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RESPONSES TO USEPA AND OEPA COMMENTS - OPERABLE UNIT 2 DRAFT FEASIBILITY STUDY - VOLUME 1 - NOVEMBER 1994 - ***DRAFT***

11/17/94

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REPORT

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

RESPONSE TO USEPA AND OHIO EPA COMMENTS OU2 DRAFT FEASIBILITY STUDY REPORT

Volume 1

November 1994

U.S. DEPARTMENT OF ENERGY
FERNALD FIELD OFFICE

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RESPONSE TO USEPA AND OHIO EPA COMMENTS OU2 DRAFT FEASIBILITY STUDY REPORT

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

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FOREWORD

This document provides responses to U.S. Environmental Protection Agency (EPA) and Ohio EPA (OEPA) comments on the August 1994 Draft Final Feasibility Study (FS) Report for Operable Unit 2 at the U.S. Department of Energy (DOE) Fernald Environmental Management Project (FEMP). In total, 103 comments were received. Of these, 65 were made by the EPA, and 38 were made by the OEPA. The following is a "user's guide" of the rationale used to develop this comment response document and an overview of how the responses to the comments from both agencies are presented in this document. The comment response document is submitted along with the corresponding changed pages for the Operable Unit 2 FS.

Comment Response Document Organization. Responses are provided to OEPA comments (1-38), followed by responses to EPA comments (39-103). All comments have been re-numbered, sequentially, in the order of receipt.

A comment number cross-reference list is provided at the end of this foreword. OEPA comments 1-38 retain their original numbering. For EPA comments 39-103, this cross-reference identifies each original EPA comment number. The list also identifies the commentor, and the section and page number where the subject of the comment appeared in the August 1994 Draft Final FS. The original page numbering has been maintained to facilitate easier review.

Each comment and response has four components:

- The comment "header" (comment number, commenting organization, commentor, section number, page number, line number, code, and original comment number in parentheses). The referenced location in the comment header refers to the section/page/line of the August 1994 Draft Final Operable Unit 2 FS.
- The agency comment, unedited.
- The narrative response indicating the DOE disposition on the comment.

- The action statement that identifies the revisions made as a result of the comment. The specific change(s) made to the corresponding text in the Draft Final FS are identified, to the extent practical. Each action statement identifies the new location of the changes in the text, table, or figure in the 1994 Draft Final FS, where possible.

Following the comments from each agency, the associated changed pages are provided. Those changed pages are organized by section and appendix. Deleted text has been crossed out. New text has been shaded. If a page or section has been replaced in its entirety, the deletion will have been mentioned in the action (in the agency comment sections), but only the new page or section will be included among the changed pages.

It is important to note that revisions and insertion of figures and tables into the text have caused the page numbers to shift. Where new pages result from the implementation of a response, original numbering is maintained by adding a letter to the original page number (e.g., 6-197, 6-197a).

OHIO AND U.S. EPA COMMENT/RESPONSE LOG – NOVEMBER 1994 OPERABLE UNIT 2 DRAFT FINAL FEASIBILITY STUDY						
Comment #	Agency Comment #	Previous Comment	Org.	Commentor	Section	Page or Table
1	1	Original #10	O	OFFO	1	Fig. 1–17
2	2		O	OFFO	3	General
3	3		O	OFFO	4.2.5.4	4–9
4	4	Original #3	O	OFFO	5	Tables 5–4,–8,–11
5	5		O	OFFO	5	Table 5–2
6	6		O	OFFO	5.3.1.2.2	5–24
7	7		O	OFFO	5	Table 5–5
8	8		O	OFFO	5	Table 5–7
9	9		O	OFFO	5.4.1.2.2	5–63
10	10		O	OFFO	5.4.2.5.1	5–78
11	11		O	OFFO	5	Table 5–10
12	12		O	OFFO	5	Fig. 5–19
13	13		O	OFFO	5.5.1.2.2	5–94
14	14		O	OFFO	5	Fig. 5–23
15	15		O	OFFO	5	Table 5–11
16	16		O	OFFO	5.5.2.2.2	5–105
17	17		O	OFFO	5.6	5–121
18	18		O	OFFO	App. B	ARARs/MCL tables
19	19		O	GeoTrans	D.I.6	D–1–82
20	20		O	GeoTrans	D.I.7	D–1–84
21	21		O	GeoTrans	D.I–III	D–1–III–1
22	22		O	GeoTrans	D.I–III	D–1–III–1
23	23		O	GeoTrans	D.I–III	D–1–III–4
24	24		O	GeoTrans	D.1–IV	D–1–IV–4
25	25		O	GeoTrans	D.1–IV	D–1–IV–3
26	26		O	GeoTrans	D.1–IV	D–1–IV–3
27	27		O	GeoTrans	E.2.2	E–2–2–1
28	28		O	GeoTrans	E.2.2	E–2–2–1
29	29		O	GeoTrans	E.2.2	E–2–2–1
30	30		O	OFFO	E.2.2	E–2–2–2
31	31		O	OFFO	E.3.1.4	E.3–1–8
32	32		O	OFFO	E.7	E–7–1
33	33		O	GeoTrans	WAC	NA
34	34		O	OFFO	5.1.5	5–3
35	35		O	OFFO	5	Table 5–2
36	36		O	OFFO	5	Table 5–3
37	37		O	OFFO	5.5.4	5–27
38	38		O	OFFO	A	A–3
39	General 1		US	Saric	2	NA
40	General 2		US	Saric	3, E.2.2	NA
41	General 3		US	Saric	4	NA
42	General 4	Orig. Gen. 14	US	Saric	C	NA
43	General 5		US	Saric	D.1.3, D.1.6	NA
44	General 6		US	Saric	D.1.5	NA
45	General 7	Orig. Gen. 31	US	Saric	I.4.5	I–4–14

OHIO AND U.S. EPA COMMENT/RESPONSE LOG – NOVEMBER 1994 OU2 FEASIBILITY STUDY						
Our #	Agency Comment #	Previous Comment	Org.	Commentor	Section	Page or Table
46	General 8	Orig. Gen 33	US	Saric	I.5.1	I–5–3
47	General 9	Orig. Gen. 39	US	Saric	I.6.2.1	I–6–63
48	General 10	Orig. Gen. 49	US	Saric	I.11.3	NA
49	General 11	Orig. Gen. 50	US	Saric	I.12.2	NA
50	Specific 1		US	Saric	2.3.2.1	2–14, 2–15
51	Specific 2		US	Saric	4.3	4–10 to 4–29
52	Specific 3		US	Saric	4.3.7.2	4–24, –25
53	Specific 4		US	Saric	5.1.2.4	5–7
54	Specific 5		US	Saric	5.2	5–11, –12
55	Specific 6		US	Saric	6.2.1	6–4
56	Specific 7		US	Saric	6.3.3	6–11
57	Specific 8		US	Saric	App. B	Table B–1
58	Specific 9		US	Saric	C.2.3.3	C–2–25
59	Specific 10		US	Saric	C.3.1.3	C–3–2, –3
60	Specific 11	Orig. Spec. 2	US	Saric	C.3.3.1	C–3–10
61	Specific 12	Orig. Spec. 19	US	Saric	C.4.2	C–4–8
62	Specific 13		US	Saric	C.5.1.1	C–5–8, –9
63	Specific 14		US	Saric	C.6.2.1	C–6–7
64	Specific 15		US	Saric	C.7.2	C–7–4
65	Specific 16		US	Saric	D.1.6	D–1–82
66	Specific 17		US	Saric	D.1.6	D–1–82
67	Specific 18	Orig. Spec. 39	US	Saric	NA	NA
68	Specific 19		US	Saric	F.3, F.7	F–3–1, F–7–22
69	Specific 20		US	Saric	F.3	F–3–1
70	Specific 21	Orig. Spec. 57	US	Saric	I.6.2.2	I–6–64
71	Specific 22	Orig. Spec. 62	US	Saric	I.7.5.3	I–7–16
72	Specific 23		US	Saric	PP 4.5	4–4, –5/5–6 to –9
73	Specific 24		US	Saric	PP 5.4.4	5–21
74	Specific 25		US	Saric	PP 6.2.1	6–4, –5
75	Specific 26		US	Saric	PP 6.3	6–13
76	Van Leeuwen 1		US	Van Leeuwen	Table 1–5	1–86
77	Van Leeuwen 2		US	Van Leeuwen	Tbls. 1–6, –7	
78	Van Leeuwen 3		US	Van Leeuwen	Table 1–16	
79	Van Leeuwen 4		US	Van Leeuwen	Table 1–25	
80	Van Leeuwen 5		US	Van Leeuwen	Table 1–23	1–132
81	Van Leeuwen 6		US	Van Leeuwen	1.7.3.1	1–98
82	Van Leeuwen 7		US	Van Leeuwen	1.7.3.4	1–205
83	Van Leeuwen 8		US	Van Leeuwen	1.7.3.5	1–213
84	Van Leeuwen 9		US	Van Leeuwen		1–213
85	Van Leeuwen 10		US	Van Leeuwen		1–213
86	Van Leeuwen 11		US	Van Leeuwen	1.7.3.1–.6	
87	Van Leeuwen 12		US	Van Leeuwen		2–5
88	Van Leeuwen 13		US	Van Leeuwen		2–11
89	Van Leeuwen 14		US	Van Leeuwen	2–8 thru 10	
90	Van Leeuwen 15		US	Van Leeuwen		Table 2–23
91	Van Leeuwen 16		US	Van Leeuwen		Table C.1–1

OHIO AND U.S. EPA COMMENT/RESPONSE LOG – NOVEMBER 1994 OU2 FEASIBILITY STUDY						
Our #	Agency Comment #	Previous Comment	Org.	Commentor	Section	Page or Table
92	Van Leeuwen 17		US	Van Leeuwen	2.4.1	C–2–35
93	Van Leeuwen 18		US	Van Leeuwen		Table C.3–4
94	Van Leeuwen 19		US	Van Leeuwen		Tables C.6–1,6–2
95	Van Leeuwen 20		US	Van Leeuwen	C.6–1,6–2	
96	Van Leeuwen 21		US	Van Leeuwen	C.6	
97	Van Leeuwen 22		US	Van Leeuwen	C.7	
98	Van Leeuwen 23		US	Van Leeuwen	C.9	
99	Van Leeuwen 24		US	Van Leeuwen	1.7	1–7–56
100	Van Leeuwen 25		US	Van Leeuwen	1.4.2.3	1–4–13
101	Barwick 1		US	Barwick	5	5–1
102	Barwick 2		US	Barwick	5	5–21
103	Barwick 3		US	Barwick	PP	

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Ohio EPA

OHIO EPA COMMENTS
DRAFT FINAL OU2 FEASIBILITY STUDY AND PROPOSED PLAN
NOVEMBER 17, 1994

Comment No. 1
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Figure 1-17 Page #: 1-53 Line #: Code: C
Original Comment #: 10
Comment: Figure 1-15 has not been corrected. Please include the sand and gravel layer in the legend.
Response: Agreed. The legend symbol for sand and gravel does not agree with the figure. Figure 1-15 will be corrected by showing the proper symbol in the legend.
Action: Figure 1-15 was revised to indicate correct legend symbol for sand and gravel.

Comment No. 2
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 3 Page #: General Comment Line #: Code: C
Original Comment #:
Comment: It would be easier to understand the information presented in Section Three if the descriptions and evaluations of the treatment alternatives were together instead of given in two separate sections. This revision would allow for an easier review of the document and keep the reader from flipping back and forth through the text.
Response: Section 3.5 was organized by general response action. A general response action is introduced, then each potentially applicable technology included in the general response action is briefly described. The evaluation of each potentially applicable technology follows immediately after the descriptions in the next subsection. This format is in general conformance with the EPA guidance document. This comment will be referred to Operable Unit 3 to be considered in the development of that FS document.
Action: Operable Unit 3 has been alerted to this consideration.

Comment No. 3
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 4.2.5.4 Page #: 4-9 Line #: 32-33 Code: C
Original Comment #:
Comment: Although DOE has chosen stabilization/solidification as the assumed technology, DOE should be aware that Ohio EPA believes that vitrification is by far the more effective treatment alternative. Ohio EPA believes that any waste requiring treatment on-site should consider vitrification as the preferred method.
Response: As noted in the comment, stabilization/solidification is the assumed technology for costing purposes. This was chosen to be representative for the reasons discussed in Section 4.2.5.4. As noted there, none of the three potential treatment technologies has been eliminated.
Action: No action.

Comment No. 4
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Tbls.5-4,5-8,5-11 Page #: Line #: Code:C
Original Comment #: 3
Comment: These tables are not labeled as showing the maximum expected cross-media uranium concentrations.
Response: Agreed. The tables will be modified to emphasize that these tables do present the maximum expected uranium concentrations.
Action: The titles of the tables have been revised to "Maximum Cross-Media Groundwater Concentrations." See revised Tables 5-4, 5-8, and 5-11.

Comment No. 5
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Table 5-2 Page #: 5-13 Line #: Code: E
Original Comment #:
Comment: The shading on the copy reviewed was indistinguishable from the rest of the table. The table should be revised.
Response: Agreed. The shading will be darkened so that it does not fade when reproductions are made.
Action: The shading has been darkened. See revised Table 5-2.

Comment No. 6
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 5.3.1.2.2 Page #: 5-24 Line #: 8-10 Code: C
Original Comment #:
Comment: The last sentence of this paragraph should be deleted. DOE should specify within the FS/PP the disposition of wastes within OU2. On-site disposal for this material should only be considered as a contingency in the event off-site disposal is not possible. Unless DOE intends to provide a detailed evaluation of on-site disposal and treatment for mixed waste within the FS, the sentence should be deleted.
Response: Agreed. The reference to on-site disposal of mixed waste will be deleted.
Action: The sentence on lines 8 to 10 on page 5-24 has been deleted.

Comment No. 7
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Table 5-5 Page #: 5-37 Line #: Code: C
Original Comment #:

Comment: The PRLs provided in this table differ significantly from those provided in Table 5-3. The presentation of these two sets of PRLs is confusing and not clarified by the text. DOE should provide additional discussion within the text explaining the differences in these tables.

Response: The two tables present PRLs for areas under the cap (Table 5-5) and areas not under the cap (Table 5-3). Materials directly over the Great Miami Aquifer or which will not be covered by a cap, yet have contaminant levels greater than the PRLs in Table 5-3, will be consolidated to the area that will be covered by the cap.

Table 5-5 is provided to show that all material in the Operable Unit 2 subunits are able to meet the PRLs, if capped, and lateral migration is prevented in the South Field and Inactive Flyash Pile. The text will be expanded to explain the use of these two tables.

Action: The following text was added on page 5-36, line 29 to clarify the uses of Tables 5-3 and 5-5: "Table 5-3 provides the PRLs for residual materials remaining after excavation that are not under the cap." In the previous sentence, the words "capped material" were deleted and replaced by "material under the cap."

Comment No. 8
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Table 5-7 Page #: 5-53 Line #: Code: C
Original Comment #:

Comment:
a) The table should be footnoted to define those ARARs driving the concentrations presented in the ARAR column.
b) The table should designate which of the presented concentrations (ILCR, HI, or ARAR) is the PRL for each contaminant. Presumably the lowest concentration is the PRL, but this is unclear.
c) It is unclear where footnote "b" is employed within the table. This footnote is only applicable for radionuclides.
d) DOE should review the table for accuracy. It does not seem appropriate for higher PRLs to exist for waste over the GMA (see IAFP and SF) than for waste over the till.

Response:
a) Agreed. The requested footnote will be added.
b) Agreed. The driving PRLs will be shaded in the table to make them clearer.
c) Footnote b should be applied to the first appearance of the abbreviation ILCR. The footnote should be modified to indicate that the addition of background only applies to radionuclides.
d) While it seems inappropriate for the material over the till to have lower PRLs than that over the Great Miami Aquifer, this result follows directly from the mechanism for contaminant transport in the South Field/Inactive Flyash Pile area. Seepage along the fill/till interface joins with water from the perched zone while moving laterally. This water, which leached contamination from material over the till, enters the Great Miami Aquifer in a narrow zone where the till thickness goes effectively to zero. This serves to concentrate the contamination from the "over the till" area and necessitate low PRLs.

Action: Tables 5-3, 5-5, 5-7, and 5-10 contain the following changes per the respective comments:

a) Footnotes d, e, and f were added to define the ARARs driving the concentrations in the table.
b) Shading was added to clarify which level was the PRL, and a note was added to explain the shading.
c) Footnote b was applied to the first appearance of the abbreviation ILCR, and the footnote was revised to indicate that background concentrations were added only to radionuclides.
d) None

Additional modifications were also made to Table 5-3 to make it more consistent with Section 2.0.

Comment No. 9
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 5.4.1.2.2 Page #: 5-63 Line #: 10-13 Code: C
Original Comment #:
Comment: This sentence should be deleted. It is inappropriate to consider on-property disposal for this material when the alternative being discussed proposes off-site disposal of all other waste.
Response: Agreed. The reference to on-site disposal will be deleted.
Action: The sentence on lines 11 to 13 on page 5-63 has been deleted.

Comment No. 10
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 5.4.2.5.1 Page #: 5-78 Line #: 1-3 Code: C
Original Comment #:
Comment: There appears to be an editorial problem with one of these sentences. The risks differ but the text doesn't for each sentence.
Response: Agreed, the second sentence has a typographical error in it. The word "federal" should read "private". The second sentence will be modified to indicate private ownership rather than federal ownership.
Action: The word "private" in the second sentence on page 5-78 was changed to "federal".

Comment No. 11
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Table 5-10 Page #: 5-85 Line #: Code: C
Original Comment #:
Comment:
a) The table should be footnoted to define those ARARs driving the concentrations presented in the ARAR column.
b) The table should designate which of the presented concentrations (ILCR, HI, or ARAR) is the PRL for each contaminant. Presumably the lowest concentration is the PRL, but this is unclear.
c) It is unclear where footnote "b" is employed within the table. This footnote is only applicable for radionuclides.

Response: a) Agreed. The requested footnote will be added.
b) Agreed. The driving PRLs will be shaded in the table to make them clearer.
c) Footnote b will be applied to the first appearance of the abbreviation ILCR. The footnote should be modified to indicate that the addition of background only applies to radionuclides.

Action: See Comment No. 8.

Comment No. 12
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Figure 5-19 Page #: 5-89 Line #: Code: C
Original Comment #:

Comment: This figure is confusing. The use of "A" and "B" circles adds to the confusion. DOE should attempt to clarify the figure. A good starting point for the flow chart revision is, where does it start?

Response: Agreed. Figure 5-19 will be revised. The "A" and "B" circles will be clarified. The "A" circle is defined as off-site disposal while the "B" circle is defined as vegetative cover at restoration site. The resulting chart will indicate two parallel diagrams: one for the remedial action of the Operable Unit 2 subunits and the other for the construction of the disposal cell. The parallel diagrams will both begin with site preparation.

Action: Figure 5-19 was revised to indicate two parallel block flow diagrams: one for the remedial action of the Operable Unit 2 subunits and the other for the construction of the disposal cell.

Comment No. 13
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 5.5.1.2.2 Page #: 5-94 Line #: 31-33 Code: C
Original Comment #:

Comment: The last sentence of this paragraph should be deleted. DOE should specify within the FS/PP the disposition of wastes within OU2. On-site disposal for this material should only be considered as a contingency in the event off-site disposal is not possible. Unless DOE intends to provide a detailed evaluation of on-site disposal and treatment for mixed waste within the FS, the sentence should be deleted.

Response: Agreed. The reference to on-site disposal of mixed waste will be deleted.

Action: The sentence on lines 31 to 33 on page 5-94 has been deleted.

Comment No. 14
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Figure 5-23 Page #: 5-99 Line #: Code: C
Original Comment #:

Comment: Ohio EPA has expressed concerns during previous meetings regarding infiltration through the side slopes where the composite cap does not extend. DOE should revise the design to extend the cap over these berms. In order to comply with Ohio EPA solid waste disposal facility design requirements the synthetic liner and cap should meet at the edges of the cell.

Response: In response to Ohio EPA concerns expressed at meetings prior to submittal of the FS, infiltration through the side slopes was calculated and found to be significantly lower than through the cap. The HELP model output shown on pages E-5-I-15 through E-5-I-20 examines the sides/slopes of the disposal facility. As noted on page E-5-I-19, the average annual percolation from the lowest model layer (Layer 8) is about 0.14 inches. However, OEPA's interpretation of the solid waste requirement necessitates revision of the design concept, and the liner and cap will be revised to satisfy the solid waste regulations. The capping system will be extended down the side slopes and tied in with the liner system. This will be reflected in text changes to Section 5, figure revisions in Section 5 and Appendix E, and cost estimate changes in Appendix F. The side slope infiltration calculation will also be revised and the text in Appendix E will be revised to indicate the results of that calculation.

Action: Page 5-99, Figure 5-23: Revised the cap design and typical cross-sections for the on-site disposal cell. Extended the cap down the side slopes and tied-in with the liner.

Page 5-90, Figure 5-20 and Page 5-98, Figure 5-22: Corrected size of the proposed on-site disposal cell based on revised cap design and cell cross-sections.

Page 5-100, Deleted sentence on lines 15, 16 and 17 and replaced with the following text: "Following placement of the cap components, the cap surface at the top of disposal cell would be finish graded with a minimum slope of 3 percent and side slopes of 1 -vertical and 5 -horizontal. After completion of finish grading, top and side slopes of disposal cell would be seeded and mulched in accordance with the approved erosion and sediment control plan".

Page 5-115, line 9: Deleted "34.4 ha (85ac)" and added "30.4 ha (75ac)." Corrected acreage based on revised disposal cell size.

Page 5-116, line 14: Deleted "$110" and added "$105.9". Corrected estimated cost based on revised cap design and disposal cell size.

Page 5-116, line 15: Deleted "13.7" and added "13.2" Corrected percentage for increase in revenue based on revised estimated cost for Alternative 6.

Page 5-119, Table 5-12: Revised capital and net present worth costs to read "$85,900,000" and "$105,900,000" respectively. Corrected these costs based on revised cap design and disposal cell size.

Page 5-125, Table 5-13: Revised present worth cost for Alternative 6 to read "105,900" in $1,000s.

Page 5-126, Table 5-14:

Long Term Impact - Soil and Geology, Alternative 6: Revised area to read "9.3 ha" Corrected area based on revised disposal cell size.

Short Term Impact - Soil and Geology, Alternative 3: Revised area to read "24.3 ha".

Short Term Impact - Socioeconomic and Land Use, Alternative 6: Revise percentage for increase in CMSA revenue to read "13.2". Corrected percentage based on revised estimated cost for Alternative 6.

Page 6-13, Table 6-1: Alternative 6, corrected capital cost and present worth costs based on revised cap design and disposal cell size.

Page 6-14, Table 6-2: Alternative 6, corrected present worth cost based on revised cap design and disposal cell size.

Page 6-16, Table 6-3: Alternative 6, corrected net present worth costs for federal ownership and private ownership land-use scenarios based on revised cap design and disposal cell size.

Pages E-3-1-7, E-3-1-8, and E-3-1-10; Figures E.3.1-3, E.3.1-4, and E.3.1-6, respectively: Corrected these figures based on revised cap design and size of disposal cell.

Pages E-3-4-1 through E-3-4-33: All pages were removed and replaced by six pages (E-3-4-1 through E-3-4-6) for revision of disposal cell size calculation based on revised cap design.

Page E-5-I-15 through E-5-I-20: Corrected HELP model output for the cap over the disposal cell side slopes based on the revised cap design. Deleted pages E-5-I-15 through E-5-I-20 and replaced with revised pages E-5-I-15 through E-5-I-27.

Page E-6-6, Figure E.6-6: Corrected slope for cap surface based on the revised cap design and added cap and liner thicknesses.

Based on the revised cap design and disposal cell size, Appendices F.1, F.6, F.7 and F.8 were corrected by modifying the following pages:

Appendix F.1: Revisions to Scope of Work on pages F-1-2 and F-1-10

Appendix F.6 and Appendix F.7: Replaced all pages.

Appendix F.8: Corrected net present worth for Alternative 6 on page F-8-1 and replaced pages F-8-5 and F-8-6.

In the Executive Summary of the FS, the following changes were made:

- On page ES-11, line 29, "$69.6" was changed to "$69.5"
- On page ES-11, line 30, "$110.3" was changed to "$105.9"
- On page ES-11, line 32, the typographic error "trheshold" was corrected to "threshold"
- On Table ES-2, bottom row, all Alternative 6 costs were replaced.

During revision of Section 5 of the FS, the following typographical error was found and corrected: "134,00" on line 8 on page 5-97 and was changed to "240,000."

Comment No. 15
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Table 5-11 Page #: 5-104 Line #: Code:C
Original Comment #:

Comment: It doesn't seem prudent for DOE to design a disposal cell that would be expected to contaminate the aquifer up to the MCL. The lack of room for error may result in DOE having to remediate the cell in the future. DOE should revise the Waste Acceptance Criteria to provide a margin of safety in meeting the MCL ARAR.

Response: Prior to development of the WAC, DOE incorporated certain assumptions to provide a margin of safety. Those assumptions included:

1) Evaluating the MCL criterion anywhere under the facility rather than at the edge of the facility where additional dilution, adsorption, and dispersion in the aquifer would have occurred.
2) Ignoring the geomembrane in the capping system and liner system.
3) Ignoring the contributions of the liner, leachate collection, and leak detection systems.
4) Ignoring adsorption and transport time through the brown till.
5) Utilizing assumptions for moisture content and infiltration that result in conservative values of contaminant travel time.

Appendix D.1-IV offers an alternative evaluation which utilized the clay liner and used less conservative assumptions for moisture content and infiltration. As noted in the results of that evaluation on page D-1-IV-3, "The simulated maximum uranium concentration in the Great Miami Aquifer in 1,000 years was about 1.4 μg/L, well below the target MCL value of 20 μg/L."

Action: The footnote on Table 5-11 was revised by adding the following:

"The groundwater modeling procedures and results are presented in detail in Appendix D."

The following paragraph was inserted at line 21 on page D-1-77:

"The following conservative assumptions were made to provide a margin of safety in the WAC development:

1) Evaluating the MCL criterion anywhere under the facility rather than at the edge of the facility where additional dilution, adsorption, and dispersion in the aquifer would have occurred,
2) Ignoring the geomembrane in the capping system and liner system,
3) Ignoring the contributions of the liner, leachate collection, and leak detection systems,
4) Ignoring adsorption and transport time through the brown till, and
5) Utilizing assumptions for moisture content and infiltration that result in conservative values of contaminant travel time."

Comment No. 16
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 5.5.2.2.2 Page #: 5-105 Line #: 9-10 Code: C
Original Comment #:
Comment: The contaminants left in place would still be considered a waste and will require long-term monitoring. The long-term monitoring will ensure land-use is still being controlled and that contaminants have not migrated into the groundwater or surface water.
Response: The statement on Page 5-105 is believed to be correct for PRLs based on the private ownership scenario (e.g., unrestricted use of land and groundwater). For alternatives with more restrictive use scenarios (e.g., federal ownership), the materials below PRLs associated with the federal ownership scenario would be left in place, however, long-term monitoring of the materials impact on surface water and groundwater would be required. The text will be modified to discuss the long-term monitoring.
Action: Page 5-105, line 10, the following sentence was added:

"Long-term monitoring will be performed at each subunit to monitor groundwater and surface water to ensure that material left in place causes no adverse effects."

Comment No. 17
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 5.6 Page #: 5-121 Line #: 12-15 Code: C
Original Comment #:
Comment: This section is unacceptable. The way the text is written, by concurring with the OU2 FS/PP the State of Ohio would essentially be waiving any NRD claims against the DOE. Please remove this section in its entirety.
Response: It is DOE's position that the inclusion of this section is necessary and appropriate as it summarizes information presented in the Operable Unit 2 FS/PP-EA and is required to be analyzed as a potential impact under the NEPA statute. It is DOE's understanding that Ohio EPA's concern lies in the text of the first paragraph of this section where it is stated that: "...has been included to secure the exclusion discussed in CERCLA Section 107(f)(1)."

It is DOE's position that the State of Ohio would not be waiving natural resource damage claims it may have against DOE. DOE is committed to proactively soliciting input from all appropriate stakeholders (e.g., Natural Resource Trustees) to ensure that actions at the FEMP will be conducted in a manner protective of human health and the environment; and that will avoid or mitigate natural resource impacts to the extent practicable.

Section 5.7 will remain as part of the Operable Unit 2 Feasibility Study, although the reference the State of Ohio has objected to regarding securing the CERCLA Section 107(f)(1) extension has been deleted.
Action: The last sentence of Section 5.6 (page 5-121, lines 12-14) has been deleted.

Comment No. 18
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Appendix B Page #: Line #: Code: C
Original Comment #:
Comment: An additional action specific ARAR should be 40 CFR 60.670 Subpart 000. This ARAR addresses standards for the use of a crusher.
Response: Agreed. This ARAR will be added to Appendix B.
Action: The particulate emission standards have been added to page B-9 of Appendix B.

Comment No. 19
Commenting Organization: OEPA Commentor: GeoTrans
Section #: D.I.6 Page #: D-1-82 Line #: 11-22 Code:C
Original Comment #:
Comment: Considering that simulated uranium concentrations in the unsaturated GMA exceed 50 μg/L given leachate uranium concentrations of 175-375 μg/L based on the analysis presented in D-1-III, what factors (e.g., simulated flow rate and mixing zone thickness) are responsible for the dilution of a leachate uranium concentration of 71.38 mg/L down to 20 μg/L in the saturated GMA in the analysis described on page D-1-82?
Response: Attachment D.1-III discusses lysimeter data, and the infiltration rate applicable to the lysimeter data is approximately 9 inches/year. In contrast, the infiltration rate used for the WAC development for the engineered disposal cell was 1.2 in/yr. The concentration of 50 μg/L was measured in the top 3 feet of the unsaturated GMA beneath 10 feet of gray till. When infiltration is 9 in/yr, typical dilution in the saturated GMA is about two orders of magnitude. Dilution under the disposal cell is greater due to the reduced infiltration rate. Other factors responsible for the comparatively greater reduction in concentration are

1) Greater thickness of gray till
2) Loss of uranium from the dissolved phase to the adsorbed phase in the glacial overburden and unsaturated GMA
3) Retardation which does not allow peak concentrations to reach the saturated GMA in 1000 years
4) Dispersion in the GMA, and
5) Adsorption in the GMA.

Action: No action. Also see Comment No. 44.

Comment No. 20
Commenting Organization: OEPA Commentor: GeoTrans
Section #: D.1.7 Page #: D-1-84 Line #: Code: C
Original Comment #:
Comment: Do the results provided in Table D.1-26 assume that $K_L = K_d$? Please clarify in the paragraph on page D-1-84.
Response: The K_L is applicable for the leaching of uranium from the waste while K_d is applicable for fate and transport of uranium in the soils underlying the waste. For the sensitivity analysis, K_L was held constant and only K_d was varied.

For the Table D.1-26, K_L was not assumed to be equal to the K_d. This table shows the effect of Glacial Till K_d on the GMA concentration, while keeping all other parameters constant, including K_L. Text on page D-1-84 will be revised to clarify the relationship between K_L and K_d.

Action: On line 2, page D-1-84, "of soils under the waste" was inserted after "Distribution coefficient."

On line 6, page D-1-84, "while holding all other parameters (including K_L) constant," was inserted after "200 mg/L."

Start a new paragraph on line 10 of page D-1-84. Replace "Table D.1-26 also shows that at" on line 10, page D-1-84 with "Sensitivity of preliminary WAC to the K_d of glacial till was also investigated. Due to low infiltration rate at the engineered disposal cell, WAC are more sensitive to the value of K_d for the glacial till. At".

Comment No. 21
Commenting Organization: OEPA Commentor: GeoTrans
Section #: D.1-III Page #: D-1-III-1 Line #: 20 Code: E
Original Comment #:

Comment: Suggest changing "Under similar conditions to what has occurred at the lysimeters" to "to match uranium concentrations detected in lysimeter samples."

Response: Agreed. "Under similar conditions to what has occurred at the lysimeters" will be replaced by "to match uranium concentrations detected in lysimeter samples."

Action: On line 20, page D-1-III-1, "Under similar conditions to what has occurred at the lysimeters..." was replaced with "To match uranium concentrations detected in lysimeter samples..."

Additional changes were also made to the text of Section D.I-III to clarify the discussion. The sentence starting on line 21, page D-1-III-1 was moved to the start of the paragraph on line 32. The second sentence (new) of this paragraph reads "Typical barrier layer (i.e., gray clay) thickness is about 10 feet." The text on line 2, page D-1-III-2, "model predictions and field measured data," was replaced with "model predictions (concentration ratio of 5) and field measured data (concentration ratio of 4.8)."

Comment No. 22
Commenting Organization: OEPA Commentor: GeoTrans
Section #: D.1-III Page #: D-1-III-1 Line #: 28 Code: E
Original Comment #:

Comment: Change "I" to "The model".

Response: Agreed. "I" will be changed to "The model." Also, a new paragraph will start at line 26 on page D-1-III-1.

Action: In line 28, page D-1-III-1, "I" was changed to "Model". A paragraph break was inserted between "...to be 52.8 in/yr." and "Large" on line 25 on page D-1-III-1.

Comment No. 23
Commenting Organization: OEPA Commentor: GeoTrans
Section #: D.1-III Page #: D-1-III-4 Line #: Code: M
Original Comment #:
Comment: Based on the ODAST runs, what uranium concentrations are simulated in the unsaturated GMA after 45 years due to the assumed 5-year loadings? Please provide results to describe the simulated movement of the concentration slug through the top of the GMA. If the model is correct, we should see significantly increasing uranium concentrations in the unsaturated GMA and decreasing uranium concentrations in the lower till with time. Although there are many potentially confounding factors, the 9 months of available do not reflect these simulated trends. Will the lysimeters continue to be sampled at some less frequent interval (e.g., quarterly)? What does this new analysis suggest about future uranium concentrations in the saturated GMA?
Response: Tables D.1.III-2 and D.1.III-3 show the predicted uranium concentration in the unsaturated GMA and gray till up to 45 years due to assumed 5-year loadings. For this simulation, ODAST was run to predict concentrations only up to the unsaturated GMA lysimeter. ODAST model was not setup to predict concentrations at the top of the saturated GMA.

These modeling results indicate that uranium concentrations in the saturated GMA at many locations will increase in the future. The model shows that concentrations in the top 3 feet of unsaturated GMA increase by a factor of 2 to 3 between the years 40 and 45. Lysimeter data were collected once in September 1993 and periodically during March to June 1994. The scatter in the lysimeter data does not indicate any trends. For modeling purposes, it was assumed that uranium loading was at a constant rate for 5 years and no more uranium loading after first 5 years. However, the exact nature of uranium loss and loading to the glacial overburden is unknown.

Operable Unit 5 has accounted for the implications of the lysimeter data during the establishment of clean-up levels that recognize cross-media impacts. Operable Unit 5 has continued to sample the lysimeters and will be responsible for any long term plans to continue collecting that data.
Action: No action.

Comment No. 24
Commenting Organization: OEPA Commentor: GeoTrans
Section #: D.1-III Page #: D-1-III-4 Line #: Code: E
Original Comment #:
Comment: Change "ration" to "ratio" in each table.
Response: Agreed. "Ration" will be changed to "ratio".
Action: "Ration" was replaced with "ratio" in Tables D.1.III-1, D.1.III-2, and D.1.III-3.

Comment No. 25
Commenting Organization: OEPA Commentor: GeoTrans
Section #: D.1-IV Page #: D-1-IV-3 Line #: 1 Code: C
Original Comment #:
Comment: Text is missing between page D-1-IV-1 and this page.
Response: Agreed. The sentence that currently reads "The 19 percent" was intended to read "The retardation factor in the gray clay layer was also recalculated using the HELP model simulated moisture content of 19 percent."
Action: In order to both correct the missing text and provide a clearer discussion of the K_d of the clay liner (see Comment No. 26) two text revisions were done. First, in line 35 of page D-1-IV-1, "in the original modeling" was replaced with "of the gray glacial till". Second, the following missing text was inserted at the beginning of page D-1-IV-2:

"clay liner was the first of two layers in the ODAST model.

The second layer in the ODAST model consisted of gray till (clay). Properties of the gray till are shown in Table D.1-IV-1. The moisture content of the gray till from the HELP modeling was 19 percent. Therefore, the retardation factor in the gray till was recalculated using the simulated moisture content of..."

Comment No. 26
Commenting Organization: OEPA Commentor: GeoTrans
Section #: D.1-IV Page #: D-1-IV-3 Line #: 2 Code: C
Original Comment #:
Comment: The change in retardation factor is attributable to the different value of K_d used.
Response: The confusion is due to the missing text identified in the previous OEPA Comment. The text addressed by this comment refers to the retardation factor for glacial till. While both use 3.1 mL/g as the distribution coefficient for the glacial till, the two scenarios use different values of moisture content, which resulted in different values of retardation factor. While Attachment D.1-IV uses 19 percent moisture content, original WAC development used 41 percent as moisture content for the glacial till. In order to clarify this, the missing text will be added and enhanced as noted in the previous OEPA comment. Also, the missing text will start a new paragraph.
Action: See Comment No. 25.

Comment No. 27
Commenting Organization: OEPA Commentor: GeoTrans
Section #: E.2.2 Page #: E-2-2-1 Line #: 8 Code: M
Original Comment #:
Comment: The WAC for on-site disposal are identified as preliminary. What analyses/investigations are envisioned to be made during design of the disposal facility to derive final WAC?
Response: The waste acceptance criteria presented in the FS are proposed as feasible based on a number of conceptual factors (disposal facility location, disposal facility cap design, disposal facility liner design, and facility contents). The criteria could be modified due to changes in any of those factors. The most likely studies to affect these factors are

(1) the pre-design investigation that DOE has initiated in the area where the facility could potentially be located,
(2) infiltration studies as part of the final cap design,
(3) the remaining RI/FS reports from other Operable Units (since these will identify additional COCs).

Action: The text on page E-2-2-1 was modified as follows:

1) On lines 9-11, the sentence "Due to cap or liner ... are presented." was deleted.
2) The following text replaces the deleted sentence:
"During design, additional information that will allow finalization of the WAC will be available from the following studies:
- The pre-design investigation that has begun in the area where a site-wide disposal facility could potentially be located,
- Infiltration studies during final cap design,
- The RI/FS reports from other Operable Units (which will identify additional COCs)."

Comment No. 28
Commenting Organization: OEPA Commentor: GeoTrans
Section #: E.2.2 Page #: E-2-2-1 Line #: 20 Code: E
Original Comment #:
Comment: The distribution coefficient units need to be corrected. Change "mL" to "mL/g".
Response: Agreed. The units for distribution coefficient will be corrected by changing "mL" to "mL/g."
Action: On Page E-2-2-1, Line 20, "mL" was changed to "mL/g".

Comment No. 29
Commenting Organization: OEPA Commentor: GeoTrans
Section #: E.2.2 Page #: E-2-2-1 Line #: 22 Code: C
Original Comment #:
Comment: Change "and results in a lower associated uranium concentration" to "and results in a higher associated dissolved uranium concentration" or to "and results in a lower WAC for uranium concentration in soil."
Response: Agreed. The wording "and results in a lower associated uranium concentration" will be changed to "and results in a lower WAC for uranium concentration in soil."
Action: On page E-2-2-1, lines 22-23, the wording "and results in a lower associated uranium concentration" will be changed to "and results in a lower WAC for uranium concentration in soil."

Comment No. 30
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: App. E.2.2 Page #: E-2-2-2 Line #: Code: C
Original Comment #:
Comment: Several exponential notation errors in Table E.2.2-1 should be corrected (e.g., change "E+0.3" to "E+03"). Please review the preliminary waste acceptance criteria for total uranium listed within this table. The value of 1.1E+0.3 seem uncharacteristically low. Please verify and modify accordingly.
Response: Table E.2.2-1 has been reviewed and the following errors were found:

- "E+0.3" should be "E+03"
- "E+3" should be "E+03"
- The third column heading, "Preliminary Waste Acceptance Criteria for On-Site Disposal (pCi/g)," should simply be "Preliminary Waste Acceptance Criteria for On-Site Disposal" since the units are specified in the second column.

These errors will be corrected.
Action: On page E-2-2-2, Table E.2.2-1 has been revised as follows:

- In the third column, second row, the decimal in "E+0.3" was deleted
- In the sixth column, second row "E+3" was changed to "E+03"
- In the third column, "pCi/g" was deleted from the column heading.

Comment No. 31
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Fig. E.3-1-4 Page #: E.3-1-8 Line #: C Code:C
Original Comment #:
Comment: Please re-evaluate the design of the composite cap. As shown in this diagram the cap material pinches out into the dike material. This current design may lead to failure of the cap in this area. An alternate design should extend the cap material over the disposal cell to the existing land surface.
Response: Please refer to Comment No. 14.
Action: See Comment No. 14 for action.

Comment No. 32
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: App. E.7 Page #: E-7-1 Line #: 4 Code: C
Original Comment #:
Comment: Please include a discussion within the text as to what the on-site borrow material will be used for.
Response: Additional soil investigation will be performed to describe the lithology and geotechnical properties of the prospective borrow material and to determine the use of that material during construction of the on-site disposal facility and the restoration of the subunits.
Action: Page E-7-1, line 4, the first sentence of Section E.7 was replaced with:

"An on-site borrow source is being considered for soils to be used during the construction of the proposed on-site disposal facility and for restoration of the subunits. Soils from the borrow source will be investigated for use as site restoration backfill, disposal facility cap components and disposal facility liner components."

Comment No. 33
Commenting Organization: OEPA Commentor: GeoTrans
Section #: WAC Criteria Page #: Line #: Code: M
Original Comment #:

Comment: Please provide OEPA with copies of the ODAST and SWIFT codes and data sets used to evaluate WAC.

Response: SWIFT V2.55 for UNIX, supplied by GeoTrans, was used. ODAST code was adapted from a book by Javendel, et al (1984). The SWIFT code, ODAST code and input data sets can be provided for review. However, it is requested that the codes be used only in conjunction with a review of FEMP documents. Optionally, it is encouraged that reviewer(s) come to the Cincinnati area to examine the codes and data sets as they reside on the computer system utilized for the project and capable of handling these large data sets. In this way, modelers familiar with the codes and the data sets can facilitate review of codes and application.

Action: Diskettes containing electronic files have been included in the response documents being sent directly to the following persons:

1) T. Schneider/OEPA
2) L. August/Geotrans

The contents of those files are as follows:

Diskette 1

Filename	Ext.	Bytes	Description
SLAT	EXE	25872	ODAST executable file
INPUT	DAT	134	Data file for ODAST
WASTAREA	DAT	526	Input file containing waste area identification
HELPAREA	DAT	113	Input file containing infiltration identification
LAY1THIK	GRD	24507	Input file containing Layer 1 thicknesses
LAY2THIK	GRD	24507	Input file containing Layer 2 thicknesses
CONMAX	EXE	4752	Post-processing program to find maximum concentration
CONMAX	IN	42	Input file for CONMAX.EXE
README		286	A text file explaining the use of the other files on diskette

Diskette 2

Filename	Ext.	Bytes	Description
SWIFT	BAT	49	Batch file to run SWIFT
SWIFT253	ZIP	211433	Archived file containing SWIFT V.2.5.3 executables
RUN16	ZIP	10975	Archived file containing inputs specific to WAC development (Run 16)
R1-21	ZIP	501187	Archived files containing
R1-26	ZIP	83012	other input files
R1-28	GZIP	21792	for cards 21, 26, 28
XYZMAX1	EXE	4704	A post-processing program to find maximum concentration
XYZMAX1	IN	37	Input file for XYZMAX1.EXE
README		560	A text file explaining the use of the other files on the diskette

It is requested that any use of these files be limited to the purpose of reviewing documentation from the Fernald Environmental Management Project (FEMP).

PROPOSED PLAN COMMENTS

Comment No. 34
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 5.1.5 Page #: 5-3 Line #: 5-8 Code: C
Original Comment #:
Comment: The contaminated soils left in place are considered a waste and will require long-term monitoring in accordance with CERCLA. Long-term monitoring will be necessary to ensure contaminants have not migrated and to ensure that the selected land use is maintained.
Response: See response to Comment No. 16.
Action: This minor change will be reflected in the Operable Unit 2 Record of Decision.

Comment No. 35
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Tbl. 5-2 Page #: 5-6 Line #: Code: C
Original Comment #:
Comment: This table fails to include a number of the contaminants listed in Table 5-10 of the Feasibility Study. The table should be revised to agree with the FS.

