel and cobbles derived from the older Rocky Flats Alluvium. The colluvium consists predominantly of clay with common occurrences of sandy clay and gravel with caliche common locally. The thickness of the colluvium ranges from 3 to 22 feet (Rockwell International, 1986).

There are two types of artificial fill on the 881 Hillside derived from separate sources. The first is fill material derived from excavation of the Building 881 foundation, and the second is soil placed at SWMU 130 from the 1969 RFP fire cleanup.

Material excavated from the Building 881 foundation was spread over a large area generally south of the building. The very poorly sorted and unconsolidated

artificial fill was derived from Rocky Flats Alluvium, colluvium, and claystone bedrock. It is predominantly composed of sandy clay with some gravelly zones. The fill is underlain by colluvial and bedrock materials, and ranges from two to five feet in thickness.

Soils placed at SWMU 130 comprise the second type of artificial fill. This fill represents soils from around Building 776 after the 1969 fire, and cover material. It consists of clayey sand with subangular quartzite cobbles. The fill at SWMU 130 overlies natural colluvial materials and is generally undersaturated.

Comment: Page 1-19, Paragraph 2

"Relatively impermeable" should be defined. The size of the area affected by the bedrock high east of Building 881 and the direction of diverted groundwater flow should be described.

Response to Comment: Page 1-19, Paragraph 2

The hydraulic conductivity of Laramie claystone is approximately $4x10^{-8}$ cm/s (Rockwell International, 1987). As shown in Table 5-1 of the 881 Hillside Draft RI Report (page 5-10), hydraulic conductivity ranges from $2x10^{-6}$ cm/sec to $2x10^{-7}$ cm/sec for weathered claystone of the Arapahoe Formation. The hydraulic conductivity geometric mean is $7x10^{-7}$ cm/sec. The unweathered claystones of the Arapahoe Formation have hydraulic conductivities ranging from $3x10^{-6}$ to $1x10^{-8}$ cm/sec, with a geometric mean of $1x10^{-7}$ cm/sec. These values are considered low conductivities.

The size of the area affected by the bedrock high east of Building 881 is shown in Plate E-5 of RCRA Part B (Rockwell International, 1986). This relatively large undersaturated surficial material starts approximately 250 feet east and north of Building 881, is 2,500 feet wide in the east-west direction, and 2,200 feet long in the north-south direction. The bedrock ridge runs east-northeast from Building 881 for approximately 1.8 miles. Groundwater flow, instead of moving in the regional flow direction of west to east is locally flowing from north-northwest to south-southeast toward the South Interceptor Ditch.

This map (Plate E-5) will be included for the 881 Hillside revised Draft Report. However, Plates 5-5, 5-6, and 5-7 from the 881 Hillside Draft RI Report illustrate this concept in a larger, more localized scale.

Comment: Page 1-21, Paragraph 2

The selection of input parameters used to calculate groundwater flow rate should be justified. The remarks made about a molecule traveling 10,000 feet in 30 years are misleading since they appear to ignore the mass and extent of a contaminant plume that may be present. Also, they seem inconsistent with the "quite dynamic" shallow groundwater

flow system, described on the preceding page, in which large water level changes would affect hydraulic head and, consequently, contaminant transport.

Response to Comment: Page 1-21, Paragraph 2

Groundwater flow rates are a function of hydraulic conductivity, hydraulic gradient, and effective porosity. Following Anderson (1979), the equation for average linear velocity in groundwater is:

$v = K\ i/n$

Where:

v = average linear velocity (L/T)

K = hydraulic conductivity (L/T)

n = effective porosity (unitless)

i = hydraulic gradient (L/L)

The RI/FS hydraulic conductivity values were developed for surficial materials from drawdown recovery tests performed on all bedrock wells drilled in 1986 during the initial site characterization (Rockwell International, 1986), as noted in the text. Results of these tests are summarized in Table 5-2 of the Draft RI Report. Test data and analyses are presented in Appendix E of the Draft RI Report and will be in the revised Draft Report.

Hydraulic conductivity values from drawdown recovery tests for the Woman Creek valley fill alluvium ranged from $9x10^{-4}$ cm/sec (931 ft/yr) to $3x10^{-3}$ cm/sec (3,103 ft/yr), with a geometric mean of $1x10^{-3}$ cm/sec, (1,000 ft/yr). It is noted that 2,000 ft/yr was given in the Draft RI Report and will be corrected in the final revision.