Response: Instead of including the lengthy tables from the FS, the Proposed Plan presents cleanup levels for the major radionuclides in Operable Unit 2 (uranium, thorium, and radium). This point will be clarified in the text and a reference to the complete tables included.

Action: Rather than revising the Proposed Plan, this minor change will be reflected in the Operable Unit 2 Record of Decision.

Comment No. 36
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Tbl. 5-3 Page #: 5-7 Line #: Code: C
Original Comment #:

Comment: This table fails to include a number of the contaminants listed in Table 5-3 of the Feasibility Study. The table should be revised to agree with the FS.

Response: See response to Comment No. 35.

Action: See action for Comment No. 35.

Comment No. 37
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 5.5.4 Page #: 5-27 Line #: 2 Code: C
Original Comment #:

Comment: The OAC citation in the paragraph is incorrect. These rules were revised effective 6/1/94. The correct citations should be OAC 3745-27-07(H)(2)(c) and (2)(d).

Response: Agreed.
On Pg. 5-27, line 5-2, the following changes will be made:
Delete reference to "OAC 3745-27-07(B)(5) and (B)(9)"
The citation will be revised to "OAC 3745-27-07(H)(2)(c) and (H)(2)(d)."

Action: This minor change will be reflected in the Operable Unit 2 Record of Decision.

In addition, the following changes have been made to maintain consistency:

Line 6 on page 2-16 of the FS has been changed to read, "...sole-source aquifer [OAC 3745-27-07(H)(2)(c)]."

Line 8 on page 2-16 of the FS has been changed to read, "...gallons per minute for a 24-hour period [OAC 3745-27-07(H)(2)(d)]."

Line 16 on page 2-16 of the FS has been changed to read, "...CERCLA §121(d)(4)(D) from OAC 3745-27-07(H)(2)(c) and (H)(2)(d) would be required from EPA."

Rows 2 and 3 on page B-65 of the FS have been revised to read, "OAC 3745-27-07(H)(2)(c)" and "OAC 3745-27-07(H)(2)(d)" respectively.

Appendix B of the FS has been thoroughly reviewed to ensure consistency with the revised Ohio Solid Waste Landfill Regulations. Associated modifications to Appendix B of the FS are presented in the changed pages.

Comment No. 38
Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Appendix A Page #: A-3 Line #: Code: C
Original Comment #:
Comment: An additional action specific ARAR should be 40 CFR 60.670 Subpart 000. This ARAR addresses standards for the use of a crusher.
Response: Appendix A presents the major ARARs for Operable Unit 2. Since crusher standards are not major ARARs, no change will be made to Appendix A, but the standards will be added to Appendix B of the FS Report.
Action: See action for Comment No. 18.

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U.S. EPA

U.S. EPA COMMENTS
DRAFT FINAL FEASIBILITY STUDY AND PROPOSED PLAN
NOVEMBER 17, 1994

Comment No. 39
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 2 Page #: NA Line #: NA Code:
Original Comment #: 1

Comment: Section 2 presents preliminary remediation goals (PRG) and preliminary remediation levels (PRL) for Operable Unit (OU) 2. Although lead is a contaminant of concern (COC) at the firing range, lead is not listed as a COC in any of the PRG or PRL tables in Section 2 (see Specific Comment 8). The soil lead cleanup level should be calculated using the U.S. Environmental Protection Agency (U.S. EPA) guidance "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities," July 14, 1994, and these levels should be presented in Section 2.

Response: The firing range is a small, isolated area within the South Field disposal area. Based on historical use, this small area has contaminant characteristics different from the South Field area as whole. The FS report stipulates that the firing range will be remediated. Therefore, lead will be added to the COC list and a PRL will be added in Section 2. However, a note will be added to indicate that the PRL is applicable only to the firing range area. The PRL for soil will be based on cited reference at 400 ppm.

Action: See changed Tables 2-1, 2-3, 2-5, 2-22, 2-23, and 2-24.

Comment No. 40
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 3 and App. E.2.2 Page #: NA Line #: NA Code:
Original Comment #: 2

Comment: Section 3 proposes on-site disposal of OU2 wastes that are below on-site waste acceptance criteria (WAC) and off-site disposal of OU2 wastes that are in excess of on-site WAC. Appendix E.2.2 proposes preliminary WAC. Several issues exist regarding the on-site WAC. First, to provide more certainty in remedy selection, the final on-site WAC should be established before the Record of Decision (ROD) is issued. Using preliminary on-site WAC in the ROD and waiting until the design phase to finalize the on-site WAC is ill-advised because the ROD is enforceable and should provide all performance and cleanup standards. In addition, Appendix E.2.2 presents on-site WAC for uranium only. On-site WAC should include other COCs or the text should explain why these have been excluded. The final WAC for all COCs should be added to the feasibility study (FS).

Response: Finalization of the WAC. One of the objectives of the FS was to propose a feasible waste acceptance criteria (WAC) for OU2 materials. Finalization of the WAC for all materials that might be considered for on-site disposal would need to encompass a number of additional factors. Some of those factors include the following:

1) The design of the cap and liner systems - While feasible proposals are presented in the OU2 FS, the ultimate design will depend on further engineering evaluation and review and approval by the EPAs.

2) The proposed location - The OU2 FS presents a feasible choice. The final location and final geometry of the disposal facility will depend on the findings of a recently initiated study and coordination of actual waste volumes with other operable units.

3) Other OUs' COCs - OUs 3 and 5 will propose additional COCs for on-site disposal (Note: Uranium isotopes are the only GMA COCs for Operable Unit 2).

4) The material to be disposed - The material generated by OU3 will be construction debris. Construction debris primarily exhibits surface contamination. In contrast to the limited amounts of debris associated with OU2 and OU5 waste, the large quantity of debris expected to be generated by OU3 may require a different set of acceptance criteria.

It is proposed here that the maximum WAC for uranium content of untreated OU2 materials be finalized in the OU2 ROD and that the WAC be set at 360 pCi/g, the OU2 FS value for uranium-238, as discussed in Appendix E.2.2., is based on groundwater modeling which relies on conservative values for a number of parameters including cap permeability, liner configuration, facility location, and source uranium concentration (see response to Comment No. 15).

Other COCs. The reason that other COCs were not considered for OU2 is discussed in Appendix D.1.6. As noted there:

"If a contaminant was not a COC for subunits based on the Baseline Risk Assessment, it did not become a COC at the disposal cell because the infiltration rate is much less at the disposal cell than at the unremediated subunits. Because uranium isotopes were the only COCs at the Operable Unit 2 subunits, the only COCs for groundwater at the proposed disposal cell were uranium isotopes."

The text in Appendix E.2.2 will be revised by adding language similar to that in Appendix D.1.6 to discuss the identification of the uranium isotopes as the only COCs.

Action: Finalization of the WAC. There was no change to the FS. However, the ROD will reference Waste Acceptance Criteria for uranium in untreated OU2 material of 360 pCi/g uranium 238. The Proposed Plan was revised as such that page 5-21, lines 8-12, will discuss the maximum waste acceptance criteria concentration.

Other COCs. In Appendix E.2.2, on page E-2-2-1, the following text was inserted on line 7 immediately after "... were developed for uranium":

"As discussed in Appendix D, the only COCs for groundwater at the disposal cell were uranium isotopes. This is because uranium isotopes were the only groundwater COCs identified at the individual subunits and the infiltration rate is much lower at the disposal cell than at the unremediated subunits."

A new paragraph was started with "The preliminary WAC were ..."

Comment No. 41
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 4 Page #: NA Line #: NA Code:
Original Comment #: 3

Comment: Section 4 presents the development and initial screening of alternatives. Alternative 7 is eliminated without sufficient justification, especially when the cost difference between it and Alternative 6 is considered. Additional justification should be provided because eliminating the alternative that treats the identified principal threat is not consistent with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (see Specific Comment 3).

Response: As identified in Section 2 of the FS, the contaminated material in the Inactive Flyash pile constitutes a "principal threat" because it is located directly over the GMA. Both Alternatives 6 and 7 include the elimination of that threat by excavating the material and removing it from the vicinity of the GMA. Alternatives 6 and 7 differ only in their approach to disposal of the material which exceeds the WAC for on-site disposal. Alternative 7 proposes on-site disposal after treatment while Alternative 6 provides off-site disposal without treatment.

The text of Section 4 will be revised to discuss the practicability of treatment and on-site disposal in comparison to off-site disposal. The expanded text will focus on the following factors:

1) The amount of material being considered for treatment (that portion exceeding the on-site WAC) is only about 1% of the overall OU2 waste volume.
2) Candidate treatment technologies are under study at the FEMP, but a practical and fully proven soil treatment technology has not yet been identified.
3) For the minor amount of material under consideration, it is considered impractical to implement a treatment facility specific to Operable Unit 2. Hence, any treatment facility would be implemented by another operable unit at the site.
4) Treatment would likely cause a need for interim storage (in order to avoid jeopardizing the overall OU2 schedule for remediation) for two reasons:
    a) The time required to demonstrate that a soil treatment technology is practical.
    b) Ties to the remediation schedules of other operable units.

Based on the factors noted above, two approaches to off-site disposal and treatment can be considered. One approach is to plan for off-site shipment, but to be prepared to amend the ROD to allow treatment and on-site disposal in the event that a practical/proven treatment technology is identified and implemented at the FEMP. The other approach, the approach that was chosen in the FS based on practicability, was to simply transport the material off-site for disposal without potential delays or concerns about appropriate technology.

Action: Text in Section 4.3.7.2 was revised as follows:

The wording "(approximately 1% of the Operable Unit 2 waste volume)" was inserted on line 5 of page 4-24 immediately after the wording "... expected to be insignificant."

The following text was added at the end of line 12 on page 4-24:
"Alternative 7, like Alternatives 3, 4, 5, and 6, eliminates the principal threat at Operable Unit 2 by excavating the contaminated material in the Inactive Flyash Pile that is located directly over the GMA."

The text under "Technical Feasibility" on page 4-24 was deleted and replaced by the following:
"The technical feasibility of Alternative 7 is similar to that of Alternatives 5 and 6. Alternative 7 is considered less implementable than Alternative 6 for the following reasons:

- Candidate treatment technologies are under study at the FEMP, but a practical and fully proven soil treatment technology has not yet been identified.
- For the minor amount of material under consideration, it is considered impractical to implement a treatment facility specific to Operable Unit 2. Hence, any treatment facility would be implemented by another operable unit at the site.
- Currently, the only treatment technology that has been identified as part of a preferred remedial alternative is vitrification (by Operable Unit 4). This technology is known to be sensitive to the nature of the feed material. Therefore, pilot testing would be required to ensure proper treatment of Operable Unit 2 material, in addition to the extensive pilot program that is needed for Operable Unit 4 material. Based on the schedule for Operable Unit 4 and the priority assumed for that material, lengthy interim storage of Operable Unit 2 material would be required.

The text under "Summary" on page 4-25 was deleted and replaced with the following:
"Alternative 7 eliminates concern over meeting the WAC for on-site disposal and is as effective and cost effective as Alternatives 5 and 6. However, since it is marginally less implementable than Alternative 6 while offering no advantage over Alternative 6, it is not retained for detailed analysis."

On page 4-28, the Implementability text for Alternative 7 was deleted and replaced with the following:
"Somewhat less implementable than Alternative 6 because of the potential for delays and concerns about appropriate technology."

Comment No. 42
Commenting Organization: U.S. EPA Commentor: Saric
Section #: Appendix C Page #: NA Line #: NA Code:
Original Comment #: 4 (Original General Comment 14)
Comment: The original comment identified several errors in calculating the number of trucks required under the various alternatives. The response indicates that Appendix C (and its attachments) has been clarified to reconcile the volume and weight capacity of the trucks with the number of trucks that the alternative requires. However, the information formerly contained in "Attachment I, Relevant Information for Alternatives" is no longer presented as part of Appendix C. Therefore, it is not possible to verify if the response has been reconciled. Appendix C should be revised to provide the information or a reference to the source of the information necessary to verify that the reconciliation has been performed.

Response: In the previous FS each of the alternatives involved with off-site disposal used trucks or a combination of railcars and trucks to transport the contaminated materials. In this version of the FS, Appendix C was revised to reflect off-site transportation of contaminated materials by railcars (gondolas) to the representative off-site facility. Trucks were not used for off-site transportation. As a result of this change in off-site disposal the tables containing truck transportation data as referenced in the original comment were deleted.

Action: No action.

Comment No. 43
Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.1.3 and D.1.6 Page #: NA Line #: NA Code:
Original Comment #: 5

Comment: Section D.1.3 states that groundwater COCs identified in the OU2 remedial investigation (RI) and modeled in the OU2 FS are uranium isotopes. According to the response to comments for Appendix A, the COCs for the various subunits in OU2 were revised and include other COCs in addition to uranium isotopes. The text should be revised to state that uranium isotopes were not the only COCs identified during the OU2 RI and should further state how these additional COCs were addressed in the groundwater fate and transport model.

Response: Appendix A presents data for all COCs in all subunits regardless of pathway, which may be the reason for confusion. COCs by pathways are identified in Section 2, Table 2-1. Uranium isotopes were the only COCs identified for the Great Miami Aquifer groundwater pathway (see Table 2-1 in Section 2 of FS). Other COCs were identified but they apply to other pathways. This appendix deals with only the fate and transport of COCs for the Great Miami Aquifer. A statement will be added at the beginning of Appendix A to clarify this issue.

Action: The following text changes were done in Appendix A:

1) On page A-1-1, line 18 after "...in the individual tables." insert the sentence "For comprehensiveness, sampling results are included for all parameters listed in the tables, regardless of the parameters' applicability to any specific pathway."

2) Start new paragraph on line 22 of page A-1-1 at the words "It should be..."

Additional changes were made in Appendix D.

Replaced the sentence "The groundwater COCs..." in line 14, page D-1-11 with the following sentences:

"Table 2-1 in Section 2 provides the list of COCs identified in the Final RI report for Operable Unit 2. Table 2-1 lists that only uranium isotopes were identified as COCs for the groundwater pathway."

Inserted "groundwater" before "COC" in lines 3, 4, and 5 on page D-1-77a.

Comment No. 44
Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.1.5 Page #: NA Line #: NA Code:
Original Comment #: 6

Comment: Section D.1.5 discusses maximum predicted loading concentrations, maximum on-site Great Miami Aquifer (GMA) concentrations, and maximum fenceline GMA concentrations for the various subunit remediation scenarios evaluated in determining cross-media PRGs that are protective of the GMA. The text discusses model results for the subunits but does not justify and discuss the significance of the modeling results. For example, if the results of modeling for a subunit indicate that GMA concentrations are below the 10^{-6} incremental lifetime cancer risk (ILCR), the text should explain why the concentrations are below this level, and should not just state that this is what the model indicates. This information would be helpful because the presentation of the actual modeling data is difficult to follow due to its size. The text should be revised to discuss modeling results and their significance in more detail.

Response: Text will be modified to include significance of the modeling results in Section D.1.5. Whenever model predicted concentrations are very small (i.e. below 10^{-6} ILCR) explanation will be provided. For example, for the alternative of consolidation and capping at the Solid Waste Landfill, the maximum predicted fenceline concentration was below the 10^{-6} ILCR because of low infiltration rate, low maximum uranium concentration, and the relatively large distance between the Solid Waste Landfill and the downgradient receptor at the fenceline.

Action: The following text was inserted after "level." in line 10, page D-1-30:

"Predicted maximum fenceline concentration is below 10^{-6} ILCR because of low infiltration rate, low maximum uranium concentration (below WAC developed in Section D.1.6), and relatively large distance between the Solid Waste Landfill and the downgradient receptor at the fenceline."

Inserted the following before "Because" in line 29, page D-1-30:

"Predicted maximum fenceline concentration is below 10^{-6} ILCR because of low maximum uranium concentration (below WAC developed in Section D.1.6) and relatively large distance between the Lime Sludge Ponds and the downgradient receptor at the fenceline."

Replaced "current uranium-238 concentrations" in line 8, page D-1-37 with the following:

"predicted uranium-238 concentrations without source controls"

Inserted "due to low infiltration rate." after "level)" in line 23, page D-1-72.

Comment No. 45
Commenting Organization: U.S. EPA Commentor: Saric
Section #: I.4.5 Page #: I-4-14 Line #: NA Code:
Original Comment #: 7 (Original General Comment 31)
Comment: In response to the original comment, text has been added to discuss the linear relationship between soil concentrations and risks. However, the added text does not adequately address the original comment. Additional documentation is required to accurately determine if all COCs that have been reduced in concentration by 99.9 percent are within the acceptable risk range.
Response: Table I.4-4 will be supplemented and clarified to provide the requested information. Table I.4-4 will include the estimated post remediation risk for each COC as defined in the FS reports for the Operable Units. The post remediation risk is the risk due to that COC before reduction. A comparison of the post remediation risk to the post reduction risk (also included in Table I.4-4) indicates that the reduced COCs are within the acceptable risk range.
Action: Section I.4 was rewritten to address Comment No. 100. Original Table I.4-4 was removed and replaced with a new version. Please see Comment No. 100 and revised Section I.4.

Comment No. 46
Commenting Organization: U.S. EPA Commentor: Saric
Section #: I.5.1 Page #: I-5-3 Line #: NA Code:
Original Comment #: 8 (Original General Comment 33)
Comment: In response to the original comment, additional text has been added to clarify the assumption of no significant demographic change. However, the on-site farmer receptor is the pathway that is most conservative and most protective of human health based on the assumption of no significant demographic change. This assumption should be substantiated by including the discussion about the conservative and protective on-site farmer receptor.
Response: The selection of the on-site resident farm adult and child is conservative because of their level of exposure. Text will be added to substantiate this assumption.
Action: The following discussion was added to page I-5-3. line 14:

"The on-site resident farmer is exposed to on-site contaminants 24 hours a day for 350 days per year. This is a longer exposure than a resident who may work elsewhere eight hours a day for 250 days per year, if the property were residential. It is also higher than an on-site worker, if the future land use was commercial, who may work eight hours a day for 250 days per year. If the property were converted to recreational use, the daily and annual exposures would be even lower because the receptor would not be living on-site. Also, farming involves working with the soil, which contains most of the residual contamination. An on-site farmer will inhale dust, ingest small quantities of soil, and eat home grown fruits, vegetables, beef, and milk. The commercial and residential receptors will have much lower exposures to soil and no exposures to produce and meats."

Comment No. 47
Commenting Organization: U.S. EPA Commentor: Saric
Section #: I.6.2.1 Page #: I-6-63 Line #: 22 Code:
Original Comment #: 9 (Original General Comment 39)
Comment: The response to the original comment uses the assumption that wind erosion of caps and

cover soils is less than 4 inches over the 1,000-year period. Also, the text states that the combined erosion rates for wind and surface water runoff would not cause the contaminated layers in these areas to be exposed. This assumption appears to be too low if no cap or cover soil maintenance occurs over the 1,000-year period. A reference or justification should be provided for this assumption.

Response: The requested clarification will be provided. Emission rate data and calculations are described in Section I.6.2.4, from which the maximum emission rate was calculated to be 1.2 x 10^{-6} g/s/m^2. This value was then converted to the wind erosion rate, using an average soil density of 1.8 g/cm^3. Surface water erosion rates are calculated in Appendix D.1 (Table D.1-1), and range from 3.34 to 9.10 in./1,000 years for slopes ranging up to 22%. In contrast, the Operable Unit 2 disposal cell, as described in Section I.2.4.3, will have 27" of soil over 36" of cobbles. The top slope will be at 3-5% and the side slope at 20% (1 vertical: 5 horizontal). Other soil cover designs are expected to include similar soil thicknesses. Therefore, contaminated layers would not be exposed in a 1,000 year period. Similar calculations will be provided for wind erosion in order to calculate the combined erosion rate. Text will be modified to explain the assumptions for combined erosion of caps and cover soils over the 1000 year period and will reference the specific section in the FS which justifies this calculation.

Action: The following text was added to page I-6-67, line 17 for clarification:

"Wind erosion rates are based on the emissions determined from the U.S. EPA, 1985, "Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites," EPA/600/8-85/002, Office of Health and Environmental Assessment. Emission rate data and calculations are described in Section I.6.2.4, from which the maximum emission rate was calculated to be 1.2 x 10^{-6} g/s/cm^2. This value was then converted to the wind erosion rate, using an average soil density of 1.8 g/cm^3. Surface water erosion rates are calculated in Appendix D.1 (Table D.1-1), and range from 3.34 to 9.10 in./1,000 years for slopes ranging up to 22%. In contrast, the Operable Unit 2 disposal cell, as described in Section I.2.4.3, will have 27" of soil over 36" of cobbles. The top slope will be at 3-5% and the side slope at 20% (1 vertical:5 horizontal). Other soil cover designs are expected to include similar soil thicknesses. Therefore, contaminated layers would not be exposed in a 1,000 year period."

Figures D.1-1 and D.1.II-1 were revised to correctly indicate "Slope = 22%" for Location-B.

000033

Comment No. 48
Commenting Organization: U.S. EPA Commentor: Saric
Section #: I.11.3 Page #: NA Line #: NA Code:
Original Comment #: 10 (Original General Comment 49)

Comment: The response to the original comment states that missing health effects information or a lack of quantitation in chemical analysis may provide a significant source of uncertainty and may thereby underestimate risk. Although these sources of uncertainty were added to the text, whether the uncertainty was overestimated or underestimated was not included in the text. Also, the response stated that additional information regarding uncertainties in underestimating risk would be added to Table I.11-6. However, this information does not appear to be added to Table I.11-6. A more detailed discussion of uncertainty should be provided.

Response: The requested text in the table will be revised and clarification provided to state that the uncertainty inherent from missing health effects information or a lack of quantitation in chemical analysis would underestimate risk. This information will also be added under the COC category as item No. 3 in Table I.11-6.

Action: A section was added to Table I.11-6 to discuss uncertainty due to lack of quantitation or missing health effects. See changed Table I.11-6.

Comment No. 49
Commenting Organization: U.S. EPA Commentor: Saric
Section #: I.12.2 Page #: NA Line #: NA Code:
Original Comment #: 11 (Original General Comment 50)

Comment: The response to the original comment states that all receptors for all land use scenarios are "above" the ILCR of 10^{-6}. This statement is unclear. "Above" should be changed to "greater than" or "less than," as appropriate. Also, if "above" is replaced with "greater than," it would be more appropriate to discuss receptors with an ILCR of greater than 10^{-4} because this the greatest ILCR within the acceptable range.

Response: "Above" will be replaced with "greater than" as requested, and the 10^{-4} upper limit will be referred to as suggested.

Action: The following text was modified on page I-12-3:

"For all three land use scenarios, the ILCR for the adult farmer (and on-property RME child) ~~all~~ receptors ~~are above the ILCR of~~ is greater than ~~10^{-6}~~ 10^{-4}. All receptors in the Current Land Use scenario ~~are below the~~ have a HI ~~of~~ less than 1.0."

SPECIFIC COMMENTS

Comment No. 50
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 2.3.2.1 Page #: 2-14 to 15 Line #: 28-31, 3-8 Code:
Original Comment #: 1

Comment: Section 2.3.2.1 discusses the regulatory definition of wastes. Page 2-14 states that although the bullets are not considered waste, they will be assumed to be mixed waste (hazardous and radioactive) when they are actively managed. Page 2-15 contradicts this statement by stating that the firing range material will be screened during the remedial action and may be handled in a variety of ways depending on whether contaminant levels are above or below PRLs. This inconsistency should be corrected and the text revised appropriately.

Response: The active portion of the firing range (with bullets) will be treated as a mixed waste. Soils adjacent to this area, will be analyzed and be classified according to the following:

Mixed waste: If analysis shows the TCLP lead concentration to exceed 5 mg/l and contain a detectable amount of radionuclides.

Low level waste: If the analysis shows the TCLP lead concentration to be less than 5 mg/l and greater than any PRL for the South Field (a lead PRL will be added per Comment No. 39).

Mixed wastes would be sent to an approved off-site disposal facility. Low level wastes would be sent to the on-site disposal facility. The text will be revised to clarify the proposed remedial actions.

Action: Lines 2 and 3 on page 2-15 have been revised to read, "It is assumed that the firing range material containing bullets is mixed waste; however, the material surrounding the area with bullets will be screened during the remedial action to confirm the type of waste."

In addition, the following changes have been made to maintain consistency:

Line 27 on page 5-35 has been revised to read, "Material containing bullets from the South Field Firing Range that is mixed waste would be treated and...."

Line 2 on page 5-36 has been revised to read, "Firing Range material surrounding the area with bullets that is not found to be hazardous after testing, but contains COCs above the PRLs, would...."

Line 7 on page 5-73 has been revised to read, "Material containing bullets from the South Field Firing Range that is mixed waste would be treated and...."

The following sentence has been added to Line 12 on page 5-73, "Firing Range material surrounding the area with bullets that is not found to be hazardous after testing, but contains COCs above the PRLs, would be considered low-level radioactive waste/residual radioactive material and would be disposed off-site with the rest of the South Field material."

Line 14 on page 5-105 has been revised to read, "Material containing bullets from the South Field Firing Range that is mixed waste would be treated and...."

Line 22 on page 5-105 has been revised to read, "Firing Range material surrounding the area with bullets that is not found to be hazardous after testing, but contains COCs above the PRLs, would...."

Comment No. 51
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 4.3 Page #: 4-10 to 4-29 Line #: NA Code:
Original Comment #: 2

Comment: Section 4.3 presents the initial screening of alternatives. The effectiveness criterion evaluates the reduction in contaminant toxicity, mobility, or volume through treatment. This evaluation discusses the reduction in mobility achieved by capping or containing the waste. However, capping and containment are not considered to be methods of treatment. Therefore, reductions in contaminant mobility through capping and containment should not be discussed as part of this evaluation. Reductions in contaminant mobility associated with capping and containment instead should be included as part of the long-term effectiveness and permanence evaluation.

Response: The FS carefully separates mobility from migration; however, migration is inappropriately discussed under "Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment" at the following locations:

Alternative 2 on page 4-14
Alternative 5 on page 4-20
Alternative 6 on page 4-22
Alternative 7 on page 4-24
Alternative 8 on page 4-25

Section 4 will be revised so that migration is only discussed under "Long-Term Protection of Human Health and the Environment." Section 5 of the FS and Table 6-1 of the Proposed Plan will be checked for similar inconsistencies.

Action: The following modifications have been made:

On page 4-14, lines 15-17, the sentence "However, through containment in the capped consolidation areas and installation of a subsurface drainage system in the South Field area, infiltration and migration of perched groundwater would be minimized" was deleted.

On page 4-20, lines 17-19, the sentence "However, through containment in an engineered cell, the potential for the contaminated material to migrate would be minimized" was deleted. The sentence "Containment in an engineered cell would minimize the potential for contamination to migrate" was added to line 27 at the end of the paragraph.

On page 4-22, lines 20-21, the words "Alternative 6 would minimize the migration potential of the contaminated material through containment in an engineered cell" were deleted. The sentence "Containment in an engineered cell would minimize the potential for the contamination to migrate" was added to line 26 at the end of the paragraph.

On page 4-24, line 7, the words "and the disposal cell would effectively minimize the migration of contaminants" were deleted. The sentence "Containment in an engineered cell would minimize the potential for the contamination to migrate" was added to line 14 at the end of the paragraph.

On page 4-25, lines 23-24, the words "and migration of contaminants would be minimized by containment in an engineered cell" were deleted. The sentence

"Containment in an engineered cell would minimize the potential for the contamination to migrate" was added to page 4-25a, line 3 at the end of the paragraph.

On page 5-42, lines 6-8, the last two sentences of the first paragraph under section 5.3.2.4 were deleted.

On page 5-112, lines 28-31, the last two sentences of the first paragraph under section 5.5.2.4 were deleted.

In the FS, Table 6-2, the following text was deleted from the fifth column:

- From Alternative 2 - "but capping system would minimize the potential for migration"
- From Alternative 3 - "but disposal in an off-site facility would minimize the potential for migration"
- From Alternative 6 - "but disposal in an on-site facility would minimize the potential for migration"

Rather than revising the Proposed Plan, these minor changes will be reflected in the Operable Unit 2 Record of Decision.

Comment No. 52
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 4.3.7.2 Page #: 4-24 to 25 Line #: 3-8, 1-5 Code:
Original Comment #: 3

Comment: Section 4.3.7.2 presents the initial screening evaluation for Alternative 7. The evaluation of contaminant reduction through treatment does not explain that the principal threat to the GMA is treated by Alternative 7; this should be added to the text. The text summarizes the evaluation by stating that Alternative 7 offers no advantage over Alternative 6 and is therefore, not retained for detailed analysis. However, the summary does not provide sufficient justification for eliminating Alternative 7. This is especially true because the threat to the GMA from contaminant migration has been identified as a principal threat and because Alternative 7 treats this principal threat. Additional justification must be added to eliminate Alternative 7 since it meets the statutory preference for treatment of principal threats, especially in light of the nearly insignificant cost increase resulting from this treatment.

Response: See the response to Comment No. 41.

Action: See the action for Comment No. 41.

Comment No. 53
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 5.1.2.4 Page #: 5-7 Line #: 17 to 22 Code:
Original Comment #: 4

Comment: Section 5.1.2.4 describes the evaluation criterion of reduction of toxicity, mobility, or volume through treatment. The text states that for contaminated soils, three ex situ treatment technologies are components of several alternatives selected for detailed analysis. However, the only treatment proposed for the alternatives in the detailed analysis is stabilization of lead-contaminated soil. This discrepancy should be corrected.

Response: Two components of the waste materials within Operable Unit 2 are candidates for treatment - materials which exceed the WAC for on-site disposal and the lead-containing soils from the South Field. The estimated volumes of these components are 3100 and 300 cubic yards, respectively.

For the first of these components, it was determined in Section 4 that the most practical option is off-site disposal. Hence, the discussion in Section 5.1.2.4 was aimed at the lead-containing soil. Since the volume of that component is small in comparison to the overall quantity of material proposed to be excavated in Alternatives 3 and 6 (approximately 0.1 percent), it was not considered practical to provide detailed discussion of the types of treatments that might be appropriate for this component.

Three treatment options were determined to be potentially feasible in the screening of process options - vitrification, soil washing, and solidification/stabilization. For the small quantities of this component, it would be appropriate to purchase the treatment as a service rather than to construct and operate a treatment facility. Therefore, the treatment process chosen will depend largely on which treatment is most readily available (likely due to its presence for primary use by some other operable unit at the FEMP). To avoid tripling the number of alternatives or subalternatives in Sections 4 and 5 of the OU2 FS, the analysis of alternatives relies on a representative treatment option (solidification/stabilization), but none of the three potentially feasible alternatives is intended to be excluded from further consideration.

The text will be revised to indicate that the treatment technologies apply only to lead-containing soils.

Action: On page 5-7, the first two sentences of the second paragraph under Section 5.1.2.4 (lines 17 through 20) were deleted and were replaced by "In subsequent discussions in Section 5, treatment of contaminated soil applies to the lead-containing soil from the South Field firing range in Alternative 2, 3, and 6. Three ex situ treatment technologies were proposed in the technology development in Section 4 -- solidification/stabilization, vitrification, and soil washing. When treatment is indicated in the following subsections, any of those three technologies is considered potentially feasible."

Comment No. 54
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 5.2 Page #: 5-11 to 12 Line #: 15-17, 27-32 Code:
Original Comment #: 5

Comment: Section 5.2.2.1 discusses overall protectiveness of the no action alternative and states that none of the receptors (specifically, the expanded trespasser and on-property resident farmer) would be exposed to COCs with an unacceptable hazard index. However, Section 5.2.2.3.1 discusses long-term protectiveness of the no action alternative and states that the on-property resident farmer would be exposed to a noncarcinogenic hazard index of 23. This inconsistency should be corrected.

Response: Agreed, the reference to no receptors having an HI of greater than 1.0 is incorrect. The text will be changed to indicate that "the off-property child, on-property farmer (adult and child), and trespassing youth have HI levels greater than 1.0."

Action: The sentence on page 5-11, lines 16-17 "None of the receptors would be exposed to COCs with an unacceptable hazard index" has been deleted. The following has been added: "The off-property farmer (child), on-property farmer (adult and child), and trespassing youth receptors would be exposed to COCs with a hazard index greater than 1.0."

Comment No. 55
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 6.2.1 Page #: 6-4 Line #: 3 to 10 Code:
Original Comment #: 6

Comment: Section 6.2.1 compares the overall protectiveness of the alternatives. The overall protectiveness is erroneously described in degrees, although previous text correctly identifies overall protectiveness as a threshold criterion. The text should be revised to paraphrase the following: "All the action alternatives rely on engineered containment to provide overall protectiveness. However, the alternatives differ in the stringency of the engineering controls and location of the disposal cell." Lines 3 through 10 should be replace with this text.

Response: Agreed. The description of degrees of protectiveness should be revised. The paragraph will be revised as follows: "Residual risk (see Appendix C) associated with these action alternatives is within the established acceptable target range in the National Oil and Hazardous Substance Pollution Contingency Plan (NCP). Therefore, they would be protective of human health and the environment. All of these alternatives would rely on engineered containment systems to provide this protectiveness. However, there is a difference in the design and location of these systems. Uncertainties associated with long-term protectiveness are discussed in Section 6.3.1."

Action: Lines 3-10 on page 6-4 beginning with "However..." were deleted and replaced with the following:

"All of these alternatives would rely on engineered containment systems to provide this protectiveness. However, there is a difference in the design and location of these systems. Uncertainties associated with long-term protectiveness are discussed in Section 6.3.1."

Comment No. 56
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 6.3.3 Page #: 6-11 Line #: 9 to 10 Code:
Original Comment #: 7

Comment: Section 6.3.3 compares the short-term effectiveness of the alternatives. The text states that Alternative 2 provides slightly better short-term effectiveness than Alternative 6 because more material is excavated under Alternative 6 and because the same amount of contaminated material is treated and transported off site for disposal. Based on the detailed analysis presented in Section 6 and because (1) Alternative 6 requires excavation of a great deal more waste than Alternative 2 does, and (2) Alternative 6 involves off-site disposal of low-level radioactive waste, Alternative 2 provides more than slightly better short-term effectiveness than Alternative 6. The text should be clarified.

Response: Agreed. The text will be revised to indicate that Alternative 2 provides better short-term effectiveness than Alternative 6 because Alternative 6 requires excavation of more waste than Alternative 2, and also because Alternative 6 includes off-site transport and disposal of material exceeding on-site disposal facility WAC.

Action: On page 6-11, lines 9-11, the second sentence of the paragraph was deleted and replaced by the sentence "Alternative 2 provides better short-term effectiveness than Alternative 6 because Alternative 6 requires excavation of more waste than Alternative 2, and because Alternative 6 includes off-site transport and disposal of material exceeding on-site disposal facility WAC."

Comment No. 57
Commenting Organization: U.S. EPA Commentor: Saric
Section #: App. B, Table B-1 Page #: B-12 Line #: NA Code:
Original Comment #: 8

Comment: Table B-1 lists chemical-specific applicable or relevant and appropriate requirements (ARAR) and other criteria to be considered (TBC) for OU2. The table erroneously lists the Resource Conservation and Recovery Act (RCRA) toxicity characteristic leaching procedure (TCLP) level for lead as the soil lead cleanup standard. The RCRA TCLP analysis only determines whether or not the soil is considered a RCRA hazardous waste, but does not determine if it is a risk-based cleanup standard. Lead contaminated soil may not be RCRA hazardous waste, but it may still present a risk. The recently issued U.S. EPA directive, "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities," July 14, 1994, Directive Number 9355.34-12, should be used to calculate the soil lead cleanup level for the private and federal ownership land use scenarios. These cleanup levels would be TBCs. The RCRA TCLP lead level would be an action-specific applicable requirement for determining appropriate disposal options.

Response: Agreed. The referenced Table B-1 heading should be labeled Land Disposal Restriction Level. This level was not intended to be used as a PRL. Please see response to Comment Nos. 39 and 50.

Action: The heading on page B-12 has been changed to "Land Disposal Restriction Level."

Comment No. 58
Commenting Organization: U.S. EPA Commentor: Saric
Section #: C.2.3.3 Page #: C-2-25 Line #: NA Code:
Original Comment #: 9

Comment: Table C.2-2 presents a summary of receptors evaluated for OU2 residual risk. The table indicates that ingestion of perched water by the on-property resident farmer will not be evaluated under either federal or private ownership. However, Figures C.2-14, C.2-17, and C.2-19 all indicate that this exposure will be evaluated under private ownership. Therefore, Table C.2-2 should be revised to indicate that ingestion of perched groundwater by the on-property resident farmer will be evaluated under private ownership.

Response: The Table C.2-2 was in error and will be corrected to reflect ingestion of perched water by the on-property resident farmer under the private land use scenario, perched groundwater for this receptor was evaluated in the risk assessment.

Action: The table was corrected to read "Yes" instead of "No" for the On-Property Resident Farmer Perched Water receptor under Private Ownership. See changed Table C.2-2.

Comment No. 59
Commenting Organization: U.S. EPA Commentor: Saric
Section #: C.3.1.3 Page #: C-3-2 to 3 Line #: 18, 7, 18 Code:
Original Comment #: 10

Comment: Section C.3.1.3 addresses exposure to radionuclides via immersion during excavation activities. Equation C.3-2 (on Page C-3-2, Line 18) uses the term "T_1" and indicates that values for this parameter are presented in Table C.5-1. In fact, Table C.5-1 does not present values for the term "T_1." The text should be revised to define the term "T_1" and to indicate where values for this term are presented.

Section C.3.1.4 addresses exposure to radionuclides via inhalation during excavation activities. Equation C.3-5 (Page C-3-3, Line 7) uses the term "T_1" and indicates that values for this parameter are presented in Tables C.II-1 through C.II-12. In fact, Tables C.II-1 through C.II-12 do not present values for the term "T_1." The text should be revised to define the term "T_1" and to indicate where values for this term are presented. Further, Equation C.3-6 (Page C-3-3, Line 18) uses the term "T_3" and indicates that values for this parameter are presented in Tables C.II-1 through C.II-12. In fact, Tables C.II-1 through C.II-12 do not present values for the term "T_3." The text should be revised to define the term "T_3" and to indicate where values for this parameter are presented.

Response: Equations in this section will be updated to reflect the correct spreadsheets. This requires a change in the parameter designation for these equations. Parameters used in the spreadsheets contained in the Attachment are correct and consistent with RAWPA.

Action: Text was revised on changed pages C-3-1 through C-3-4, sections C.3.1.2, C.3.1.3, C.3.1.4, and C.3.1.7; page C-3-10, Table C.3-1; and page C-5-18, Table C.5-12.

Comment No. 60
Commenting Organization: U.S. EPA Commentor: Saric
Section #: C.3.3.1 Page #: C-3-10 Line #: NA Code:
Original Comment #: 11 (Original Specific Comment 2)

Comment: The original comment stated that short-term (or remedial risks) could not be verified because values for exposure duration were not provided. The response indicated that the text was revised to provide the information necessary to verify the calculations. Some of the major nonalternative- and noncontaminant-specific exposure parameters for remedial action risk are now provided in Table C.3-1. Other Alternative-specific parameters are presented in individual tables in Attachment C.II. However, some of these individual tables, such as Tables C.II-1 through C.II-12 present a single product of several parameters. Specifically, the above-referenced tables present the product of exposure time, exposure frequency, and exposure duration, rather than values for each of these parameters. Because a single product value is difficult to verify, the tables should be revised to present values for each of the individual parameters.

Response: Exposure durations for the calculations were determined using the total hours estimated for each work activity. These total hours correspond to the product of ET, ED, and EF in equation C.3-5. However, because the short term risk assessment is based on estimated work requirements and exposures, only the total duration of the remedial activity was estimated, not specific exposure times, exposure durations, and exposure frequencies.

Action: The following text was modified:

Page C-6-1, Line 20:

PH = person-hours of construction work, (See Attachment II, ~~Table C.II-21~~ See page C-62) and

Page C-6-2, Line 3:

TM = truck miles for construction work, (see Attachment II~~, Table C.II-22~~), and

Page C-6-2, Line 28:

"Exposure durations for the calculations were determined using the total hours estimated for each work activity. These total hours correspond to the product of ET, ED, and EF in Equation C.3-5. However because of the duration of the remediation activity (a few years) and the duration of the various activities, the specific values for ET, ED, and EF did not need to be evaluated; therefore, the product of those values, which represent total project hours for each activity, has been used."

Comment No. 61
Commenting Organization: U.S. EPA Commentor: Saric
Section #: C.4.2 Page #: C-4-8 Line #: NA Code:
Original Comment #: 12 (Original Specific Comment 19)

Comment: The original comment requested that the text be revised to explain and justify the dermal reference dose for polychlorinated biphenyls. The response indicated that the issue of the dermal reference dose for polychlorinated biphenyls had been addressed in Section C.4.2, specifically in Table C.4.2. Table C.4.2 presents carcinogenic slope factors that do not address the dermal reference dose for polychlorinated biphenyls. Rather, Table C.4.4 presents dermal reference doses; however, this table (and associated text) does not explain or justify the value of 5.30 E-05 milligram per kilogram per day presented as the dermal reference dose for polychlorinated biphenyls. Section C.4.2 should be revised to clearly explain and justify the use of a dermal reference dose for polychlorinated biphenyls when no oral reference dose for polychlorinated biphenyls is available.

Response: The earlier comment response referenced the wrong table number. The table that addresses the comment is Table C.4.4. Table C.4.4 is in error when referencing a dermal reference dose for polychlorinated biphenyls. The dermal reference dose value for PCBs presented in the table will be replaced with NA (not appropriate).

Action: Table C.4-4, Column 3, row 7 has been changed from 5.30×10^{-5} to NA. See changed Table C.4-4.

Comment No. 62
Commenting Organization: U.S. EPA Commentor: Saric
Section #: C.5.1.1 Page #: C-5-8 to 9 Line #: NA Code:
Original Comment #: 13

Comment: Tables C.5-4 and C.5-5 present subsurface soil concentrations and air concentrations for COCs, respectively. The COCs presented in the tables are identical with the exception of the polyaromatic hydrocarbons. Table C.5-4 presents subsurface soil concentrations for pyrene (apparently the concentrations presented represent a sum of the concentrations for all polyaromatic hydrocarbon COCs) while Table C.5-5 presents air concentrations only for benzo(a)pyrene. Several problems exist for these two tables. First, it is not clear why pyrene is used to represent polyaromatic hydrocarbon COCs when pyrene has not been identified as a COC for any subunit. Second, it is not clear why Table C.5-4 does not present concentrations for each of the polyaromatic hydrocarbon COCs. Table C.5-4 should be revised to present subunit-specific concentrations for each of the polyaromatic hydrocarbon COCs.

It is also not clear why Table C.5-5 presents air concentrations only for benzo(a)pyrene among the polyaromatic hydrocarbons. Table C.5-5 should be revised to present air concentrations for all of the polyaromatic hydrocarbon COCs or should include a footnote to clarify why values for only benzo(a)pyrene are presented.

Response: The use of pyrene in Table C.5-4 is an error. The sum of the concentrations for all PAHs should be expressed as benzo(a)pyrene. This table will be revised to reflect this correction. Table C.5-4 presents the sum of PAH concentrations as benzo(a)pyrene as per the TEF approach (Clement International, 1990) as suggested by USEPA Region V original specific comment #153 on the Operable Unit 1 FS Risk Assessment (June, 1994). The text will be revised to indicate that the benzo(a)pyrene assessed in this risk assessment is actually a total PAH assessment using the TEF approach. The table will be revised to correct pyrene to benzo(a) pyrene.

Action: The following footnote was added to Tables C.5-4 and C.5-5:

> [b]PAH COCs have been expressed as benzo(a)pyrene equivalents using the toxicity equivalency factor approach (Clement International, 1990). In this approach, benzo(a)pyrene has a relative potency of 1.0 and other PAHs are expressed as benzo(a)pyrene equivalents.

See changed Tables C.5-4 and C.5-5.

Comment No. 63
Commenting Organization: U.S. EPA Commentor: Saric
Section #: C.6.2.1 Page #: C-6-7 Line #: 2 to 4 Code:
Original Comment #: 14

Comment: These lines state that direct radiation risks to the public were calculated by "apportioning the risk at 1 m [meter] (for example, the remediation worker) to that at 305 m...." This statement seems to contradict the discussion pertaining to inhalation risks from excavation activities (page C-6-4) in which the distance to the remediation worker is described as 300 meters and the distance to the public (see Table C.6-1A) from each subunit ranges from 335 meters to 701 meters. Section C.6.2.1 should be revised to clarify the calculation of direct radiation risks to the general public; specifically, the distances used for the public should be consistent throughout Appendix C.

Response: When the calculation of direct radiation exposure was made, the remedial worker was considered to be one meter away from the source, the non-remediation worker was considered to be 300 meters away from the source, and the off-site public was not calculated because the direct radiation risk at 300 m was already well below levels of concern. As a result of not calculating radiation risk for the off-site public, the exposure level for this receptor was set equal to that of the non-remedial worker at 300 meters. This is conservative for the public since the public is located between 335 and 1000 m depending on the subunit. The calculation of inhalation risks were performed; the off-site levels of exposure were high enough to warrant an independent calculation for the off-site public receptor. Thus for inhalation risks the off-site public has risks calculated at distances between 335 and 1000 meters. The following will be included in <u>Direct Radiation</u> discussion for each alternative:

Risks to the public from direct radiation were estimated using the same calculation as for the non-remediation worker, that is by apportioning the risk at 1 m (i.e., the remediation worker) to that at 300 m (1000 ft) using the inverse square law applicable to direct penetrating radiation. Since the risks calculated were at this distance were less than 10^{-8}, this is a reasonable approach. The actual distance of exposure for the general public are distances to the fenceline (i.e., 335 to 701 m).

Action: The following text was modified:

Page C-6-4, line 9 - the following sentence was deleted:

~~The ratio of the dispersion factor for 300 m to the factor for the 50m was multiplied by the remedial worker dust concentration to obtain the nonremediation worker dust concentration.~~

Page C-6-7, second line 2:

"Direct Radiation. Direct radiation risks were calculated for excavation activities for each subunit. Calculations are shown in Table C.II-28 (Attachment II) and summarized in Table C.6-4. ~~Risks to public were calculated by apportioning the risk at 1 m (i.e., the remediation worker) to that at 305 m (1000 ft) using the inverse square law applicable to direct penetrating radiation.~~Risks to the public from direct radiation were estimated using the same calculation for the nonremediation worker, that is by apportioning the risk at 1 m (i.e., the remediation worker) to that at 300 m (1000 ft) using the inverse square law applicable to direct penetrating radiation. Since the risks calculated at this distance were less than 10^{-8}, this is a reasonable approach. This yields a conservative approximation; risks from the air transport pathways were calculated using actual distances to the fence line (i.e., 335 to 701 m), since the risks were higher than those from direct radiation. The risks presented have been calculated using this ~~the~~ methodology and values presented in HEAST, as opposed to MICROSHIELD. Risks calculated using MICROSHIELD were in the same order of magnitude as those presented.

Page C-6-12, line 13:

"that at 300 ~~305~~ m using the inverse square law applicable to direct penetrating radiation. Risks have been.."

Comment No. 64
Commenting Organization: U.S. EPA Commentor: Saric
Section #: C.7.2 Page #: C-7-4 Line #: 17 Code:
Original Comment #: 15

Comment: The discussion of residual risks uses the phrase "...better than the incremental lifetime cancer risk (ILCR) target risk range of 10^{-4} to 10^{-6}." The meaning of this phrase is not clear; apparently what is meant is that the risks are "less than" the target risk range. Section C.7.2 should be revised to eliminate any use of the phrase "better than the ILCR target risk range" and to replace it as appropriate with the phrase "less than the ILCR target risk range."

Response: The comment will be addressed by stating that residual risks are less than the target risk range. The phrase "better than the ILCR target risk range" will be replaced with "less than the target risk range."

Action: The phrase "better than ILCR target risk range" has been replaced with "less than the target risk range" on changed pages C-7-4 (lines 17, 18, 22, 27 and 29), C-7-5 (lines 4, 6, 12, 15, and 18) and C-7-6 (line 2).

Comment No. 65
Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.1.6 Page #: D-1-82 Line #: 13 TO 17 Code:
Original Comment #: 16

Comment: The text states that in the disposal cell, a leachate concentration of 71.38 milligrams per liter (23,980 picocuries per liter) will produce a fenceline GMA concentration of 0.23 picocuries per liter. The text in this section apparently uses a GMA concentration of 0.23 picocuries per liter to be protective of the GMA; however, in previous sections of the text (for example Section D.1.5.3.2, Page D-1-47), a value of 0.72 picocuries per liter was used as a fenceline GMA concentration that is protective of the aquifer. The value of 0.72 picocuries per liter is the 10^{-6} ILCR value. The text should be revised to state why a value of 0.23 picocuries per liter was used as a concentration that is protective of the GMA at the fenceline.

Response: Text will be added to clarify that 0.23 pCi/L is below the 10^{-6} ILCR value of 0.72 pCi/L. However, the ARAR MCL limits maximum total uranium concentration at the boundary of the Disposal Cell to 20 ug/L. Due to hydrogeology of the site, maximum concentration occurs in the west parts of the disposal cell, on the upgradient side. To be conservative, maximum on-site total uranium concentration was limited to 20 ug/L instead of maximum concentration at the boundary of the Disposal Cell.

Action: Insert the following sentence in line 16, page D-1-82:

"Note that 0.23 pCi/L is below the 10^{-6} ILCR value of 0.72 pCi/L. However, 20 ug/L is the MCL for total uranium."

Comment No. 66
Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.1.6 Page #: D-1-82 Line #: 17 to 22 Code:
Original Comment #: 17

Comment: The text states that waste concentrations in the disposal cell are a function of waste leachability, which can be quantified with the use of the distribution coefficient for leaching (K_L). The text then references Appendix D.3 for K_L values. Appendix D.3 provides uranium partition coefficient values (K_d). The text should be revised to discuss how K_L values are determined from K_d values.

Response: Appendix D.3 provides uranium partition coefficients for waste material determined from the desorption (leaching) tests. These partition coefficients for waste/source material are the distribution coefficients for leaching (K_L). The text in D.1 will be revised to clarify this.

Action: Insert "or desorption" after "leaching" in line 20, page D-1-82.

Comment No. 67
Commenting Organization: U.S. EPA Commentor: Saric
Section #: NA Page #: NA Line #: NA Code:
Original Comment #: 18 (Original Specific Comment 39)

Comment: The response to the original comment states that the ECTran model was used as a screening tool for PRGs and that final PRGs were developed using a more complex model. Therefore, Appendix D-1, which contained the ECTran model discussion, will be eliminated from the final FS. Because Appendix D-1 will be omitted, the text should be revised to contain a brief discussion of the ECTran modeling that was used to screen out contaminants that did not reach the final PRG development.

Response: ECTran model was not used to eliminate COCs from the PRG development. Instead, in the trial and error process of determining PRGs, ECTran was used to provide a first estimate for the PRG development. Although ECTran model was not necessary for PRG development and does not affect the final PRG values, it's use reduced the modeling effort significantly. Since final results are not dependent on the ECTran results, ECTran modeling description was eliminated in the final FS report.

Action: No action.

Comment No. 68
Commenting Organization: U.S. EPA Commentor: Saric
Section #: F.3 & F.7 Page #: F-3-1,F-7-22 Line #: NA Code:
Original Comment #: 19

Comment: Appendix F.3, Table F-3-1 on page F-3-1 presents comparative estimated costs for Alternatives 2 through 8. Appendix F-7 presents Alternative 6 cost estimate details. The base estimate presented in the cost table on page F-7-22 does not correspond with the base estimate for Alternative 6 in Table F.3-1. This discrepancy should be resolved and corrected.

Response: Agreed. Table F.3-1 will be revised.

Action: Page F-3-1, resolve discrepancy and replace Table F.3-1, Comparative Estimated Costs.

Page 4-15a, Lines #2 and 3, were revised to read as follows:

"As presented in Appendix F.3, the total cost for Alternative 2 in 1994 constant dollars would be approximately $86 million."

Page 4-18, Line #9, was revised to read as follows:

"The total cost for Alternative 3 in 1994 constant dollars is approximately $246 million (See Appendix F.3)."

Page 4-19, Line #19, was revised to read as follows:

"The total cost for Alternative 4 in 1994 constant dollars is approximately $246 million (see Appendix F.3)."

Page 4-21, Line #27, was revised to read as follows:

"The total cost for Alternative 5 in 1994 constant dollars is approximately $128 million (see Appendix F.3)."

Page 4-23, Lines 13, 14, and 15, were revised to read as follows:

"The total cost for Alternative 6 in 1994 constant dollars is approximately $129 million, including approximately $1.3 million for off-site transportation and disposal of material that would not meet WAC for the on-site disposal cell (see Appendix F.3)."

Page 4-24a, Lines #12, 13, and 14, were revised to read as follows:

"The total cost for Alternative 7 in 1994 constant dollars would be approximately $130.8 million, including approximately $2 million for the treatment of contaminated material exceeding WAC for the on-site disposal cell (see Appendix F.3)."

Page 4-26, Lines #16 and 17, was revised to read as follows:

"The total cost Alternative 8 in 1994 constant dollars would be approximately $355.2 million (see Appendix F.3).

Comment No. 69
Commenting Organization: U.S. EPA Commentor: Saric
Section #: F.3 Page #: F-3-1 Line #: NA Code:
Original Comment #: 20

Comment: Appendix F.3, Table F-3-1 on page F-3-1 presents comparative estimated costs for Alternatives 2 through 8. Subsequent appendixes present detailed cost estimates for each alternative. However, detailed cost estimates for Alternatives 7 and 8 are not presented in the appendixes. The reason for this omission should be stated or the detailed estimates for Alternatives 7 and 8 should be added.

Response: For screening purposes, costs for Alternatives 6, 7, and 8 were calculated as variations on the costs for Alternative 5. Those alternatives utilized the base costs associated with Alternative 5, and then the pertinent treatment or disposal cost was added or subtracted to estimate the costs presented on page F-3-1 and Section 4. Because Alternative 6 was carried to Section 5, a detailed cost estimate was done for that Alternative. However, since Alternatives 7 and 8 were screened out, no detailed costs were prepared specifically for those alternatives. For clarity, detailed estimates for Alternatives 7 and 8 will be added to Appendix F.

Action: Prepared detailed cost estimate for Alternatives 7 and 8 and add the following appendices in Volume 5:

Appendix F.9: Detailed Cost Estimate,
Alternative 7 - Excavation and On-Site Disposal with Treatment of Fractions Exceeding WAC (Expanded Trespasser). See changed pages F-9-1 through F-9-203.

Appendix F.10: Detailed Cost Estimate,
Alternative 8 - Excavation and Treatment with On-Site Disposal (Expanded Trespasser). See changed pages F-10-1 through F-10-203.

Page F-i, Table of Contents, added following text:

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Page F-1, Line 20, revised to read as follows:

"Appendices F.4 through F.7, F.9, and F.10: Detailed Cost Estimates"

Comment No. 70
Commenting Organization: U.S. EPA Commentor: Saric
Section #: I.6.2.2 Page #: I-6-64 Line #: NA Code:
Original Comment #: 21 (Original Specific Comment 57)

Comment: The response to the original comment states that text will be added to further justify and clarify the grouped sources for air modeling. However, the sources have been regrouped and the method used to group these sources is not provided. The method used to group the sources should be provided.

Response: The method used to group the sources for air modeling was changed to make it consistent with the method used to group the sources for surface water modeling. Sources for surface water modeling were based on basin drainage patterns. The same statistical analysis for the grouping of the surface water sources was used for the air modeling. The methodology used to group sources for surface water modeling is presented in Appendix F of the OU5 RI report. The text will be clarified to explain that source groups were originally developed for surface water modeling, and it was appropriate for this site and for consistency to use the same source groups for air modeling.

Action: The following text was added to page I-6-68, line 12:

"The air dispersion model assumes uniform contamination within a source group. Since the source of contamination in both the air pathway and surface water pathway are assumed to be the surface soil, the surface water source groups developed for the Operable Unit 5 RI Report were adopted for this air pathway analysis. Some modifications were applied to the source groups shown in Appendix F of the Operable Unit 5 RI Report. These modifications for the air pathway analysis include:

- A separate source group for each waste pit in Operable Unit 1 (8 groups instead of 1 group).
- Incorporation of the Operable Unit 2 FS Report source groups (9 groups instead of 4 groups)."

Comment No. 71
Commenting Organization: U.S. EPA Commentor: Saric
Section #: I.7.5.3 Page #: I-7-16 Line #: 14 Code:
Original Comment #: 22 (Original Specific Comment 62)

Comment: The indicated action in response to the original comment has not been included in the revised report. The text should be revised to include the following sentence:

"Np-237 has a half-life of 2.14 x 10^6 years and is primarily produced in nuclear reactors."

Response: The requested revision will be made.

Action: The following text was added to page I-7-16, line 18.

> ....large group of rats fed with doses of neptunium exceeding 1 mg/kg. Neptunium (NP-237) has a half-life at 2.14×10^6 years and is primarily produced in nuclear reactors. When the dietary dose was.....

PROPOSED PLAN SPECIFIC COMMENTS

Comment No. 72
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 4,5 Page #: 4-4 to 5, 5-6 to 5-9 Line #: NA Code:
Original Comment #: 23
Comment: Tables 4-1, 5-2, and 5-3 present cleanup levels for the private and federal ownership scenarios. The lead cleanup level should be calculated and added to both (sic) tables.
Response: See response to Comment No. 39.
Action: This minor change will be reflected in the Operable Unit 2 Record of Decision.

Comment No. 73
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 5.4.4 Page #: 5-21 Line #: 10-12 Code:
Original Comment #: 24
Comment: Section 5.4.4 describes Alternative 6 and references preliminary on-site WAC. The text should be revised to reference the on-site final WAC.
Response: See response to Comment No. 40.
Action: See action to Comment No. 40.

Comment No. 74
Commenting Organization: U.S. EPA Commentor: Saric
Section #: 6.2.1 Page #: 6-4 to 6-5 Line #: 28-32,1-2 Code:
Original Comment #: 25
Comment: Section 6.2.1 presents the overall protectiveness evaluation from the FS. The text compares the protectiveness of Alternatives 2, 3, and 6 in degrees. Because this criterion is a threshold criterion, the overall protectiveness of alternatives is not measured in degrees. The referenced text therefore should be deleted.
Response: Agreed. The last paragraph of Section 6.2.1 will be deleted.
Action: Rather than revising the Proposed Plan, this minor change will be reflected in the Operable Unit 2 Record of Decision.

Comment No. 75
Commenting Organization: U.S. EPA Commentor: Saric
Section #: PP 6.3 Page #: 6-13 Line #: NA Code:
Original Comment #: 26
Comment: Section 6.3 summarizes the comparative analysis of alternatives conducted in the FS. A paragraph should be added to the end of Section 6.3 summarizing why Alternative 6 is the preferred alternative and how Alternative 6 best meets the statutory mandates outlined on Page 6-2. This summary should discuss why Alternative 6 is considered to meet the statutory mandate for using treatment to the maximum extent practicable and how it satisfies the statutory preference for treatment as a principal element.
Response: Agreed. Text will be modified.
Action: Rather than revising the Proposed Plan, this minor change will be reflected in the Operable Unit 2 Record of Decision.

ADDITIONAL U.S. EPA COMMENTS

Comment No. 76
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Table 1-5 Page #: 1-86 Line #: Code:
Original Comment #:
Comment: It would appear that the "Max. Hit" value for benzo(a)anthracene should be 880 ug/kg, not 88. Please check this value.

Response: Agreed. The typographical error will be corrected, the table should read "880 ug/kg."
Action: Table 1-5 will be corrected so that 88 µg/kg reads 880 µg/kg. See changed Table 1-5.

Comment No. 77
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Tbls. 1-6,1-7 Page #: Line #: Code:
Original Comment #:
Comment: The reported "Conc. Term" value is often less than the mean value. How was the "Conc. Term" value calculated for the tables in this section. The Conc. Term value is often close to the Min. Value, rather than a UCL or Max. Value. Please review these calculations and correct all errors.
Response: Under certain circumstances, the mean value can be greater than the concentration term. If the frequency distribution is determined to be neither normal nor lognormal, the non-parametric 95th percentile value is used as the concentration term. When this occurs, the 95th percentile value is usually the second or third highest concentration value. If the maximum concentration value is much greater than the second highest value, then the mean value can (and probably is) greater than the concentration term. For example, the two highest concentration values for thorium-230 in Table 1-6 are 720 pCi/g and 15.4 pCi/g. The 95th percentile value is 15.4, but the mean value is 22.2 because 720 is much greater than 15.4. Since the distributions are frequently found to be neither normal nor lognormal, there are a number of instances where this phenomenon occurs.

The information shown in the Section 1.0 tables has been taken from the data lists and statistical summaries presented in Appendix A. The statistical analyses in appendix A were performed in accordance with the approved statistical methods presented in Risk Assessment Workplan Addendum (DOE 1992).

Action: The circumstance described in the comment (the arithmetic average being greater than the concentration term) occurs when almost all results are below the Contract Required Detection Limit (CRDL), a few of those results are detects, and the majority of the results are posted as simply below the CRDL. In order to address uncertainties in the risk assessment associated with these occurrences, text has been added to Section C.8 on page C-8-2. Please refer to the changed page.

Comment No. 78
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Table 1-16 Page #: Line #: Code:
Original Comment #:

Comment: The table shows a range of contaminant concentration values from sampling of perched groundwater. Were these data used in the subsequent risk evaluations? The ranges indicate an inhomogeneous aquifer. Would any receptor ever be exposed to the mean or even the 95% UCL of the mean concentration?

Response: The sample data for perched groundwater was only used to calibrate the perched groundwater modeling results. The risk assessment evaluations were performed on the maximum groundwater results considering future site conditions over a 1000-year period. The sampling data represents current sight conditions that were not evaluated in the risk assessment. The source term concentrations (i.e., contaminated waste/soil) for perched groundwater are presented in Appendix C.5.2.1.3.

Action: No action.

Comment No. 79
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Table 1-25 Page #: Line #: Code:
Original Comment #:

Comment: Again, check the calculation of the "Conc. Term". Some "Conc. Term" values are lower than the mean values, even though the range is very large.

Response: Please refer to Comment No. 77.

Action: No action.

Comment No. 80
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Table 1-23 Page #: 1-132 Line #: Code:
Original Comment #:

Comment: Table 1-23 and discussion of the South Field Firing Range on page 1-132 indicate high lead levels in the surface and subsurface soils. I did not see lead listed as an OU2 COC in Table 2-1 or see it evaluated in the remediation strategies or in the worker/residual risk scenarios. Did I miss something? Where is this contaminant addressed?

Response: See Comment No. 39.

Action: See action for Comment No. 39.

Comment No. 81
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: 1.7.3.1 Page #: 1-198 Line #: 31-32 Code:
Original Comment #:

Comment: Table 1-41 summarized the risks for a number of receptors in addition to those listed here - e.g., homebuilder. The discussion needs to better coordinate with the data presented in the Table.

Response: Agreed, the text was intended to highlight a few receptors but can be expanded to cover all receptors of concern. The text will be modified to include a discussion of all receptors and their associated risk.

Action: The following text has been changed and added:

Page 1-198, line 31:

"Table 1-40 and Table 1-41 summarize risks and hazards associated with the Solid Waste Landfill for the future receptors ~~expanded trespasser and on- and off-property resident farmers.~~ Total risk exceeded 1.0 x 10^{-6} for all on-property receptors.~~both future farmer receptors. The risk was primarily due to the estimated presence of naturally occurring radionuclides uranium-234 and uranium-238 in soil.~~

Page 1-205, line 4:

"Risk exceeded 1 x 10^{-5} for the expanded trespasser and 9 x 10^{-5} for the homebuilder. Risks due to exposure to perched groundwater exceeded 1 x 10^{-3} for the perched groundwater user.

Within Table 1-41 itself, the fifth column (Great Miami User/Perched Groundwater Child) will be deleted since the information presented there is insignificant.

During revision of Table 1-41, the following typographic error was corrected: "41.E-06" on the "Thorium-228" row under "Expanded Trespasser" was changed to "4.1E-06."

Comment No. 82
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: 1.7.3.4 Page #: 1-205 Line #: Code:
Original Comment #:

Comment: See above comment. Discussion does not cover data presented in Table 1-44. Tables and discussions should be better coordinated.

Response: Agreed, the text was intended to highlight a few receptors but can be expanded to cover all receptors of concern. The text will be modified to include a discussion of all receptors and their associated risk.

Action: The following text was changed and added:

Page 205, lines 27 and 28:

"...for ~~the~~ future receptors ~~expanded trespasser and on- and off-property resident farmers~~.

Page 213, line 2:

"The expanded trespasser had risks exceeding 1 x 10^{-4} due predominantly to direct radiation from soils. The Great Miami River user and homebuilder also had risks exceeding 1 x 10^{-6}."

Comment No. 83
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: 1.7.3.5 Page #: 1-213 Line #: 8 Code:
Original Comment #:
Comment: Table 1-45 does not support an expanded trespasser risk of 1 x 10^{-3}. Please check this evaluation for errors.
Response: Agreed. The expanded trespasser risk will be changed to "1.0x10^{-5}."
Action: Page 1-213, line 9 was changed to read "1.0 x 10^{-5}."

Comment No. 84
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Page #: 1-213 Line #: 11 Code:
Original Comment #:
Comment: Table 1-45 does not support an off-property resident farmer risk in excess of 1 x 10^{-5}. Is this a rounding error? If so a footnote is needed in these tables. See comments for the OU1 report.
Response: The text is in error, there is no rounding error. The text will be changed to read: "1.0x10^{-6}."
Action: Page 1-213, line 13 was changed to read "1.0 x 10^{-6}."

Comment No. 85
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Page #: 1-123 Line #: 18 Code:
Original Comment #:
Comment: Table 1-45 does not support the RME farmer risk listed here.
Response: The text is in error. The text will be changed to read; "exceeded 5.0x10^{-5}."
Action: Page 1-213, line 20 was changed to read "exceeded 5.0 x 10^{-5}."

Comment No. 86
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: 1.7.3.1 through 1.7.3.6 Page #: Line #: Code:
Original Comment #:
Comment: The risk summaries in these sections discuss the non-carcinogenic risks as well as the carcinogenic risks for receptors exposed to the various OU2 locations. These data are not presented in the summary tables in these sections. The data should be included or referenced.

Response: The noncarcinogenic risk values are provided in Table 1-40.The text will be modified to include a reference to Table 1-40 for the discussion of noncarcinogenic risks.

Action: References to Table 1-40 were provided at the beginning of 1.7.3.1 through 1.7.3.5. Section 1.7.3.6 has a reference to Section 6.3.7 of the RI Report for background risk assessment summaries. The following text changes were made:

Page 198, line 31:

"Table 1-40 and Table 1-41 summarizes risks and hazards associated..."

Page 205, line 9:

"Table 1-40 and Table 1-42 summarizes..."

Page 205, line 17:

"Table 1-40 and Table 1-43 summarizes..."

Page 205, line 27:

"Table 1-40 and Table 1-44 summarizes the risks and hazards..."

Page 213, line 6:

"Table 1-40 and Table 1-45 summarizes carcinogenic..."

Comment No. 87
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Page #: 2-5 Line #: 1 Code:
Original Comment #:

Comment: The footnote at the end of Table 2-1 indicates that the contaminants marked with an asterisk are specific to both the private ownership and the federal ownership scenarios. Please correct this sentence to be consistent with Table 2-1.

Response: Agreed. The text will be modified to state that the contaminants marked with an asterisk are specific to both the private and federal ownership scenarios.

Action: The text at the top of page 2-5, line 1 was corrected to read:

"Contaminants marked with an asterisk on Table 2-1 are ~~the~~ COCs ~~specific to~~ for both the federal and private ownership scenarios."

Comment No. 88
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Page #: 2-11 Line #: 14 Code:
Original Comment #:

Comment: The Region 5 position is that 15 pCi/g, averaged over 15 cm layers of soil more than 15 cm below the surface is not protective of human health. Region 5 suggests a soil concentration cleanup criterion of 5 pCi/g (combined Ra-226 and Ra-228) for soil at any depth. The Region 5 guidance (soon to be USEPA guidance) should be cited here, and the variance with these guidelines explained.

Response: Reducing 15 pCi/g to 5 pCi/g does not impact OU2 remediation volume. If EPA provides the referenced guidance, we can reference the change in guidance.
Action: No action at this time.

Comment No. 89
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Tables 2-8,2-9,2-10 Page #: Line #: Code:
Original Comment #:
Comment: The tables are not consistently labeled in section 2.0. All tables should indicate which scenarios/receptors are being evaluated by the data presented. There are three distinct types of labeling in this section. Some continuity is needed.
Response: Agreed. The headings for Tables 2-9, 10, 18, 19, 23, 24, and 25 will be modified to list the receptors and scenarios applicable to the tables.
Action: The heading for Tables 2-9, 2-10, 2-18, 2-19, 2-23, 2-24, and 2-25 were modified to include the scenario and receptors applicable to the table. See the following changed tables: 2-9 at page 2-40, 2-10 at page 2-41, 2-18 at page 2-54, 2-19 at page 2-55, 2-23 at page 2-65, 2-24 at page 2-68, and 2-25 at page 2-70.

Comment No. 90
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Table 2-23 Page #: Line #: Code:
Original Comment #:
Comment: It is not clear which scenario(s) are represented by this data. The labeling is not consistent with Table 2-22.
Response: Agreed."RISK BASED SOIL" will be removed from the title of this table to make it consistent with Table 2-22.
Action: The text "Risk Based Soil" was removed from the title to make it consistent with Table 2-22. See changed Table 2-23 at page 2-65.

Comment No. 91
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Table C.1-1 Page #: Line #: Code:
Original Comment #:
Comment: Correct wrap-error in "Risks Type" columns.
Response: Error will be corrected.
Action: Type wrap was corrected. See changed Table C.1-1 at page C-1-15.

Comment No. 92
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: 2.4.1 Page #: C-2-35 Line #: - Code:
Original Comment #:
Comment: It is usually appropriate to assume that all excavation workers, remediation workers, etc., will use PPE and follow OSHA guidelines for protection of such workers. I am not certain I understand why this assessment assumes that these will not be followed. If this strategy is followed, perhaps the risks should be bounded (present a range). Other evaluations presented in Appendix C are appropriate.

Response: According to OSHA guidance for hazardous waste site remediation, it is inappropriate to assume the use of PPE until it has been determined that PPE will be required in order to meet regulatory requirements. OSHA[1] has directed that engineering controls and work practices be used as the primary methods of controlling worker exposures to air contaminants[2] to the extent required, and PPE be used whenever engineering controls and work practices are not feasible or required. This level of detail is generally addressed during the remedial design phase. The selection of PPE is determined in the development of the Personal Protective Equipment program which is part of the safety and health program[3].

The RAWPA[4] indicates that:

> The degree of protection of on-property workers during remediation will be evaluated with respect to occupational limits rather than the acceptable range of lifetime health risks ... Occupational exposure standards are implemented in the site Health and Safety Program and control exposure to hazardous materials for on-property workers.

The purpose of this risk assessment is to determine potential risks. The use of PPE provides a factor of protection, not zero risk, and is selected from levels of protection designated as A, B, C, and D. As an example of the protection factors that should be used, the factors for respirators for radioactivity range from 10 to 1000 for particulate exposures using air-purifying respirators[5]. OSHA cautions that the use of PPE can result in significant health risks to workers (i.e., heat stress, diminished work capacity leading to other risks) and should be selected very carefully and not overly prescribed. The use of respirators leads to significantly reduced worker efficiency, and hours must be added to estimate work schedules to account for the use of PPE. Current practice is to increase the work hours by 25% to account for this[6]; a resultant increase in external exposure must also be taken into account.

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[1]29 CFR 1910.120(g)(1)

[2]as listed in 29 CFR 1910 subpart Z

[3]29 CFR 1910.120(g)(5)

[4]Section 10.2.3.2, p. 22

[5]10 CFR 20, Appendix A, and ANSI Z88.2 (as directed by 29 CFR 1910.120)

[6]Kephart, Gary S., 1994. Respiratory Protection and Worker Efficiency - A Review, Radiation Protection Management, 11(4):70-74.

This analysis evaluates potential worker risk in terms of occupational limits for potential exposures. No dose or risks has been shown to exceed the 10 CFR 835 dose limit of 100 mrem/yr for members of the public (assumed to include remediation workers) or any OSHA limits based on the contamination data provided. Therefore no PPE is required to meet regulatory standards for worker exposure, but may be included in the Health and Safety Program in order to meet ALARA or other requirements. That determination, however, is not part of this analysis.

Action: No action.

Comment No. 93
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Table C.3-4 Page #: Line #: Code:
Original Comment #:
Comment: Some dermal absorption coefficients are given as decimal values and some are given in engineering notation. Be consistent.
Response: Agreed. Terminology will be made consistent by revising table to engineering notation.
Action: Table C.3-4 at page C-3-18 was modified to use engineering notation exclusively; "0.06" was modified to "6.00×10^{-2}."

Comment No. 94
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Page #: C-4-34 Line #: 28 Code:
Original Comment #:
Comment: The statement here is somewhat confusing. Region 5 suggested that a review of the IRIS database showed no evidence that the administered dose was adjusted for absorption in the calculation of the RfD and Cancer Slope Factors for beryllium and therefore, a value of 1.0 should be used in calculating the dermal toxicity values. Region 5 did not mean that the oral absorption of beryllium is 100%. Perhaps this statement should be moved to the discussion of toxicity values.
Response: Agreed, this statement will be moved to the discussion of toxicity values and clarified.
Action: The statement on line 27 of page C-4-34 was deleted and the discussion was added to Table C-4-4 as a footnote. See changed page C-4-34 and changed Table C.4-4 at page C-4-8.

Comment No. 95
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Table C.6-1,C.6-2 Page #: Line #: Code:
Original Comment #:
Comment: What scenarios are covered by this data? Need some labeling.
Response: The data covers private and federal ownership scenarios. The tables will be revised and clearly labelled.
Action: The following text was added to page C-6-3, line #22 for clarification:

"Evaluations for Alternative 2 have been made for the Federal Ownership scenario, since it is the only scenario under evaluation. For the other alternatives,...."

"Federal Ownership" has been added to Table C.6-1. See changed Table C.6-1 at page C-6-4.

Comment No. 96
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: C.6 Page #: Line #: Code:
Original Comment #:
Comment: All tables in this section should have a footnote which explains that risk evaluations to remediation workers, truckers, etc., assumed no PPE or shielding.
Response: Footnote indicating no PPE or shielding will be added.
Action: The following footnote was added to Tables C.6-1 through C.6-5 and C.6-7 through C.6-22.

"[a]Risks calculated assuming no PPE or shielding"

See changed Tables C.6-1 through C.6-5 and C.6-7 through C.6-22 from page C-6-4 to C-6-19.

Comment No. 97
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: C.7 Page #: Line #: Code:
Original Comment #:
Comment: Tables should be labeled to indicate that data is evaluation of Residual Risks.
Response: Tables will be labeled to indicate the data pertains to residual risks.
Action: The heading for Tables C.7-1 through C.7-61 was changed from "Health Effects" to "Residual Risks." See changed Tables C.7-1 through C.7-61 from pages C-7-7 to C-7-67.

Comment No. 98
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: C.9 Page #: Line #: Code:
Original Comment #:
Comment: Tables of Remedial Action Risks should contain a footnote indication that risks were based on the assumption of no PPE or shielding.

Response: Footnote will be added to indicate that risks assume no PPE or shielding.
Action: The following footnote was added to Tables C.9-1, C.9-2, C.9-7, C.9-11, C.9-12, and C.9-15:

"[a]Risks calculated assuming no PPE or shielding"

See changed Tables C.9-1, C.9-2, C.9-7, C.9-11, C.9-12, and C.9-15 from pages C-9-4 to C-9-19.

Comment No. 99
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: Page #: I-7-56 Line #: 9-13 Code:
Original Comment #:
Comment: The 1989 Directive cited here has been replaced with the 1994 Directive issued earlier this year, which calls for further evaluation of soil which contains lead concentrations in excess of 400 ppm. Please update this section of the tox profile for Lead.

Response: This reference will be updated in the tox profile for lead.
Action: The following text was modified:

Page I-7-56, line 8:

"OSWER Directive No. 9355.4-~~02~~12 (EPA ~~1989g~~1994g) established a soil ~~cleanup~~screening level for lead of ~~500~~400 to 1000 ppm, based on recommendations by the Centers for Disease Control designed to protect children from blood lead concentrations above background, which are associated with lead-induced neurological effects. In compliance with EPA guidance (Saunders, M. 1994), the OSWER directive has been applied in this risk assessment since lead concentrations are well below 400 ppm there will be no calculations using the IEUBK model. Additionally, since the firing range lead concentrations will be remediated to less than 400 ppm, the IEUBK calculations will not be required."

Page I-13-10, line 41:

"U.S. Environmental Protection Agency (EPA), ~~1989h~~1994g, "OSWER Directive No. 9355.4-~~0~~12: ~~Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites," Memorandum from H.L. Longest II and B. Diamond to the EPA Regional Directors.~~Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities." Memorandum from Elliot P. Laws, Assistant Administrator to EPA Regional Administrators I-X, July 14, 1994."

Comment No. 100
Commenting Organization: U.S. EPA Commentor: VanLeeuwen
Section #: 1.4.2.3 Page #: 1-4-13 Line #: Code:
Original Comment #:
Comment: The elimination of organic COCs in the CRARE based on degradation has been commented on in past OU CRARE reports. FERMCO was provided with a copy of the April 11, 1994 Memorandum from ECAO and attachment: "Risk Assessment Issue Paper: Review of Degradation of PAHs in Soil", which raised serious questions about the validity of such elimination. The use of degradation half lives obtained under laboratory conditions to eliminate other chemicals using this process is likewise subject to the same criticism. I have previously stated that there appears to be something wrong with a methodology in which the only chemicals retained in the CRARE as COCs are those for which there is no degradation data. I also noted some concern from ECAO over whether a 100-year degradation period was reasonable for the site, and suggest that perhaps this issue needs to be revisited. Since carcinogens are considered to have no threshold, a 70 year exposure is not necessary to produce an adverse effect; a short exposure to residual levels of some site carcinogens might be all that is needed to produce the response. Noncarcinogens might also produce adverse health effects from short term exposures. Perhaps the effect of exposure to average concentrations of residual chemicals over successive future time periods would provide a better evaluation. In addition, some newer discussions on the issue of degradation of COCs has raised the question of whether modeling exercises are sufficiently accurate enough to determine that COCs in groundwater will be completely degraded before they reach the site boundary (off-site receptors). This entire topic requires further discussion, and the CRARE should not be approved until some satisfactory agreement can be reached on this issue.

Response: The CRARE is intended to calculate the risk after all remediation is complete. Based on the remediation schedule, the CRARE risk has been assessed for the period of 100 years to 1000 years from now. The organic screening in the Operable Unit 2 CRARE was not intended to remove COCs that are major contributors to risk but rather to allow better use of limited computer resources by modeling only the major COCs.

It is assumed that the remediation of the uranium contamination would remove the significant portion of the organic contamination. This has been demonstrated by the Operable Units 1, 2 and 4 FSs and the draft Operable Unit 5 FS where organic COCs posed no post remedial risk greater than 10^{-6} whereas the uranium poses one to two orders of magnitude greater risk. Degradation of the organic COCs would reduce the risk and increase the significance of radionuclides as the major COCs at the FEMP.

It is proposed that additional assessments of risks due to major organic COCs be performed in the Operable Unit 5 CRARE unless it can also be shown that the Operable Unit 5 post remediation risk due to organics is order(s) of magnitude below the radionuclide risk.

Action: Section I.4, "Contaminants of Concern," has been modified to remove the two screening steps that include volatilization and degradation and to reflect screening of constituents by residual risk assessment results. Please refer to the changed pages, which present a totally revised Section I.4. The following items were retained from the original text:

- Section I.4.2.1
- Table I.4-1
- Table I.4-2

The introduction to Section I.4 is also very similar to the original text, but all other portions of Section I.4 are new.

Comment No. 101
Commenting Organization: U.S. EPA Commentor: Barwick
Section #: PP 5 Page #: 5-1 Line #: 11 Code:
Original Comment #:
Comment: Use of the term "mixture" suggests that all OU2 wastes are physically blended together. We know that is not correct as the only potential mixed waste identified is the lead contaminated firing range materials. Clarifying this sentence is not imperative but could avoid confusion later. I would suggest DOE replace "mixture" with "variety."
Response: Agreed. This sentence in the Proposed Plan will be clarified as suggested.
Action: Rather than revising the Proposed Plan, this minor change will be reflected in the Operable Unit 2 Record of Decision.

Comment No. 102
Commenting Organization: U.S. EPA Commentor: Barwick
Section #: PP 5 Page #: 5-21 Line #: 11 and 12 Code:
Original Comment #:
Comment: DOE states that the final waste acceptance criteria (WAC) will be determined during the remedial design process. After our public meeting of September 13, we know the WAC is a major concern for the public. While 40 CFR § 300.435(c)(1) provides that the community relations plan (CRP) may be revised to "describe further public involvement activities during RD/RA," the opportunity to appeal RD/RA decisions is limited to circumstances where the remedy design differs significantly from the one specified in the ROD. Therefore, the public's best opportunity to affect the WAC would be at the ROD state.

DOE must specify in the ROD a WAC which contains a range of values (e.g., Uranium 300-400 ppm). This would give the citizens of Ohio, and of Nevada and Utah, a best and a worst case scenario. So long as the final WAC fell somewhere in this range, there would be no basis to challenge the remedy design as being inconsistent with the ROD. If the final WAC fell outside of this range, we may need to consider a ROD amendment.

Response: See Comment No. 40.
Action: See action for Comment No. 40.

Comment No. 103
Commenting Organization: U.S. EPA Commentor: Barwick
Section #: Page #: Line #: Code:
Original Comment #:
Comment: The Proposed Plan, in conjunction with the draft August 1994 Feasibility Study Report for Operable Unit 2, contains a preliminary description of the proposed disposal unit, including elements designed to attain the same level of performance as is required by Ohio Administrative Code rules 3745-27-07(B)(5) and (B)(9). What it does not include, however, is an explanation of how these engineering controls will attain a standard of performance equivalent to that afforded by the geological features required by OEPA for an Ohio Revised Code (ORC) Section 3734.02(G) exemption to Rules 3745-27-07(B)(5) and (B)(9).

In the preamble to the National Contingency Plan (NCP), U.S. EPA explained that when considering equivalent standard of performance waivers, it would compare the ARAR to the proposed alternative by looking at the following factors:

- degree of protection;
- level of performance;
- reliability into the future; and
- time required for results.

U.S. EPA believes that the first three criteria, i.e., degree of protection, level of performance, and future reliability, should at least be equaled for an alternative to be considered equivalent. Regarding the fourth criterion, the time required to achieve results using the alternative remedy should not be significantly more than that required under the waived ARAR.

In addition, U.S. EPA explained that comparison based on risk is only permitted where the original standard is risk-based. Therefore, since the ORC § 3734.02(G) exemption criteria for OAC Rules 3745-27-07(B)(5) and (B)(9) are not risk based, the comparison should be expressed in technological terms.

In the draft OU2 ROD, DOE must do the following:

1. Set forth the ORC § 3734.02(G) exemption criteria for OAC Rules 3745-27-07(B)(5) and (B)(9);

2. Describe how the best available site geology does not meet that criteria thereby establishing that the ARAR is unattainable;

3. Describe the proposed disposal unit including the anticipated geology and engineering controls;

4. Describe, in terms of degree of protection, level of performance, future reliability, and time required to achieve results, how the proposed disposal unit will attain an equivalent standard of performance as the waived ARAR; and

5. Ensure that the comparison is expressed in appropriate terms (risk versus technological based).

Response: Agreed. Based on conversations with EPA and OEPA, the waiver language will be modified to discuss the items identified in this comment. The basis of the waiver will be ORC 3734.02(G) that allows the director of OEPA to exempt projects from the OEPA regulations based on a determination that the exemption would be unlikely to adversely affect the public health or safety or the environment.

Current OEPA policies allow an exemption to the specified siting criteria based on protection of the aquifer by the overlying hydrogeologic conditions only. DOE cannot meet all of the conditions of these policies and will, therefore, provide additional engineering controls beyond these required by the OEPA solid waste landfill regulations. The resulting combination of hydrogeologic conditions and engineering controls will provide protection of human health and the environment.

This combination meets the criteria for an EPA waiver of the identified OEPA ARARs based on an equivalent standard of performance. As directed by the NCP, DOE will provide a discussion of the following factors to support an EPA waiver:

- degree of protection (risk based)
- level of performance (technology based)
- reliability into the future

Action: The modified waiver language was added to the FS Section 2.3.3.1, page 2-16, line 5, and Section 5.5.2.2.3, page 5-106, line 36 after "ARARs."

For consistency, the text in the Executive Summary of the FS was modified on page ES-10 by doing the following:

- On line 30, inserting ",unless sufficient hydrogeologic conditions exist to protect the aquifer" immediately after the word "Aquifer."

- Deleting "protection of human health and the environment," from lines 31 and 32.

- Deleting "as demonstrated by the risk assessment contained in this FS Report." from lines 32 and 33.

- On line 32, replacing "the design of the on-site disposal facility" with "a combination of the design of the on-site disposal facility and existing hydrogeology to provide protection of the aquifer."

Executive Summary

does not meet PRLs for the private ownership scenario. Therefore, each of the alternatives would provide protectiveness of human health and the environment under the Federal ownership land-use scenario.

Alternative 2 would provide protectiveness by capping the contaminated material in three consolidation areas and installing a subsurface drainage system in the South Field area to eliminate a potential lateral pathway in the glacial till. The capping system would be designed to isolate the contaminated material, preclude human and ecological intrusion, and limit potential impacts to the groundwater to an acceptable level. However, there would be no liner nor a leak-detection system to monitor performance.

Alternative 3 would provide protectiveness by disposing of the contaminated material in engineered facilities in the arid west where, due to harsh climatic conditions, there is little resident population or usable groundwater/surface water resources in the immediate vicinity.

Alternative 6 would provide protectiveness by disposing of the contaminated material in an on-site facility designed to isolate the contaminated material, preclude human and ecological intrusion, and limit potential impact to the groundwater to an acceptable level. The FS proposes a feasible location, design, and waste acceptance criteria for an on-site disposal facility. The geology of the on-site disposal facility location, based on a series of soil borings in the area, would be protective of human health and the environment. However, the location, design, and waste acceptance criteria for the disposal facility would be subject to review during the Remedial Design phase. DOE would construct only one disposal facility at the FEMP. Therefore, should on-site disposal be selected for other FEMP operable units, the disposal facility capacity and footprint would be adjusted accordingly during remedial design.

With the exception of Alternative 6, all of the action alternatives would meet identified ARARs and non-ARAR requirements. For protection of human health and the environment, OEPA regulations prohibit the construction of solid waste landfills over sole-source aquifers, such as the Great Miami
No. 103 Aquifer, unless sufficient hydrogeologic conditions exist to protect the aquifer. Therefore, a waiver from this regulation, based on the equivalent standard of performance, would be required to implement Alternative 6. The equivalent standard of performance~~, protection of human health and the environment,~~ would be achieved by ~~the~~ a combination of the design of the on-site disposal facility ~~as~~

demonstrated by the risk assessment contained in this FS Report and existing hydrogeology to provide protection of the aquifer.

The comparison of the balancing criteria shows that the action alternatives have differences, but not major differences:

- All of the action alternatives would provide an effective long-term solution to the current or potential risk from Operable Unit 2 subunits.

- All of the action alternatives would include treatment of construction water at the on-site advanced wastewater treatment facility. These alternatives would also include treatment of a small volume of lead-contaminated mixed waste from the firing range portion of the South Field and disposal at the designated off-site facility. In addition, crushing/shredding, dewatering/drying, and in situ stabilization/solidification of contaminated material would be included in each alternative, as required. However, these treatments would affect only a very small volume of and would not result in significant reductions of toxicity, mobility, or volume.

- Short-term risks to remediation workers and off-site receptors would differ slightly among the action alternatives, primarily because of the amount of material excavated and transported off site.

- All of the action alternatives would employ proven technology and conventional equipment and therefore would be equal on a technical feasibility basis. There are no administrative feasibility issues associated with Alternative 2. Alternative 3 would require public acceptance of the transport of contaminated material across several states to the off-site facility; this process is expected to be very difficult. Alternative 6 would require an EPA waiver from the Ohio Environmental Protection Agency disposal-facility siting requirements, which is expected to be moderately difficult to obtain.