Using a gradient of 0.024 ft/ft (based on topography), an effective porosity of 0.1, and a mean hydraulic conductivity of $1x10^{-3}$ cm/sec, the average groundwater velocity in Woman Creek valley fill is approximately 250 ft/yr. To illustrate:

$(1x10^{-3}$ cm/sec)(365.25 days/yr)(86,400 sec/day)(ft/30.48 cm) = 1,035 ft/yr

v = (1,035 ft/yr)(0.024 ft/ft)/0.1 = 248.5 ft/year

10,000 ft/250 ft per year = 40 years to migrate to the site boundary

Assuming that the groundwater flows at this velocity for about half the year, ground water would travel the 10,000 feet to the property boundary in about 80 years. The assumption that the groundwater flows only half the year is based on actual observations of unsaturated conditions in the valley fill alluvium. This will be stated

in the revised RI. There is no organic contamination downgradient of the 881 Hillside Area.

Comment: Page 1-22, Paragraph 2

This paragraph should be rewritten so that the conditions described and the conclusions drawn about low hydraulic conductivity can be more readily understood.

Response to Comment: Page 1-22, Paragraph 2

As noted, calculated vertical gradients range from about 2 to 0.3 ft/ft. High vertical gradients generally indicate the presence of intervening low conductivity materials. In addition, intervening low conductivity materials (claystone) do occur based on visual observations of core.

It appears that a vertical gradient greater than one indicates unconfined conditions in the lower unit and unsaturated conditions in the intervening layers. For unconfined conditions, the differential head will be at least equal to, if not greater than, the thickness of the intervening materials. However, vertical gradients do not indicate the extent of hydraulic interconnection. A high vertical gradient means only that there is high potential to flow. Actual downward flow rates are controlled by the vertical hydraulic conductivity of the intervening layers as well as the vertical gradient.

This discussion will be included in the revised Draft FS Report.

Comment: Page 1-24, Paragraph 2

It is unclear if the first sentence is intended to refer to a distinct difference between upgradient and downgradient groundwater conditions, or between groundwater and general (but undefined) plant background conditions.

Response to Comment: Page 1-24, Paragraph 2

This sentence is intended to make note of the distinct difference between Plant (background) and groundwater conditions immediately downgradient of the 881 Hillside. We will make this concept clearer in the sentence for the revised Draft FS Report.

Comment: Page 1-25, Paragraph 4

This last paragraph in item 4 does not seem objective. The words "actually quite low" should be deleted, and the data simply compared to the standard. Additional

discussions, including the presentation of the isotopic ratios, are necessary to support the conclusion that the uranium isotopes reported are of natural origin.

Response to Comment: Page 1-25, Paragraph 4

The sentence, as you propose, will read "Although uranium concentrations are elevated with respect to conditions west of the plant, they are less than the proposed drinking water standard of 40 pCi/l." This sentence will be corrected for the revised Draft FS Report.

Isotope ratios of dissolved uranium will be discussed more thoroughly and a discussion on why these ratios are probably considered to be of natural origin will also be included in the revised Draft FS Report.

This will be added to the discussion at the end of the paragraph:

> "The activity ratio of U-234 to U-238 in natural uranium is nearly 1 to 1. In depleted uranium, where the U-234 and U-235 have been removed, the activity of U-234 is on the order of 1/100 the activity of U-238. In enriched uranium, the activity of U-234 is on the order of 3,000 times greater than the U-238 activity. The ratios in depleted and enriched uranium are significantly different from what would be observed for natural uranium."

Comment: Page 1-26, Paragraph 1

The distance and direction to the nearest downgradient well should be provided.

Response to Comment: Page 1-26, Paragraph 1

The sentence should read "This contamination has not migrated to the nearest downgradient well, which is well 2-87, approximately 295 feet south of well 53-87." This will be corrected in the revised FS report.

Comment: Page 1-27, Paragraph 2

Provide data to support the statement that groundwater flow "is probably low. . . and of small quantity."

Response to Comment: Page 1-27, Paragraph 2

Most of the surficial materials are clayey soils consisting of natural or slightly disturbed colluvium. Hydraulic conductivity tests performed by the RI team are available for three wells completed in colluvium at the 881 Hillside; two are completed in gravel layers and one is completed in clayey soil (well 69-86). The test results indicate hydraulic conductivities of 5×10^{-4} cm/s for gravel layers and 3×10^{-5} cm/s for the clayey soil. Using the maximum hydraulic conductivity value of 5×10^{-4}

cm/s (520 ft/yr), an average gradient of 0.15, and an assumed effective porosity of 0.1, the maximum groundwater velocity through colluvial materials is 780 ft/year, although this is not likely to occur because the gravel lenses are not continuous (see response to comment Page 1-21, paragraph 2 for calculation discussion).

The rest of paragraph 2 helps support the initial sentence regarding low infiltration and low recharge.

Comment: Page 1-27, Paragraph 3

Define the "low permeability" of "most of the colluvium."

Response to Comment: Page 1-27, Paragraph 3

The measured hydraulic conductivity for clayey soil in the colluvium was $3x10^{-5}$ cm/s (31 ft/yr). This value for hydraulic conductivity is in the low to medium range. Most of the colluvium displays this low conductivity; however, thin and discontinuous gravel lenses show locally slightly higher hydraulic conductivities of $5x10^{-4}$ cm/s (520 ft/yr). Please also note the response to Page 1-27, paragraph 2.

Comment: Page 1-28, Paragraph 3

Delete "rather low."

Response to Comment: Page 1-28, Paragraph 3

We will delete "and are actually rather low" from this paragraph for the revised 881 Hillside Draft FS Report.

Comment: Page 1-29, Data Table

It is unclear what the "U" stands for.

Response to Comment: Page 1-29, Data Table

"U" indicates the constituent was not detected. The associated numerical value is the estimated quantitation limit. We will clarify this for the revised Draft FS Report.

Comment: Page 1-30, Paragraph 3

No data were presented in this chapter to correlate potential or observed groundwater contamination with specific SWMUs. Therefore the statement limiting

degradation to only four of twelve SWMUs is not supported. It is unclear if the FS intends to address remediation of only these four SWMUs.

Response to Comment: Page 1-30, Paragraph 3

Based on data presented in Section 4.0 of the Draft RI Report, SWMUs 102, 104, 105, 130, 145, and 177 are not considered potential sources of groundwater or surface water contamination. SWMUs 103, 106, 107, and 119.1 appear to be potential sources of groundwater contamination based on concentrations of volatiles in soil gas and/or soils.

The preferred alternative of using a french drain will effectively collect all shallow groundwater from the 881 Hillside. Therefore, the design of the FS addresses remediation of all SWMUs regardless of their potential contribution to groundwater contamination.

Comment: Page 1-31, Paragraph 2

The statement regarding "leaching of naturally occurring elements from waste disposed" seems contradictory and does not lend any assurance that actual or potential contamination is not occurring. Use of the terms "may result" and "may reflect" does not lend certainty to the conclusion being made.

Response to Comment: Page 1-31, Paragraph 2

This conclusion will be revised to state, "It appears based on estimated background chemical conditions that alluvial and shallow bedrock groundwater is contaminated with inorganic constituents, i.e., major ions, selenium, strontium, and uranium. Because these constituents are not known or expected to have been disposed at the 881 Hillside Area, they have been leached from soils by the waste that was disposed. Although a better characterization of background may change this conclusion, it is assumed for this study that these constituents are contaminants of the 881 Hillside." The RI team plans to install 30 additional background wells to further characterize background in late 1988/early 1989.

Comment: Page 1-32, Paragraph 3

The validity of using Draeger Tube readings in outdoor ambient air for risk-level remediation decision-making seems highly questionable.

Response to Comment: Page 1-32, Paragraph 3

Agreed. Draeger Tube readings were discussed in terms of potential health risks because the data was available. Draeger Tubes were used to monitor the ambient air near an open monitoring well for health and safety purposes. There was never any intention of using them as the basis for a risk assessment. An ambient air

monitoring program for volatiles was not implemented because there were no highly contaminated surface soils or surface water bodies.

Comment: Page 1-32, Paragraph 4

It is unclear which "obvious stress" was looked for in the biota. Available data on plant and animal contaminant uptake, particularly of strontium and the uranium isotopes, should be used if broad conclusions on ecological impact are to be made.

Response to Comment: Page 1-32, Paragraph 4

"Obvious stress" is considered to be dead vegetation, stressed vegetation, or lack of vegetation. Numerous radioecology studies have been commissioned by the contractors of the Rocky Flats Plant. They conclude there is no ecological impact from radionuclide release from the facility. The studies will be reviewed, and the pertinent details will be presented in the revised Draft FS Report.