- The cost estimates developed in the feasibility study process are order-of-magnitude estimates with an intended accuracy range of -30 to +50 percent. For the action alternatives, Alternative
s. 14, 31 2 would be the least costly (~~$69.5~~ $69.6 million) on a present worth basis, followed by Alternative 6 (~~$110.3~~ $105.9 million) and Alternative 3 ($212.8 million).

14 In terms of the ~~trheshold~~ threshold and balancing criteria, the alternatives can be summarized as follows:

- Consolidation and capping is the lowest-cost alternative, but does not offer an engineered liner with leachate collection and leak detection to ensure cap integrity. However, monitoring of the groundwater wells at the edge of the subunit would ensure the protection of the groundwater for off-property users.

- Excavation and disposal at an off-site facility would remove the source of contamination from the site. Thus, this alternative is considered to be the most protective. However, this alternative would cost almost twice as much as the next lowest cost alternative. Additionally, the public would be concerned about off-site transportation and disposal of wastes.

- Excavation and on-site disposal with off-site disposal of the fraction exceeding the WAC offers an increase in effectiveness from the other on-site option, consolidation and capping. This is based on an engineered liner that provides leachate collection and leak detection. By combining all the waste into one disposal location, this alternative also allows increased

TABLE ES-2

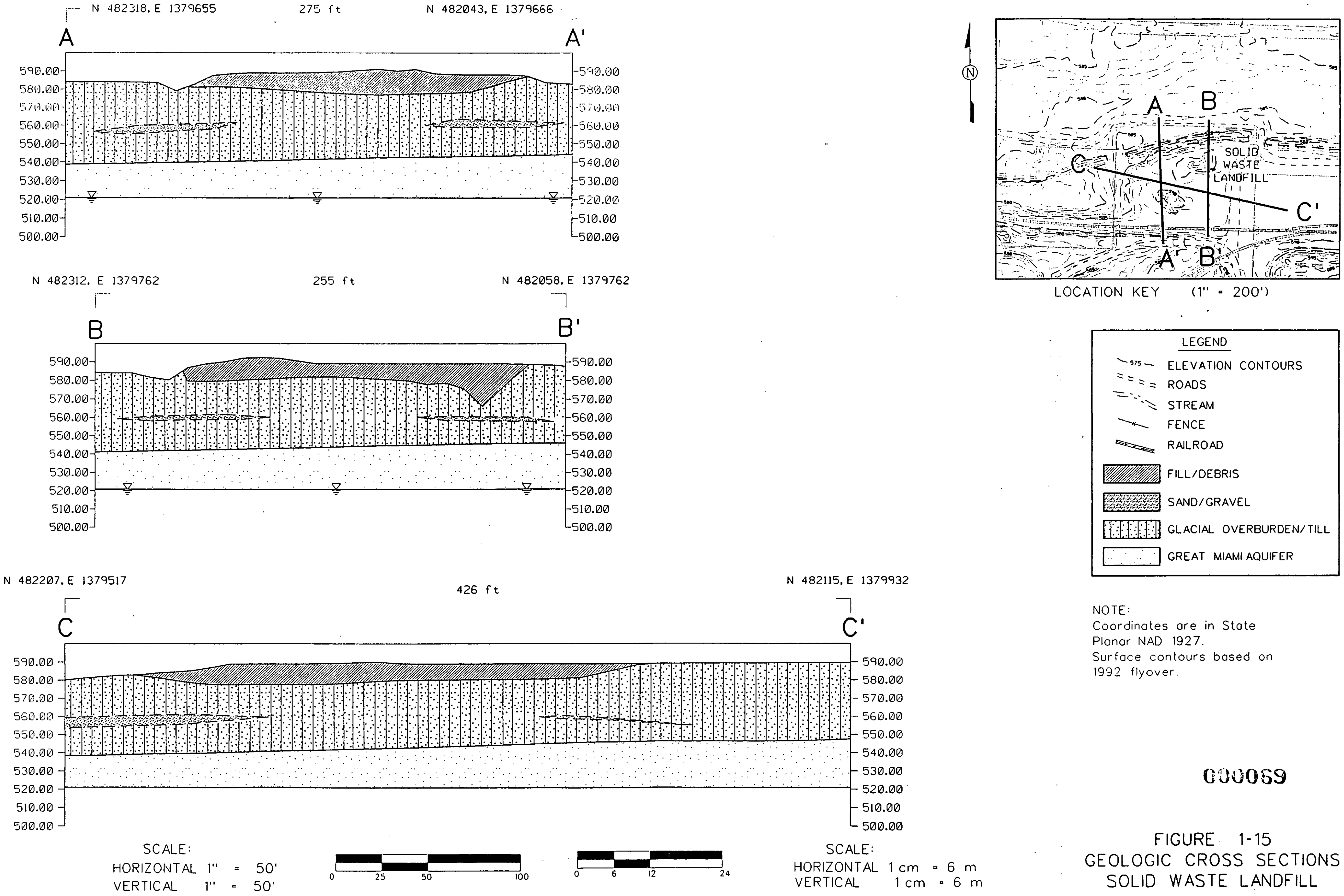
COMPARISON OF NET PRESENT WORTH COSTS ALTERNATIVE LAND-USE SCENARIOS AND PRL RISK VALUES

Operable Unit 2 Alternative	Net Present Worth Cost ($millions)			
	Federal Ownership		Private Ownership	
	Target ILCR = 10^{-5}	Target ILCR = 10^{-6}	Target ILCR = 10^{-5}	Target ILCR = 10^{-6}
1 - No Action	0	0	0	0
2 - Consolidation and Capping	61.2	69.6	NA	NA
3 - Excavation and Off-Site Disposal	175.6	212.8	321.8	464.9
6 - Excavation and On-Site Disposal with Off-Site Disposal of Fraction Exceeding Waste Acceptance Criteria	~~92.9~~ 89.4	~~110.3~~ 105.9	~~105.5~~ 119.2	~~148.3~~ 167.7

[shaded box] Indicates land-use scenario and PRL risk value used for comparative analysis.

Comment Nos. 14, 31

Section 1



NOTE:
Coordinates are in State Planar NAD 1927.
Surface contours based on 1992 flyover.

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FIGURE 1-15
GEOLOGIC CROSS SECTIONS
SOLID WASTE LANDFILL

TABLE 1-5

CONTAMINANTS OF CONCERN, SURFACE SOILS
SOLID WASTE LANDFILL

Parameter	# of Samples	# of Hits	Min. Hit	Max. Hit	Mean	Units	Conc. Term
Metals							
Antimony	12	0	-	-	0.5	mg/kg	NA
Arsenic	12	12	4.4	8.3	6.1	mg/kg	6.8
Beryllium	12	12	0.5	1.0	0.6[a]	mg/kg	0.7
Radionuclides							
Neptunium-237	8	8	0.05	3.1	0.3[a]	pCi/g	3.4
Plutonium-238	12	10	0.02	0.9	0.2[a]	pCi/g	0.8
Radium-226	12	12	0.9	2.3	1.2	pCi/g	2.3
Radium-228	12	12	0.7	3.0	1.3[a]	pCi/g	1.7
Strontium-90	12	8	0.5	1.4	0.7	pCi/g	1.0
Thorium-228	9	9	0.5	2.3	1.2[a]	pCi/g	1.6
Thorium-230	9	9	0.9	9.6	3.4[a]	pCi/g	6.4
Thorium-232	9	9	0.6	2.5	1.1[a]	pCi/g	1.5
Uranium-234	12	12	1.4	48.9	14.4[a]	pCi/g	42.1
Uranium-235/236	12	12	0.1	3.3	0.9[a]	pCi/g	2.8
Uranium-238	12	12	2.3	63.8	23.7[a]	pCi/g	77.1
Organics							
Benzo(a)anthracene	12	6	55	880.0	227.42	ug/kg	880
Benzo(a)pyrene	12	6	59.0	760.0	214.3	ug/kg	760.0
Benzo(b)fluoranthene	12	5	64.0	710.0	217.5	ug/kg	710.0
Dibenzo(a,h)anthracene	12	2	56.0	200.0	194.3	ug/kg	200.0
Indeno(1,2,3-cd)pyrene	12	5	46.0	480.0	186.7	ug/kg	480.0

[a]Estimated Mean
[b]NA = not applicable.
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FER\CRU2FS\JLG\SECTION1\TAB1-5\November8, 1994 8:44am

- an off-property resident farmer (adult and child)
- Great Miami River user

Future land use receptors, assuming private ownership, include:

- the reasonable maximum exposure (RME) on-property resident farmer receptor (adult and child)
- the central tendency (CT) on-property resident farmer (adult and child)
- the future homebuilder (for the South Field and Solid Waste Landfill only)
- the perched-groundwater user (for the Solid Waste Landfill and Lime Sludge Ponds)

The risks associated with ingestion of groundwater for the Inactive Flyash Pile, South Field, and the Active Flyash Pile were based on ingestion of Great Miami Aquifer water only. Ingestion of perched groundwater was not evaluated as a drinking water source for these subunits, because a relatively shallow well in these areas will reach the Great Miami Aquifer. It was assumed that a well designed to provide drinking water would not be placed in a perched zone, when a slightly deeper well would reach the Great Miami Aquifer. In addition to these receptors, risks to a potential future recreational user of the Great Miami River are assessed.

The carcinogenic and noncarcinogenic risks associated with each of these receptors via all media contacted are summarized in detail in the Baseline Risk Assessment (Appendix B) of the Operable Unit 2 RI Report. Total carcinogenic risk and noncarcinogenic hazard for each of the receptors is summarized by subunit in Table 1-40.

For the purpose of evaluating alternatives, Remedial Action Objectives (RAOs) focus primarily on the following three future receptors: the expanded trespasser, the off-property resident farmer, and the on-property resident RME farmer. Therefore, risks to these receptors are summarized in the subsections below.

1.7.3.1 <u>Solid Waste Landfill</u>

los. 86,81 Table 1-40 and Table 1-41 summarizes risks and hazards associated with the Solid Waste Landfill for the future receptors ~~expanded trespasser and on- and off-property resident farmers.~~ Total risk exceeded 1.0 x 10^{-6} for all property receptors ~~both future farmer receptors. The risk was primarily due to the estimated presence of naturally occurring radionuclides uranium-234 and uranium-238 in soil.~~ Risks exceeded 1.0 x 10^{-3} for the RME on-property resident farmer exposed to radium-226, thorium-228, and thorium-232 in surface 1

TABLE 1-41

SOLID WASTE LANDFILL FUTURE LAND USE SUMMARY OF COC CARCINOGENIC RISK CONTRIBUTIONS[a,b]

Medium/ Parameter	Expanded Trespasser	% Total Receptor Risk	On-Property Resident Farmer (RME)	% Total Receptor Risk	On-Property Resident Farmer (CT)	% Total Receptor Risk	~~Great Miami River User~~	~~% Total Receptor Risk~~
Soil:								
Neptunium-237	-[c]	-	2.3E-05	0.82	1.9E-06	0.95	~~NA~~[d]	
Plutonium-238	-	-	-	-	-	-	~~NA~~	
Radium-226	3.8E-06	18.96	3.5E-04	12.91	2.9E-05	15.03	~~NA~~	
Radium-228	2.2E-06	10.92	2.0E-04	7.41	1.7E-05	8.66	~~NA~~	
Thorium-228	4.1E-06	20.43	3.8E-04	13.89	3.2E-05	16.40	~~NA~~	
Thorium-230	-	-	-	-	-	-	~~NA~~	
Thorium-232	5.8E-06	28.74	5.4E-04	19.33	4.5E-05	22.86	~~NA~~	
Uranium-234	-	-	1.5E-05	0.53	-	-	~~NA~~	
Uranium-235/236	-	-	2.9E-05	1.05	2.4E-06	1.24	~~NA~~	
Uranium-238	1.4E-06	6.76	1.7E-04	6.03	1.3E-05	6.76	~~NA~~	
Arsenic	-	-	3.0E-05	1.09	-	-	~~NA~~	
Benzo(a)anthracene	-	-	-	-	-	-	~~NA~~	
Beryllium	-	-	-	-	-	-	~~NA~~	
Benzo(b)-fluoranthene	-	-	-	-	-	-	~~NA~~	
Dibenzo(a,h)-anthracene	-	-	-	-	-	-	~~NA~~	
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	~~NA~~	
Perched Groundwater:								
Technetium-99	NA		NA		NA		~~NA~~	
Carbazole	NA		NA		NA		~~NA~~	
Home Grown Produce (Dust Affected):								
Neptunium-237	NA		3.4E-06	0.12	-	-	~~NA~~	
Radium-226	NA		2.1E-06	0.08	-	-	~~NA~~	
Strontium-90	NA		1.1E-05	0.40	-	-	~~NA~~	
Uranium-234	NA		3.5E-06	0.13	-	-	~~NA~~	
Uranium-238	NA		1.1E-05	0.40	-	-	~~NA~~	

See footnotes at end of table.

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TABLE 1-41
(Continued)

Medium/ Parameter	Expanded Trespasser	% Total Receptor Risk	On-Property Resident Farmer (RME)	% Total Receptor Risk	On-Property Resident Farmer (CT)	% Total Receptor Risk	~~Great Miami River User~~	~~% Total Receptor Risk~~
<u>Home Grown Produce (Dust Affected): (continued)</u>								
Arsenic	NA		5.1E-06	1.82	2.8E-06	1.42	~~NA~~	
Benzo(a)anthracene	NA		4.0E-06	0.14	-	-	~~NA~~	
Benzo(a)pyrene	NA		2.1E-05	0.74	1.1E-06	0.58	~~NA~~	
Benzo(b)fluoranthene	NA		4.2E-06	0.15	-	-	~~NA~~	
Beryllium	NA		3.3E-06	0.12	-	-	~~NA~~	
Dibenzo(a,h)anthracene	NA		4.5E-06	0.17	-	-	~~NA~~	
Indeno(1,2,3-cd)pyrene	NA		1.5E-06	0.06	-	-	~~NA~~	
Beef/Milk (Dust Affected):								
Radium-226	NA		-	-	-	-	~~NA~~	
Strontium-90	NA		5.0E-05	1.80	2.3E-06	1.16	~~NA~~	
Uranium-234	NA		-	-	-	-	~~NA~~	
Uranium-238	NA		9.6E-06	0.34	-	-	~~NA~~	
Arsenic	NA		6.7E-05	2.42	3.8E-06	1.94	~~NA~~	
Benzo(a)anthracene	NA		1.1E-05	0.39	-	-	~~NA~~	
Benzo(a)pyrene	NA		2.0E-04	7.04	9.9E-06	5.03	~~NA~~	
Benzo(b)fluoranthene	NA		4.2E-05	1.51	2.1E-06	1.08	~~NA~~	
Beryllium	NA		-	-	-	-	~~NA~~	
Dibenzo(a,h)anthracene	NA		4.2E-04	15.17	2.1E-05	10.85	~~NA~~	
Indeno(1,2,3-cd)pyrene	NA		6.2E-05	2.24	3.1E-06	1.61	~~NA~~	
Ambient Radon	-	-	1.4E-06	0.05	-	-	~~NA~~	

See footnotes at end of table.

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TABLE 1-41
(Continued)

Medium/ Parameter	On-Property Resident Child	Total Receptor Risk	Homebuilder	Total Receptor Risk	Perched Groundwater User	% Total Receptor Risk	Perched Groundwater Child	% Total Receptor Risk
Soil:								
Neptunium-237	1.7E-06	0.27	-	-	2.3E-05	0.083	NA	
Plutonium-238	-	-	-	-	-	-	NA	
Radium-226	2.7E-05	4.18	-	-	3.5E-04	12.73	NA	
Radium-228	1.5E-05	2.39	-	-	2.4E-04	7.30	NA	
Thorium-228	2.9E-05	4.48	1.1E-06	12.25	3.8E-04	13.70	NA	
Thorium-230	-	-	-	-	-	-	NA	
Thorium-232	4.0E-05	6.30	1.8E-06	19.83	5.4E-04	19.28	NA	
Uranium-234	-	-	-	-	-	-	NA	
Uranium-235/236	2.2E-06	0.04	-	-	2.9E-05	1.05	NA	
Uranium-238	1.0E-05	1.62	-	-	1.7E-04	6.02	NA	
Arsenic	1.3E-05	2.04	-	-	3.0E-05	1.09	NA	
Benzo(a)anthracene	-	-	-	-	-	-	NA	
Benzo(b)-fluoranthene	-	-	-	-	-		NA	
Beryllium	6.6E-06	1.03	-	-	-	-	NA	
Benzo(a)pyrene	5.4E-06	0.86	2.7E-06	30.05	-	-	NA	
Dibenzo(a,h)-anthracene	3.2E-06	0.50	-	-	-	-	NA	
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	NA	
Perched Groundwater:								
Technetium-99	NA		NA		1.8E-06	0.07	NA	
Carbazole	NA		NA		5.3E-03	0.19	NA	
Home Grown Produce (Dust Affected):								
Neptunium-237	-	-	NA		3.4E-06	0.12	NA	
Radium-226	-	-	NA		2.1E-06	0.08	NA	
Strontium-90	-	-	NA		1.1E-05	0.40	NA	
Uranium-234	-	-	NA		3.5E-06	0.13	NA	
Uranium-238	-	-	NA		1.1E-05	0.40	NA	

See footnotes at end of table.

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TABLE 1-41
(Continued)

Medium/ Parameter	On-Property Resident Child	Total Receptor Risk	Homebuilder	Total Receptor Risk	Perched Groundwater User	% Total Receptor Risk	Perched Groundwater Child	% Total Receptor Risk
Home Grown Produce (Dust Affected): (continued)								
Arsenic	1.7E-05	2.61	5.1E-05	1.82	NA		NA	
Benzo(a)anthracene	1.7E-06	0.21	4.0E-06	0.14	NA		NA	
Benzo(a)pyrene	1.3E-06	1.06	2.1E-05	0.74	NA		NA	
Benzo(b)fluoranthene	6.8E-06	0.22	4.2E-06	0.15	NA		NA	
Beryllium	1.4E-06	0.17	3.3E-06	0.12	NA		NA	
Dibenzo(a,h)anthracene	1.1E-06	0.23	4.5E-06	0.16	NA		NA	
Indeno(1,2,3-cd)pyrene	-	-	1.5E-06	0.06	NA		NA	
Beef/Milk (Dust Affected):								
Radium-226	-	-	NA		-	-	NA	
Strontium-90	9.3E-06	1.46	NA		5.0E-05	1.79	NA	
Uranium-234	-	-	NA		-	-	NA	
Uranium-238	-	-	NA		9.6E-06	0.34	NA	
Arsenic	1.6E-05	2.48	NA		6.7E-05	2.42	NA	
Benzo(a)anthracene	6.6E-06	0.98	NA		1.1E-05	0.39	NA	
Benzo(a)pyrene	1.1E-04	17.63	NA		2.0E-04	7.02	NA	
Benzo(b)fluoranthene	2.4E-05	3.80	NA		4.2E-05	1.51	NA	
Beryllium	-	-	NA		-	-	NA	
Dibenzo(a,h)anthracene	2.4E-04	3.99	NA		4.2E-04	15.13	NA	
Indeno(1,2,3-cd)pyrene	3.6E-05	5.62	NA		6.2E-05	2.24	NA	
Ambient Radon	-	-	NA		1.4E-06	0.05	NA	

[a]Off-property resident farmer and child receptors did not have any COCs associated with them and, therefore, were not included in this table.
[b]Sediment, groundwater, surface water, home grown produce (groundwater affected), perched groundwater, beef/milk (groundwater and surface water affected) pathways did not have any COCs associated with them and, therefore, were not included in this table.
[c]No risk greater than the threshold level of 1 x 10^{-6}.
[d]NA signifies that exposure of the receptor to the indicated medium is not applicable.

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soil, and benzo(a)pyrene and dibenzo(a,h)anthracene in dust-affected milk. Risk exceeded the 1.0 x 10^{-4} level for the on-property resident child exposed to the same contaminants as the RME farmer. Total HI levels exceeded 1.0 only for the future on-property resident child, due mostly to arsenic in soil and dust-affected homegrown produce and beef and milk products. Risk exceeded 1 x 10^{-5} for
No. 81 the expanded trespasser and 9 x 10^{-5} for the homebuilder. Risks due to exposure to perched groundwater exceeded 1 x 10^{-3} for the perched groundwater.

1.7.3.2 Lime Sludge Ponds

No. 86 Tables 1-40 and 1-42 summarizes risks and hazards associated with Lime Sludge Ponds for the future expanded trespasser and the on- and off-property resident farmers. Risks due to groundwater did not exceed 1.0 x 10^{-6}. Risks associated with the expanded trespasser exceeded 1.0 x 10^{-5}, due primarily to direct contact with surface soil containing radium-226, thorium-228, and thorium-232. Risks associated with the RME farmer receptors exceeded 1.0 x 10^{-5}, due mostly to the presence of the same compounds in surface soil. Total HI levels for future receptors were less than 1.0.

1.7.3.3 Inactive Flyash Pile

o. 86 Tables 1-40 and 1-43 summarizes the risks and hazards associated with the Inactive Flyash Pile for the future expanded trespasser and on- and off-property resident farmers.

The largest carcinogenic risk, which slightly exceeded 1.0 x 10^{-3}, was associated with groundwater use by the RME farmer. Total risk for this receptor was 1.5 x 10^{-3} due mostly to the future estimated concentrations of uranium-234 and uranium-238 in groundwater and irrigated produce, beef, and milk. HI levels greater than 1.0 were associated with ingestion of groundwater and homegrown produce contaminated with total uranium by the on-property residents.

1.7.3.4 South Field

Nos. 86,82 Tables 1-40 and 1-44 summarizes the risks and hazards associated with the South Field for ~~the~~ future receptors ~~expanded trespasser and on- and off-property resident farmers~~. The greatest risk, which was 3.4 x 10^{-2}, was associated with the RME on-property resident farmer. Risks to the off-property resident farmer via contact with groundwater, beef, milk, and homegrown produce were in the 1.0 x 10^{-5} to 1.0 x 10^{-2} range. A proportion of the risks to farmer receptors for each of these pathways was attributable to the future estimated concentrations of uranium-234 and uranium-238 in groundwater and, consequently, in irrigated produce and beef and milk from livestock watered with contaminated groundwater. The on-property resident farmer had major additional risk from the presence of radium-228, thorium-228, and PAHs in surface soil. Exposures resulting in HI levels greater than 1.0 for on- and off-property

resident farmer receptors were due to the estimated future presence of the total uranium in
No. 82 groundwater. The expanded trespasser had risks exceeding 1 x 10^{-4} due predominently to direct radiation from soils. The Great Miami River user and homebuiler also had risks exceeding 1 x 10^{-6}.

1.7.3.5 Active Flyash Pile

No. 86 Table 1-40 and Table 1-45 summarizes carcinogenic and noncarcinogenic risks and hazards associated with the Active Flyash Pile for the future expanded trespasser and on- and off-property resident farmer receptors. The largest risks are from direct contact with soil or surface flyash material. Total
No. 83 estimated risks to the expanded trespasser slightly exceed 1.0 x 10~~$^{-3}$~~$^{-5}$, due mostly to the estimated presence of radium-226, radium-228, thorium-228, thorium-232, neptunium-237, and arsenic in flyash material.

No. 84 Total estimated risk to the off-property resident farmer exceeded 1.0 x 10~~$^{-5}$~~$^{-6}$, due mostly to direct exposure to the estimated future concentration of uranium-234 and uranium-238 in groundwater. The estimated presence of strontium-90 in flyash material deposited on homegrown produce also contributed to the total risk to this receptor. Total estimated risk and hazard to the users of the Great Miami River were on the order of 1.0 x 10^{-9}.

Total estimated risks to future on-property residents were greatest for the RME farmer. Total risk to
No. 85 this receptor ~~was~~ exceeded ~~1.9~~ 5.0 x 10~~$^{-3}$~~$^{-5}$, due mostly to the presence of uranium-234 and uranium-238 in groundwater, which accounted for 54.4 percent of the total receptor risk. Contributions to risk of homegrown produce for this receptor are 23.7 percent of the total receptor risk, primarily from arsenic in dust-affected produce, and strontium-90 and radium-226 in groundwater-affected produce.

The only receptor associated with total HI levels greater than 1.0 is the future on-property RME child. Total HI for the future on-property resident child is 2.8, due mostly to the presence of total uranium in groundwater, which accounted for 62.1 percent of the total receptor risk, and total uranium in groundwater-affected produce, which accounted for an additional 29.6 percent of the total receptor risk.

1.7.3.6 Comparison with Natural Background

All subunit-specific risks in the risk assessment are total risks, including the potential contribution from natural background concentrations of CPCs. In many cases, the concentrations of CPCs in soil at Operable Unit 2 waste areas are only slightly above natural background concentrations; however, the ILCRs and HIs for these site-related concentrations are often greater than 1.0×10^{-4} and 1.0, 635Ⅱ

Section 2

TABLE 2-1

OPERABLE UNIT 2 CONTAMINANTS OF CONCERN

Solid Waste Landfill	Lime Sludge Ponds	Inactive Flyash Pile	South Field	Active Flyash Pile
		Surface Soil		
Neptunium-237	Cesium-137	Radium-226*	Cesium-137	Cesium-137
Radium-226*	Radium-226*	Radium-228*	Neptunium-237	Neptunium-237*
Radium-228*	Radium-228*	Thorium-228*	Radium-226*	Radium-226*
Strontium-90	Thorium-228*	Thorium-232*	Radium-228*	Radium-228*
Thorium-228*	Thorium-230	Arsenic*	Strontium-90	Thorium-228*
Thorium-230	Thorium-232*	Dibenzo(a,h)anthracene	Technetium-99	Thorium-232*
Thorium-232*	Uranium-238*		Thorium-228*	Arsenic*
Plutonium-238	Uranium-total*		Thorium-230*	Beryllium
Uranium-234			Thorium-232*	
Uranium-235/236			Uranium-234	
Uranium-238*			Uranium-235/236	
Antimony			Uranium-238	
Arsenic			Uranium-total	
Beryllium			Arsenic	
Benzo(a)anthracene			Beryllium	
Benzo(a)pyrene			Aroclor-1254	
Benzo(b)fluoranthene			Aroclor-1260*	
Dibenzo(a,h)anthracene			Benzo(a)anthracene	
Indeno(1,2,3-cd)pyrene			Benzo(a)pyrene*	
			Benzo(b)fluoranthene	
			Benzo(k)fluoranthene	
			Dibenzo(a,h)anthracene*	
			Dieldrin	
			Indeno(1,2,3-cd)pyrene*	
			Lead	
		Sediment		
Uranium-total*	No COCs	No COCs	Radium-226*	Radium-226* Arsenic*

See footnotes at end of table.

TABLE 2-1
(Continued)

Solid Waste Landfill	Lime Sludge Ponds	Inactive Flyash Pile	South Field	Active Flyash Pile
Groundwater				
Uranium-234 Uranium-235/236 Uranium-238 Uranium-total	Uranium-234 Uranium-235/236 Uranium-238 Uranium-total	Uranium-234* Uranium-235/236* Uranium-238* Uranium-total*	Uranium-234* Uranium-235/236* Uranium-238* Uranium-total*	Radium-226 Strontium-90 Uranium-234* Uranium-235/236* Uranium-238* Uranium-total*
Perched Groundwater				
Technetium-99 Carbazole Uranium-234 Uranium-235/236 Uranium-238 Uranium-total	Neptunium-237 Strontium-90 Technetium-99 Uranium-234 Uranium-235/236 Uranium-238 Uranium-total	No COCs	No COCs	No COCs
Impact on Air (Gaseous Emissions)				
Radon-222	No COCs	Radon-222	Radon-222*	Radon-222
Great Miami River Surface Water				
No COCs	No COCs	No COCs	Radium-226* Technetium-99*	No COCs

*COCs to be considered under both the private ownership and the federal ownership scenarios. COCs not marked with an asterisk are considered for the private ownership scenario only.

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Contaminants marked with an asterisk on Table 2-1 are ~~the~~ COCs for both ~~specific to~~ the federal and No. 87 private ownership scenarios. Contaminants not marked by an asterisk were not found to be COCs for the federal ownership scenario. The asterisk-marked COCs were determined from the Baseline Risk Assessment for the expanded trespasser and the off-property resident farmer.

2.3 IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO BE CONSIDERED CRITERIA

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, (CERCLA) §121(d)(2) directs that for wastes left on site, remedial actions must comply with federal laws and regulations and more stringent state requirements that apply or are relevant and appropriate under the circumstances of the release or potential release. Off-site actions must comply with all requirements that legally apply. This section discusses the ARARs for Operable Unit 2.

ARARs are defined as follows:

- Applicable requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

- Relevant and appropriate requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

- To Be Considered (TBC) criteria is a category that includes non-promulgated criteria, advisories, and guidance issued by federal or state government that are not legally binding and do not have the status of potential ARARs. However, pertinent TBCs will be considered along with the ARARs in determining the necessary level of cleanup or technology requirements.

The sources of Operable Unit 2 ARARs are federal and state laws, regulations and guidance, and DOE Orders that address the site-specific circumstances in Operable Unit 2.

The NCP identifies three categories of ARARs [40 CFR §300.400(g)]:

- Chemical-specific ARARs are usually health- or risk-based numerical values or methodologies used to determine acceptable concentrations of chemicals that may be found to the NESHAP dose standard of 10 mrem per year which was discussed in the previous section, may be required based on the type of exposure scenario. The requirements of NESHAP and DOE Order 5820.2A would be for the protection of the off-property members of the public or the on-property resident farmer if the area is no longer under federal ownership. DOE Order 5400.5 would also be a TBC criteria if waste is maintained on site and members of the public are allowed access, as represented by the expanded trespasser scenario, where direct radiation could also occur.

The relevant and appropriate EPA regulation is 40 CFR §192.20, which requires remedial actions be conducted to provide reasonable assurance that as a result of residual radioactive materials from any designated processing site, the concentrations of radium-226 in land averaged over any area of 100 square meters shall not exceed the background level by more than:

- 5 pCi/g, averaged over the first 15 cm of soil below the surface
- 15 pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface.

Radium-226 was identified as a COC for each Operable Unit 2 subunit.

2.3.1.5 As Low As Reasonably Achievable (ALARA) Requirements

40 CFR § 192.21(f) and § 192.22(b), considered relevant and appropriate, require that reasonable measures be taken to maintain releases of radioactivity in effluent to the general environment as low as is reasonably achievable. The level of releases shall be based on cost and benefit considerations. DOE Order 5400.5 Chapters I (4) and II (2) adopt this ALARA process in planning and carrying out all DOE activities.

2.3.2 Action-Specific ARARs

The principal action-specific requirements for Operable Unit 2 are based on the regulatory definitions and classifications of the materials in each of the subunits. This section describes the waste classifications and indicates the action-specific requirements associated with each material. These action-specific ARARs are described in detail in Appendix B-2.

2.3.2.1 Regulatory Definition of Wastes

Operable Unit 2 subunits contain a variety ~~mixture~~ of waste materials and other material that will direct pertinent action-specific ARAR and TBC criteria for in situ containment, on-site disposal, and/or off-site disposal. These materials are classified as follows:

The RCRA requirements for off-site disposal are considered to be non-ARAR requirements and are listed in Table B-6 of Appendix B. It is assumed that the firing range material containing bullets is No. 50 mixed waste; however, the material surrounding the area with bullets will be screened during the remedial action to confirm the type of waste ~~this assumption~~. If the material, or a portion of the material, is found to be only hazardous, only radioactive, or neither, it will be managed, respectively, as a hazardous waste, low-level radioactive waste, or solid waste if there are contaminants above the PRLs. If the material is not hazardous and does not contain contaminants above the PRLs, it will be managed, respectively, as a soil or residual radioactive material below the PRLs.

Soils and Residual Radioactive Material Below the PRLs

Soils and residual radioactive materials below PRLs determined through the CERCLA process are protective of human health and the environment and are therefore not considered to be waste material. This is consistent with both EPA and OEPA policies. The RCRA Subtitle C "contained-in" policy does not consider environmental media to be a waste material. Thus, if the waste constituents can be removed, the environmental media is no longer a waste. OEPA applied this contained-in policy to petroleum-contaminated soils (Ohio Division of Solid and Infectious Waste Management Policy PP 01 03 200, March 25, 1991) by stating that the soils containing a petroleum hydrocarbon would not need to be managed as a solid waste if the contaminants were removed. As RCRA Subtitle C regulations are not considered to be an ARAR for Operable Unit 2, the OEPA petroleum-contaminated soils policy will be considered a TBC requirement for Operable Unit 2 environmental material below the PRLs. Based on this TBC requirement, these materials will not be defined or handled as a solid waste.

2.3.3 Location-Specific ARARs

The principal location-specific requirements for Operable Unit 2 are based on the location of the FEMP above a sole-source aquifer and near a floodplain and wetlands. This section describes the location-specific requirements for different disposal alternatives.

2.3.3.1 On-Site Disposal of Operable Unit 2 Wastes

The most significant issue influencing the location-specific ARARs is the determination by EPA Region V [53 Federal Register (FR) 25670] that the buried valley aquifer system of the Great Miami/Little Miami Rivers of southwestern Ohio (Great Miami Aquifer) is a sole or principal source of drinking water and that contamination of this aquifer would create a significant hazard to the public health. The determination was effective July 8, 1988. The Federal Safe Drinking Water Act requires all federally-funded projects to undergo a review to ensure that the project will not adversely impact a sole source of drinking water.

OEPA has established solid waste siting criteria that prohibit locating a solid waste landfill over a No. 37 sole-source aquifer [OAC 3745-27-07(H)(2)(c)(B)(5)]. OEPA has also established that a solid waste disposal facility may not be located above an unconsolidated aquifer capable of sustaining a yield of 100 gallons per minute for a 24-hour period [OAC 3745-27-07(H)(2)(d)(B)(9)]. The Great Miami Aquifer qualifies as both a sole-source and a 100-gallon-per-minute-yield aquifer. These requirements are derived from the ORC 3734.02(A) which instructs the director of environmental protection to adopt rules "in order to ensure that the facilities [solid waste] will be located, maintained, and operated, and will undergo closure and post-closure care, in a sanitary manner so as not to create a nuisance, cause or contribute to water pollution, create a health hazard, or violate 40 CFR § 257.3-2 or 3-8."

No 103 ~~Therefore, if on site disposal is chosen as the preferred remedial alternative, a waiver pursuant to~~ No. 37 ~~CERCLA §121(d)(4)(D) from OAC 3745-27-07(H)(2)(c)(B)(5) and (H)(2)(d)(B)(9) would be required from EPA. The waiver request would be based on the ability of the selected remedial action, through the use of another method or approach, to attain a standard of performance that is equivalent to that required by the ARARs. The pertinent standard of performance in this case is the protection of human health and the environment as established by ORC 3734.02(A). The protective standard would be attained through a combination of site geology and engineering controls.~~

~~Protection of human health and the environment is a requirement of the CERCLA process by which all remedial alternatives are evaluated in order to be considered for the preferred remedial alternative. Protective levels to meet this standard after remediation are determined through the risk assessment process using contaminant transport modeling based on the NCP acceptable risk range of 1×10^{-4} to 1×10^{-6} and compliance with MCLs. The risk assessment and transport modeling processes for Operable Unit 2 will verify that the on site alternative is protective of human health and the environment, including the Great Miami Aquifer. These results are summarized Section 5.0 and presented in detail in Appendices C and D.~~

~~A feasible location for the on site disposal facility and the necessary engineering controls to meet the equivalent standard of performance to protect human health and the high yield sole source aquifer are addressed in Section 5.0. If on site disposal is chosen as the preferred remedial alternative, the specific design of the engineering controls and location of the disposal facility would be finalized during the remedial design process.~~

No. 103 OEPA has established solid waste siting criteria that prohibit locating a new solid waste landfill over a sole source aquifer[OAC 3745-27-07(H)(2)(c)]. OEPA has also established that a new solid waste disposal facility may not be located above an unconsolidated aquifer capable of sustaining a yield of 100 gallons per minute for a 24 hour period [OAC 3745-27-07(H)(2)(d)]. The Great Miami Aquifer qualifies as both a sole source aquifer and a 100-gallon-per-minute-yield aquifer.

ORC 3734.02(G) allows exemptions to requirements identified in the regulations for obtaining a permit or license. These exemptions must be based on a determination that the exemption would be unlikely to adversely affect the public health or safety or the environment.

OEPA has established two specific policies [GD0202.101 and GD0202.102] that identify conditions that would be acceptable to allow an exemption to the two cited rules. While these policies state that several factors will be considered in evaluating an exemption, the specific factors identified indicate that the protection of human health and the environment should be provided solely by the existing hydrogeologic conditions. This has been reaffirmed by OEPA in several meetings.

The primary hydrogeologic standards established by these policies are:

- Significant thickness of low permeable material between the disposal facility and the aquifer
- Lack of inter-connection between the sole source aquifer and any significant zones of saturation
- Significant amount of sediment [soil] between the disposal facility and the high yield aquifer to prevent leachate from migrating to the high yield aquifer during the life of the landfill and the post-closure care period. The post-closure care period for a solid waste landfill is a minimum of 30 years [OAC 3745-27-14(A)].

It has been determined, based on existing hydrogeologic information, that the existing hydrogeologic conditions at the FEMP do not fully meet these conditions. This is based on the possibility that some

granular soils are interbedded in the till and the need to protect the aquifer for significantly longer
103 than 30 years [at least for 200 years; an ARAR under 40 CFR 192].

The existing geologic information is based on boring within the boundaries of the on-site area determined to exhibit the best hydrogeologic conditions. The current definition for the on-site area with the best hydrogeologic conditions is where 12 feet or more of gray clay would exist between the bottom of a proposed engineered disposal facility and the aquifer (as shown on Figure 5-21 and discussed in Appendix E.3). A pre-design investigation has been initiated to establish the best location for a disposal facility in this identified area. The objective is to locate the disposal facility footprint where there is the greatest amount of gray clay and the least amount of interbedded granular material. The pre-design investigation will also obtain site specific field information to verify the modeling parameters that demonstrated the protection of human health and the environment(i.e., protection of the aquifer).

Based on the pre-design investigations, DOE will, therefore, provide additional engineering controls beyond these required by the OEPA solid waste landfill regulations to protect the aquifer. The resulting combination of hydrogeologic conditions and engineering controls will provide protection of human health and the environment. Descriptions of the feasible design of the engineered disposal facility will be presented in Section 5.

This combination meets the criteria for an EPA waiver of the identified OEPA ARARs based on an equivalent standard of performance. The preamble to the NCP [55 FR 8748] directs that for a CERCLA waiver of ARARs based on the equivalent standard of performance, the following factors need to be considered: degree of protection; level of performance; reliability into the future; and the time required for results.

EPA further directs that the purpose of the waiver is for the use of alternative but equivalent technologies, methods or approaches and that a comparison based on risk is only permitted where the original standard is risk based. ORC 3734.02(G) and the supporting policies can be interpreted to be based on a combination of method (i.e. performance) and risk. Therefore, a discussion addressing the equivalency of the proposed alternative to the OEPA standards based on performance and risk will be provided.

The specific OEPA requirements for each of these criteria are as follows:

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- <u>Degree of Protection</u>

  The justification to allow a solid waste landfill over a high yield, sole source aquifer is for the existing hydrogeology to provide adequate protection to the high yield sole source aquifer from the effects of a release of leachate and thereby protect the aquifer from contamination. The degree spelled out by the pertinent policies is to prevent leachate from reaching the aquifer during the active life of the landfill and the post closure period of 30 years. The active life of the disposal facility for Operable Unit 2 wastes is estimated to be 51 months. It should be noted that if future decisions direct disposal of other wastes in the on-site disposal facility, the maximum active life could be approximately 20 years.

- <u>Level of Performance:</u>

  Method Based:

  - Significant thickness of low permeable material between the disposal facility and the aquifer

  - Lack of inter-connection between the sole source aquifer and any significant zones of saturation

  - Significant amount of sediment between the disposal facility and the high yield aquifer to prevent leachate from migrating to the high yield aquifer during the life of the landfill and the post-closure care period. The post-closure care period for a solid waste landfills is for a minimum of 30 years [OAC 3745-27-14(A)].

  Risk Based:

  ORC 3734.02(G) allows exemptions of OEPA regulations if an alternative is unlikely to adversely affect the public health or safety or the environment. The pertinent policies mirror this requirement using an approach which requires existing hydrogeologic conditions to provide this protection.

  OEPA does not propose a specific definition for the protection of human health and the environment. However, OAC 3745-27-10 (7)(a)-(d), which specifies solid waste landfill operating requirements, sets forth concentration levels for constituents detected in the groundwater for which a corrective action is required. This standard provides an

103 appropriate framework for risk analysis in this case because the waiver concerns the establishment of a solid waste disposal unit. These levels are concentrations that are at a statistically significant level to be:

- protective of human health and the environment, and
- the promulgated MCL, or
- background concentrations for constituents that do not have a promulgated MCL, or
- alternative groundwater protection standard - for a known or suspected carcinogen-concentration levels that represent a cumulative excess upper-bound lifetime cancer risk to an individual within the 1×10^{-4} to 1×10^{-6} range.

This same definition has been use in the CERCLA decision making process at the FEMP and specifically in the Operable Unit 2 FS/Proposed Plan with the addition that constituents in groundwater should not be higher than proposed MCLs.

- <u>Reliability into the Future:</u>
  The protection of the aquifer from a combination of engineering controls and existing hydrogeology needs to be as reliable as the hydrogeologic conditions described in the OEPA policies.

- <u>Time Required for Results:</u>
  Not applicable to this circumstance because the requirement to achieve results using the alternative remedy should not be any different than the waived ARAR.

A justification of a CERCLA ARAR waiver of the OEPA prohibition of siting a disposal facility over a high yield, sole source aquifer, through an equivalent standard of performance [40 CFR 300.430 (f)(1)(ii)(C)(4)], will be presented in Section 5.5.2.2.3 of the Detailed Analysis of Alternatives.

TABLE 2-3

SUMMARY OF CONTAMINANTS OF CONCERN AND RISK-BASED SOIL PRELIMINARY REMEDIATION GOALS (PRGs)[a]

COC	PRIVATE OWNERSHIP On-Property Resident Farmer (RME)[b] PRG (pCi/g or mg/kg)			ARAR/ TBC	Surface Soil Background (pCi/g or mg/kg)
	10^{-4} ILCR[c]	10^{-5} ILCR	10^{-6} ILCR		
Carcinogenic					
Cesium-137	1.1	1.1E-01	1.1E-02		0.71
Neptunium-237	4.3	4.3E-01	4.3E-02		0.0
Plutonium-238	4.0E+01	4.0	4.0E-01		0.0
Radium-226	3.9E-01	3.9E-02	3.9E-03	5 pCi/g[d]	1.42
Radium-228	8.2E-01	8.2E-02	8.2E-03	5 pCi/g[d]	1.25
Strontium 90	1.6	1.6E-01	1.6E-02		0.0
Technetium 99	1.7	1.7E-01	1.7E-02		0.0
Thorium-228	4.3E-01	4.3E-02	4.3E-03		1.43
Thorium-230	7.7E+01	7.7	7.7E-01	5 pCi/g[e]	1.97
Thorium-232	2.8E-01	2.8E-02	2.8E-03	5 pCi/g[e]	1.36
Uranium-234	7.7E+01	7.7	7.7E-01		1.24
Uranium-235/236	9.0	9.0E-01	9.0E-02		0.15
Uranium-238	2.5E+01	2.5	2.5E-01		1.22
Arsenic	4.5	4.5E-01	4.5E-02		8.20
Beryllium	3.3	3.3E-01	3.3E-02		0.60
Benzo(a)anthracene	2.3	2.3E-01	2.3E-02		0.0
Benzo(a)pyrene	1.5E-01	1.5E-02	1.5E-03		0.0
Benzo(b)fluoranthene	1.4	1.4E-01	1.4E-02		0.0
Benzo(k)fluoranthene	4.7	4.7E-01	4.7E-02		0.0
Dibenzo(a,h)anthracene	4.6E-02	4.6E-03	4.6E-04		0.0
Indeno(1,2,3-cd)pyrene	7.3E-01	7.3E-02	7.3E-03		0.0
Aroclor-1254	1.5E-01	1.5E-02	1.5E-03		0.0
Aroclor-1260	2.3E-02	2.3E-03	2.3E-04		0.0
Dieldrin	4.0E-03	4.0E-04	4.0E-05		0.0

See footnotes at end of table.