Comment: Pages 1-33 through 1-37

Section 1.3 on ARARs appears to be a recitation of EPA's guidance on this topic. The section does little to explain why or how ARARs are used in the Rocky Flats FS process, and seems out of context in Chapter 1. It would seem more appropriate to address the hows and whys of ARARs in the context of FS screening criteria, which should be discussed elsewhere in the text. The discussion of EPA's guidance could be abbreviated and placed in the appendices or deleted entirely, unless specific points from the guidance are being made.

The example of "applicability" cited on page 1-33, paragraph 3, is incorrect. In point of fact, the Land Disposal Restrictions may be regarded as "relevant and appropriate" or "other" under certain circumstances.

Response to Comment: Pages 1-33 through 1-37

The discussion of ARARs in Section 1.3 is provided to refresh the reader on the distinction between, and proper development of applicable or relevant and appropriate requirements. The text will be modified to include more discussion on the use of ARARs in the context of alternative development and screening.

We do not understand what is incorrect about the Land Disposal Restrictions example of applicability. As stated, the Land Disposal Restrictions are applicable for land disposal of RCRA hazardous waste for actions that constitute disposal. Land

Disposal Restrictions may be considered as relevant and appropriate if the waste is not RCRA hazardous waste or the action involves movement but not disposal.

Comment: Page 1-37, Source

A more recent document, "CERCLA Compliance with Other Laws" dated May 6, 1988, is now available.

Response to Comment: Page 1-37, Source

This comment is noted.

Comment: Pages 1-37 through 1-39

The objectives should be the culmination of all the data and conclusions discussed in Chapter 1. Instead, the brief discussion presented centers only on vague generalities rather than site-specific action items. Site-specific objectives are relegated to two "issues and pathways" in Table 1-1, which are not discussed within Section 1.4. This section should be rewritten so that the data and site conditions discussed throughout Chapter 1 are cogently and succinctly linked with the remedial action necessary at the site by area, media, and/or contaminants as appropriate. The discussion of general response actions would be better presented at the beginning of Chapter 2 (Technology Screening). Also, elimination of Section 1.3 (ARARs) would help editorially in making the transition from site background data to remediation objectives.

Response to Comment: Pages 1-37 through 1-39

See the response to General Comments, Paragraph 3

Comment: Page 2-1, Paragraph 1

This introductory section should lay out the ground rules/criteria/procedures by which the technology screening is conducted. It should include discussion of general response actions, and how they (and specific technologies) will address the site-specific objectives that should be set forth in Chapter 1.

Response to Comment: Page 2-1, Paragraph 1

Section 2 is written in a format that identifies and discusses the remedial technologies associated with general response actions anticipated for the 881 Hillside. There is no discussion on how the technologies address specific remedial action goals because the specific goals were never presented in the document. Revisions to the Draft FS Report will provide the necessary connection between specific remedial goals and the appropriate technologies.

Comment: Page 2-3, Paragraph 3

Comparison to background levels is insufficient. Risk assessment conclusions regarding soil radionuclides should be cited to support the point. Also, the presence of uranium isotopes in those soils could invalidate the conclusion regarding the need for mixed waste facilities.

Response to Comment: Page 2-3, Paragraph 3

Background levels were used for comparison because they imply acceptable levels of risk. We agree that risk characterization conclusions regarding soil radionuclide levels would strengthen the point that soils pose no risk from radionuclides. What constitutes radioactive waste has not been adequately defined. We agree the mere presence of uranium isotopes in the soils at the Rocky Flats Plant may necessitate disposal at a mixed waste facility on a political/community acceptance basis.

Comment: Pages 2-10 through 2-17

Throughout the discussion of infiltration controls, there was no mention of the amount of infiltration that could be expected, thus affording a relative comparison of control methods. While the multi-media cap appears to be a technically-acceptable cap for further evaluation, a far less costly cap could prove to be equally effective. RCRA minimum technical requirements, which don't necessarily require a full RCRA cap, should be discussed.

Response to Comment: Pages 2-10 through 2-17

The multi-media cap was proposed because it addressed the action specific ARARs associated with encapsulation of areas assumed to be contaminated. In further analysis of this technology and associated encapsulation alternative (Alternative 5) it was determined that the alternative did not meet ARARs because of continual release of small quantities of contaminated ground water. However, the alternative was still seen as being protective of human health, therefore meeting the NCP category 5.

We agree with both points regarding the lack of discussion on infiltration and the multi-media cap. We agree that an adequate and comparable level of protectiveness may be possible using a less costly cap design even though annual maintenance costs could exceed the requirements for maintenance of the multi-media cap. Revisions to the Draft FS Report will provide discussions on both accounts.

Comment: Page 2-17, Paragraph 2

The discussion of in situ treatment "to expedite the remediation of groundwater" seems to be very inconsistent with the earlier dismissal of thermal soil treatment on page 2-3.

Response to Comment: Page 2-17, Paragraph 2

It was determined, based on the risk characterization, that the level of soils contamination did not present unacceptable levels of risk. Although not made clear in Draft FS Report text, in situ soil treatment technologies were retained over thermal technologies because the cost for thermal treatment proved too costly for the level of benefit realized. In situ technologies were retained because although the level of soil contamination is acceptable on a risk basis, and the soil does not necessarily require remediation, the treatment of residual soil contamination could prove beneficial for the remediation of ground water at costs more commensurate with the level of contamination. In addition, implementation of thermal treatment will only remediate contaminated soils, while in situ methods remediate contaminated soils and ground water.

Comment: Page 2-19, Paragraph 3

Does not vitrification have the potential for immobilization of strontium and the uranium isotopes? What about for the plutonium activity at SWMU No. 130? Since vitrification was recently chosen for application at Pristine, Ohio, site, it would appear there are data to justify its possible consideration and it should not be dismissed solely on the basis of limited previous applications.

Response to Comment: Page 2-19, Paragraph 3

Vitrification will be considered in more depth in the revised Draft FS Report.

Comment: Page 2-25, Paragraph 2

The concluding statement dismissing this (and any other) technology should cite specific reasons.

Response to Comment: Page 2-25, Paragraph 2

The text states that in situ aeration is not technically feasible for the 881 Hillside because of the large amount of clay in the soil. This technology has proven effective on soils that are sandy in nature. The revised Draft FS Report will provide specific reasons for dismissing technologies from further consideration.

Comment: Page 2-25, Paragraph 4

Depth limitations to easily maintain in situ anaerobic bioreclamation should be explained.

Response to Comment: Page 2-25, Paragraph 4

We agree that depth is a limitation to the implementation of anaerobic biodegradation. This will be included in the revised Draft FS Report. Anaerobic conditions would be difficult to maintain at the 881 Hillside Area. Flooding of the soils and containment of the groundwater, or addition of readily biodegradable organics may induce the low redox potential (anaerobic conditions) required for biodegradation. However, these methods or other methods have not been demonstrated (EPA, 1985).

Comment: Page 2-34, Paragraph 2

Treatability studies could be performed to predict the effectiveness of this method. Therefore, this alternative should not be dismissed solely on the basis of lack of performance data.

Response to Comment: Page 2-34, Paragraph 2

This technology is not dismissed solely on the lack of performance data. It was also found to be much more costly than other treatment alternatives.

Comment: Page 3-1, Item 2

These are general, not specific, objectives.

Response to Comment: Page 3-1, Item 2

We agree. Revisions will itemize the specific remedial objectives.

Comment: Page 3-2, Item 4

The regulatory citations do not specifically address source control or offsite remedial actions as stated, but instead identify seventeen considerations for assessing remedial actions. This error apparently originated in the 1985 EPA FS guidance, which is the apparent source of the statement. The sentence reading "These source control measures adequately address . . ." is an unsupported conclusion that should be deleted or further explained.

Response to Comment: Page 3-2, Item 4

The 1985 FS guidance cites the NCP Sections 40 CFR 300.68(e)(2), and (e)(3) as the source and rationale for developing source control and migration control remedial alternatives. In reviewing these citations, we agree that they do not directly require source and migration control alternatives, but rather list evaluation criteria to be considered in the RI.

Comment: Page 3-2, Item 5

This list should be expanded to address the nine evaluation criteria mentioned on page 3 of these comments.

Response to Comment: Page 3-2, Item 5

Current FS guidance was not available at the time of FS preparation. The nine criteria listed in the current guidance will be used to evaluate alternatives in the revised Draft FS Report.

Comment: Page 3-2, Item 6

According to the FS guidance, cost cannot be used to eliminate an alternative from consideration, unless there is another alternative that provides the same level of remediation (see the general comment on cost-effectiveness).

Response to Comment: Page 3-2, Item 6

We understand the current guidance and will incorporate these changes in the Draft FS Report revisions.