TABLE 2-3
(Continued)

Parameter	PRIVATE OWNERSHIP On-Property Resident Farmer (RME) PRG (pCi/g or mg/kg) HI[f] = 0.1	HI = 0.2	HI = 1.0	ARAR/ TBC	Surface Soil Background (pCi/g or mg/kg)
Noncarcinognic					
Antimony	0.66	1.33	6.6		0.0
Arsenic	4.54	8.97	45.44		8.20
Lead[g]	-	-	-	400 mg/kg	26.4
Uranium-Total	17900	37000	1.79E+05		3.7

[a]Risk-based PRGs in this table represent the minimum PRGs for any of the Operable Unit 2 subunits. Specific subunit risk-based PRGs for the on-property resident farmer are presented in Appendix D. Data is taken from Table 7-19 of the RI Report. PRGs were calculated using Equation 2-1.

[b]RME = reasonable maximum exposure.

[c]ILCR = incremental lifetime cancer risk.

[d]First 15 cm (6 in.) depth (40 CFR 192) for radium-226 5 progeny and 15 pCi/g added for each additional 15 cm.

[e]First 15 cm (6 in.) depth [DOE Order 5400.5, Chapter IX (4)(a)(2), (3)] and 15 pCi/g added for each additional 15 cm.

[f]HI = hazard index.

[g]Lead PRG applies to the Firing Range area in the South Field

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TABLE 2-5

SUMMARY OF OPERABLE UNIT 2 MODIFIED SOIL PRELIMINARY REMEDIATION GOALS (PRGs)[a] FOR THE EXPANDED TRESPASSER WITH FEDERAL OWNERSHIP

CARCINOGENIC

	FEDERAL OWNERSHIP				Surface Soil Background (pCi/g or mg/kg)
	Expanded Trespasser (pCi/g or mg/kg)			ARAR/ TBC	
COC	10^{-4} ILCR[b]	10^{-5} ILCR	10^{-6} ILCR		
Neptunium-237	4.99E+02	4.99E+01	4.99	-	0.0
Radium-226	3.69E+01	3.69	3.69E-01	5 pCi/g[c]	1.42
Radium-228	7.7E+01	7.7	7.7E-01	5 pCi/g[c]	1.25
Thorium-228	3.99E+01	3.99	3.99E-01		1.43
Thorium-232	2.63E+01	2.63	2.63E-01	5 pCi/g[d]	1.36
Uranium-238	5.36E+03	5.36E+02	5.36E+01		1.22
Arsenic	1.69E+03	1.69E+02	1.69E+01		8.20
Benzo(a)pyrene	2.86E+02	2.86E+01	2.86		0.00

NONCARCINOGENIC

	FEDERAL OWNERSHIP				Surface Soil Background (pCi/g or mg/kg)
	Expanded Trespasser (pCi/g or mg/kg)			ARAR/ TBC	
COC	HI[c] = 0.1	HI = 0.2	HI = 1.0		
Arsenic	560	1000	5600		8.20
Lead[f]	-	-	-	400 mg/kg	26.4
Uranium - Total	102	200	1020		3.7

[a]Modified soil PRGs in this table represent the minimum PRGs for any of the Operable Unit 2 subunits. Specific subunits' modified soil PRGs for the expanded trespasser are presented in Appendix D.
[b]ILCR = incremental lifetime cancer risk.
[c]First 15 cm (6 in.) depth (40 CFR 192) for radium-226 + 5 progeny and 15 pCi/g added for each additional 15 cm in depth.
[d]First 15 cm (6 in.) depth [DOE Order 5400.5 Chapter IV (4)(a)(2),(3)] TBC and 15 pCi/g added for each additional 15 cm in depth.
[e]HI = hazard index.
[f]The lead PRG applies to the Firing Range area in the South Field.

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TABLE 2-9

SOUTH FIELD
CROSS-MEDIA MODIFIED PRGs
PROTECTIVE OF THE GREAT MIAMI RIVER SURFACE WATER
WITHOUT SOURCE CONTROLS

COCs Impacting Great Miami River	Units	Federal Ownership Great Miami River User Modified Soil PRGs[a]			Background
		10^{-4} ILCR[b]	10^{-5} ILCR	10^{-6} ILCR	
Radium-226	pCi/g	2400	240	24	1.42
Technetium-99	pCi/g	7100	710	71	0

[a]Modified soil PRGs were calculated using Equation 2-1.

[b]ILCR = incremental lifetime cancer risk.

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TABLE 2-10

SOUTH FIELD
CROSS-MEDIA MODIFIED SOIL PRGs
MEETING ARARs IN PADDYS RUN WITHOUT SOURCE CONTROLS

COCs Impacting Paddys Run	Federal or Private Ownership Modified Soil PRGs[a] (mg/kg)
Dieldrin	9.57×10^{-3}
Benzo(a)anthracene	4.55×10^{-1}
Benzo(a)pyrene	7.77×10^{-1}
Benzo(b)fluoranthene	5.13×10^{-1}
Benzo(k)fluoranthene	6.03×10^{-1}
Dibenzo(a,h)anthracene	1.57×10^{-1}
Indeno(1,2,3-cd)pyrene	4.96×10^{-1}
Phenanthrene	1.90×10^{-1}

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[a]Modified soil PRGs were calculated using Equation 2-2.

TABLE 2-18

SOLID WASTE LANDFILL
MODIFIED SOIL PRGs
PROTECTIVE OF THE GREAT MIAMI AQUIFER USING A CAP

COCs Impacting Groundwater	Units	Federal Ownership Modified Soil PRGs[a] (Off-Property Resident Farmer) 10^{-6} ILCR[b]	0.2 HI[c]	ARAR	Background Concentration
Uranium-234	pCi/g	>100,000	NA[d]	NA	1.04
Uranium-235/236	pCi/g	>100,000	NA	NA	0.15
Uranium-238	pCi/g	>100,000	NA	NA	1.12
Uranium-Total	mg/kg	NA	>100,000	>100,000	3.4

[a]Modified soil PRGs are based on ODAST/SWIFT modeling and assume an infiltration rate of 1.14 in./yr through the cap and soils (HELP model results). Glacial till K_d and Great Miami Aquifer K_d were assumed to be 24 mL/g and 1.78 mL/g, respectively.

[b]ILCR = incremental lifetime cancer risk.

[c]HI = hazard index.

[d]NA = not applicable.

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TABLE 2-19

LIME SLUDGE PONDS
MODIFIED SOIL PRGs
PROTECTIVE OF THE GREAT MIAMI AQUIFER USING A CAP

COCs Impacting Groundwater	Units	Federal Ownership Modified Soil PRGs[a] (Off-Property Resident Farmer)			Background Concentration
		10^{-6} ILCR[b]	0.2 HI[c]	ARAR	
Uranium-234	pCi/g	>100,000	NA[d]	NA	1.04
Uranium-235/236	pCi/g	>100,000	NA	NA	0.15
Uranium-238	pCi/g	>100,000	NA	NA	1.12
Uranium-Total	mg/kg	NA	>100,000	>100,000	3.4

[a]Modified soil PRGs are based on ODAST/SWIFT modeling and assume an infiltration rate of 1.14 in./yr through the cap and soils (HELP model results). Glacial till K_d and Great Miami Aquifer K_d were assumed to be 24 mL/g and 1.78 mL/g, respectively.

[b]ILCR = incremental lifetime cancer risk.

[c]HI = hazard index.

[d]NA = not applicable.

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TABLE 2-22

SUMMARY OF OPERABLE UNIT 2 PRLS FOR PRIVATE OWNERSHIP

COC	Background Value[b]	Private Ownership On-Property Resident Farmer (RME)[a] PRL (pCi/g or mg/kg)				
		10^{-4} ILCR[c]	10^{-5} ILCR	10^{-6} ILCR	HI[d] 0.2	ARAR
ALL SUBUNITS						
Radium-226	1.42	1.81	1.46	1.43	-	6.42
Radium-228	1.25	2.07	1.33	1.26	-	6.25
Thorium-228	1.43	1.85	1.44	1.43	-	-
Thorium-232	1.36	1.64	1.39	1.36	-	6.36
SOLID WASTE LANDFILL						
Neptunium-237	0.0	4.3	4.3E-1	4.3E-2	-	-
Thorium-230	1.97	79	9.6	2.74	-	6.97
Technetium-99	0.0	1.89E-1	1.89E-2	1.89E-3	-	-
Strontium-90	0.0	1.6	1.6E-1	1.6E-2	-	-
Plutonium-238	0.0	4.0E+1	4.0	4.0E-1	-	-
Uranium-234	1.04	9.29	1.86	1.12	-	-
Uranium-235/236	0.15	8.4	0.97	0.23	-	-
Uranium-238	1.12	6.52	1.66	1.17	1.12[e]	1.12[e]
Uranium-238[f]	1.22	26.2	3.72	1.47	-	-
Antimony	0.0	-	-	-	1.33	-
Arsenic	8.2	8.2	8.2	8.2	-	-
Beryllium	0.6	3.3	0.6	0.6	-	-
Benzo(a)anthracene	0.0	2.3	2.3E-1	2.3E-2	-	-
Benzo(a)pyrene	0.0	1.5E-1	1.5E-2	1.5E-3	-	-
Benzo(b)fluoranthene	0.0	1.4	1.4E-1	1.4E-2	-	-
Carbazole	0.0	6.43E-1	6.43E-2	6.43E-3	-	-
Dibenzo(a,h)anthracene	0.0	4.6E-2	4.6E-3	4.6E-4	-	-
Indeno(1,2,3-cd)pyrene	0.0	7.3E-1	7.3E-2	7.3E-3	-	-
Uranium-Total	3.4	-	-	-	3.4	3.4
LIME SLUDGE POND						
Cesium-137	0.71	1.8	0.89	0.72	-	-
Neptunium-237	0.0	5.1E-1	5.1E-2	5.1E-3	-	-
Strontium-90	0.0	5.6E-1	5.6E-2	5.6E-3	-	-
Technetium-99	0.0	1.89E-1	1.89E-2	1.89E-3	-	-
Thorium-230	1.97	79	9.6	2.74	-	6.97
Uranium-234	1.04	23	3.24	1.26	-	-
Uranium-235/236	0.15	9.2	1.05	0.24	-	-
Uranium-238	1.12	15.5	2.56	1.26	1.12[e]	1.33[e]
Uranium-238[f]	1.22	26.2	3.72	1.47	-	-
Uranium-Total	3.4	-	-	-	3.4	4.0

See footnotes at end of table.

TABLE 2-22
(Continued)

COC	Background Value[b]	Private Ownership On-Property Resident Farmer (RME)[a] PRL (pCi/g or mg/kg)				
		10^{-4} ILCR[c]	10^{-5} ILCR	10^{-6} ILCR	HI[d] 0.2	ARAR
ACTIVE FLYASH PILE						
Cesium-137	0.71	1.8	0.89	0.72	-	-
Neptunium-237	0.0	4.3	4.3E-1	4.3E-2	-	-
Arsenic	8.2	8.2	8.2	8.2	-	-
Beryllium	0.6	3.3	0.6	0.6	-	-
Uranium-234	1.24	78.2	8.9	2.0	-	-
Uranium-235/236	0.15	9.2	1.05	0.24	-	-
Uranium-238	1.22	26.2	3.72	1.47	8[e]	9.3[e]
Uranium-Total	3.4	-	-	-	24	28
INACTIVE FLYASH PILE						
Arsenic	8.2	8.2	8.2	8.2	-	-
Dibenzo(a,h)anthracene	0.0	4.6E-2	4.6E-3	4.6E-4	-	-
Uranium-234	1.24	78.2	8.9	2.0	-	-
Uranium-235/236	0.15	9.2	1.05	0.24	-	-
Uranium-238	1.22	26.2	3.72	1.47	7[e]	8.3[e]
Uranium-Total	3.4	-	-	-	21	24.8
SOUTH FIELD						
Cesium-137	0.71	1.8	0.89	0.72	-	-
Neptunium-237	0.0	4.3	4.3E-1	4.3E-2	-	-
Thorium-230	1.97	79	9.6	2.74	-	6.97
Strontium-90	0.0	1.6	1.6E-1	1.6E-2	-	-
Technetium-99	0.0	1.74	1.74E-1	1.74E-2	-	-
Uranium-234	1.24	78.2	8.9	2.0	-	-
Uranium-235/236	0.15	9.2	1.05	0.24	-	-
Uranium-238	1.22	26.2	3.72	1.47	7[e]	8.3[e]
Uranium-Total	3.4	-	-	-	21	24.8
Arsenic	8.2	8.2	8.2	8.2	-	-
Beryllium	0.6	3.3	0.6	0.6	-	-
Aroclor-1254	0.0	1.5E-1	1.5E-2	1.5E-3	-	-
Aroclor-1260	0.0	2.3E-2	2.3E-3	2.3E-4	-	-
Benzo(a)anthracene	0.0	2.3	2.3E-1	2.3E-2	-	0.455
Benzo(a)pyrene	0.0	1.5E-1	1.5E-2	1.5E-3	-	0.777
Benzo(b)fluoranthene	0.0	1.4	1.4E-1	1.4E-2	-	0.513
Benzo(k)fluoranthcene	0.0	4.7	4.7E-1	4.7E-2	-	0.603
Dibenzo(a,h)anthracene	0.0	4.6E-2	4.6E-3	4.6E-4	-	0.157
Dieldrin	0.0	4.0E-3	4.0E-4	4.0E-5	-	9.57E-3

See footnotes at end of table.

TABLE 2-22
(Continued)

COC	Background Value[b]	Private Ownership				
		On-Property Resident Farmer (RME)[a] PRL (pCi/g or mg/kg)				
		10^{-4} ILCR[c]	10^{-5} ILCR	10^{-6} ILCR	HI[d] 0.2	ARAR
SOUTH FIELD (Continued)						
Indeno(1,2,3-cd)pyrene	0.0	7.3E-1	7.3E-2	7.3E-3	-	0.496
Phenanthrene	0.0	-	-	-	-	0.19
Lead[g]	26.4	-	-	-	-	400 mg/kg

[a]RME = reasonable maximum exposure.

[b]Background value from RI Report, Table 4-1a, surface concentrations.

[c]ILCR = incremental lifetime cancer risk; value shown is ILCR plus background.

[d]HI = hazard index.

[e]This value determined by calculating the uranium-238 concentration in uranium-total.

[f]This PRL applies for direct contact with surface soils and becomes significant in the Solid Waste Landfill and Lime Sludge Ponds when the perched groundwater is remediated and no longer applies.

[g]The lead PRL is applicable to the Firing Range area in the South Field.

TABLE 2-23

SUMMARY OF OPERABLE UNIT 2 ~~RISK-BASED SOIL~~ PRLs FOR FEDERAL OWNERSHIP

		FEDERAL OWNERSHIP				
		All Receptors PRL (pCi/g or mg/kg)				
COC	Background[a]	10^{-4} ILCR[b]	10^{-5} ILCR	10^{-6} ILCR	HI[c] 0.2	ARAR
ALL SUBUNITS						
Radium-226	1.42	38.3	5.1	1.8	-	6.42
Radium-228	1.25	78.3	8.9	2.0	-	6.25
Thorium-228	1.43	41.3	5.4	1.8	-	-
Thorium-232	1.36	27.6	3.9	1.5	-	6.36
SOLID WASTE LANDFILL						
Uranium-234[d]	1.04	6191	620	62.9	-	-
Uranium-235/236[d]	0.15	6190	619	63.1	-	-
Uranium-238	1.22	5361	537	54.8	318.7[e]	12.9[e]
Uranium-Total	3.4	-	-	-	200	38.6
LIME SLUDGE POND						
Uranium-234[d]	1.04	19501	1951	196	-	-
Uranium-235/236[d]	0.15	19500	1950	195	-	-
Uranium-238	1.22	5361	537	54.8	1000[e]	45.3[e]
Uranium-Total	3.4	-	-	-	200	136
ACTIVE FLYASH PILE						
Arsenic	8.2	1690	169	16.9	-	-
Neptunium-237	0.0	4.99E+2	4.99E+1	4.99	-	-
Uranium-234[d]	1.04	761	77.0	8.64	-	-
Uranium-235/236[d]	0.15	760	76.2	7.75	-	-
Uranium-238[d]	1.12	501	51.1	6.12	57.3[e]	9.3[e]
Uranium-Total[d]	3.4	-	-	-	172	28
INACTIVE FLYASH PILE (SOURCE OVER THE GREAT MIAMI AQUIFER)						
Arsenic	8.2	1690	169	16.9	-	-
Uranium-234[d]	1.04	1251	92	8.68	-	-
Uranium-235/236[d]	0.15	1250	91	7.79	-	-
Uranium-238[d]	1.12	820	61	6.12	39.3[e]	8.3[e]
Uranium-Total[d]	3.4	-	-	-	118	24.8

See footnotes at end of table.

TABLE 2-23
(Continued)

COC	Background[a]	FEDERAL OWNERSHIP All Receptors PRL (pCi/g or mg/kg)				
		10^{-4} ILCR[b]	10^{-5} ILCR	10^{-6} ILCR	HI[c] 0.2	ARAR
INACTIVE FLYASH PILE (SOURCE OVER THE GLACIAL TILL TERRACE)						
Arsenic	8.2	1690	169	16.9	-	-
Uranium-234[d]	1.04	321	33	4.24	-	-
Uranium-235/236[d]	0.15	320	32	3.35	-	-
Uranium-238[d]	1.12	211	22	3.22	16.7[e]	8.3[e]
Uranium-Total[d]	3.4	-	-	-	50	24.8
SOUTH FIELD (SOURCE OVER THE GREAT MIAMI AQUIFER)						
Aroclor-1260[d]	0.0	2500	250	25	-	-
Benzo(a)anthracene	0.0	-	-	-	-	0.455
Benzo(a)pyrene	0.0	286	28.6	2.86	-	0.777
Benzo(b)fluoranthene[d]	0.0	-	-	-	-	0.513
Benzo(k)fluoranthene	0.0	-	-	-	-	0.603
Dibenzo(a,h,)anthracene[d]	0.0	1300	130	13	-	0.157
Dieldrin	0.0	-	-	-	-	9.57E-3
Indeno(1,2,3-cd)pyrene[d]	0.0	20000	2000	200	-	0.496
Phenanthrene	0.0	-	-	-	-	0.19
Lead[f]	26.4	-	-	-	-	400
Technetium-99	0.0	7100	710	71	-	-
Thorium-230[d]	1.97	40002	4002	402	-	6.97
Uranium-234[d]	1.04	1251	92	8.68	-	-
Uranium 235/236[d]	0.15	1250	91	7.79	-	-
Uranium-238[d]	1.12	820	61	6.12	57.3[e]	8.3[e]
Uranium-Total[d]	3.4	-	-	-	118	24.8
SOUTH FIELD (SOURCE OVER THE GLACIAL TILL)						
Aroclor-1260[d]	0.0	2500	250	25	-	-
Benzo(a)anthracene	0.0	-	-	-	-	0.455
Benzo(a)pyrene	0.0	286	28.6	2.86	-	0.777
Benzo(b)fluoranthene[d]	0.0	-	-	-	-	0.513
Benzo(k)fluoranthene	0.0	-	-	-	-	0.603
Dibenzo(a,h,)anthracene[d]	0.0	1300	130	13	-	0.157
Dieldrin	0.0	-	-	-	-	9.57E-3
Indeno(1,2,3-cd)pyrene[d]	0.0	20000	2000	200	-	0.496
Phenanthrene	0.0	-	-	-	-	0.19
Technetium-99	0.0	7100	710	71	-	-

TABLE 2-23
(Continued)

COC	Background[a]	FEDERAL OWNERSHIP All Receptors PRL (pCi/g or mg/kg)				
		10^{-4} ILCR[b]	10^{-5} ILCR	10^{-6} ILCR	HI[c] 0.2	ARAR
SOUTH FIELD (SOURCE OVER THE GLACIAL TILL)						
Thorium-230[d]	1.97	40002	4002	402	-	6.97
Uranium-234[d]	1.04	321	33	4.24	-	-
Uranium 235/236[d]	0.15	320	32	3.35	-	-
Uranium-238[d]	1.12	211	22	3.22	16.7[e]	8.3[e]
Uranium-Total[d]	3.4	-	-	-	50	24.8

[a]Background value from RI Report, Table 4-1A, surface concentrations.

[b]ILCR = incremental lifetime cancer risk; value shown is ILCR plus background.

[c]HI = hazard index.

[d]PRL due to off-property resident farmer receptor

[e]This value determined by calculating the uranium-238 concentration in uranium-total.

[f]The lead PRL applies to the Firing Range area in the South Field

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000103

TABLE 2-24

SUMMARY OF OPERABLE UNIT 2 RISK-BASED SOIL PRLs FOR FEDERAL OWNERSHIP (LATERAL MIGRATION CONTROLS)

COC	Background[a]	FEDERAL OWNERSHIP All Receptors - PRL (pCi/g or mg/kg)				
		10^{-4} ILCR[b]	10^{-5} ILCR	10^{-6} ILCR	HI[c] 0.2	ARAR
ALL SUBUNITS[d]						
Radium-226	1.42	38.3	5.1	1.8	-	6.42
Radium-228	1.25	78.3	8.9	2.0	-	6.25
Thorium-228	1.43	41.3	5.4	1.8	-	-
Thorium-232	1.36	27.6	3.9	1.5	-	6.36
SOLID WASTE LANDFILL[d]						
Uranium-234[e]	1.04	6191	620	62.9	-	-
Uranium-235/236[e]	0.15	6190	619	63.1	-	-
Uranium-238	1.22	5361	537	54.8	318.7[f]	12.9[f]
Uranium-Total	3.4	-	-	-	200	38.6
LIME SLUDGE POND[d]						
Uranium-234[e]	1.04	19501	1951	196	-	-
Uranium-235/236[e]	0.15	19500	1950	195	-	-
Uranium-238	1.22	5361	537	54.8	1000[f]	45.3[f]
Uranium-Total	3.4	-	-	-	200	136
ACTIVE FLYASH PILE[d]						
Arsenic	8.2	1690	169	16.9	-	-
Uranium-234[e]	1.04	761	77.0	8.64	-	-
Uranium-235/236[e]	0.15	760	76.2	7.75	-	-
Uranium-238[e]	1.12	501	51.1	6.12	57.3[f]	9.3[f]
Uranium-Total[e]	3.4	-	-	-	172	28
INACTIVE FLYASH PILE (Source Material over the Great Miami Aquifer)						
Arsenic	8.2	1690	169	16.9	-	-
Uranium-234[e]	1.04	1251	92	8.68	-	-
Uranium-235/236[e]	0.15	1250	91.2	7.79	-	-
Uranium-238[e]	1.12	820	61.1	6.12	57.3[f]	150[f]
Uranium-Total[e]	3.4	-	-	-	172	28
INACTIVE FLYASH PILE (Source Material over the Glacial Till Terrace)						
Arsenic	8.2	1690	169	16.9	-	-
Uranium-234[e]	1.04	10700	1071	108	-	-
Uranium-235/236[e]	0.15	10700	1070	107	-	-
Uranium-238	1.22	5361	537	54.8	-	-
Uranium-238[g]	1.12	7001	701	71	991.7[f]	150[f]
Uranium-Total[e]	3.4	-	-	-	2975	450
SOUTH FIELD (Source Material over the Great Miami Aquifer)						
Aroclor-1260[e]	0.0	2500	250	25	-	-
Benzo(a)anthracene	0.0	286	28.6	2.86	-	0.455

See footnotes at end of table.

000104

TABLE 2-24
(Continued)

COC	Background[a]	FEDERAL OWNERSHIP				
		All Receptors - PRL (pCi/g or mg/kg)				
		10^{-4} ILCR[b]	10^{-5} ILCR	10^{-6} ILCR	HI[c] 0.2	ARAR
SOUTH FIELD (Source Material over the Great Miami Aquifer) Continued						
Benzo(a)pyrene	0.0	286	28.6	2.86	-	0.777
Benzo(b)fluoranthene[e]	0.0	-	-	-	-	0.513
Benzo(k)fluoranthene	0.0	-	-	-	-	0.603
Dibenzo(a,h)anthracene[e]	0.0	1300	130	13	-	0.157
Dieldrin	0.0	-	-	-	-	9.57E-3
Indeno(1,2,3-cd)pyrene[e]	0.0	20000	2000	200	-	0.496
Lead[h]	26.4	-	-	-	-	400
Phenanthrene	0.0	-	-	-	-	0.19
Technetium-99	0.0	7100	710	71	-	-
Thorium-230[e]	1.97	40002	4002	402	-	6.97
Uranium-234[e]	1.04	1251	92	8.68	-	-
Uranium 235/236[e]	0.15	1250	91.2	7.79	-	-
Uranium-238[d]	1.12	820	61.1	6.12	57.3[f]	9.3[f]
Uranium-Total[e]	3.4	-	-	-	172	28
SOUTH FIELD (Source Material over the Top of the Glacial Till Terrace)						
Aroclor-1260[e]	0.0	2500	250	25	-	-
Benzo(a)anthracene	0.0	-	-	-	-	0.455
Benzo(a)pyrene	0.0	286	28.6	2.86	-	0.777
Benzo(b)fluoranthene[e]	0.0	-	-	-	-	0.513
Benzo(k)fluoranthene	0.0	-	-	-	-	0.603
Dibenzo(a,h)anthracene[e]	0.0	1300	130	13	-	0.157
Dieldrin	0.0	-	-	-	-	9.57E-3
Indeno(1,2,3-cd)pyrene[e]	0.0	20000	2000	200	-	0.496
Phenanthrene	0.0	-	-	-	-	0.19
Technetium-99	0.0	7100	710	71	-	-
Thorium-230[e]	1.97	40002	4002	402	-	6.97
Uranium-234[e]	1.04	10700	1071	108	-	-
Uranium 235/236[e]	0.15	10700	1070	107	-	-
Uranium-238	1.22	5361	537	54.8	991.7[f]	150[f]
Uranium-238[g]	1.12	7001	701	71	991.7[f]	150[f]
Uranium-Total[e]	3.4	-	-	-	2975	450

[a]Background value from RI Report, Table 4-1A, surface concentrations.
[b]ILCR = incremental lifetime cancer risk; value shown is ILCR plus background.
[c]HI = hazard index.
[d]Lateral migration controls are only employed for the Inactive Flyash Pile and South Field and only effect groundwater; thus, the only PRLs that change from Table 2-23 are uranium-234, 235/236, 238, and total uranium for the Inactive Flyash Pile and South Field.
[e]PRL due to off-property resident farmer receptor.
[f]This value determined by calculating the uranium-238 concentration in uranium-total.
[g]This PRL applies for protection of groundwater and becomes significant when the lateral migration of perched groundwater is controlled and direct contact no longer applies (i.e., excavations below the impacted till).
[h]The Lead PRL applies to the Firing Range area in the South Field.

TABLE 2-25

SUMMARY OF OPERABLE UNIT 2 RISK-BASED SOIL PRLs FOR FEDERAL OWNERSHIP (LATERAL GROUNDWATER MITIGATION CONTROLS AND INFILTRATION SOURCE CONTROLS)

		FEDERAL OWNERSHIP				
		All Receptors PRL[c] (pCi/g or mg/kg)				
COC	Background[a]	10^{-4} ILCR[b]	10^{-5} ILCR	10^{-6} ILCR	HI[d] 0.2	ARAR
SOLID WASTE LANDFILL						
Uranium-234	1.04	> 1E+5	> 1E+5	> 1E+5	-	-
Uranium-235/236	0.15	> 1E+5	> 1E+5	> 1E+5	-	-
Uranium-238	1.12	> 1E+5	> 1E+5	> 1E+5	>30,000[e]	>30,000[e]
Uranium-Total	3.4	-	-	-	>1E+5	> 1E+5
LIME SLUDGE PONDS						
Uranium-234	1.04	> 1E+5	> 1E+5	> 1E+5	-	-
Uranium-235/236	0.15	> 1E+5	> 1E+5	> 1E+5	-	-
Uranium-238	1.12	> 1E+5	> 1E+5	> 1E+5	>30,000[e]	>30,000[e]
Uranium-Total	3.4	-	-	-	> 1E+5	> 1E+5
ACTIVE FLYASH PILE/SOUTH FIELD/INACTIVE FLYASH PILE[d]						
Uranium-234	1.04	> 1E+5	> 1E+5	> 10,000	-	-
Uranium-235/236	0.15	> 1E+5	> 1E+5	> 10,000	-	-
Uranium-238	1.12	> 1E+5	> 1E+5	> 10,000	>3,000[e]	>3,000[e]
Uranium-Total	3.4	-	-	-	> 10,000	> 10,000

[a]Background value from RI Report, Table 4-1A, surface concentrations.

[b]ILCR = incremental lifetime cancer risk; value shown is ILCR plus background.

[c]PRL due to off-property resident farmer receptor only.

[d]HI = hazard index.

[e]This value determined by calculating the uranium-238 concentration in uranium-total.

[f]The Active Flyash Pile, South Field, and Inactive Flyash Pile are consolidated prior to capping. The capping controls are performed in conjunction with lateral perched water controls for these subunits.

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6351

Section 3

Section 3 had no changed pages.

Section 4

subsurface drain would discharge by gravity into a pumping station. Collected leachate/groundwater would be pumped to the AWWT facility for treatment.

Following the completion of consolidation activities at each subunit, excavated areas would be backfilled and regraded (see Section 4.2.5.2). A multi-layered capping system would then be constructed over the consolidated materials. (Refer to Appendix E for details.)

The consolidation and capping alternative would include the following institutional actions at each of the consolidation areas: access restrictions (fencing); groundwater monitoring; cap maintenance; and deed restrictions to prohibit use of groundwater and future development.

4.3.2.2 <u>Screening Evaluation</u>

<u>Effectiveness</u>

<u>Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment</u> - Alternative 2 would No. 51 not reduce the mobility or toxicity of the contaminated material. ~~However, through containment in the capped consolidation areas and installation of a subsurface drainage system in the South Field area, infiltration and migration of perched groundwater would be minimized.~~ Crushing/shredding would be utilized, as necessary, to make specified material more manageable and would result in a slight decrease in volume. Finally, treatment (assumed to be stabilization/solidification; see Section 4.2.5.4) of the contaminated material from the Firing Range would reduce the mobility of contaminants but increase the total volume for disposal. Because the volume of lead-contaminated mixed waste would only be approximately 0.1 percent of the total volume to be consolidated, the net effect of these activities would be that total volume would be essentially unchanged.

<u>Long-Term Protection of Human Health and the Environment</u> - Under Alternative 2, contaminated material above the PRLs and directly overlying the Great Miami Aquifer in the South Field area (including the Active and Inactive Flyash Piles) would be removed to the consolidation area. This would eliminate a source of contamination that leaches directly into the aquifer. The subsurface drainage system would preclude the lateral migration of contaminants, thus eliminating a pathway for transport into the aquifer. Furthermore, the capping systems and drainage layer (South Field area only) would minimize infiltration, thus decreasing the potential for leaching to groundwater. The capping systems would also preclude ingestion of, dermal contact with, inhalation of, and direct radiation exposure from the contaminated material.

The impact to wetlands under this alternative would be minimal. Adequate space is available on site for replacement of the engineered drainage ditches.

Uncertainties exist regarding the long-term protection of human health and the environment due to the lack of engineered liner systems in the consolidation areas and, therefore, the inability to detect the migration of contaminants until they reach the groundwater. In addition, this alternative would not be protective under the private ownership land-use scenario.

Short-Term Protection of Human Health and the Environment - Impacts during implementation of this alternative would be minimal. Not all contaminated material would be excavated and consolidated, and only a minimal amount ((lead-contaminated mixed waste) would be transported off site. Measures to achieve as-low-as-reasonably-achievable (ALARA) levels and to meet ARARs, transportation requirements, DOE orders, and Occupational Safety and Health Administration (OSHA) requirements, such as wetting dusty areas and covering trucks and storage areas, would be implemented to manage risks to acceptable levels.

The implementation period for Alternative 2 would be approximately 51 months.

Implementability

Technical Feasibility - Excavation, shredding/crushing, treatment, transport, and capping are technically feasible processes. The capping systems would require periodic inspection and maintenance to ensure integrity and continued performance.

Administrative Feasibility - Although minimal, impacts to wetlands would require coordination with U.S. Army Corps of Engineers (COE), Ohio Environmental Protection Agency (OEPA), and EPA. No other permits or licenses are anticipated. Therefore, coordination regarding wetlands impacts is expected to be a relatively minor issue. The alternative would require continued institutional controls.

Availability of Services and Materials - Engineering services, equipment, and operational personnel needed to implement this alternative are readily available.

Costs

No. 68 As presented in Appendix F.3, the total cost for Alternative 2 in 1994 constant dollars would be approximately ~~$73~~ $86 million.

would require coordination with COE, OEPA, and EPA. Complying with these approval and coordination requirements is expected to be involved, but not prohibitive.

Availability of Services and Materials - Engineering services, equipment, and operational personnel for this alternative are readily available. It is anticipated that the designated off-site disposal facility has adequate capacity to accommodate the Operable Unit 2 material.

Costs

No. 68 The total cost for Alternative 3 ~~would be~~ in 1994 constant dollars is approximately ~~$200~~ $246 million (see Appendix F.3). This cost would be significantly higher for the private ownership land-use scenario due to the fact that the volume of contaminated material that would require off-site disposal would increase from over 200,000 cu m (300,000 cu yd) to nearly 600,000 cu m (800,000 cu yd).

Summary

Alternative 3 would meet RAOs and provide long-term protection. The alternative is technically feasible, but the administrative feasibility is considered difficult. Because all of the excavated material, except that from the Firing Range (which will be treated), is expected to meet WAC for the designated off-site disposal facility, this alternative is retained for detailed analysis.

4.3.4 Alternative 4: Excavation and Off-Site Disposal with Treatment of Fraction Exceeding WAC

4.3.4.1 Description

Alternative 4 includes all of the measures described under Alternative 3 and adds treatment (Section 4.2.5.4) of excavated material that exceeds the WAC for the off-site disposal facility.

4.3.4.2 Screening Evaluation

Effectiveness

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment - As in Alternative 3, there would be no significant change in volume as a result of Alternative 4 (no additional material is expected to require treatment). Toxicity and mobility (only a small amount of lead-contaminated mixed waste would be treated) would not be affected, although the off-site disposal facility is sited and managed to reduce migration.

Long-Term Protection of Human Health and the Environment - The long-term effectiveness of Alternative 4 would be essentially the same as for Alternative 3.

Short-Term Protection of Human Health and the Environment - The short-term effectiveness of Alternative 4 would be essentially the same as for Alternative 3. (No additional material is expected to require treatment.)

Implementability

Technical Feasibility - The technical feasibility of Alternative 4 would be essentially the same as for Alternative 3.

Administrative Feasibility - The administrative feasibility of Alternative 4 would be essentially the same as for Alternative 3.

Availability of Services and Materials - The availability of services and materials would be essentially the same as for Alternative 3.

Costs

No. 68 The total cost for Alternative 4 in 1994 constant dollars is approximately $20~~0~~ 46 million (see Appendix F.3). These costs are identical to those for Alternative 3, since no additional material is expected to require treatment to meet WAC.

Summary

Because all of the excavated material from Operable Unit 2, except that from the Firing Range, is expected to meet WAC for the designated off-site disposal facility, Alternative 4 is not retained for detailed analysis, in favor of Alternative 3.

4.3.5 Alternative 5: Excavation and On-Site Disposal

4.3.5.1 Description

Alternative 5 includes excavation of all soils with COCs above the PRLs (see Section 4.2.5.2), material processing for size reduction and moisture control (if required), and on-site disposal in an engineered disposal cell (Section 4.2.5.5). Excavation activities and construction of the disposal cell would be coordinated with Operable Units 1, 3, 4, and 5.

At the North Lime Sludge Pond, free-standing water would be removed (see Section 4.2.5.3). To improve its handling/compaction characteristics, lime sludge would be mixed with other waste material (such as flyash) as necessary. Non-soil material (e.g., concrete, steel, pallets, etc.) from all subunits would be visually segregated, hauled to the staging/material preparation area, processed for size reduction, and placed in the on-site disposal cell.

This alternative would require the following institutional actions at the on-site disposal cell: access restrictions (fencing); groundwater monitoring; cap maintenance; and deed restrictions to prohibit use of groundwater and future development.

4.3.5.2 Screening Evaluation

Effectiveness

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment - Alternative 5 would
No. 51 not reduce the inherent mobility or toxicity of the contaminated material. ~~However, through containment in an engineered cell, the potential for the contaminated material to migrate would be minimized.~~ Crushing/shredding and drying would be utilized, as necessary, to make specified material more manageable and would result in a decrease in volume. Finally, treatment (assumed to be stabilization/solidification; see Section 4.2.5.4) of the contaminated material from the Firing Range would reduce the mobility of contaminants but slightly increase the total volume for disposal. In total, there would be no significant change in volume.

Long-Term Protection of Human Health and the Environment - Under Alternative 5, contaminated material above the PRLs would be removed, deposited in the on-site disposal cell, and capped. This
No. 51 would contain the source of contamination and preclude contact and exposure. Containment in an engineered cell would minimize the potential for contamination.

Preliminary studies indicate that an on-site disposal cell would be protective of human health and the environment over time. This protectiveness would be verified by a monitoring system.

The impact to wetlands under this alternative would be minimal. Adequate space is available on-site for replacement of the engineered drainage ditches.

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Short-Term Protection of Human Health and the Environment - Impacts to workers during implementation of this alternative could be significant. Measures to achieve ALARA levels and to meet ARARs, transportation requirements, DOE orders, and OSHA requirements, such as wetting dusty areas and covering trucks and storage areas, would be implemented to manage risks to acceptable levels. Increased risk to workers is possible due to the excavation and management of a large volume of contaminated material.

The implementation period for Alternative 5 would be approximately 51 months.

Implementability

Technical Feasibility - Excavation, shredding/crushing, drying, transport, and capping are technically feasible processes. The engineered disposal cell would require periodic inspection and maintenance to ensure integrity. There is some uncertainty regarding the ability to meet WAC for the on-site disposal cell. Alternatives 6 and 7 address this uncertainty.

Administrative Feasibility - Although minimal, impacts to wetlands would require coordination with COE, OEPA, and EPA. A waiver from an OEPA regulation prohibiting the siting of a disposal facility over a sole-source aquifer would be required. Coordination regarding wetlands impacts is expected to be a relatively minor issue, and the waiver is expected to be justifiable.

Availability of Services and Materials - Engineering services, equipment, and operational personnel for this alternative are readily available. The disposal facility would be sized to accommodate contaminated material from other operable units, as required, and there is adequate space on site for the facility.

Costs

No. 68 ~~As presented in Appendix F.3, t~~ The total cost for Alternative 5 in 1994 constant dollars is approximately $1~~11~~ 28 million (see Appendix F.3). This cost would increase significantly for the private ownership land-use scenario due to the fact that the volume of contaminated material that would be deposited in the on-site disposal cell would increase from over 200,000 cu m (300,000 cu yd) to nearly 600,000 cu m (800,000 cu yd).

Summary

Alternative 5 would meet RAOs and has the potential to provide long-term protection. The alternative is technically and administratively feasible. However, since it is anticipated that some contaminated material would not meet the WAC for the on-site disposal cell, the alternative is not retained for detailed analysis, in favor of Alternatives 6 and 7.

4.3.6 Alternative 6: Excavation and On-Site Disposal with Off-site Disposal of Fraction Exceeding WAC

4.3.6.1 Description

Alternative 6 includes all of the measures described under Alternative 5 and adds off-site disposal (see Section 4.2.5.5) of a small fraction of the excavated material that exceeds the WAC of the on-site disposal facility (see Appendix E.2). It is expected that up to 2,400 cu m (3,100 cu yd) of material would not meet the WAC for on-site disposal and would require disposal at the designated off-site facility.

4.3.6.2 Screening Evaluation

Effectiveness

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment - As in Alternative 5, No. 51 ~~Alternative 6 would minimize the migration potential of the contaminated material through containment in an engineered cell,~~ Tthe net volume of contaminated material would be essentially unchanged, and the toxicity and inherent mobility would not be affected.

Long-Term Protection of Human Health and the Environment - The long-term effectiveness of Alternative 6 would be essentially the same as that for Alternative 5, except uncertainty regarding the No. 51 ability to meet WAC for the on-site disposal cell would be eliminated. Containment in an engineered cell would minimize the potential for contamination to migrate.

Short-Term Protection of Human Health and the Environment - The short-term effectiveness of Alternative 6 would be essentially the same as that for Alternative 5, except for the increased potential for exposure to workers and the public from the off-site transportation of the fraction not meeting WAC for the on-site disposal cell.

Implementability

Technical Feasibility - The technical feasibility of Alternative 6 would be essentially the same as for Alternative 5.

Administrative Feasibility - The administrative feasibility of Alternative 6 would be essentially the same as for Alternative 5. However, EPA and DOT approvals and coordination would be required for the increased amount of contaminated material to be shipped off site.

Availability of Services and Materials - The availability of services and materials would be essentially the same as for Alternative 5.

Costs

No. 68 The total cost for Alternative 6 in 1994 constant dollars is ~~estimated to be~~ approximately ~~$112~~ $129 million, including approximately $1.3 million for off-site transportation and disposal of material that would not meet WAC for the on-site disposal cell (see Appendix F.3).

Summary

Alternative 6 eliminates any concern over meeting WAC for the on-site disposal cell and is as effective, implementable, and cost effective as Alternative 5. Therefore, the alternative is retained for detailed analysis.

4.3.7 Alternative 7: Excavation and On-Site Disposal with Treatment of Fraction Exceeding WAC

4.3.7.1 Description

Alternative 7 includes all of the measures described under Alternative 5 and adds treatment (see Section 4.2.5.4) of up to 2,400 cu m (3,100 cu yd) of the excavated material with COC concentrations that exceed the WAC of the on-site disposal facility.

4.3.7.2 Screening Evaluation

Effectiveness

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment - As in Alternatives 5 and 6, the net volume of contaminated material would be essentially unchanged under Alternative 7, No. 41 since the volume of material requiring treatment is expected to be insignificant (approximately 1% of the Operable Unit 2 waste volume). The mobility of a portion of the contaminated material would be No. 51 reduced through treatment. ~~, and the disposal cell would effectively minimize the migration of contaminants.~~ The toxicity would not be changed.

Long-Term Protection of Human Health and the Environment - The long-term effectiveness of Alternative 7 would be essentially the same as for Alternatives 5 and 6, except uncertainty regarding No. 41 the ability to meet WAC for the on-site disposal cell would be eliminated. Alternative 7, like Alternatives 3, 4, 5, and 6, eliminates the principal threat at Operable Unit 2 by excavating the No. 51 contaminated material in the Inactive Flyash Pile that is located directly over the GMA. Containment in an engineered cell would minimize the potential for contamination to migrate.

Short-Term Protection of Human Health and the Environment - The short-term effectiveness of Alternative 7 would be essentially the same as for Alternatives 5 and 6, except for the increased potential for exposure to workers from the additional handling and treatment of the fraction not meeting WAC for the on-site disposal cell.

Implementability

No. 41 Technical Feasibility - ~~The technical feasibility of Alternative 7 would be essentially the same as that for Alternatives 5 and 6. However, the treatability of the fraction exceeding WAC for the on-site disposal cell would need to be verified.~~ The technical feasibility of Alternative 7 is similar to that of Alternatives 5 and 6. Alternative 7 is considered less implementable than Alternative 6 for the following reasons:

- Candidate treatment technologies are under study at the FEMP, but a practical and fully proven soil treatment technology has not yet been identified.

- For the minor amount of material under consideration, it is considered impractical to implement a treatment facility specific to Operable Unit 2. Hence, any treatment facility would be implemented by another operable unit at the site.

- Currently, the only treatment technology that has been identified as part of a preferred remedial alternative is vitrification (by Operable Unit 4). This technology is known to be sensitive to the nature of the feed material. Therefore, pilot testing would be required to ensure proper treatment of Operable Unit 2 material, in addition to the extensive pilot program that is needed for Operable Unit 4 material. Based on the schedule for Operable Unit 4 and the priority assumed for that material, lengthy interim storage of Operable Unit 2 material would be required.

Administrative Feasibility - The administrative feasibility of Alternative 7 would be essentially the same as for Alternatives 5 and 6.

Availability of Services and Materials - The availability of services and materials for Alternative 7 would be essentially the same as for Alternatives 5 and 6.

Costs

No. 68 The total cost for Alternative 7 in 1994 constant dollars would be approximately ~~$113~~ $130.8 million, including approximately $2 million for the treatment of contaminated material exceeding WAC for the on-site disposal cell (see Appendix F.3).

Summary

No. 41 ~~Alternative 7 eliminates any concern over meeting WAC for the on site disposal cell and is as effective, implementable, and cost effective as Alternatives 5 and 6. However, it provides no advantage over Alternative 6 and is therefore not retained for detailed analysis, in favor of Alternative 6.~~ Alternative 7 eliminates concern over meeting the WAC for on-site disposal and is as effective and cost-effective as Alternatives 5 and 6. However, since it is marginally less implementable than Alternative 6 while offering no advantage over Alternative 6, it is not retained for detailed analysis.

4.3.8 Alternative 8: Excavation and Treatment with On-Site Disposal

4.3.8.1 Description

Alternative 8 includes the same remedial measures as Alternative 5, but adds treatment (see Section 4.2.5.4) of the excavated material to reduce leachability of COCs. The excavation operation for the subunits and construction of the disposal cell would be coordinated with the removal operations associated with other operable units.

All excavated material would be visually segregated into flyash, lime sludge, soil, trash, and debris. Flyash would be staged, stabilized (see Section 4.2.5.4), and deposited in an on-site disposal facility (see Section 4.2.5.5). The remaining material would be processed for size reduction and moisture control, as required, treated (see Section 4.2.5.4), and deposited in the on-site disposal facility.

4.3.8.2 Screening Evaluation

Effectiveness

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment - Alternative 8 would No. 51 reduce the mobility of contaminated material through treatment. ~~, and migration of contaminants would be minimized by containment in an engineered cell.~~ Also, crushing/shredding and drying would be utilized, as necessary, to make specified material more manageable and result in a decrease in contaminant volume. The assumed treatment, stabilization/solidification, would result in a significant increase in the total volume for disposal. There would be no change in the toxicity.

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Long-Term Protection of Human Health and the Environment - The long-term effectiveness of Alternative 8 would be essentially the same as for Alternative 6, except additional contaminated No. 51 material would be treated prior to disposal. Containment in an engineered cell would minimize the potential for the contamination to migrate.

Short-Term Protection of Human Health and the Environment - The short-term effectiveness of Alternative 8 would be essentially the same as for Alternative 6, except for the increased potential for exposure to workers from the handling and treatment of additional contaminated material.

Implementability

Technical Feasibility - The technical feasibility of Alternative 8 would be essentially the same as for Alternative 6.

Administrative Feasibility - The administrative feasibility of Alternative 8 would be essentially the same as for Alternative 6.

Availability of Services and Materials - The availability of services and materials for Alternative 8 would be essentially the same as for Alternative 6.

Costs

No. 68 The total cost of Alternative 8 in 1994 constant dollars would be approximately ~~$245~~ $355.2 million (see Appendix F.3).

Summary

Alternative 8 would be effective and implementable. However, because Alternative 6 is protective of human health and the environment, the additional cost of Alternative 8 is not justified. Therefore, Alternative 8 is not retained for detailed analysis.

4.3.9 Summary of Alternatives Screening

The alternatives developed from the process options remaining after the initial screening (Section 3.0) have been screened against three general criteria: effectiveness, implementability, and cost. The intent of this evaluation and screening was to select alternatives that would meet RAOs and achieve long-term protection of human health and the environment. A summary of the screening analysis is provided in Table 4-2. Based on this screening, the following alternatives have been selected for detailed analysis (Section 5.0):

- Alternative 1 - No Action
- Alternative 2 - Consolidation and Capping
- Alternative 3 - Excavation and Off-Site Disposal

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- Alternative 6 - Excavation and On-Site Disposal with Off-Site Disposal of Fraction Exceeding WAC

TABLE 4-2

SUMMARY OF ALTERNATIVE SCREENING - OPERABLE UNIT 2

Alternative	Effectiveness	Implementability	Cost ($Millions)	Screening Result
1 No Action	• Contaminant toxicity, mobility, and volume would not be altered. • Human health and the environment would not be protected. • Remedial activities would not pose short-term risks.	No activities to implement.	0	Retained as baseline, per NCP.
2 Consolidation and Capping	• Contaminant toxicity and net volume would be essentially unchanged. • Potential for contaminant migration would be reduced through installation of subsurface drainage system and the capping system. • Human health and the environment would be protected long term through capping, although there are uncertainties. • Remedial activities would pose manageable short-term risks.	Readily implementable utilizing proven technology and conventional equipment, although administrative controls would have to remain in place.	73	Retained for detailed analysis.
3 Excavation and Off-Site Disposal	• Contaminant toxicity, mobility, and net volume would be essentially unchanged. • Human health and the environment would be protected long-term through disposal in an off-site facility. • Remedial activities could pose significant short-term risks because of large volume of material being excavated, managed, and transported off site.	Readily implementable utilizing proven technology and conventional equipment; DOE/EPA/state/local approvals required for off-site shipment.	200	Retained for detailed analysis.
4 Excavation and Off-Site Disposal with Treatment of Fraction Exceeding WAC	• Essentially the same as Alternative 3 (no additional material expected to be treated).	Essentially the same as Alternative 3 (no additional material expected to be treated).	200	Screened out; no material expected to exceed WAC for off-site facility; see Alternative 3.

TABLE 4-2
(Continued)

Alternative	Effectiveness	Implementability	Cost ($Millions)	Screening Result
5 Excavation and On-Site Disposal	• Contaminant toxicity and net volume would be essentially unchanged. • Potential for contaminant migration would be reduced through disposal in on-site cell. • Human health and the environment would be protected long-term through disposal in an on-site facility and removal of a direct contaminant pathway to the Great Miami Aquifer. • Remedial activities could pose significant short-term risks because of large volume of material being excavated, managed, and disposed.	Readily implementable utilizing proven technology and conventional equipment; waiver from OEPA siting restrictions would be required.	111	Screened out; some material expected to exceed on-site WAC; see Alternatives 6 and 7.
6 Excavation and On-Site Disposal with Off-Site Disposal of Fraction Exceeding WAC	• Essentially the same as Alternative 5, except for the increased potential for exposure to workers and the public from the off-site transportation of contaminated material.	Essentially the same as Alternative 5, except DOE/EPA approvals required for off-site shipment.	112	Retained for detailed analysis.
7 Excavation and On-Site Disposal with Treatment of Fraction Exceeding WAC	• Essentially the same as Alternative 5, except for the increased potential for exposure to workers from the additional handling and treatment of contaminated material.	~~Essentially the same as Alternative 5.~~ Somewhat less implementable than Alternative 6 because of the potential for delays and concerns about appropriate technology.	113	Screened out; no advantage over Alternative 6.

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TABLE 4-2
(Continued)

Alternative	Effectiveness	Implementability	Cost ($Millions)	Screening Result
8 Excavation and Treatment with On-Site Disposal	• Essentially the same as Alternative 7, except for significant increase in volume due to treatment; decreased effectiveness due to increased potential for exposure to workers from the additional handling and treatment of contaminated material; and increased effectiveness due to treatment of additional contaminated material.	Essentially the same as Alternative 7, except for larger volume to treat.	245	Screened out; additional cost over Alternative 6 not justified.

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on soil and geology, water quality and hydrology, air quality, biotic resources, and wetlands and floodplains. Impacts on socioeconomics, land use, and cultural resources are also considered.

The evaluation of adequacy and reliability of controls assesses the effectiveness of any treatment, containment, or institutional actions that are part of the alternative. Factors considered include performance characteristics, maintenance requirements, and expected durability. Information and data from treatability studies, past performance, and similar technology applications are incorporated into the evaluation as appropriate. Institutional actions are considered where they potentially improve the effectiveness of engineered measures.

5.1.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

CERCLA discusses a preference for remedial actions that employ treatment for the significant and permanent reduction of toxicity, mobility, or volume of the hazardous material. The evaluation considers the extent to which remedial action process technologies can effectively and irreversibly fix, transform, immobilize, and/or reduce the volume of waste materials and contaminated media.

o. 53 ~~There are three ex situ treatment technologies for contaminated soil that are components of several alternatives selected for this detailed analysis: stabilization/solidification, vitrification, and soil washing. When treatment is indicated in the following sections, any of these three technologies is considered potentially feasible.~~ In subsequent discussions in Section 5, treatment of contaminated soil applies to the lead-containing soil from the South Field firing range in Alternatives 2, 3, and 6. Three ex situ treatment technologies were proposed in the technology development in Section 4 – solidification/stabilization, vitrification, and soil washing. When treatment is indicated in the following subsections, any of those three technologies is considered potentially feasible. However, the technology selected will depend on the outcome of current treatability studies and the availability of different treatment processes on site. For comparison purposes in this FS, stabilization/solidification is assumed.

5.1.2.5 Short-Term Effectiveness

This criterion addresses the effects of the alternative during the construction and implementation phase until the RAOs are achieved. The evaluation considers the effects on human health and the environment posed by operations conducted during the remedial action. Both the potential impacts and associated mitigative measures are examined for maintaining protectiveness for the community, remedial-action workers, and environmental receptors over the duration of the activities.

Appendix C of this FS provides an evaluation of short-term risks to the public and workers under various scenarios associated with each alternative's operations. Potential short-term risks to the public include inhalation of airborne particulates released during waste removal and treatment operations;

5.2.1 Description

Under this alternative, no remedial action would be taken. In the no action alternative, the contaminated material would be left in place "as is," without the implementation of any containment, removal, treatment, or other mitigating actions. In addition, this alternative would not provide monitoring of soil or groundwater and would not provide for institutional actions, such as access controls or deed restrictions, to reduce the potential for exposure.

5.2.2 Detailed Analysis

5.2.2.1 Overall Protection of Human Health and the Environment

The no action alternative does not meet the RAOs for the site. With this alternative, there is no protection of human health and the environment beyond current conditions and; therefore, the risk associated with this alternative is consistent with the Operable Unit 2 Baseline Risk Assessment.

The residual risk for an expanded trespasser and the on-property resident farmer was greater than
No. 54 1×10^{-4}. The risks are primarily from the COCs of radium-228, thorium-228, and beryllium. ~~None of the receptors would be exposed to COCs with an unacceptable hazard index.~~ The off-property farmer (child), on-property farmer (adult and child), and trespassing youth receptors would be exposed to COCs with a hazard index greater than 1.0.

The no action alternative for private ownership does not reduce any exposure pathways, but the no action alternative with federal ownership mitigates the time of exposure and eliminates some pathways (e.g., the on-property produce and milk/beef pathways). Compliance with chemical-specific ARARs is not achieved, because exposure concentrations in surface water, groundwater, and soils are above ARAR levels. The no action alternative does not reduce the residual risk enough to be protective of the public, and the reliability of controls is limited (i.e., the expanded trespasser can receive unacceptable risk from direct exposure to waste).

The mobility, volume, and toxicity of waste is not addressed because the materials remain in place. The mobility of wastes is reduced if the land use is determined to be federal ownership, because farming activities are eliminated. The no action alternative does not produce short-term risk to the remedial or nonremedial worker, because no remedial activities would be performed. The no action scenario does not mitigate current land-use risks.

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TABLE 5-2

BASELINE COMPARISON OF OPERABLE UNIT 2 CHEMICAL-SPECIFIC ARARs NO ACTION ALTERNATIVE

SURFACE WATER[a]

COCs[b]	ARAR Standard[c]	Point of Compliance	Solid Waste Landfill	Inactive Flyash Pile	South Field	Active Flyash Pile
Dieldrin	7.6×10^{-4} µg/L	Paddys Run	not a COC	not a COC	7.7×10^{-4} µg/L	not a COC
		Great Miami River	not a COC	not a COC	9.5×10^{-7} µg/L	not a COC
PAHs[d]	0.31 µg/L	Paddys Run	0.13 µg/L	9.0×10^{-5} µg/L	3.75 µg/L	not a COC
		Great Miami River	1.6×10^{-4} µg/L	1.1×10^{-7} µg/L	4.6×10^{-3} µg/L	not a COC

AIR

COC	ARAR Standard (pCi/m^2s)	Emission Rate (pCi/m^2s)				
		Solid Waste Landfill	Lime Sludge Ponds	Inactive Flyash Pile	South Field	Active Flyash Pile
Radon-222	20	0.53	0.09	0.68	6.8	1.52

GROUNDWATER

COC	ARAR Standard	Point of Compliance	Solid Waste Landfill	Lime Sludge Ponds	Inactive Flyash Pile/South Field	Active Flyash Pile
Total Uranium	20 µg/L	Under Subunit	167 µg/L	3.2 µg/L	1840 µg/L	77.6 µg/L
		FEMP Fenceline	5.7 µg/L	0.1 µg/L	94.5 µg/L	10.2 µg/L

Note: The shading indicates where the ARAR standard is being exceeded.

[a]The Lime Sludge Ponds are not included in this part of the table because the berms around the ponds keep any surface water from running off.

[b]These are the surface soil COCs for which OEPA has promulgated a water quality standard and that Operable Unit 2 does not meet under the no action alternative.

[c]This limit is the lowest standard from warmwater habitat, human health, or agricultural water quality criteria from the Ohio Water Quality Standards.

[d]This is the sum of anthracene, benzo(a)anthracene, benzo(k)fluoranthene, 3,4-benzofluoranthene (benzo(b)fluoranthene), benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluorene, indeno(1,2,3-c,d)pyrene, napthalene, phenanthrene, and pyrene.

Comment No. 5

TABLE 5-3

SUMMARY OF OPERABLE UNIT 2 RISK-BASED SOIL PRELIMINARY REMEDIATION LEVELS (PRLs) FOR THE EXPANDED TRESPASSER AND OFF-PROPERTY FARMER IN THE SOUTH FIELD AREA WITH CONSOLIDATION AND CAPPING

		Expanded Trespasser (pCi/g or mg/kg)		
COC	Background[a]	10^{-6} ILCR[b]	HI 0.2	ARAR
ALL SUBUNITS (OVER THE GREAT MIAMI AQUIFER)				
Radium-226	1.42	1.8	-	6.42[d]
Radium-228	1.25	2.0	-	6.25[d]
Thorium-228	1.43	1.8	-	-
Thorium-232	1.36	1.5	-	6.36[d]
ACTIVE FLYASH PILE				
Arsenic	8.2	16.9	-	-
Neptunium-237	0.0	4.99	-	-
Uranium-234[c]	1.04	8.64	-	-
Uranium-235/236[c]	0.15	7.75	-	-
Uranium-238[c]	1.12	6.12	57.3[g]	9.3[e,g]
Uranium-Total[c]	3.4	-	172	28[e]
INACTIVE FLYASH PILE (SOURCE OVER THE GREAT MIAMI AQUIFER)				
Arsenic	8.2	16.9	-	-
Uranium-234[c]	1.04	8.68	-	-
Uranium-235/236[c]	0.15	7.79	-	-
Uranium-238[c]	1.12	6.12	57.3[g]	150[e,g]
Uranium-Total[c]	3.4	-	172	28[e]
INACTIVE FLYASH PILE (SOURCE OVER THE GLACIAL TILL)				
Arsenic	8.2	16.9	-	-
Uranium-234[c]	1.04	108	-	-
Uranium-235/236[c]	0.15	107	-	-
Uranium-238	1.22	54.8	-	-
Uranium-238[h]	1.12	71	991.7[g]	150[e,g]
Uranium-Total[c]	3.4	-	2975	450[e]
SOUTH FIELD (SOURCE OVER THE GREAT MIAMI AQUIFER)				
Aroclor-1260[c]	0.0	25	-	-
Benzo(a)anthracene[c]	0.0	2.86	-	0.455[f]
Benzo(a)pyrene	0.0	2.86	-	0.777[f]
Benzo(b)fluoranthene[c]	0.0	-	-	0.513[f]
Benzo(k)fluoranthene	0.0	-	-	0.603[f]
Dibenzo(a,h,)anthracene[c]	0.0	13	-	0.157[f]
Dieldrin	0.0	-	-	9.57E-03[f]
Indeno(1,2,3-cd)pyrene[c]	0.0	200	-	0.496[f]
Phenanthrene	0.0	-	-	0.19[f]
Technetium-99	0.0	71	-	-

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TABLE 5-3
(Continued)

COC	Background[a]	Expanded Trespasser (pCi/g or mg/kg)		
		10^{-6} ILCR[b]	HI 0.2	ARAR
SOUTH FIELD (SOURCE OVER THE GREAT MIAMI AQUIFER) (Continued)				
Thorium-230[c]	1.97	402	-	6.97[d]
Uranium-234[c]	1.04	8.68	-	-
Uranium 235/236[c]	0.15	7.79	-	-
Uranium-238[c]	1.12	6.12	57.3[g]	9.3[e,g]
Uranium-Total[c]	3.4	-	172	28
South Field (Source Material over the Top of the Glacial Till Terrace)				
Aroclor-1260[c]	0.0	25	-	-
Benzo(a)anthracene[c]	0.0	-	-	0.455[f]
Benzo(a)pyrene	0.0	2.86	-	0.777[f]
Benzo(b)fluoranthene[c]	0.0	-	-	0.513[f]
Benzo(k)fluoranthene	0.0	-	-	0.603[f]
Dibenzo(a,h)anthracene[c]	0.0	13	-	0.157[f]
Dieldrin	0.0	-	-	9.57E-03[f]
Indeno(1,2,3-cd)pyrene[c]	0.0	200	-	0.496[f]
Phenanthrene	0.0	-	-	0.19[f]
Technetium-99	0.0	71	-	-
Thorium-230[c]	1.97	402	-	6.97[d]
Uranium-234[c]	1.04	108	-	-
Uranium 235/236[c]	0.15	107	-	-
Uranium-238	1.22	54.8	991.7[g]	150[e,g]
Uranium-238[h]	1.12	71	991.7[g]	150[e,g]
Uranium-Total[c]	3.4	-	2975	450[e]

NOTE: The shading indicates the controlling (minimum) PRL.

[a]Background value from revised RI, Table 4-1A, surface concentrations.

[b]ILCR = Incremental Lifetime Cancer Risk~~, value shown is ILCR plus background.~~ In the case of radionuclides, the PRL is the concentration responsible for the incremental risk plus the background concentration.

[c]PRL due to off-property farmer receptor.

[d]PRL is based on 40 CFR § 192.12(a) and DOE Order 5400.5 Chapter IV(4)(a)(2)(3).

[e]PRL is based on proposed maximum contaminant level (MCL) for uranium (56 Federal Register 33050; July 18,1991).

[f]PRL is based on Ohio Water Quality Standards, OAC 3745-1-07.

[g]This value determined by calculating the uranium-238 concentration in uranium-total.

[h]This PRL applies for protection of groundwater and becomes significant when the lateral migration of perched groundwater is controlled and direct contact no longer applies (i.e., excavations below the impacted till).

5.3.1.2.2 Firing Range Lead Removal

Lead bullets and fragments from the Firing Range are embedded in the embankment of the South Field east of the running track, as shown in Figure 5-4. Approximately 230 cu m (300 cu yd) of soil containing lead bullets would be excavated along the embankment. The soils containing the lead bullets and fragments would be analyzed by the TCLP for lead. Soils that are not a hazardous waste would be processed with the other contaminated material in the South Field, and soils that leach lead above 5 mg/L would be treated and placed in DOT-approved containers and transported to the representative off-site mixed waste disposal facility. ~~In the event that future RODs for the site include development of an on site mixed waste treatment and disposal facility, the feasibility of treatment and disposal of the Firing Range soil at the facility will be evaluated.~~

No. 6

5.3.1.3 Treatment of Contaminated Material

To facilitate handling and consolidation, the size of any large debris excavated from the South Field and Inactive Flyash Pile and the K-65 trench material and associated piping at the Lime Sludge Ponds, would have to be reduced (by shredding/crushing). It is estimated that approximately 12,100 cu m (15,800 cu yd) would require size reduction, which would be performed using a heavy-duty crusher.

To ensure that the Lime Sludge Ponds can support a cap, the top 0.9 m (3 ft) of lime sludge in both ponds would be stabilized in place with flyash and/or cement to support the cap. A backhoe with a mixer attached to the end of the arm would be used to mix the lime sludge while adding flyash and cement. The resulting mixture would have properties similar to lean concrete.

To treat the lead-contaminated soil from the Firing Range, a standard pug mill type mixer would be used to mix the contaminated soil with cement, water, and any required additives. The additives required would be based on treatability studies conducted during remedial design. Once the material is thoroughly mixed and cured, samples for unconfined compressive strength and TCLP testing would be collected. Treated soils found to be above the toxic characteristic for lead would be recycled back to the mixer for further mixing until acceptable tests are achieved. During mixing, monitoring of particulates generated by mixing would be performed and controlled as necessary. The mixed material would be conveyed directly into International Bulk Containers (IBCs).

5.3.2.2 Compliance with ARARs

Compliance with the chemical-, action-, and location-specific ARARs is discussed below. Detailed discussion of waste classifications, principal ARARs and TBCs is presented in Section 2.3. The complete list of ARARs and TBCs is presented in Appendix B.

5.3.2.2.1 Chemical-Specific ARARs/TBCs

Alternative 2 would comply with the chemical-specific ARARs/TBCs identified in Table B-1 of Appendix B. ARARs associated with penetrating radiation and potential releases of contaminants to air, surface water, and groundwater would be met through the consolidation and containment of all contaminated material above the PRLs from Operable Unit 2.

The engineering and administrative controls described earlier for the containment areas were established for the protection of human health and would ensure that the groundwater MCLs and non-zero MCLGs would be met at the boundary of the containment facility; Ohio Water Quality Standards would be met at both Paddys Run and the Great Miami River; and air emission standards and radon protection standards would be met above each subunit. These standards are identified in Table B-1 of Appendix B. The caps over the subunits would prevent surface water from coming into contact with waste material; therefore, surface water concentrations of contamination are assumed to be zero under this alternative. Table 5-4 demonstrates that consolidation and capping in place brings Operable Unit 2 into compliance with the groundwater MCL for uranium, which would not be met under the no action alternative.

TABLE 5-4

COMPLIANCE WITH OPERABLE UNIT 2 CHEMICAL-SPECIFIC ARARs

ALTERNATIVE 2

No. 4

MAXIMUM CROSS-MEDIA GROUNDWATER CONCENTRATIONS						
COC	ARAR Standard	Point of Compliance	Solid Waste Landfill	Lime Sludge Ponds	Inactive Flyash Pile/South Field	Active Flyash Pile
Total Uranium	20 μg/L	Underneath Subunit	<0.002 μg/L	<0.0001 μg/L	10.7 μg/L	10.7 μg/L
		FEMP Fenceline	<0.002 μg/L	<0.0001 μg/L	1.5 μg/L	1.5 μg/L

000133

The maximum groundwater concentration is presented in the table (underneath subunit); therefore, the point of compliance, which is at the boundary of the containment facility, would also comply with the uranium MCL.

Water encountered during construction at all subunits and water from the remediation of the contaminated perched groundwater in the South Field/Inactive Flyash Pile area would be treated at the AWWT facility to meet the Ohio Water Quality Standards found in Table B-1 of Appendix B.

5.3.2.2.2 Action-Specific ARARs/TBCs

Alternative 2 would meet the principal action-specific ARARs/TBCs discussed in Section 2.3 and listed in Tables B-2, B-3, and B-4 of Appendix B. Because Operable Unit 2 includes both low-level radioactive waste/residual radioactive material and solid waste, design and construction of the in situ cap would meet the more stringent requirements for the disposal of low-level radioactive waste/residual radioactive material. EPA states in 40 CFR §192.02(a) that the disposal facility must be designed to be effective for up to 1,000 years, to the extent reasonably achievable, and in any case, for at least 200 years. DOE Order 5820.2A requires compliance with performance objectives for a low-level radioactive waste disposal site, including protection of public health and safety, protection of the public and the environment from releases of radioactivity, and protection of groundwater resources.

Consolidation/containment would also meet the less stringent OEPA technical requirements for the disposal of solid waste. These requirements include specifications for the design and construction of a cap system which consists of a recompacted soil layer, a granular drainage layer, a soil vegetative layer, and a surface water control system. Material with contaminant levels that are below the PRLs (see Section 2.0) would not be considered waste and would be left in place.

No. 50 Material containing bullets from the South Field Firing Range that is ~~assumed to be~~ mixed waste ~~and~~ would be treated and shipped to an off-site disposal facility that is approved to accept mixed waste. This waste must comply with the storage, packaging, and transportation requirements of RCRA, including the manifest system, while it is being prepared and shipped from the FEMP. Packaging and transportation of these wastes would also be required to meet Department of Transportation (DOT) and DOE requirements for the transport of hazardous materials. These RCRA, DOT, and

DOE regulations are considered to be non-ARAR requirements and are listed in Table B-6 of Appendix B. Operable

Unit 2 must comply with both the administrative and substantive standards of non-ARAR
No. 50 requirements. Firing Range material surrounding the area with bullets that is not found to be hazardous after testing, but contains COCs above the PRLs, would be considered low-level radioactive waste/residual radioactive material and would be managed with the rest of the South Field material for consolidation and containment.

5.3.2.2.3 Location-Specific ARARs/TBCs

Alternative 2 would meet the principal location-specific ARARs/TBCs discussed in Section 2.3 and listed in Table B-5 of Appendix B. CERCLA guidance allows consolidation and capping within the area of contamination to be performed without considering the action as disposal or placement of waste. Therefore, this alternative would not invoke the OEPA siting criteria for solid waste disposal facilities.

There is a 0.1 ha (0.2 acre) area of wetlands located to the north of the Solid Waste Landfill that would be adversely impacted during the removal of contaminated material. Operable Unit 2 would comply with the substantive permitting requirements for impacts to wetlands under the Clean Water Act (33 CFR §§ 323-330) through a site-wide wetlands management plan . Compensatory mitigation for wetlands impacted by Operable Unit 2 activities would be determined using 404(b)(1) [33 U.S.C. §1344(b)(1)] guidelines of the Clean Water Act in consultation with the Army Corp of Engineers, EPA, and OEPA. The Inactive Flyash Pile and a portion of the South Field are located in the 100-year floodplain of Paddys Run. Under this alternative, no adverse impact to the floodplain is expected.

5.3.2.3 Long-Term Effectiveness and Permanence

5.3.2.3.1 Magnitude of Residual Risks

The contaminated material in the subunits contain different COCs for different media associated with the route of exposure. After the RAOs are achieved, all COCs will be remediated to their respective PRLs based on a 1 x 10^{-6} ILCR or HI of 0.20. The COCs and their respective PRLs and background
No. 7 concentrations for the material under the cap~~ped material~~ are listed in Table 5-5. Table 5-3 provides the PRLs for residual materials remaining after excavation that are not under the cap. Following consolidation and capping of materials with contaminant concentrations above the PRLs for the

expanded trespasser and off-property resident farmer, the exposure risk would be reduced to acceptable levels.

Indian Religious Freedom Act (AIRFA) and Native American Graves Protection and Repatriation Act (NAGPRA). (See Section 5.3.2.5.3, Short-Term Environmental Impacts.)

5.3.2.4 <u>Reduction of Toxicity, Mobility, or Volume Through Treatment</u>

Alternative 2 would not treat the contaminated material such that toxicity, mobility, or volume would
No. 51 be significantly reduced. ~~The contaminated material would be consolidated and capped, which would reduce the potential for migration of the contaminants. Engineered and institutional actions would reduce the potential for exposure.~~

Alternative 2 uses stabilization/solidification of an estimated 230 cu m (300 cu yd) of lead contaminated soil from the Firing Range. Special requirements for solidification treatment would include performing treatability studies on the waste before full-scale operation. Stabilization/ solidification reduces the mobility of the contaminants by binding them in a cement mixture. Volumetric increases occur as a result of the additives used in the process. Qualitative and quantitative determination of required additives would be based on treatability studies. The treatment would not destroy the lead in the soil or reduce its volume. The mobility is expected to be reduced by preventing the lead from leaching out of the treated soil and would be verified through treatability studies. However, compared to the total volume of contaminated material in the South Field area, the increase in volume is insignificant.

Alternative 2 will also treat perched groundwater that may migrate laterally in the South Field to reduce the principal threat of contaminated groundwater. The COCs in the groundwater are uranium-234, uranium-235/236, and uranium-238. However, perched groundwater beneath the Solid Waste Landfill and Lime Sludge Ponds does not pose a threat and would not be removed or treated. The perched groundwater would be treated at the AWWT facility using precipitation and ion exchange to concentrate the contaminants. The treatment would be reversible but would not destroy the uranium-234, uranium-235/236, and uranium-238 and would only concentrate them into a wastewater sludge. The treated water would be discharged to the Great Miami River and would contain residual quantities of the uranium. The residual quantity of uranium in the water would pose no health risk and would be below EPA-approved discharge limits for uranium.

TABLE 5-7

SUMMARY OF OPERABLE UNIT 2 RISK-BASED SOIL PRELIMINARY REMEDIATION LEVELS (PRLs) FOR THE EXPANDED TRESPASSER AND OFF-PROPERTY FARMER

COC	Background[a]	Expanded Trespasser (pCi/g or mg/kg)		
		10^{-6} ILCR[b]	HI 0.2	ARAR
ALL SUBUNITS				
Radium-226	1.42	1.8	-	6.42[d]
Radium-228	1.25	2.0	-	6.25[d]
Thorium-228	1.43	1.8	-	-
Thorium-232	1.36	1.5	-	6.36[d]
SOLID WASTE LANDFILL				
Uranium-234[c]	1.04	62.9	-	-
Uranium-235/236[c]	0.15	63.1	-	-
Uranium-238	1.22	54.8	-	-
Uranium-Total[c]	3.4	-	956	38.6[e]
LIME SLUDGE POND				
Uranium-234[c]	1.04	196	-	-
Uranium-235/236[c]	0.15	195	-	-
Uranium-238	1.22	54.8	-	-
Uranium-Total[c]	3.4	-	3000	136[e]
ACTIVE FLYASH PILE				
Arsenic	8.2	16.9	-	-
Neptunium-237	0.0	4.99	-	-
Uranium-234[c]	1.04	8.64	-	-
Uranium-235/236[c]	0.15	7.75	-	-
Uranium-238[c]	1.12	6.12	-	-
Uranium-Total[c]	3.4	-	172	28[e]
INACTIVE FLYASH PILE (SOURCE OVER THE GREAT MIAMI AQUIFER)				
Arsenic	8.2	16.9	-	-
Uranium-234[c]	1.04	8.68	-	-
Uranium-235/236[c]	0.15	7.79	-	-
Uranium-238[c]	1.12	6.12	-	-
Uranium-Total[c]	3.4	-	118	19[e]

See footnotes at end of table.

TABLE 5-7
(Continued)

COC	Background[a]	Expanded Trespasser (pCi/g or mg/kg)		
		10^{-6} ILCR[b]	HI 0.2	ARAR
INACTIVE FLYASH PILE (SOURCE OVER THE GLACIAL TILL)				
Arsenic	8.2	16.9	-	-
Uranium-234[c]	1.04	4.24	-	-
Uranium-235/236[c]	0.15	3.35	-	-
Uranium-238[c]	1.12	3.22	-	-
Uranium-Total[c]	3.4	-	50	8[e]
SOUTH FIELD (SOURCE OVER THE GREAT MIAMI AQUIFER)				
Aroclor-1260[c]	0.0	25	-	-
Benzo(a)anthracene	0.0	-	-	0.455[f]
Benzo(a)pyrene	0.0	2.86	-	0.777[f]
Benzo(b)fluoranthene[c]	0.0	-	-	0.513[f]
Benzo(k)fluoranthene	0.0	-	-	0.603[f]
Dibenzo(a,h,)anthracene[c]	0.0	2.0	-	0.157[f]
Dieldrin	0.0	-	-	9.57E-3[f]
Indeno(1,2,3-cd)pyrene[c]	0.0	12000	-	0.496[f]
Phenanthrene	0.0	-	-	0.19[f]
Technetium-99	0.0	71	-	-
Thorium-230[c]	1.97	402	-	6.97[d]
Uranium-234[c]	1.04	8.68	-	-
Uranium 235/236[c]	0.15	7.79	-	-
Uranium-238[c]	1.12	6.12	-	-
Uranium-Total[c]	3.4	-	118	19[e]
SOUTH FIELD (SOURCE OVER THE GLACIAL TILL)				
Aroclor-1260[c]	0.0	25	-	-
Benzo(a)anthracene	0.0	-	-	0.455[f]
Benzo(a)pyrene	0.0	2.86	-	0.777[f]
Benzo(b)fluoranthene[c]	0.0	-	-	0.513[f]
Benzo(k)fluoranthene	0.0	-	-	0.603[f]
Dibenzo(a,h,)anthracene[c]	0.0	2.0	-	0.157[f]
Dieldrin	0.0	-	-	9.57E-3[f]
Indeno(1,2,3-cd)pyrene[c]	0.0	12000	-	0.496[f]
Phenanthrene	0.0	-	-	0.19[f]
Technetium-99	0.0	71	-	-

TABLE 5-7
(Continued)

COC	Background[a]	Expanded Trespasser (pCi/g or mg/kg)		
		10^{-6} ILCR[b]	HI 0.2	ARAR
SOUTH FIELD (SOURCE OVER THE GLACIAL TILL)				
Thorium-230[c]	1.97	402	-	6.97[d]
Uranium-234[c]	1.04	4.24	-	-
Uranium 235/236[c]	0.15	3.35	-	-
Uranium-238[c]	1.12	3.22	-	-
Uranium-Total[c]	3.4	-	50	8[e]

NOTE: The shading indicates the controlling (minimum) PRL.
[a]Background value from revised RI, Table 4-1A, surface concentrations.
[b]ILCR = Incremental Lifetime Cancer Risk. ~~value shown is ILCR plus background~~ In the case of radionuclides, the PRL is the concentration responsible for the incremental risk plus the background concentration.
[c]PRL due to off-property farmer receptor
[d]PRL is based on 40 CFR §192.12(a) and DOE Order 5400.5 Chapter IV (4)(a)(2)(3).
[e]PRL is based on proposed maximum contaminant level (MCL) for uranium (56 Federal Register 33050, July 18, 1991)
[f]PRL is based on Ohio Water Quality Standards, OAC 3745-1-07

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be performed. Once it is determined that the contaminated material has been removed, restoration of the site would begin.

5.4.1.2.2 Firing Range Lead Removal

Lead bullets and fragments from the Firing Range are embedded in the embankment of the South Field east of the running track, as shown in Figure 5-4. Approximately 230 cu m (300 cu yd) of soil containing lead bullets would be excavated along the embankment. The soils containing the lead bullets and fragments would be analyzed by the TCLP for lead. Soils that are not a hazardous waste would be processed with the other contaminated material in the South Field, and soils that leach lead above 5 mg/L would be treated and placed in DOT-approved containers and transported to the No. 9 representative off-site mixed waste disposal facility. ~~In the event that future RODs for the site include development of an on-site mixed waste treatment and disposal facility, the feasibility of treatment and disposal of the Firing Range soil at that facility will be evaluated.~~

5.4.1.3 Treatment of Contaminated Material

It is assumed that large debris, including concrete, steel, etc., will be encountered during excavation of the Solid Waste Landfill, Inactive Flyash Pile, and South Field. Size reduction (shredding/crushing) of this debris would be required to facilitate handling and packaging. It is estimated that approximately 12,100 cu m (15,800 cu yd) of debris would require size reduction, which would be performed using a heavy-duty crusher.

A portion of the contaminated material excavated from the subunits would be dried to reduce the moisture content of the material to meet acceptance criteria for the representative off-site disposal facility, as described in Appendix E.2. Drying of the contaminated material would be performed using an indirect heat rotary tube drier located at the staging area. It is estimated that approximately 25,000 cu m (32,700 cu yd) of contaminated material would require drying.

To treat the lead-contaminated soil from the Firing Range, a standard pug mill type mixer would be used to mix the contaminated soil with cement, water, and any required additives. The additives required would be based on treatability studies conducted during remedial design. Once the material is thoroughly mixed and cured, samples for unconfined compressive strength and TCLP testing would be collected. Treated soils found to above the toxic characteristic for lead would be recycled back to the mixer for further mixing until acceptable levels are achieved. During mixing, monitoring of

The South Field was the only subunit that would exceed the surface water ARARs for the no action alternative. Under Alternative 3, the concentrations of dieldrin and PAHs at Paddys Run would be equal to the ARAR standards of 7.6×10^{-4} μg/L and 0.31 μg/L, respectively. The concentrations at the Great Miami River would be 9.8×10^{-7} μg/L for dieldrin (below the 7.6×10^{-4} μg/L standard) and 4.1×10^{-4} μg/L for PAHs (below the 0.31 μg/L standard). These concentrations are for the expanded trespasser scenario, which would have higher soil cleanup levels than the on-property farmer. Therefore, since the expanded trespasser scenario would meet the ARAR standards, the on-property farmer scenario would meet them also.

Table 5-8 demonstrates that off-site disposal also brings Operable Unit 2 into compliance with the groundwater MCL for uranium, which would not be met under the no action alternative. The maximum groundwater concentration is presented in the table (under subunit); therefore, the point of compliance, which is at the boundary of the subunit, would also comply with the uranium MCL.

TABLE 5-8
COMPLIANCE WITH OPERABLE UNIT 2 CHEMICAL-SPECIFIC ARARs
ALTERNATIVE 3

MAXIMUM CROSS-MEDIA GROUNDWATER[a] CONCENTRATIONS						
COC	ARAR Standard	Point of Compliance	Solid Waste Landfill	Lime Sludge Ponds	Inactive Flyash Pile/South Field	Active Flyash Pile
Total Uranium	20 μg/L	Under Subunit	18 μg/L	3.2 μg/L	18.4 μg/L	10.7 μg/L
		FEMP Fenceline	0.7 μg/L	0.1 μg/L	2.2 μg/L	1.5 μg/L

[a] These concentrations are for the expanded trespasser scenario, which would have higher soil cleanup levels than the on-property resident farmer. Therefore, since the expanded trespasser scenario would meet the ARAR standards, the on-property resident farmer scenario would meet them also.

Water encountered during construction would be treated at the AWWT facility to meet the Ohio Water Quality Standards found in Table B-1 of Appendix B.

5.4.2.2.2 Action-Specific ARARs/TBCs

Excavation and off-site disposal of the contaminated material from Operable Unit 2 would not activate any of the principal action-specific ARAR/TBC requirements identified in Section 2.3 or the detailed listing in Tables B-2, B-3, and B-4 of Appendix B. Due to the radiological constituents in the waste and planned disposal at an off-site low-level radioactive waste disposal facility, the waste would be classified as low-level radioactive waste/residual radioactive material. Packaging and transportation of these wastes would be required to meet DOT and DOE requirements for the transport of hazardous materials. The DOT and DOE regulations are considered to be non-ARAR requirements and are listed in Table B-6 of Appendix B. Operable Unit 2 must comply with both the administrative and substantive standards of non-ARAR requirements. Material with contaminant levels that are below the PRLs (see Section 2.0) would not be considered waste and would be left in place.

No. 50 Material containing bullets from the South Field Firing Range that is ~~assumed to be~~ mixed waste ~~and~~ would be treated and shipped to an off-site disposal facility that is approved to accept mixed waste. In addition to the DOT and DOE requirements discussed above, this waste must comply with the storage, packaging, and transportation requirements of RCRA, including the manifest system, while it is being prepared and shipped from the FEMP. These RCRA regulations are also considered to be non-ARAR requirements and are listed in Table B-6 of Appendix B. Firing Range material surrounding the area with bullets that is not found to be hazardous after testing, but contains COCs above the PRLs, would be considered low-level radioactive waste/residual radioactive material and would be disposed off-site with the rest of the South Field material.

5.4.2.2.3 <u>Location-Specific ARARs/TBCs</u>

There is a 0.1 ha (0.2 acre) area of wetlands located to the north of the Solid Waste Landfill that would be adversely impacted during the removal of contaminated material. Operable Unit 2 would comply with the substantive permitting requirements for impacts to wetlands under the Clean Water Act (33 CFR §§ 323-330) through a site-wide wetlands management plan. Mitigation for wetlands impacted by Operable Unit 2 activities would be determined using 404(b)(1) [33 U.S.C. §1344(b)(1)] guidelines of the Clean Water Act in consultation with the COE, EPA, and OEPA through a site-wide mitigation program. The Inactive Flyash Pile and a portion of the South Field are located in the 100-year floodplain of Paddys Run. Under this alternative, no adverse impacts to the floodplain would be expected.

5.4.2.3 <u>Long-Term Effectiveness and Permanence</u>

5.4.2.3.1 <u>Magnitude of Residual Risks</u>

The contaminated materials in the subunits contain different COCs for different media associated with the route of exposure. After the RAOs are achieved, all COCs will be remediated to their respective PRLs based on a 1×10^{-6} ILCR or a HI of 0.20. The COCs and their representative PRLs and background concentrations are listed in Table 5-6. Following removal and off-site disposal of the contaminated material with COCs above the PRLs, the exposure risk would be reduced to acceptable levels. The groundwater would be protected because the source of contamination is removed.

lines. Injuries and fatality risks related to train transportation for the private ownership land-use option are estimated at 1.8 and 0.48, respectively. Injuries and fatality risks related to train No. 10 transportation for the ~~private~~ federal ownership land-use option are estimated at 0.73 and 0.19, respectively. The total dose to the public from an incident-free rail trip is estimated to be 4.6 x 10^{-6} rem per person. During a simulated rail accident, the most severely impacted public population was a suburban or rural population, with a 2.7 x 10^{-2} rem per person dose.

Misting of the excavation area, haul roads, and staging areas during excavation and disposal would reduce particulate emissions. Vehicular traffic through the site could cause transport of contamination, but this would be minimized through the use of equipment decontamination facilities within close proximity to the excavation. During construction, the site would be delineated into specific work zones. Also, contaminant migration due to surface water transport would be controlled using silt fences, sedimentation basins, and other measures. In addition, access controls would be implemented to ensure contamination is not transported off site by personnel and vehicles. Airborne emissions would be monitored.

Disposing of contaminated material from the Operable Unit 2 subunits at the representative commercial facility is not expected to exceed protective levels for the community near the facility in the short term. The material would meet the representative facility's waste acceptance criteria and would be managed within the facility's protective criteria.

5.4.2.5.2 Protection of Workers During Remedial Action

Potential exposure pathways for the on-site workers include inhalation of particulates, dermal contact, ingestion, and external radiation. The short-term risks were evaluated for the private ownership land-use option, which is a worst case risk evaluation. During remediation activities, the highest short-term risk potentially experienced by the remedial worker was 5.1 x 10^{-5} for the Active Flyash Pile. Almost all of this risk is due to direct radiation from radionuclides. The dose level for the remedial work was 210 mrem per person, well within the DOE occupational requirement of 5 rem/year. Also, the risk due to dose is manageable through ALARA principles; therefore, the remedial worker risk can be reduced if required. The HI for the remedial worker was below 1.0 for all subunits.

TABLE 5-10

SUMMARY OF OPERABLE UNIT 2 PRLS FOR PRIVATE OWNERSHIP

COC	Background Value[c]	PRIVATE OWNERSHIP		
		On-Property Resident Farmer (RME)[a]		
		10^{-6} ILCR[b]	HI 0.2	ARAR
All Subunits				
Radium-226	1.42	1.43	-	6.42[d]
Radium-228	1.25	1.26	-	6.25[d]
Thorium-228	1.43	1.43	-	-
Thorium-232	1.36	1.36	-	6.36[d]
Solid Waste Landfill				
Neptunium-237	0.0	4.3E-2	-	-
Thorium-230	1.97	2.74	-	6.97[d]
Technetium-99	0.0	1.89E-3	-	-
Strontium-90	0.0	1.6E-2	-	-
Plutonium-238	0.0	4.0E-1	-	-
Uranium-234	1.04	1.12	-	-
Uranium-235/236	0.15	0.23	-	-
Uranium-238	1.12	1.17	-	-
Antimony	0.0	-	150	-
Arsenic	8.2	8.2	-	-
Beryllium	0.6	0.6	-	-
Benzo(a)anthracene	0.0	2.3E-2	-	-
Benzo(a)pyrene	0.0	1.5E-3	-	-
Benzo(b)fluoranthene	0.0	1.4E-2	-	-
Carbazole	0.0	6.43E-3	-	-
Dibenzo(a,h)anthracene	0.0	4.6E-4	-	-
Indeno(1,2,3-cd)pyrene	0.0	7.3E-3	-	-
Uranium-Total	3.4	-	3.4	1.5[d]
Lime Sludge Pond				
Cesium-137	0.71	0.72	-	-
Neptunium-237	0.0	5.1E-3	-	-
Strontium-90	0.0	5.6E-3	-	-
Technetium-99	0.0	1.89E-3	-	-
Thorium-230	1.97	2.74	-	6.97[d]
Uranium-234	1.04	1.26	-	-
Uranium-235/236	0.15	0.24	-	-
Uranium-238	1.12	1.26	-	-
Uranium-Total	3.4	-	3.4	4.0[e]

See footnotes at end of table.