Comment: Page 3-3, Paragraph 1

Delete "welfare."

Response to Comment: Page 3-3, Paragraph 1

This language is used in the 1985 EPA-FS guidance. We will delete this word.

Comment: Pages 3-3 through 3-51 (Sections 3.2 through 3.4)

There is no transitional discussion that shows how these alternatives were developed from the technologies discussed in Section 2. The preceding discussion in Section 3.1 served only to itemize the various requirements and considerations that go into the

preliminary screening. Also there is no apparent attempt made to place the listed alternatives into the five categories required under the NCP. What is needed is a discussion that presents the rationale for combining the technologies into the alternatives presented, which would also provide justification why other likely combinations were not selected. One approach that may be taken is to first place the alternatives in the NCP categories (based on perceived performance from the technology screening), then perform the preliminary screening such that cost-effectiveness conclusions can be reached within each category consistent with both SARA and the FS guidance. Then only the most cost effective alternative from each category would be carried forward to the detailed evaluation. These should be clearly summarized, by NCP category, in what is now Section 3.4. While this approach initially may possibly create more than the eight alternatives listed in Section 3.2, the end result should be a more defensible argument for the ultimate selection of a preferred alternative.

Response to Comment: Pages 3-3 through 3-51 (Sections 3.2 through 3.4)

We concur with this comment. The Draft FS Report was prepared according to the 1985 EPA FS guidance. Your comments relate to the format suggested in the Draft March 1988 guidance.

Comment: Page 3-9, Alternative 2

The method for determining the numbers of extraction wells and their locations, depths, and pumping rates should be described.

Response to Comment: Page 3-9, Alternative 2

We agree. This information will be supplied in the revised Draft FS Report.

Comment: Page 3-11, Paragraph 2

Define "eventually."

Response to Comment: Page 3-11, Paragraph 2

Eventually is used to convey the uncertainty associated with the estimated time required to remove residual ground water contamination from the 881 hillside using this alternative. Predicting the estimated time for reaching remediation goals would require a modeling effort that would involve an understanding of the dynamics and fate and transport of the contaminants existing in the ground water. It was the opinion of the FS team that there was a lack of sufficient data to perform the quantitative model needed to assess the time accurately.

Comment: Page 3-13, Alternative 3

It appears that the french drain intercept is upgradient of SWMUs 102 and 107.

Response to Comment: Page 3-13, Alternative 3

The figure is misleading because the french drain alternative will include the collection of contaminated ground water from all of the SWMUs on the 881 Hillside. The figure will be corrected.

Comment: Page 3-20, Paragraph 2

The rationale and expected results for selecting ten pore volumes should be stated. Anticipated cleanup levels should be established.

Response to Comment: Page 3-20, Paragraph 2

Ten pore volumes was an estimate derived from the literature available on soil flushing, in lieu of pilot scale studies on the 881 Hillside soils.

Although the residual contamination in the soils of the 881 Hillside is not considered to be a significant source of ground water contamination, soil flushing may be implemented in order to expedite the removal of contaminants from the unsaturated soils and to provide additional hydraulic pressure for expediting ground water collection and treatment. The anticipated cleanup levels are identified in the chemical specific ARARs section as either background or SDWA MCLs for the organics, and background or MCLs for metals.

Comment: Page 3-27, Paragraph 1

The conclusion that Alternative 3 is "equally effective" should be justified. The statement that one is significantly more costly than the other is inaccurate since the estimated present worth cost estimate difference is only $50,000. (Both alternatives 3 and 4 could properly be estimated at $2.4 million present worth.)

Response to Comment: Page 3-27, Paragraph 1

The Draft FS Report never states that Alternative 4 (french drain w/ soil flushing) is significantly more costly than Alternative 3 (french drain w/o soil flushing), only that both are expected to be equally effective. Alternative 4 was not retained for further analysis because it is more costly and it can not be proven more effective than Alternative 3 without some form of testing (pilot or full scale).

Comment: Page 3-27, Paragraph 2

Is the bedrock fractured?

Response to Comment: Page 3-27, Paragraph 2

The weathered claystone bedrock was found to be fractured; however, packer tests performed (Rockwell, 1987, 1988) on the weathered and unweathered bedrock indicate that the hydraulic conductivity of both the weathered and unweathered zones is sufficient to provide adequate bottom containment. Conductivity ranged from a high of $2x10^{-6}$ to a low of $1x10^{-8}$ cm/sec for both the weathered and unweathered bedrock. These conductivities are comparable to those observed for natural and man-made liners.

Comment: Page 3-30, Paragraph 1

The "small volume of water" should be quantified.

Response to Comment: Page 3-30, Paragraph 1

The small volume of water will be calculated and will be included in the Draft FS Report revision.

Comment: Page 3-30, Paragraph 4

SARA appears to be misinterpreted here. SARA prefers treatment alternatives in that they reduce waste volume, mobility, and toxicity. Also, Land Disposal Restrictions could affect implementability of this alternative.

Response to Comment: Page 3-30, Paragraph 4

See response to General Comments, Paragraph 4.

Land Disposal Restrictions are not applicable to actions that do not constitute disposal. EPA's Draft CERCLA Compliance with Other Laws Manual, June 1987, states that encapsulation and consolidation of contamination within an area of contamination does not constitute disposal. The Land Disposal Restrictions may be considered relevant and appropriate for this alternative; however, soils do not exhibit concentrations of organics that would eliminate land disposal or require treatment before land disposal.

Comment: Page 3-30, Paragraph 5

An Alternate Concentration Limit (ACL) would have to be issued for the contaminated groundwater flow to be allowed to continue.

Response to Comment: Page 3-30, Paragraph 5

This is a good comment and will be included in the Draft FS Report revision.

Comment: Page 3-27, Paragraph 1

Alternative 4 is rejected on the basis of undocumented capability of soil flushing. If so, soil flushing probably should not have passed technology screening.

Response to Comment: Page 3-27, Paragraph 1

Soil flushing has been demonstrated to be successful in removal of organic contaminants with octanol/water partition coefficients of 3 or less. Many of these contaminants exist in the soil and ground water at the 881 Hillside.

Comment: Page 3-27, Alternative 5

This alternative acknowledges that downgradient contamination will be left uncontrolled. Furthermore, the alternative is stated not to meet ARARs, but meets RCRA closure requirements. These statements are inconsistent.

Response to Comment: Page 3-17, Alternative 5

The statement that this alternative does not meet ARARs refers to the fact that chemical specific ARARs for organics and inorganics will not be met if the plume is not remediated. RCRA technical design requirements for closure could still be met, however. This will be clarified in the revised Draft FS Report.

Comment: Page 3-38, Paragraph 3

The term "significantly reduce" should be quantified.

Response to Comment: Page 3-38, Paragraph 3

We agree that the ability of this alternative to reduce contamination migration should be quantified in light of the fact that the alternative is being retained even though it does not meet ARARs. The revised Draft FS Report will quantify the reduction in contaminant migration to the extent possible.

Comment: Page 3-40, Paragraph 3

Not meeting ARARs would appear to be a sufficient reason to reject this alternative.

Response to Comment: Page 3-40, Paragraph 3

This alternative was retained because it met the NCP category that states that alternatives may be considered, although they do not meet ARARs, if they reduce the likelihood of present or future threat from the hazardous substances.

Comment: Page 3-42, Paragraph 2

The Land Disposal Restrictions could adversely affect implementability of this alternative.

Response to Comment: Page 3-42, Paragraph 2

The RCRA Land Disposal Restrictions will adversely impact the implementation of this alternative only if the soils would require treatment by Best Demonstrated Available Technologies (BDAT) to reduce contaminant concentration levels below Toxicity Characteristic Leaching Procedure (TCLP) limits. We don't anticipate that soils will contain contaminant concentrations above the TCLP levels.

Comment: Page 4-1, Paragraph 1

It is not clear which of the five NCP remedial alternative categories are represented by the four alternatives identified here.

Response to Comment: Page 4-1, Paragraph 1

We agree that the Draft FS Report is not clear on which of the five NCP categories are represented by the retained alternatives. Summary tables will be included in the revised Draft FS Report.

Comment: Page 4-1, Paragraph 4

This section, entitled "Introduction," would be better identified as a discussion of the evaluation criteria.

Response to Comment: Page 4-1, Paragraph 4

We agree.

Comment: Page 4-2, Paragraph 1

The list of evaluation criteria should be amended to address the nine criteria listed in the July 1987 OSWER directive.

Response to Comment: Page 4-2, Paragraph 1

The nine evaluation criteria cited in the OSWER directive will be incorporated into the analysis of alternatives for the revised Draft FS Report.