TABLE 5-10
(Continued)

COC	Background Value[c]	PRIVATE OWNERSHIP On-Property Resident Farmer (RME)[a]		
		10^{-6} ILCR[g]	HI 0.2	ARAR
Active Flyash Pile				
Cesium-137	0.71	0.72	-	-
Neptunium-237	0.0	4.3E-2	-	-
Arsenic	8.2	8.2	-	-
Beryllium	0.6	0.6	-	-
Uranium-234	1.24	2.0	-	-
Uranium-235/236	0.15	0.24	-	-
Uranium-238	1.22	1.47	-	-
Uranium-Total	3.4	-	24	28[e]
Inactive Flyash Pile				
Arsenic	8.2	8.2	-	-
Dibenzo(a,h)anthracene	0.0	4.6E-4	-	-
Uranium-234	1.24	2.0	-	-
Uranium-235/236	0.15	0.24	-	-
Uranium-238	1.22	1.47	-	-
Uranium-Total	3.4	-	21	24.8[e]
South Field				
Cesium-137	0.71	0.72	-	-
Neptunium-237	0.0	4.3E-2	-	-
Thorium-230	1.97	2.74	-	6.97[d]
Strontium-90	0.0	1.6E-2	-	-
Technetium-99	0.0	2.1E-2	-	-
Uranium-234	1.24	2.0	-	-
Uranium-235/236	0.15	0.24	-	-
Uranium-238	1.22	1.47	-	-
Uranium-Total	3.4	-	21	24.8[e]
Arsenic	8.2	8.2	-	-
Beryllium	0.6	0.6	-	-
Aroclor-1254	0.0	1.5E-3	-	-
Aroclor-1260	0.0	2.3E-4	-	-
Benzo(a)anthracene	0.0	2.3E-2	-	0.455[f]
Benzo(a)pyrene	0.0	1.5E-3	-	0.777[f]
Benzo(b)fluoranthene	0.0	1.4E-2	-	0.513[f]
Benzo(k)fluoranthcene	0.0	4.7E-2	-	0.603[f]
Dibenzo(a,h)anthracene	0.0	4.6E-4	-	0.157[f]
Dieldrin	0.0	4.0E-5	-	9.57E-3[f]

See footnotes at end of table.

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TABLE 5-10
(Continued)

COC	Background Value[c]	PRIVATE OWNERSHIP		
		On-Property Resident Farmer (RME)[a]		
		10^{-6} ILCR[b]	HI 0.2	ARAR
South Field (Continued)				
Indeno(1,2,3-cd)pyrene	0.0	7.3E-3	-	0.496[f]
Phenanthrene	0.0	-	-	0.19[f]

Note: Shading indicates the controlling (minimum) PRL.

[a]RME = reasonable maximum exposure.

[b]ILCR = incremental lifetime cancer risk; ~~value shown is ILCR plus background.~~ In the case of radionuclides, the PRL is the concentration responsible for the incremental risk plus the background concentration.

[c]Background value from RI, Table 4-1a, surface concentrations.

[d]PRL is based on 40 CFR §192.12(a) and DOE Order 5400.5 Chapter IV (4)(a)(2)(3).

[e]PRL is based on proposed maximum contaminant level (MCL) for uranium (56 Federal Register 33050, July 18, 1991)

[f]PRL is based on Ohio Water Quality Standards, OAC 3745-1-07

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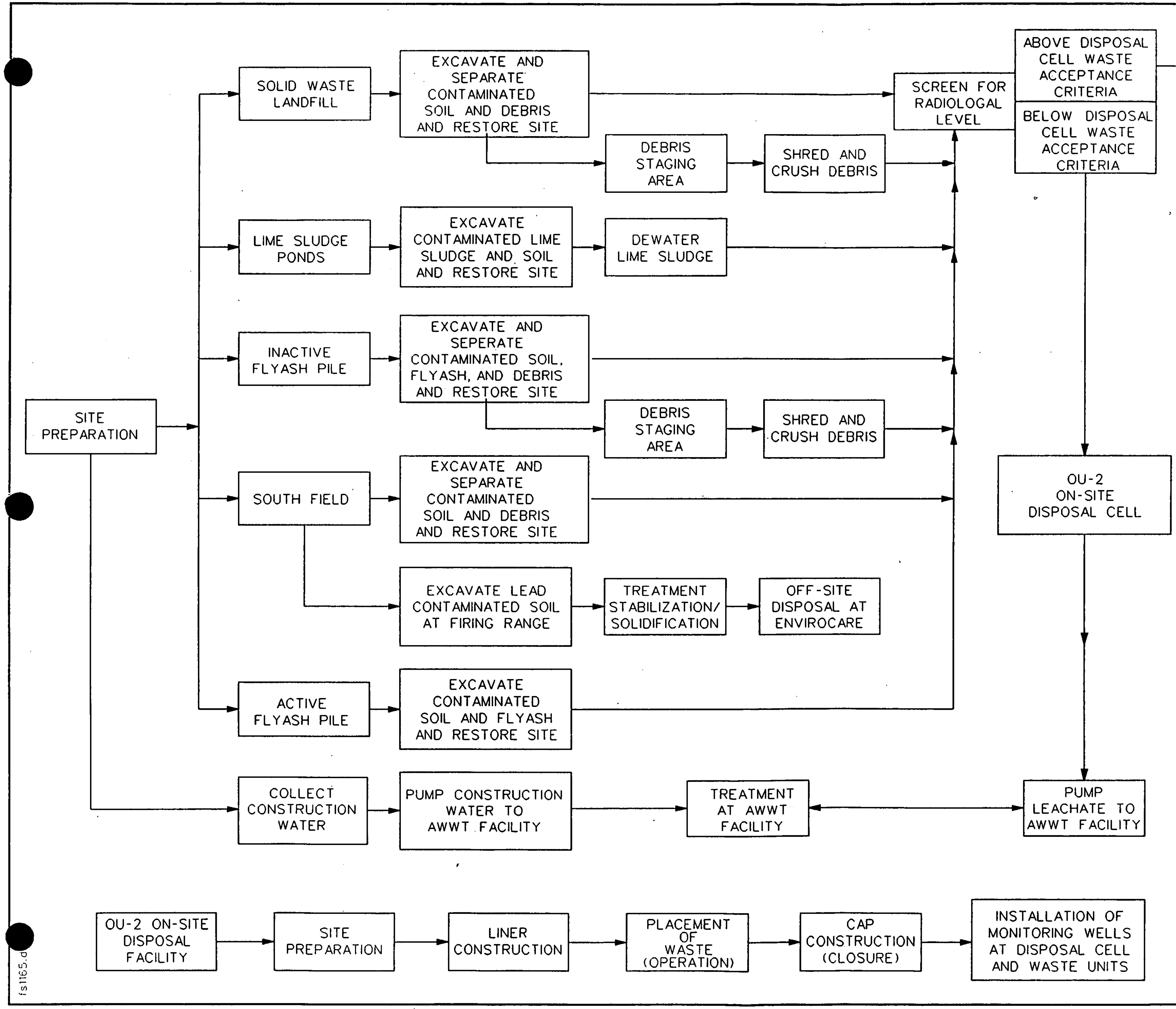

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FIGURE 5-19
BLOCK FLOW DIAGRAM
ALTERNATIVE 6
EXCAVATION AND
ON-SITE DISPOSAL
WITH OFF-SITE DISPOSAL
OF FRACTION EXCEEDING
WASTE ACCEPTANCE CRITERIA
SOLID WASTE LANDFILL,
LIME SLUDGE PONDS,
INACTIVE FLYASH PILE,
SOUTH FIELD, AND
ACTIVE FLYASH PILE

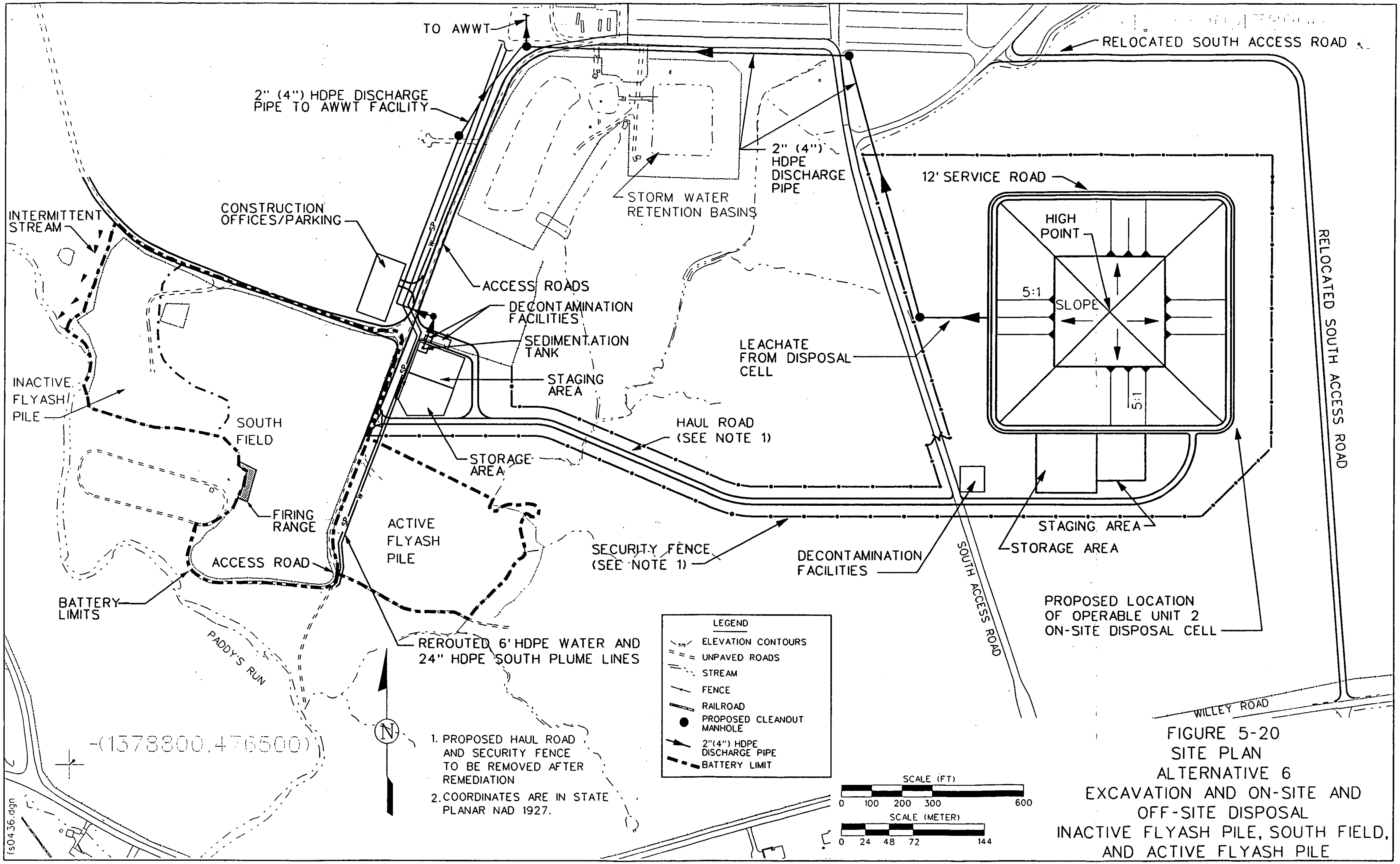

FIGURE 5-20
SITE PLAN
ALTERNATIVE 6
EXCAVATION AND ON-SITE AND OFF-SITE DISPOSAL
INACTIVE FLYASH PILE, SOUTH FIELD, AND ACTIVE FLYASH PILE

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located in a field trailer near the excavation area. Based on the field screening, contaminated soil with apparent radiological contamination below the PRLs for dermal contact would be staged and sampled for verification of contamination levels. At the same time, contaminated material with apparent radiological contamination above the WAC based on field correlated screening for the on-site disposal facility would be segregated, staged, and packaged for off-site disposal. Soil confirmed to have radiological contamination below the PRLs for dermal contact would be used to construct the interior portions of the berms for the on-site disposal facility. The remainder of the contaminated material would be segregated based on size. Larger material (debris) would be shredded/crushed and deposited in the disposal facility. The material not requiring crushing/shredding would be deposited directly in the disposal facility.

Before excavation would be performed at the Lime Sludge Ponds, free-standing water in the north pond would be removed by forming trenches to a sump and pumping the water to the sedimentation tank. Material with an appreciable amount of water would be transported to the staging area for dewatering. Any construction water encountered during excavation in each subunit would be pumped from the excavation to a sedimentation tank for removal of suspended solids before being sent to the AWWT facility via newly constructed pipeline.

After the contaminated material has been excavated from the subunits, verification sampling would be performed to ensure that removal is complete. If results of verification sampling indicate that contamination still exists, additional excavation and verification sampling would be performed. Once it is determined that the contamination has been removed, restoration of the subunit would begin.

5.5.1.2.2 Firing Range Lead Removal

Lead bullets and fragments from the Firing Range are embedded in the embankment of the South Field east of the running track, as shown in Figure 5-4. Approximately 230 cu m (300 cu yd) of soil containing lead bullets would be excavated along the embankment. The soils containing the lead bullets and fragments would be analyzed by the TCLP for lead. Soils that are not a hazardous waste would be processed with the other contaminated material in the South Field and soils that leach lead above 5 mg/L would be treated and placed in DOT-approved containers and transported to the
No. 13 representative off-site mixed waste disposal facility. ~~In the event that future RODs for the site include development of an on-site mixed waste treatment and disposal facility, the feasibility of treatment and disposal of the Firing Range soil at the facility will be evaluated.~~

other FEMP operable units, the disposal facility capacity and footprint would be adjusted accordingly during the Remedial Design process.

The contaminated material with COC concentrations exceeding the PRLs, including the flyash and lime sludge from the Operable Unit 2 subunits, would be consolidated and disposed in this facility. The disposal facility would be constructed in accordance with the applicable ARARs and DOE guidelines. The disposal cell would be designed for a minimum of 200 years design life with 1,000
No. 14 years expected effective life with proper maintenance. Approximately ~~134,00~~ 240,000 cu m (315,000 cu yd) of contaminated soil, lime sludge, flyash, debris, and generated waste from Operable Unit 2 would be placed in the disposal cell.

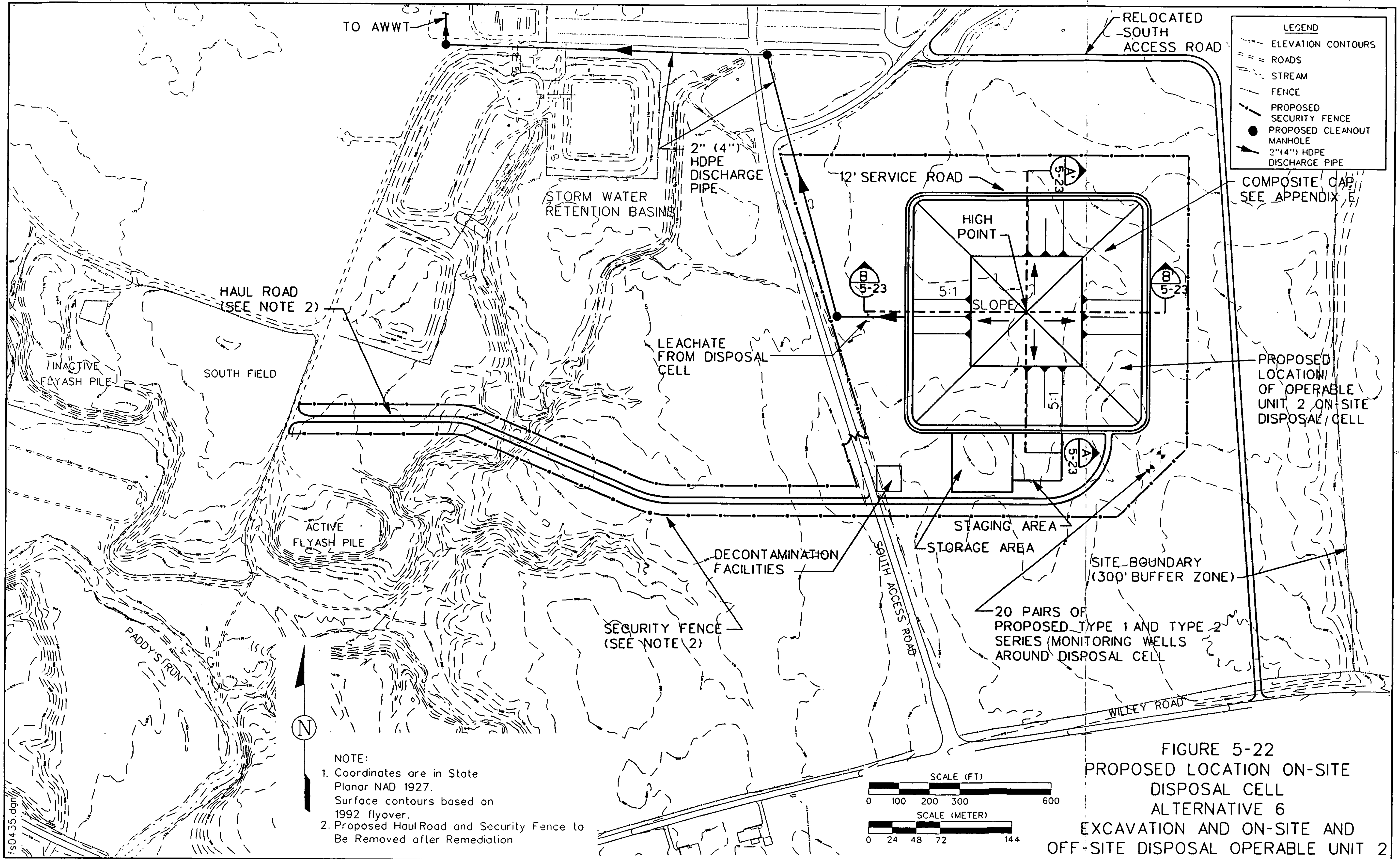
Construction of the disposal cell would include site preparation, a decontamination facility for personnel and equipment, a liner system, leachate collection and treatment system, disposal of the contaminated material, and a capping system. (Refer to Figure 5-22 and 5-23.)

<u>Disposal Cell Liner System</u>

The liner system (see Appendix E) would be constructed before the contaminated material is excavated from the Operable Unit 2 subunits. The construction of the liner system would begin with site preparation, which would include clearing and grubbing; installation of erosion and sediment controls, a runoff control facility, and the security fence; construction of a decontamination facility and an access road; and subgrade preparation for the liner.

Subgrade for the liner would be graded and compacted to at least 95 percent of the maximum standard Proctor density. The components of the liner from top to bottom include a cushion layer, a leachate collection system layer, a primary liner system layer, a leak detection system layer, and a secondary liner system layer. Contaminated material placed on top of the cushion layer would be pre-screened and would be free of sharp objects or other characteristics that could jeopardize the integrity of the non-woven geotextile below the cushion layer. No heavy equipment would be operated over the liner until the cushion layer is placed.

The leachate collection system and leak detection system would include perforated HDPE leachate collection piping in the drainage layer, two HDPE leachate collection sumps outside the liner area, double-walled HDPE leachate discharge pipe from the sump to the AWWT facility, and six HDPE clean-out manholes on the leachate discharge pipe to the AWWT facility.



NOTE:
1. Coordinates are in State Planar NAD 1927. Surface contours based on 1992 flyover.
2. Proposed Haul Road and Security Fence to Be Removed after Remediation

FIGURE 5-22
PROPOSED LOCATION ON-SITE DISPOSAL CELL
ALTERNATIVE 6
EXCAVATION AND ON-SITE AND OFF-SITE DISPOSAL OPERABLE UNIT 2

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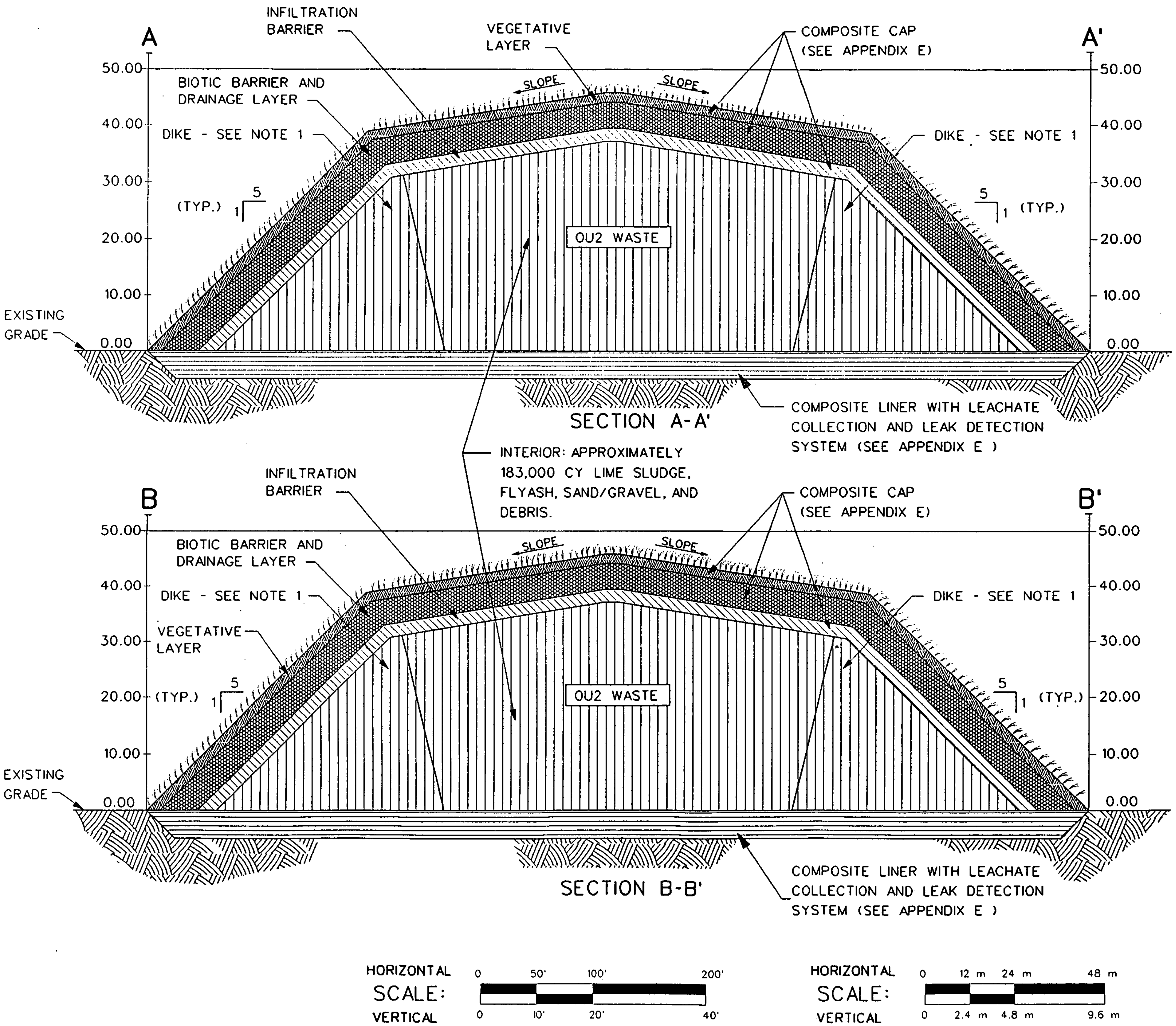

NOTE:

1. Dike shall be constructed of suitable fill and till material excavated from the waste units.

LEGEND

- VEGETATIVE LAYER
- INFILTRATION BARRIER
- BIOTIC BARRIER AND DRAINAGE LAYER
- OU2 WASTE
- COMPOSITE LINER
- EXISTING GRADE/ PREPARED SUBGRADE

FIGURE 5-23
TYPICAL SECTIONS
ON-SITE DISPOSAL CELL

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Placement of Contaminated Material

Placement of the contaminated material would begin after the completion of the liner system and when the cell is ready to accept the material from the subunits. After placement of the cushion layer, contaminated material would be placed in lifts and compacted. During placement of material and construction of the cap, runoff from within the cell would be collected and pumped to the sedimentation tank before conveying to the AWWT facility for further treatment.

Capping System

The composite cap would be constructed after the consolidation of the contaminated material in the disposal cell. The composite cap would be constructed in accordance with applicable regulations and DOE guidance. The cap would consist of the following components from bottom to top: a contouring layer, an infiltration/radon barrier, a drainage layer, a biotic barrier, a filter layer, vegetative support soil layer, and a topsoil layer.

Nos. 14,31 ~~Following placement of the capping materials, the cap surface would be finish graded with a minimum slope of 4 percent, seeded, and mulched in accordance with the approved erosion and sediment control plan.~~ Following placement of the cap components, the cap surface at the top of disposal cell would be finish graded with a minimum slope of 3 percent and side slopes of 1-vertical and 5-horizontal. After completion of finish grading, top and side slopes of disposal cell would be seeded and mulched in accordance with the approved erosion and sediment control plan. Fertilizing, seeding, and mulching for the grass cover would be performed in accordance with the approved erosion and sediment control plan to minimize surface erosion.

Various activities would be performed at the disposal facility to maintain the integrity and effectiveness of the capping system. These activities would include routine inspection of the capping system to identify subsidence, erosion, or weathering; removal of dead vegetation that would threaten the integrity of the capping system; and repairs. Five-year CERCLA reviews would also be conducted at the disposal cell.

5.5.1.5.2 Off-Site Disposal

Approximately 2,300 cu m (3,100 cu yd) of the contaminated material excavated from the subunits would contain elevated concentrations of uranium-238 that exceed the waste acceptance criteria for the on-site disposal facility (see Appendix E.2). The contaminated material exceeding the WAC would be packaged in IBCs at the staging area and loaded on trucks for transportation to the representative off-site disposal facility.

the Great Miami River would be 9.8 x 10^{-7} $\mu g/L$ for dieldrin (below the 7.6 x 10^{-4} $\mu g/L$ standard) and 4.1 x 10^{-4} $\mu g/L$ for PAHs (below the 0.31 $\mu g/L$ standard). These concentrations are for the expanded trespasser scenario, which would have higher soil cleanup levels than the on-property resident farmer. Therefore, since the expanded trespasser scenario would meet the ARAR standards, the on-property farmer scenario would meet them also.

These standards are identified in Table B-1 of Appendix B. Table 5-11 illustrates that on-site disposal also brings Operable Unit 2 into compliance with the groundwater MCL for uranium, which would not be met under the no action alternative. The maximum groundwater concentration is presented in the table (underneath subunit); therefore, the points of compliance, which are at the boundaries of the subunit and the on-site disposal facility, would also comply with the uranium MCL.

TABLE 5-11

COMPLIANCE WITH OPERABLE UNIT 2 CHEMICAL-SPECIFIC ARARs ALTERNATIVE 6

No. 4

MAXIMUM CROSS-MEDIA GROUNDWATER[a] CONCENTRATIONS							
COC	ARAR Standard	Point of Compliance	Solid Waste Landfill	Lime Sludge Ponds	Inactive Flyash Pile/South Field	Active Flyash Pile	On-Site Disposal Facility
Total Uranium	20 $\mu g/L$	Under Subunit	18 $\mu g/L$	3.2 $\mu g/L$	18.4 $\mu g/L$	10.7 $\mu g/L$	20 $\mu g/L$
		FEMP Fenceline	0.7 $\mu g/L$	0.1 $\mu g/L$	2.2 $\mu g/L$	1.5 $\mu g/L$	2.1 $\mu g/L$

No. 15 [a] These concentrations are for the expanded trespasser scenario, which would have higher soil cleanup levels than the on-property resident farmer. Therefore, since the expanded trespasser scenario would meet the ARAR standards, the on-property resident farmer scenario would meet them also. The groundwater modeling procedures and results are presented in detail in Appendix D.

Water encountered during construction would be treated at the AWWT facility to meet the Ohio Water Quality Standards found in Table B-1 of Appendix B.

5.5.2.2.2 Action-Specific ARARs/TBCs

Alternative 6 would meet the principal action-specific ARARs/TBCs discussed in Section 2.3 and listed in Tables B-2, B-3, and B-4 of Appendix B. Because Operable Unit 2 includes both low-level radioactive waste/residual radioactive material and solid waste, design and construction of the on-site disposal facility would meet the more stringent requirements for the disposal of low-level radioactive waste/residual radioactive material. EPA states in 40 CFR §192.02(a) that the disposal facility must be designed to be effective for up to 1,000 years, to the extent reasonably achievable, and in any case, for at least 200 years. DOE Order 5820.2A requires compliance with performance objectives for low-level radioactive waste disposal site, including protection of public health and safety, protection of the public and the environment from releases of radioactivity, and protection of groundwater resources.

The on-site disposal facility would also meet the less stringent OEPA technical requirements for the disposal of solid waste. These requirements include specifications for the design and construction of a liner and cap system for the on-site disposal facility. Material with contaminant levels that are below No. 16 the PRLs (see Section 2.0), would not be considered waste and would be left in place. Long-term monitoring will be performed at each subunit to monitor groundwater and surface water to ensure material left in place causes no adverse effects.

No. 50 Material containing bullets from the South Field Firing Range that is ~~assumed to be~~ mixed waste ~~and~~ would be treated and shipped to an off-site disposal facility that is approved to accept mixed waste. This waste must comply with the storage, packaging, and transportation requirements of RCRA, including the manifest system, while it is being prepared and shipped from the FEMP. Packaging and transportation of these wastes would also be required to meet DOT and DOE requirements for the transport of hazardous materials. These RCRA, DOT, and DOE regulations are considered to be non-ARAR requirements and are listed in Table B-6 of Appendix B. Operable Unit 2 must comply with both the administrative and substantive standards of non-ARAR requirements. Firing Range material surrounding the area with bullets that is not found to be hazardous after testing, but contains COCs above the PRLs, would be disposed of on-site with the rest of the South Field low-level radioactive waste/residual radioactive material.

5.5.2.2.3 Location-Specific ARARs/TBCs

Alternative 6 would not meet all the location-specific ARARs/TBCs discussed in Section 2.3 or in Table B-5 of Appendix B. Because the on-site disposal facility would contain solid waste in addition to low-level radioactive waste/residual radioactive material, it must comply with the OEPA siting criteria in the Ohio Solid Waste Disposal Regulations. OAC 3745-27-07 lists the following areas where a solid waste disposal facility may not be located:

- in a floodway;

- in surface and subsurface areas surrounding a public water supply well through which contaminants may move toward and may reach the public water supply well within a period of five years;

- above an aquifer declared by the Federal government under the Safe Drinking Water Act to be a sole source aquifer;
- above an unconsolidated aquifer capable of sustaining a yield of 100 gallons per minute for a 24-hour period to a water supply well located within 1,000 feet of the limits of solid waste placement;
- in a regulatory floodplain;
- within 1,000 feet of a water supply well or developed spring;
- within 300 feet of the facility's property line;
- within 1,000 feet of a domicile whose owner has not consented in writing to the location of the facility;
- within 200 feet of a stream, lake, or natural wetland;
- the isolation distance between the uppermost aquifer system and the bottom of the recompacted soil liner of the disposal facility cannot be less than 15 feet of in situ or added geologic material.

The proposed feasible location of the on-site disposal facility is on the eastern side of the FEMP which is not in a floodway or floodplain; near a stream, lake, or wetland; within 1,000 feet of a water supply well or developed spring; or near enough to a public water supply well so that contaminants may reach the well within a period of 5 years. The facility would not be placed within 300 feet of the FEMP property line or within 1,000 feet of a residential house. The isolation distance between the uppermost aquifer system and the bottom of the recompacted soil liner would be greater than 15 feet.

The remaining two siting criteria (bullets three and four) cannot be met because of the FEMP's location over a sole-source aquifer that is capable of sustaining a yield of 100 gallons per minute for a 24-hour period. Because the aquifer underlies the entire site, a waiver would be requested to locate an on-site disposal facility on the FEMP. The waiver request would be based on the ability of the selected remedial action, through the use of another method or approach, to attain a standard of No. 103 performance that is equivalent to that required by the ARARs. ~~The pertinent standard of performance in this case is the protection of human health and the environment. (See Section 2.3.3.1 for a detailed discussion on the basis for a waiver.) This protectiveness would be based on both the hydrology of the disposal location and the engineering design of the facility. A feasible combination of location and design has been evaluated in this FS and has been found to be protective of human~~

No.103~~health and the environment. This conclusion is based on conservative fate and transport modeling and residual risk assessment which have shown that risks to humans would be less than 1.6×10^{-6}. (See Appendices C and D for additional information on modeling and risk assessment.)~~ The criteria in determining a CERCLA ARAR waiver based on an equivalent standard of performance [40 CFR 300.430 (f)(1)(ii)(C)(4)]are: degree of protection; level of performance; reliability into the future; and time required for results. A discussion of these factors and the OEPA requirements is presented in Section 2.3.

As the support for an OEPA exemption is a combination of performance and risk, the equivalent level of performance will address both factors.

The circumstances of this alternative are considered equivalent to the OEPA requirements and thereby warrant the granting of a CERCLA ARAR waiver. The basis for equivalency is identified for each of the identified criteria:

Degree of protection:

- OEPA Standard

  The justification to allow a solid waste landfill over a high yield sole source aquifer is that the existing hydrogeology will provide adequate protection to the high yield sole source aquifer from the effects of a release of leachate and thereby protect the aquifer from contamination. The approach spelled out by the pertinent policies is to prevent leachate from reaching the aquifer during the active life of the landfill and the post closure period of 30 years. The active life of the disposal facility for Operable Unit 2 wastes is estimated to be 51 months. It should be noted that if future decisions direct disposal of other wastes in the on-site disposal facility, the maximum active life could be approximately 20 years.

- Equivalent Standard

  The combination of engineering controls and existing hydrogeology proposed in this alternative will provide the same degree of protection to the aquifer as the hydrogeologic conditions described in the OEPA policy, alone. Modeling with the combined controls shows that the leachate will not reach the aquifer during the active life of the landfill and a post closure period of thirty years.

  It should be noted that the modeling performed in this FS (Appendix D.1) was performed for 1000 years and assumed that the liner system and man-made materials (e.g. leachate collection, leak detection and synthetic liners) of the disposal facility would fail. This modeling shows that with the enhanced cap to reduce infiltration and the existing hydrogeology, leachate that

o. 103 may eventually reach the aquifer would not cause the constituent concentrations in the aquifer to exceed the promulgated and proposed MCLs.

Level of performance (method based)

- OEPA Standard

  Significant thickness of low permeable material between the disposal facility and the aquifer

- Equivalent Standard

  Modeling has shown that the combination of 12 feet of gray clay with a minimum k_d of 3.1 and a WAC of 360 pCi/g of U-238 will not exceed the proposed MCL for total uranium at the boundary of the disposal facility or a 10^{-6} concentration level at the boundary of the FEMP (see Appendix D.1). Only the layers in the engineered cap and the gray clay and unsaturated GMA hydrogeologic layers were used in this modeling. The liner and brown clay would increase the protection of the aquifer.

- OEPA Standard

  Lack of inter-connection between the sole source aquifer and any significant zones of saturation

- Equivalent Standard

  Any inter-connections will be minimized by:

  1) locating the disposal facility in an area with the greatest thickness of gray clay and the least occurrence of interbedded granular material; and

  2) providing an increase in the engineered controls to compensate for any reduction of protection due to interbedded granular material; and/or

  3) providing engineering control of lateral movement of water in an area of interbedded granular material by removing the granular material affecting the geologic protection of the aquifer or by preventing the movement of water from these areas to the aquifer.

- OEPA Standard

  Significant amount of sediment [soil] between the disposal facility and the high yield aquifer to prevent leachate from migrating to the high yield aquifer during the life of the landfill and the post-closure care period. The post-closure care period for a solid waste landfills is a minimum of 30 years [OAC 3745-27-14(A)].

. 103 • Equivalent Standard

At a minimum, a total of four additional layers will be added to the standard solid waste cap and liner [OAC 3745-27-08(C) and 11(G)]. These layers are a sand filter, biotic barrier and bentonite geocomposite layers in the cap to reduce infiltration and to protect the integrity of the cap. A leak detection layer will be provided in the liner to monitor the integrity of the containment system and to provide early warning to allow corrective action prior to any adverse impact to the aquifer. These additional engineering controls together with the natural hydrogeology will prevent leachate from reaching the aquifer during the post closure care period.

Level of performance (risk based)

• OEPA Standard

ORC 3734.02(G) allows exemptions of OEPA regulations if an alternative is unlikely to adversely affect the public health or safety or the environment. The pertinent policies mirror this requirement using an approach which requires existing hydrogeologic conditions to provide this protection.

OEPA does not propose a specific definition for the protection of human health and the environment. However, OAC 3745-27-10 (7)(a)-(d), which specifies solid waste landfill operating requirements, sets forth concentration levels for constituents detected in the groundwater for which a corrective action is required. This standard provides an appropriate framework for risk analysis in this case because the waiver concerns the establishment of a solid waste disposal unit. These levels are concentrations that are at a statistically significant level to be:

- protective of human health and the environment, and

- the promulgated MCL, or

- background concentrations for constituents that do not have a promulgated MCL, or

- alternative groundwater protection standard - for a known or suspected carcinogen-concentration levels that represent a cumulative excess upper-bound lifetime cancer risk to an individual within the 1×10^{-4} to 1×10^{-6} range.

• Equivalent Standard

This same definition has been use as a threshold criteria in evaluating alternatives in the CERCLA decision making process at the FEMP and specifically in the Operable Unit 2 FS with the addition that constituents in groundwater should not be higher than the proposed MCLs. This alternative meets this threshold criteria.

Protection of human health has been determined through the risk assessment process based on contaminant transport modeling and the NCP acceptable ILCR range of 1×10^{-4} to 1×10^{-6} and

p. 103 in compliance with promulgated and proposed MCLs. This process for Operable Unit 2 is discussed in detail in Appendices C and D and is summarized for this alternative in the protection of human health and long term protectiveness sections of the detailed analysis (Section 5).

Reliability into the future

The combination of hydrogeologic and engineering controls(including additional controls beyond the requirements for a solid waste disposal facility) provides increased reliability into the future because of the following:

- the biotic barrier in the cap will prevent burrowing animals or vegetative roots from compromising the integrity of the cap and thereby increasing the infiltration.
- leak detection monitoring will provide an early warning of any problem in leachate containment and allow corrective measures to be undertaken prior to adverse impact to the aquifer.

Time required for results

Not applicable to this circumstance

A CERCLA ARAR waiver of the OEPA prohibition of siting a disposal facility over a high yield, sole source aquifer is justified based on an equivalent standard of performance [40 CFR 300.430(f)(1)(ii)(C)(4)]to the OEPA policies allowing an exemption to the siting requirements.

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Wetlands and Floodplains

The construction of a haul road from the Operable Unit 2 waste areas to the disposal cell would result in direct impact (i.e., filling) of 0.13 ha (0.32 ac) of drainage ditch/swale wetlands. In addition, the installation of a pipeline from the on-site disposal cell to the AWWT facility would cause another 0.05 ha (0.13 ac) drainage ditch wetland to be filled. Direct and indirect impacts to the drainage ditch wetlands on the northern edge of the Solid Waste Landfill and Lime Sludge Ponds would still be expected as a result of remedial activities. Refer to Section 5.3.2.3.3 for more detail. No long-term impact (i.e., change in flood elevations) to the 100- and 500-year floodplain would be expected. However, limited excavation in the floodplain would occur during the excavation of lead bullets and fragments from the Firing Range and during the construction of a temporary haul road from the South Field to the disposal cell. A Floodplain/ Wetlands Assessment is provided as Appendix H.

Socioeconomics and Land Use

The presence of a permanent disposal cell along the southeastern boundary of the FEMP site would result in limitations for future use of 14.2 ha (35 ac), including a buffer zone and security fence, of the site. In addition, aesthetic perceptions to a member of the public (i.e., visitor, passerby) could be altered due to the controls (e.g., fence, lights) required for the disposal cell. The cell would be visible from Willey Road and State Route 126.

Cultural Resources

All non-controlled areas (not previously disturbed) associated with Alternative 6 would be surveyed and managed appropriately in accordance with the NHPA, OHPO, AIRFA and NAGPRA. (Refer to Section 5.3.2.5.3.)

5.5.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 6 would not treat the contaminated material from the subunits such that toxicity, mobility, or volume would be significantly reduced. The shredding/crushing of debris would facilitate its handling and disposal and reduce its bulk density, which would reduce its total volume slightly. ~~The contaminated material would be consolidated in an engineered disposal cell, which would reduce the migration of contaminants. Engineered controls and institutional actions would reduce the potential for exposure.~~

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would be conducted in accordance with the site-specific health and safety plan and would mitigate the potential for workers to be exposed to unacceptable contaminant concentrations. Training, procedures, and personnel monitoring would ensure that worker exposure would be ALARA. Therefore, short-term risks for remedial workers would be acceptable.

5.5.2.5.3 Short-Term Environmental Impacts

Soil and Geology

The construction of the disposal cell, treatment facilities, haul roads, various support facilities, and No. 14 waste excavation activities would disrupt approximately ~~34.4 ha (85 ac)~~ 30.4 ha (75 ac) at the FEMP site. Any trees and shrubs in these areas would be collected, chipped, and transported to a mulch pile. The pile would be temporary storage until utilized for restoration. Erosion control measures (i.e., silt fences, straw bales, vegetative covers, tarps, and dust suppressants) would be implemented during remedial activities to minimize erosion. Geological impacts would not be expected.

Water Quality Hydrology

A construction water and surface water control system would be installed to collect construction water and surface water generated during construction. Surface water controls would include construction of on-property perimeter water control dikes and collection points. Water treatment would be performed as necessary. Perched groundwater at the South Field would not be collected under Alternative 6. Refer to Section 5.2.3.5.3 for more detail.

Air Quality

Excavation and construction activities would create the potential for air quality impacts due to the disturbance of contaminated material. Personnel and environmental air monitoring would be implemented to ensure that on-site workers and ecological receptors are not exposed to unacceptable levels of airborne emissions and also that these emissions do not migrate off-site. Refer to Section 5.2.3.5.3.

Biotic Resources

Waste excavation activities would cause similar short-term impacts as described in Alternative 2, with the exception of impacting the pine plantation. However, additional disruptions would also occur, as discussed in Section 5.5.2.3.3. In addition, remedial activities would temporarily impact the intermittent aquatic habitat in the Storm Sewer Outfall Ditch; however, habitat is minimal due to the dryness of the Storm Sewer Outfall Ditch most of the year. An additional 0.7 ha (1.8 ac) of early/mid-successional and riparian woodlands would be lost.

Wetlands and Floodplains

Refer to Section 5.2.3.5.3 for more detail on expected wetland and floodplain impacts as a result of waste excavation activities. An additional 0.18 ha (0.45 ac) of drainage ditch/swale wetlands would be impacted as a result constructing a haul road to the disposal cell and a pipeline from the AWWT facility to the disposal cell. In addition, limited excavation in the floodplain would occur during the construction of a haul road. However, no change in flood elevation would be expected. A Floodplain/Wetlands Assessment is provided as Appendix H.

Socioeconomics and Land Use

Short-term impacts to socioeconomics and land use would be minor with the implementation of
No. 14 Alternative 6. The present worth capital cost of implementing Alternative 6 is estimated at ~~$110~~
& 31 $105.9 million. The collective revenue for the CMSA would increase by less than ~~13.7~~ 13.2 percent. Most of the increase would occur during the performance of the alternative (the first 4 years). Minimal increase would occur during the remainder of the 30 years. Consequently, minor economic impacts would be expected for the CMSA as a result of implementing on-property disposal.

Cultural Resources

All non-controlled areas (not previously disturbed) associated with Alternative 6 would be surveyed and managed appropriately in accordance with the NHPA, OHPO, AIRFA, and NAGPRA. (Refer to Section 5.2.3.5.3.)

5.5.2.5.4 Duration of Remedial Activities

The excavation and disposal of contaminated soil and debris at the on-site disposal cell would be completed and RAOs met within 51 months.