Comment: Pages 4-5 through 4-22 (Section 4.2)

This separate section for evaluating groundwater treatment systems is unnecessary and should have been resolved in Section 2, Technology Screening, especially since groundwater treatment is included in each of the remaining alternatives (except No Action). Since groundwater treatment is a component technology (or operable unit) of the alternative, any further comparative evaluation of cost and non-cost factors is redundant and tends to complicate the document. Discussion should be limited to the additional cost and implementation details of the preferred treatment technology which have not been previously presented. Evaluative discussions should then focus on the alternatives as complete entities.

Response to Comment: Pages 4-5 through 4-22 (Section 4.2)

We agree with this approach and will incorporate these suggestions into the Draft FS Report revision. Our approach in the Draft FS Report was not unlike the new EPA RI/FS guidance. The approach was intended to define the process option for the groundwater treatment to be included in remedial alternatives that include groundwater treatment.

Comment: Pages 4-25 through 4-38

The detailed evaluation of the four remedial alternatives as presented in these pages adds little to the information already presented in Section 3. From a purely practical standpoint, it would make sense to merge the related discussions from SEction 3 into 4, leaving Section 3 to address the development, categorization, and initial screening of remedial alternatives. In this manner, much of the evaluative detail currently found in Section 3 dealing with all of the alternatives can be shifted in to Section 4 where the final and presumably shorter, list of alternatives can be evaluated in detail. This will help in applying the evaluation criteria uniformly, thus providing better support for retaining or eliminating alternatives. The revised evaluation discussion should address the nine

evaluative criteria specified in the 1987 OSWER directive. Also, the alternatives should be evaluated as complete units, not in pieces, in order to facilitate comparisons among them.

Response to Comment: Pages 4-25 through 4-38

We also agree with these suggestions and will incorporate them into the Draft FS Report revisions.

Comment: Pages 4-37 through 4-43 (Section 4.3.4.3)

The logic in presenting an additional discussion of ARARs in this section is not apparent. It would be sufficient to identify the relevant ARARs in an earlier section of the report, and in the detailed evaluation simply indicate whether or not the ARARs will be met by the alternative.

Response to Comment: Pages 4-37 through 4-43 (Section 4.3.4.3)

The Draft FS Report was prepared using the format suggested in the 1985 EPA FS guidance. The guidance recommends placing the institutional analysis of alternatives in the section on detailed evaluation of alternatives. The approach you suggest makes more sense and will be incorporated into the Draft FS Report revisions.

Comment: Pages 4-43 through 4-52 (Section 4.4)

It would be better to simply indicate the capital and present worth costs for each alternative within their respective discussions. The "work sheets" and cost analyses presented as Tables 4-7 through 4-13 add little to the evaluation and would be better placed in the appendices.

From the information presented in Tables 4-7 and 4-8, it is not clear if all reasonably expected direct and indirect costs have been incorporated into the estimates. Some cost factors that may be considered include, but are not limited to: materials and labor associated with testing, mobilization, excavation, transportation, and disposal; soil expansion factors as they may affect removal and/or backfill volumes; burden and overhead factors on labor, materials, subcontractors, etc.; health and safety cost factors; and factors for engineering, management, and contingencies. It is useful also, if possible, to incorporate factors reflecting the facility operator's increased administrative and management costs associated with implementing the costed remedial actions. While many of these factors may have been addressed, it is not clear in Tables 4-7 and 4-8 or in Appendix 3 what factors, markups, fees, etc., were actually applied. Also, there is no explanation as to why cost estimates in Section 4 differ from those presented in Section 3.

Response to Comment: Pages 4-43 through 4-52

The placement of the worksheets in the Appendices would simplify the presentation of costs. We would also propose a summary table showing the present worth of each retained alternative in one location. The text will be modified to

provide discussion on the cost factors included in the detailed analysis, many of which are mentioned by the commentor. The cost estimates in Section 4 differ from those in Section 3 because they include design and contingency costs.

Comment: Chapter 5

The format for the summary of alternatives appears to be acceptable. However, it is not evident from Table 5-1 which of the five NCP-specified remedial categories are represented by the alternatives presented. Also, it is not clear why five alternatives are summarized when only four were evaluated in detail.

Response to Comment: Chapter 5

The alternative that includes off-site treatment, storage or disposal should not have been eliminated from detailed analysis in Section 4. This alternative will be evaluated in detail in the revised FS. Additional revisions outlined in previous comments will provide the appropriate NCP categorization of the alternatives.

REFERENCES

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