5.5.2.6 Implementability

5.5.2.6.1 Technical Feasibility

The technical feasibility of excavating, segregating, transporting, and on-site disposal of the contaminated material from the subunits is commonly performed and reliable. The excavation,

TABLE 5-12

ALTERNATIVE 6
EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL
OF FRACTION EXCEEDING WAC
CAPITAL, O&M, AND NET PRESENT WORTH COSTS

PRESENT WORTH COSTS			ANNUAL O&M			
			Year 1	Years 2-5	Years 6-30	5-Year Review
CAPITAL	O&M	NET				
~~$90,300,000~~ $85,900,000	$20,000,000	~~$110,300,000~~ $105,900,000	$1,800,000	$1,700,000	$900,000	$100,000

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Present worth cost is calculated based on a time period of 51 months for construction and 30 years for O&M after remediation.

5.5.2.7.1 Capital Cost

The capital cost consists of both direct and indirect costs. The direct capital cost includes costs for materials, subcontracts, equipment, and labor. Indirect capital cost includes costs for engineering, construction management, health and safety requirements, and contingencies associated with the alternative. A more detailed description of the capital costs, O&M costs, and assumptions used to determine costs is provided in Appendix F.

5.5.2.7.2 O&M Costs

O&M costs include any associated long-term maintenance and monitoring which would be required until the remedial action objectives are achieved. For the purpose of the cost estimate, a maximum duration of 30 years is used. Monitoring activities would support the required CERCLA 5-year reviews.

5.5.3 Sensitivity Analysis of Alternative 6

In the detailed description and analysis for Alternative 6, the receptors are the expanded trespasser and off-property farmer and the PRLs were calculated for a 1×10^{-6} ILCR and 0.2 HI. However, to assess the sensitivity of land-use scenarios on the analysis of this alternative, the private ownership scenario was also evaluated with PRLs based on the same risk goals of 1×10^{-6} ILCR and 0.2 HI as previously discussed. In addition, the federal ownership and private ownership scenarios have been contaminated material would be removed, no future remediation activities would be needed at the subunits. However, the area of the FEMP site where the disposal cell is located would be under federal ownership and would require long-term maintenance and monitoring.

The net present worth cost for achieving the on-property resident farmer PRLs for this alternative is $140.7 million which is an additional $30 million more then excavating the subunits to the expanded trespasser and off-property farmer PRLs.

5.6 SUMMARY OF DETAILED ANALYSIS

This section provides a summary of the detailed analysis for each of the alternatives discussed in Sections 5.2 through 5.5. The summary tables evaluate the alternatives with respect to the nine evaluation criteria discussed in Section 5.1. Table 5-13 summarizes the alternatives for Operable No. 17 Unit 2. ~~Table 5-14 summarizes the environmental impacts of each remedial alternative. In addition, a discussion of the Irreversible and Irretrievable commitment of Resources has also been included to secure the exclusion discussed in CERCLA Section 107(f)(1).~~

5.7 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Soil at the FEMP site would be disturbed by construction and excavation activities. Many impacts would be temporary, pending completion of remedial activities. The implementation of remedial alternatives would disturb between 14.4 and 30.4 ha (35 and 75 ac). All areas impacted by construction activities at the FEMP site would be regraded to the surrounding grade and revegetated. However, the implementation of remedial activities would also result in permanent losses.

Any remedial action alternative implemented would result in the loss of 5.6 ha (13.8 ac) of introduced grassland/leased pasture habitat, 2.6 ha (6.5 ac) early/mid-successional and riparian woodland habitat, and 0.10 ha (0.20 ac) drainage ditch wetland habitat. In addition, any remedial action alternative implemented would cause a disturbance to riparian, aquatic and managed grassland habitat. Impacts would also occur from the implementation of an on-property borrow area. If this area is selected for borrow, approximately 6.9 ha (17 ac) of woodlands and associated species would be lost. Approximately 1.2 ha (3.0 ac) of swale/forested wetlands and associated habitats could also be lost.

The introduced grassland/leased pasture areas are generally inhabited by small mammals and several species of birds. The area also provides potential habitat for federally-listed endangered running

TABLE 5-13
(Continued)

Alternative 1 No-Action	Alternative 2 Consolidation and Capping	Alternative 3 Off-Site Disposal	Alternative 6 On-Site Disposal w/Off-Site Disposal of Fraction Exceeding WAC
Implementability			
No implementation is required.	Technologies required to implement this alternative are readily available and have been sufficiently demonstrated for this type of application. The availability of the required equipment and operators would not be a problem. Multiple contractors would be available with skills and experience necessary to implement these technologies.	Technologies required to implement this alternative are readily available, and have been sufficiently demonstrated for this type of application. However issues associated with transportation and public acceptance could arise by disposing of contaminated material off-site. The availability of the required equipment and operators would not be a problem. Multiple contractors would be available with skills and experience necessary to implement these technologies.	This alternative does not require any special or unique equipment or techniques. The disposal cell will meet the criteria for a waiver from OEPA siting criteria based on achieving a standard of equivalent performance. The availability of the required equipment and operators would not be a problem. Multiple contractors would be available with skills and experience necessary to implement these technologies.
Present Worth Cost ($1,000s)			
0	69,600	212,800	~~110,300~~ 105,900

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TABLE 5-14

SUMMARY OF LONG-TERM AND SHORT-TERM ENVIRONMENTAL IMPACTS

	Long Term				Short Term			
	Alternative 1	Alternative 2	Alternative 3	Alternative 6	Alternative 1	Alternative 2	Alternative 3	Alternative 6
Soil and Geology	No impact	6.6 ha committed[a] to containment	6.5 ha committed at off-site disposal facility	~~5.3~~ 9.3 ha committed to on-site disposal facility	No impact	14.2 ha disturbed	~~14.7~~ 24.3 ha disturbed	30.4 ha disturbed
Water Quality and Hydrology	Continued migration of contaminants to surface and groundwater	No impact	No impact	No impact	Continued migration of contaminants to surface and groundwater	Minimal impact, assuming controls	Minimal impact, assuming controls	Minimal impact, assuming controls
Air Quality	Potential release to ambient air	No impact	No impact	No impact	Potential release to ambient air	Fugitive dust emissions	Fugitive dust emissions	Fugitive dust emissions
Biotic Resources	Potential release to ecological receptors	Loss of 0.8 ha managed grassland, 5.6 ha introduced grassland/leased pasture and old field, 2.6 ha early/mid-successional and riparian woodlands,[b] 4.0 ha pine plantation, and 0.10 ha wetlands habitat	Loss of 5.6 ha introduced grassland/leased pasture and old field, 2.6 ha early/mid-successional and riparian woodlands, and 0.10 ha wetlands habitat	Loss of 19.8 ha introduced grassland/leased pasture and old field, 3.4 ha early/mid-successional and riparian woodlands, and 0.26 ha wetlands habitat	Potential release to ecological receptors	Habitats disturbed	Habitats disturbed	Habitats disturbed
Wetland and Floodplain	Potential release to wetlands and floodplain	Potential loss of 0.10 ha wetlands; no floodplain impact	Potential loss of 0.10 ha wetlands; no floodplain impact	Potential loss of 0.26 ha wetlands; no floodplain impact	Potential release to wetlands and floodplain	Potential for runoff and limited excavation in wetlands and floodplain	Potential for runoff and limited excavation in wetlands and floodplain	Potential for runoff and limited excavation in wetlands and floodplain
Socioeconomics and Land Use	Restriction of site's future use	Restriction of site's future use (20.6 ha)	Potential future use of site	Restriction of site's future use (14.2 ha)	Restriction of site's future use	8.7 percent increase for CMSA revenue over 30 years[c]	26.5 percent increase for CMSA revenue over 51 months	~~13.7~~ 13.2 percent increase for CMSA revenue over 30 years

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Section 6

os. 55,74 Residual risk (see Appendix C) associated with these action alternatives is within the established acceptable target range in the National Oil and Hazardous Substance Pollution Contingency Plan (NCP). Therefore, they would be protective of human health and the environment. ~~However, Alternative 3 would be more protective than Alternative 6, since off-site disposal of all contaminated material would remove the source of contamination from the site. Alternative 6 would be more protective than Alternative 2 because of the centralization of contaminated material in the on-site disposal cell; the protectiveness of the liner, leachate collection system, and leak detection system associated with the disposal cell; and the uncertainties associated with assuring that consolidation and capping would be a permanent solution.~~ All of these alternatives would rely on engineered containment systems to provide this protectiveness. However, there is a difference in the design and location of these systems. Uncertainties associated with long-term protectiveness are discussed in Section 6.3.1.

6.2.2 Compliance with ARARs

Except for Alternative 1, No Action, all remedial alternatives for Operable Unit 2 would either attain pertinent chemical-, action-, and location-specific ARARs or meet the requirements for attaining an waiver pursuant to the NCP. ARARs are not pertinent to Alternative 1, since no remediation activities would occur. The principal ARARs for Operable Unit 2 are discussed in Section 2.3 and are presented in detail in Appendix B. Key requirements are discussed in Section 5.0 within the ARAR evaluation of each alternative. The following text summarizes those evaluations.

6.2.2.1 Chemical-Specific ARARs

As outlined in Section 2.3 and Appendix B, the principal chemical-specific ARARs for Operable Unit 2 are associated with penetrating radiation and potential releases of contaminants to air, surface water, and groundwater. Alternatives 2, 3 and 6 would meet these chemical-specific ARARs.

Alternative 2, Consolidation and Capping, would comply through consolidation and containment of contaminated material and installation of a subsurface drainage system in the South Field area. Alternative 3, Excavation and Off-Site Disposal, would comply via removal and off-site disposal. Alternative 6, Excavation and On-Site Disposal with Off-Site Disposal of Fraction Exceeding Waste Acceptance Criteria, would comply via removal and disposal in an on-site disposal facility designed to preclude human and ecological contact with the contaminated material and to eliminate unacceptable impacts to groundwater.

would require appropriate notification and mitigation measures in conjunction with implementation of the alternative.

Alternatives 2, 3, and 6 are each estimated to be completed in a 51-month time period. This time period includes a duration based on straightforward completion of the work plus an allowance for unforeseen delays (see Appendix F).

Alternative 1 would provide the best short-term effectiveness, since no remedial activities would No. 56 occur. ~~Alternative 2 would provide slightly better short-term effectiveness than Alternative 6 because less contaminated material is excavated, and the same amount of contaminated material is treated and transported off site for disposal in both alternatives.~~ Alternative 2 provides better short-term effectiveness than Alternative 6 because Alternative 6 requires excavation of more waste than Alternative 2, and because Alternative 6 includes off-site transport and disposal of material exceeding on-site disposal facility WAC. Alternative 3 would be the least effective in the short term because of the potential to expose the community to contaminated material during transportation to the off-site disposal facility.

6.3.4 Implementability

There would no implementation required for Alternative 1, because no remedial activities would be involved. For the action alternatives, removal and treatment of perched groundwater at the AWWT facility would be both technically and administratively implementable.

Alternative 2, Consolidation and Capping, would be readily implementable because consolidation of material is relatively simple, and the capping system at each subunit is readily constructable. A minimum amount of material (lead-contaminated soil from the Firing Range) would require off-site disposal, so no issues are anticipated that would affect the administrative feasibility of this action.

Alternative 3, Excavation and Off-Site Disposal, would not require the construction of caps or a disposal facility at the FEMP, but would require a significant quantity of contaminated material to be disposed off site. Off-site disposal would be subject to various local, state, and federal requirements and would require coordination efforts with jurisdictional agencies. Therefore, this alternative would be administratively possible to implement but may be time consuming. Issues associated with transportation, and public acceptance could arise.

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Construction of an on-site engineered disposal cell over a sole-source aquifer under Alternative 6, Excavation and On-Site Disposal with Off-Site Disposal of Fraction Exceeding Waste Acceptance

TABLE 6-3

COMPARISON OF NET PRESENT WORTH COSTS ALTERNATIVE LAND-USE SCENARIOS AND PRL RISK VALUES OPERABLE UNIT 2

Alternative	Net Present Worth Cost ($millions)			
	Federal Ownership		Private Ownership	
	Target ILCR = 10^{-5}	Target ILCR = 10^{-6}	Target ILCR = 10^{-5}	Target ILCR = 10^{-6}
1 - No Action	0	0	0	0
2 - Consolidation and Capping	61.2	69.6	NA	NA
3 - Excavation and Off-Site Disposal	175.6	212.8	321.8	464.9
6 - Excavation and On-Site Disposal with Off-Site Disposal of Fraction Exceeding Waste Acceptance Criteria	~~92.9~~ 89.4	~~110.3~~ 105.9	~~105.5~~ 119.2	~~148.3~~ 167.7

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Indicates land-use scenario and PRL risk value used for comparative analysis.

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TABLE 6-1

SUMMARY OF COSTS
OPERABLE UNIT 2[a]

Alternative	Capital Cost ($millions)	Annual O&M Cost ($millions)				Present Worth Cost ($millions)[b]		
		Year 1	Years 2-5	Years 6-30	5-Year Review	Capital	O&M	Total
1 - No Action	0	0	0	0	0	0	0	0
2 - Consolidation and Capping	62.8	1.0	0.9	0.8	0.1	55.6	14.0	69.6
3 - Excavation and Off-Site Disposal	225.3	0.9	0.8	0.7	0.1	200.2	12.5	212.8
6 - Excavation and On-Site Disposal with Off-Site Disposal of Fraction Exceeding Waste Acceptance Criteria	~~101.8~~ 96.8	1.8	1.7	0.9	0.1	~~90.3~~ 85.9	20.0	~~110.3~~ 105.9

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[a]Costs to meet the RAOs for the federal ownership scenario.

[b]Calculated based on the required time period for construction and 30 years O&M after remediation.

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TABLE 6-2

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OPERABLE UNIT 2

	Threshold Criteria		Primary Balancing Criteria				
Alternative	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Implementability	Present Worth Cost ($millions)
1 - No Action	Not protective	ARARs not applicable	Not effective or permanent	No treatment	Highly effective; no risks	None	0
2 - Consolidation and Capping	Protective for continued federal ownership with access controls; not protective for private ownership.	Complies with all ARARs	Effective, with concerns over permanence because of inability to monitor leaks	Minimal treatment (Firing Range soil) so no significant effect on toxicity, mobility, or volume~~, but capping system would minimize the potential for migration~~	Effective - minimal risk to community and workers	Reliable technology; administratively easy to implement	69.6
3 - Excavation and Off-Site Disposal	~~Highly p~~ Protective for both federal and private ownership land-use scenarios.	Complies with all ARARs	Highly effective and permanent	Minimal treatment (Firing Range soil) so no significant effect on toxicity, mobility or volume~~, but disposal in off-site facility would minimize the potential for migration~~	Effective - moderate risk to community and workers	Reliable technology; administratively possible to implement, but may be time consuming to obtain necessary permits and approvals	212.8
6 - Excavation and On-Site Disposal with Off-Site Disposal of Fraction Exceeding Waste Acceptance Criteria	Protective for both federal and private ownership land-use scenarios.	Would require waiver from OEPA prohibition on construction of disposal facility above a sole-source aquifer; complies with all other ARARs	Effective and permanent	Minimal treatment (Firing Range soil) so no net effect on toxicity, mobility or volume~~, but disposal in on-site facility would reduce the potential for migration~~	Effective - moderate risk to workers, minimal risk to community	Reliable technology; administratively implementable	~~110.3~~ 105.9

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Appendix A

A.1.0 INTRODUCTION

A.1.1 PURPOSE

The goal of this appendix is to present the data that were most significant to the development and evaluation of the alternatives presented within this Feasibility Study (FS). Data in this appendix consist of Remedial Investigation/Feasibility Study (RI/FS) sampling results for selected contaminants at the Operable Unit 2 subunits. Selected data from the Characterization Investigation Study (CIS) are also included. For the complete Operable Unit 2 data set and the determination of contaminants of concern (COCs), refer to the appendices of the Operable Unit 2 Remedial Investigation (RI) Report and Section 2 of the FS, respectively.

A.1.2 ORGANIZATION

Each Operable Unit 2 subunit has a separate section within Appendix A. Each section presents two statistical summary tables. The first table is for solid materials at the subunit; the second is for perched groundwater. Definition of the statistical parameters shown on the summary tables can be found in Section A.1.3. The summary statistics address only those analytes shown in Tables A.1-1 through A.1-5, which include the COCs as defined by the Operable Unit 2 RI Report, as well as
No. 43 additional analytes that have been included for the reasons stated in the individual tables. For comprehensiveness, sampling results are included for all parameters listed in the tables, regardless of the parameters' applicability to any specific pathway.

It should be noted that the grouping of results within the first statistical summary table in each section separates the solids into media classifications that differ from those presented in the Operable Unit 2 RI Report. The media classifications are defined in Table A.1-6. As a result of these classifications, the summary statistics presented here are not directly comparable to those presented in the RI Report, even though the raw data sets are identical.

Following the statistical summary tables, each subunit section includes lists of samples that present the individual sample locations that were used within each media classification shown in the summary tables. The association with a specific media was based on the position of the individual sample within a soil boring. For each soil boring a media classification was assigned to the associated samples based on the boring log descriptions. Tables A.1-7 through A.1-11 provide the elevation and depth information that defines the media classification for each soil boring, and identify whether the boring falls inside or outside of the subunit battery limits. For example, soil samples from the Solid Waste Landfill have been classified as surface soil, fill/debris, glacial overburden (till),

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Appendix B

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
EFFLUENT AND AIR EMISSION STANDARDS (continued)				
Ohio Particulate Matter Standards OAC 3745-17-11 (continued)	Restrictions on Particulate Emissions	Process Weight at Maximum Capacity lb/hr. — Allowable Rate of Particulate Emission lb/hr. 100 — 0.551 200 — 0.877 400 — 1.40 600 — 1.83 800 — 2.22 1000 — 2.58	Applicable	
Standard of Performance for Nonmetallic Mineral Processing Plants 40 CFR § 670.672 (a),(d),(e)	Restrictions on Particulate Emissions From Crushers	No owner or operator shall cause to be discharged into the atmosphere from a crusher any emissions which: • contain particulate matter in excess of 0.05 grams per dry cubic meter at standard conditions (g/dscm), and • exhibit greater than 7 percent opacity Truck dumping of nonmetallic minerals into any crusher is exempt from these requirements.	Relevant and Appropriate	
RADIONUCLIDE CONCENTRATIONS IN SOILS				
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR §192.12(a) Subpart B 40 CFR §192.20 Subpart C	Cleanup of Soils Contaminated with Residual Radioactive Materials	Remedial actions shall be conducted so as to provide reasonable assurance that, as a result of residual radioactive materials, the concentration of radium-226 in land averaged over any area of 100 m^2 shall not exceed the background level by more than: • 5 pCi/g, averaged over the first 15 cm of soil below the surface • 15 pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface Compliance with this requirement should be shown through measurements performed within the accuracy of currently available types of field and laboratory instruments in conjunction with reasonable survey and sampling procedures.	Relevant and Appropriate	

Comment No. 18

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR §192.21 (f) and §192.22 (b) Subpart C	Supplemental Standards	Where radionuclides other than radium-226 and its decay product are present in sufficient quantity and concentration to constitute a significant radiation hazard from residual radioactive materials, remedial actions shall, in addition to satisfying the standards of 40 CFR §§ 192.02, Subpart A and 192.12, Subpart B (both listed above), reduce other residual radioactivity to levels that are as low as is reasonably achievable.	Relevant and Appropriate	

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
		Procedures for calculating these hot spots limits, which depend on the extent of the elevated local concentrations, are given in DOE/CH-8901. In addition, reasonable efforts shall be made to remove any source of radionuclide that exceeds 30 times the appropriate limit in the soil, irrespective of the average concentration in the soil.		
		RADIONUCLIDE CONCENTRATIONS IN SOILS (continued)		
EPA Guidance Methods for Evaluating the Attainment of Cleanup Standards, Vol. 1	Attainment of Soil Cleanup Standards	This document describes methods for testing whether soil chemical concentrations at a site are statistically below a cleanup standard or ARAR. If it can be reasonably concluded that the remaining soil or treated soil at a site has concentrations that are statistically less than relevant cleanup standards then the site can be judged protective of human health and the environment.	TBC	
		~~LEAD SOIL CLEANUP STANDARDS~~ LAND DISPOSAL RESTRICTIONS LEVEL		
Resource Conservation and Recovery Act 40 CFR §268.41	Requirements for Lead Disposal ~~Cleanup~~	The maximum concentration of lead in the extract of any sample of treated soil is 5 mg/L.	Relevant and Appropriate	
		PCB SOIL CLEANUP STANDARDS		
PCB Manufacturing, Processing, Distribution, and Use Prohibitions 40 CFR §761.125 (c)(4)(v)	Requirements for PCB Cleanup	Soil contaminated by a PCB spill in non-restricted access areas will be decontaminated to 10 ppm PCBs by weight, provided that the soil is excavated to a minimum depth of 10 inches. The excavated soil will be replaced with clean soil, i.e. containing less than 1 ppm PCBs, and the spill site will be restored (e.g. replacement of turf).	Relevant and Appropriate	The source of PCBs in Operable Unit 2 is unknown.

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TABLE B-2
SOLID WASTE ACTION-SPECIFIC REQUIREMENTS

Citation	Action	Requirement	Determination	Remarks
DEFINITIONS				
Resource, Conservation, and Recovery Act 42 U.S.C. §6903 (27)	Definition	Solid waste means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities, but does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-01 (B)(40) ~~(UU)~~ Comment #37	Definition	Solid wastes means such unwanted residual solid or semisolid material as results from industrial, commercial, agricultural, and community operations, excluding earth or material from construction, mining, or demolition operations, or other waste materials of the type that would normally be included in demolition debris, nontoxic flyash, spent nontoxic foundry sand, and slag and other substances that are not harmful or inimical to public health, and includes, but is not limited to, garbage, tires, combustible and noncombustible material, street dirt, and debris. Solid waste does not include any material that is an infectious waste or a hazardous waste. For the purpose of this definition, "semisolid material" does not contain liquids which can be readily released under normal climatic conditions, as determined by method 9095 (paint filter liquids test) in SW-846: "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods".	Applicable	
Resource, Conservation, and Recovery Act 40 CFR §261.3(a)	Definition	A solid waste is a hazardous waste, if: • it is not excluded from regulation as a hazardous waste under 40 CFR §261.4(b). • it exhibits any of the characteristics of hazardous waste. • it is listed in 40 CFR §§ 261.30 - 261.35. • it is a mixture of solid and hazardous wastes.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
DEFINITIONS (continued)				
Ohio Solid Waste Disposal Regulations OAC 3745-27-03 (H)(2)	Definition	Chapters 3745-27 (Ohio Solid Waste Disposal Regulations) and 3745-37 (Ohio Hazardous Waste Management Regulations) do not apply to lime sludge disposal or storage. Lime sludge is defined as a material resulting from the treatment of a water supply for drinking or industrial purposes.	Applicable	
Ohio Infectious Waste Regulations OAC 3745-27-01 (B)(15) ~~(V)~~ Comment #37 OAC 3745-27-30 (A),(E),(H) ORC 3734.021 (A)(1)(c),(d)	Definition	Infectious waste is defined by 9 categories of waste including human blood specimens and blood products, sharp wastes used in the treatment or inoculation of human beings, and any other waste materials generated in the diagnosis, treatment, or immunization of human beings. A generator who places all sharp infectious wastes and all unused hypodermic needles, syringes, and scalpel blades into a "SHARPS" container before they are transported and who generates less than 50 lbs. of infectious wastes each month and does not hold a certificate of registration as a generator of infectious wastes may transport and dispose of infectious wastes in the same manner as solid wastes. Treated infectious wastes can be transported and disposed in the same manner as noninfectious waste. Infectious waste that is also radioactive shall be managed in accordance with applicable Ohio Department of Health and U.S. Nuclear Regulatory Commission regulations.	Applicable	
Resource, Conservation, and Recovery Act 40 CFR §261.4(b)(4)	Definition	Flyash waste, bottom ash waste, slag waste, and fly gas emission control waste, generated primarily from the combustion of coal or other fossil fuels, are excluded from the definition of hazardous waste.	Applicable	

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1),(2),(3),(4),(5),(6),(7),(9) Comment #37	Landfill Construction	The following layers must be installed in the construction of a sanitary landfill (from bottom to top): Recompacted Soil Liner The recompacted soil liner shall be: • constructed using loose lifts 8 inches thick with a maximum permeability of 1 x 10^{-7} cm/s. • constructed of a soil with a maximum clod size of 3 inches or half the lift thickness, whichever is less. • constructed of soil with: - 100% of the particles having a maximum dimension not greater than 2 inches. - not more than 10% of the particles, by weight ~~volume~~, having a dimension greater than 0.75 inches. - not less than 50% of the particles, by weight, passing through the 200-mesh sieve. - not less than 25% of the particles, by weight, having a maximum dimension not greater than 0.002 millimeters. • compacted to at least 95% of the maximum "Standard Proctor Density" using ASTM D-698 or at least 90% of the maximum "Modified Proctor Density" using ASTM D-1557. • compacted at a moisture content at or wet of optimum. Alternatives for the above requirements may be used if it is demonstrated to the satisfaction of the Director that the materials and techniques will result in each lift having a maximum permeability of 1 x 10^{-7} cm/s.	Applicable	This applies to new disposal of solid waste.

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		Additionally, the recompacted soil liner shall:		

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Citation	Action	Requirement	Determination	Remarks
SOLID WASTE DISPOSAL (continued)				
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1), (2),(3),(4),(5),(6),(7),(9) (continued)	Landfill Construction	• not comprised of solid waste. • be constructed using the same number of passes and lift thickness, and the same or similar type and weight of compaction equipment established by testing (as defined in this table). • be placed on the bottom and exterior excavated sides of the landfill and have a minimum bottom slope of 2% and a maximum slope based on: - compaction equipment limitations; - slope stability; - maximum friction angle between any soil-geosynthetic interface and between any geosynthetic-geosynthetic interface; and - resistance of geosynthetics and geosynthetic seams to tensile forces. • constructed on a prepared surface that shall: - be free of debris, foreign material, and deleterious material; - be able to bear the weight of the landfill and its construction operations without causing or allowing a failure of the liner to occur through settling; and - not have any abrupt changes in grade that may result in damage to geosynthetics.	Applicable	
Comment #37		• be at least 5 feet thick, although the Director may approve an alternate thickness, to be no less than 3 feet, based upon the result of calculations or on a design that is no less protective of human health and the environment.		

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Citation	Action	Requirement	Determination	Remarks
Comment #37		• be at least 3 feet thick with a geosynthetic clay liner that meets the specifications in paragraph (C)(3) of this rule although the Director may approve an alternate thickness to be no less than 1½ feet, based upon the results of calculations or on a design that is no less protective of human health and the environment. • have a factor of safety for hydrostatic uplift not less than 1.4.		

Citation	Action	Requirement	Determination	Remarks
SOLID WASTE DISPOSAL (continued)				
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1), (2),(3),(4),(5),(6),(7),(9) (continued)	Landfill Construction	• be adequately protected from damage due to desiccation, freeze/thaw cycles, wet/dry cycles, and the intrusion of objects during construction and operation.	Applicable	
Comment #37		Flexible Membrane Liner Geomembrane		
		The flexible membrane liner geomembrane shall be: • placed on the recompacted soil liner. • sixty mil high density polyethylene (HDPE). • be protected from the drainage layer by a cushion layer, as required by the Director Other materials or thicknesses may be used if, at a minimum, the flexible membrane liner meets all the following: • negligibly permeable to fluid migration. • physically and chemically resistant to chemical attack by the solid waste, leachate, or other materials which may come in contact with the flexible membrane liner geomembrane. • seamed to allow no more than negligible amounts of leakage with seaming material that is physically and chemically resistant to chemical attack by the solid waste, leachate, or other materials which may come in contact with the seams. • have properties for its installation and use which are acceptable to the Director. • protected from the drainage layer by a cushion layer, as required by the Director. • have a minimum thickness of 40 mils		

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
Comment #37		**Geosynthetic Clay Liner**		
		The geosynthetic clay liner used in lieu of part of the recompacted soil liner shall be: • negligibly permeable to fluid migration. • be installed to allow no more than negligible amounts of leakage by a minimum overlap of 6 inches, or, for end of panel seams, a minimum over of 12 inches. Overlap shall be increased in accordance with manufacturers specifications or to account for shrinkage due to weather conditions. • have a bentonite mass per unit area of at least 1 pound per square foot. • be installed in accordance with the manufacturers specifications in regards to handling, overlap, and the use of granular or powdered bentonite to enhance bonding at the seams. • be constructed above the recompacted soil liner.		
		Leachate Management System		
		The leachate management system shall: • be designed to prevent clogging and crushing of the system and to limit the level of leachate in areas other than lift stations to a maximum of 1 foot.		

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
SOLID WASTE DISPOSAL (continued)				
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1), (2),(3),(4),(5),(6),(7),(9) (continued) Comment #37	Landfill Construction	• include a drainage layer placed on top of the flexible membrane liner geomembrane composed of granular material that must: - have a minimum permeability of 1 x 10^{-3} [-3] cm/s; - have a minimum thickness of 1 foot; - have a negligible amount of fines; and - not contain carbonate material. An alternate material and/or thickness may be used if it is demonstrated to the satisfaction of the Director that the material meets the requirements. • include leachate collection pipes to remove leachate from the bottom of the landfill. The pipes must: - be imbedded in the drainage layer; - have a minimum slope of 0.5%; - have lengths and configuration which shall not exceed the capabilities of clean-out devices; - be provided with access for clean-out devices which shall be protected from differential settling; - have joints sealed to prevent separation; and - be physically and chemically resistant to attack by the solid waste, leachate, or other materials that they may come in contact with. Sealing material and means of access for clean-out devices shall also be physically and chemically resistant to attack by the solid waste, leachate, or other materials that they may come in contact with.	Applicable	

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		An alternate means for leachate removal may be used if it is demonstrated to the satisfaction of the Director that the means for leachate removal meets the requirements.		

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Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1), (2),(3),(4),(5),(6),(7),(9) (continued) Comment #37	Landfill Construction	• include a filter layer to prevent clogging of the leachate collection system~~, as required by the Director~~. • include a protective layer to protect the recompacted soil liner, flexible membrane liner ~~geomembrane~~, geosynthetic clay liner (if applicable), and leachate collection system from the intrusion of objects during construction and operation. • include lift stations which are to be protected from adverse effects from leachate and differential settling. If manholes are used as lift stations, they must be equipped with automatic high level alarms located no greater than 6 feet above the invert of the leachate inlet pipe. Lift station pipes should be of adequate capacity and shall automatically commence pumping before the leachate elevation activates the high level alarm.	Applicable	
		Leachate Collection and Storage		
Comment #37		~~Collected leachate shall be managed in one of the following ways:~~ ~~• treated and disposed on site at the sanitary landfill facility;~~ ~~• treated on site and disposed off site of the sanitary landfill facility; or~~ ~~• treated and disposed off site of the sanitary landfill facility.~~ Any leachate conveyance and storage structures located outside the limits of solid waste placement shall be no less protective of the environment than the landfill facility, as determined by the Director, and: • The structures must be monitored, as required by the Director.		

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		• Storage tanks must be provided with spill containment		

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Citation	Action	Requirement	Determination	Remarks
SOLID WASTE DISPOSAL (continued)				
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1), (2),(3),(4),(5),(6),(7),(9) (continued)	Landfill Construction	• Leachate lines must be double-cased • Storage structures must have a minimum of 1 week of storage capacity using design assumptions simulating final closure. • If at any time leachate is evaluated to be hazardous in accordance with rule 3745-52-11 of the OAC, it shall be managed in accordance with Chapters 3745-50 to 3745-69 of the OAC, and the generator standards for storage shall apply in accordance with Chapter 3745-52 of the OAC.	Applicable	
		Surface Water Control		
Comment #37		• Any permanent or temporary surface water control structures shall be designed to accommodate, by non-mechanical means, the peak flow from the 25-year/24-hour ~~100 year/24 hour~~ storm event. ~~• Any temporary surface water control structures shall be designed to accommodate the peak flow from the 25-year/ 24 hour storm event.~~ • Surface water control structures shall be designed to minimize silting and scouring. • If sedimentation ponds are used, they shall be designed and constructed according to OAC 3745-27-08 (C)(6)(b) ~~(d)~~.		
		Benchmarks		
Comment #37		• At least 3 permanent third order benchmarks on separate sides of the landfill facility shall be within ~~in~~ easy access to the limits of solid waste placement and shall be constructed in accordance with OAC 3745-27-08(C)(7)(a)-(c).		

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
Comment #37		~~• The benchmarks shall have a stability class of A or B and be referenced horizontally and vertically to the National Geodetic Reference System.~~		

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
SOLID WASTE DISPOSAL (continued)				
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1), (2),(3),(4),(5),(6),(7),(9) (continued) Comment #37	Landfill Construction	Groundwater Control • Any permanent groundwater control structures shall adequately control groundwater infiltration through the use of non-mechanical means such as impermeable barriers or permeable drainage structures. • No permanent groundwater control structures may be used to dewater an aquifer system, except if the recharge and discharge zone of the aquifer system are located entirely within the boundary of the landfill facility.	Applicable	
EPA Criteria for Municipal Solid Waste Landfills 40 CFR §258.40	Landfill Design Criteria	The liner and leachate system shall be designed and constructed to maintain less than a 30-cm depth of leachate over the liner. The geomembrane must be at least 30-mil thick.	Relevant and Appropriate	
EPA Criteria for Municipal Solid Waste Landfills 40 CFR §258.26	Run-On/Run-Off Control Systems	The landfill shall have: • a run-on control system to prevent flow onto the active portion of the landfill during the peak discharge from a 25-year storm. • a run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm.	Relevant and Appropriate	
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (D) and (E)	Landfill Construction	Prior to being used in the construction of the recompacted soil liner and drainage layer of the sanitary landfill or the landfill cap, the following characteristics of the earthen materials must be determined to show that the material is suitable for use in construction of the landfill.	Applicable	

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (D) and (E) (continued) Comment #37	Landfill Construction	**Soil Material Specifications** The following tests shall be performed on representative samples at least once for every 1,500 yd^3 of soil except the recompacted permeability test, which shall be performed at least once for every 10,000 yd^3 of soil. • recompacted permeability at construction specifications; • moisture content and density using an approved ASTM method; • grain size distribution using ASTM D-422 for sieve and hydrometer methods; and • Atterberg limits using ASTM D-4318~~423 and D-424 methods~~. • chemical compatibility testing may be required by the Director. **Granular Drainage Material Specifications** The following tests shall be performed at least once for every 3,000 yd^3 of material. • permeability; • grain size distribution using ASTM D-422 for the sieve method; and • chemical compatibility testing may be required by the Director. **Geosynthetic Material Specifications**	Applicable	

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Citation	Action	Requirement	Determination	Remarks
Comment #37		Geosynthetics, other synthetic materials, and joint sealing compounds used in the construction of the flexible membrane liner, geosynthetic clay liner, and leachate management system for a sanitary landfill facility or a sanitary landfill cap system shall be shown to:		

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (D) and (E) (continued)	Landfill Construction	• be physically and chemically resistant to attack by the solid waste, leachate, or other materials that they may come in contact with using USEPA Method 9090 or other documented data. • have properties acceptable for installation and use.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1)(m),(o) and (C)(2)(g) ~~(F)(1), (3),(4)~~ Comment #37	Landfill Construction	The following activities must be performed to ensure that the components of the sanitary landfill facility meet the specifications of this rule. **Test Pads** The recompacted soil liner and the recompacted soil barrier layer in the cap system shall be modeled by the construction of test pads. The test pads shall: • be designed such that the proposed tests are appropriate and their results are valid. • be constructed to establish the construction details which are necessary to obtain sufficient compaction to satisfy the permeability requirement. The construction details include: - lift thickness; - water content necessary to achieve the desired compaction; and - type, weight, and number of passes of construction equipment. • be constructed prior to the construction of the sanitary landfill component which the test pad will model. • be constructed whenever there is a significant change in soil material properties.	Applicable	

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1)(m),(o) and (C)(2)(g) ~~(F)(1), (3),(4)~~ (continued) Comment #37	Landfill Construction	• have a minimum width three times the width of the compaction equipment, and a minimum length two times the length of compaction equipment, including power equipment and any attachments. • be comprised of at least four lifts. • be tested for field permeability, following the completion of test pad construction. For each lift a minimum of 3 tests for moisture content and density shall be performed. • be reconstructed as many times as necessary to meet the permeability requirement. Any amended construction details shall be noted. An alternative to test pads may be used if it is demonstrated to the satisfaction of the Director that the alternative meets the requirements.	Applicable	
		Moisture Content and Density Testing		
		Moisture content and density testing of the recompacted soil liner and recompacted soil barrier in the cap system shall be performed at a frequency of no less than 5 tests per acre per lift. Any penetrations shall be repaired using methods acceptable to the Director.		
Comment #37		Flexible Membrane Liner ~~Geomembrane~~ Testing		
		• For the purpose of testing every seaming apparatus in use each day, peel and shear tests shall be performed on scrap pieces of flexible membrane liner ~~geomembrane~~ at the beginning of the seaming period and every four hours thereafter. • Nondestructive testing shall be performed on 100% of the flexible membrane liner ~~geomembrane~~ seams.		

Citation	Action	Requirement	Determination	Remarks
SOLID WASTE DISPOSAL (continued)				
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1)(m),(o) and (C)(2)(g) ~~(F)(1), (3),(4)~~ (continued) Comment #37	Landfill Construction	• Destructive testing for peel and shear shall be performed at least once for every 500 feet of seam length. An alternate means may be used if it is demonstrated to the satisfaction of the Director that the alternate means meets the requirements.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (G)	Landfill Construction	All tests failing to meet the specifications outlined above must be investigated and the areas reconstructed to meet specifications.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (F) ~~(H)~~ Comment #37 Comment #37	Landfill Construction	The following testing procedures shall be included in a Quality Assurance/Quality Control Plan ~~A Quality Assurance/Quality Control Plan for construction shall include~~: • sampling and testing procedures to be used in the field and in the laboratory; • testing frequency; • parameters and sample locations; • procedures to be followed if a test fails; • the management structure and the experience and training of the testing personnel; and • contingency plan for anticipated construction difficulties. The following components shall be included in a Quality Assurance/Quality Control Plan ~~The Quality Assurance/Quality Control Plan shall certify the design and construction of any of the following items which are incorporated into the landfill design~~: • in-situ foundation preparation; • recompacted soil and/or geosynthetic clay liner system; • flexible membrane liner ~~geomembrane~~;	Applicable	

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		• leachate management system; • cap system; • permanent ground water control structures; and		

Citation	Action	Requirement	Determination	Remarks
SOLID WASTE DISPOSAL (continued)				
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (F) ~~(H)~~ (continued) Comment #37	Landfill Construction	• explosive gas control/extraction systems.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-19 (E)(19) ~~09 (H)~~ Comment #37	Sanitary Landfill Operation	To demonstrate that the solid wastes to be received at the landfill facility will not compromise the integrity of any material used to construct the landfill facility, the Director may require chemical compatibility testing to be performed.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-19 (E)(26) Comment #37	Sanitary Landfill Operation	The integrity of the engineered components of the landfill facility shall be maintained and any damage to, or failure or, the components shall be repaired.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-19 (J)(1), (4) ~~09 (N)(1),(2)~~ Comment #37	Sanitary Landfill Operations	Surface water shall be diverted from areas where solid waste is being, or has been, deposited. The facility shall be designed, constructed, maintained, and provided with surface water control structures, as necessary, to control run-on and run-off of surface water ~~properly graded and provided with additional drainage facilities as necessary~~ to ensure minimal infiltration of water through the cover material and cap system, and minimal erosion of the cover material and cap system. If ponding or erosion occurs on areas of the landfill facility where solid waste is being, or has been, deposited, action will be taken to correct the conditions causing the ponding or erosion.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-19 (K)(1) ~~09 (O)~~ Comment #37	Sanitary Landfill Operations	If leachate is detected on the surface of the landfill facility, then the outbreak(s) shall be repaired and: • leachate shall be contained and properly managed at the sanitary landfill facility. • if necessary, leachate shall be collected and disposed in accordance with paragraph (K)(5) and (K)(6) of OAC 3745-27-19 ~~(C)(4) of rule 3745-27-08 of the OAC~~.	/Applicable	

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Citation	Action	Requirement	Determination	Remarks
		• actions shall be taken to minimize, control, or eliminate the conditions which contribute to the production of leachate.		
Ohio Solid Waste Disposal Regulations OAC 3745-27-19 (K)(2) ~~09 (P)~~ Comment #37	Sanitary Landfill Operations	~~If the facility utilizes pumps for leachate removal, a~~At least one lift station back-up pump shall be kept at the sanitary waste landfill facility at all times.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
SOLID WASTE DISPOSAL (continued)				
Ohio Solid Waste Disposal Regulations OAC 3745-27-19 (K)(3) ~~09 (Q)~~ Comment #37	Sanitary Landfill Operations	The collection pipe network of the leachate management system shall be inspected after placement of the initial lift of waste to ensure that crushing has not occurred and shall be inspected annually thereafter to ensure ~~determine~~ that clogging has not occurred.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-19 (K)(4) ~~09 (R)~~ Comment #37	Sanitary Landfill Operations	If authorized ~~deemed acceptable~~ by the Director, leachate may be temporarily stored within the limits of ~~solid~~ waste placement until the leachate can be treated and disposed.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-10 Comment #37	Groundwater Monitoring Program	~~All new sanitary landfill facilities and all sanitary landfill facilities undergoing closure shall implement a program capable of determining the impact of the landfill facility on the quality of groundwater occurring within the uppermost aquifer system and all significant zones of saturation above the uppermost aquifer system underlying the landfill facility.~~ The groundwater monitoring system ~~shall collect samples that~~ for detection monitoring, assessment monitoring, or corrective measures shall consist of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from both the uppermost aquifer system and any significant zones of saturation that exist above the uppermost aquifer system that: • represent the quality of the background groundwater that has not been affected by past or present operations; and • represent the quality of the groundwater passing directly downgradient of the limits of solid waste placement.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
Comment #37		The groundwater monitoring program shall include consistent sampling and analysis procedures and statistical methods that are protective of human health and the environment and that are designed to ensure monitoring results that provide an accurate presentation of groundwater quality at the background and downgradient well.		
Ohio Solid Waste Disposal Regulations OAC 3745-27-10 (continued) Comment #37	Groundwater Monitoring Program	If contamination from the landfill is discovered, corrective measures ~~action~~ shall be taken.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-11 (H) Comment #37	Final Closure of Landfill Facilities	At final closure of a landfill facility: • all land surfaces shall be graded to prevent ponding of water where solid waste has been placed. Drainage facilities shall be provided to direct surface water from the landfill facility. • a groundwater monitoring system shall be designed and installed in accordance with OAC 3745-27-10, if a system is not already in place.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-11 (O)~~(B)~~ Comment #37	Final Closure of Landfill Facilities	Closure of the sanitary landfill facility must be completed in a manner that minimizes the need for further maintenance and minimizes post-closure formation and release of leachate and explosive gases to air, soil, groundwater, or surface water to the extent necessary to protect human health and the environment.	Applicable	

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27~~-08~~ (C)(15) ~~11 (G)(1),(2)~~ Comment #37	Construction of a Landfill Cap System	A composite cap system which shall minimize infiltration, must be constructed in all areas of solid waste placement: • The cap system shall have a ~~minimum~~ slope of between 5% and ~~a maximum slope of~~ 25% or some greater ~~alternate~~ slope based on stability analyses. • The cap system shall have a maximum projected erosion rate of 5 tons/acre/year. • Any penetrations into the cap system shall be sealed so that the integrity of the soil barrier layer is maintained. The cap system shall, at a minimum, consist of the following (from bottom to top):	Applicable	
		Recompacted Soil Barrier Layer		
Comment #37		The recompacted soil barrier layer of the cap shall be: • a minimum of 18 inches ~~2 feet~~ thick and constructed in accordance with the specifications outlined above for construction of the recompacted soil liner for a landfill facility ((C)(1)(a) to (C)(1)(g)~~(e)~~ and (C)(1)(m) to (C)(1)(o) of OAC 3745-27-08) with the exception that the maximum permeability of the recompacted soil barrier shall be 1x10^{-6} cm/sec ~~and modeled by the construction of a test pad.~~; OR • a geosynthetic clay liner of equal or less permeability as the recompacted soil barrier layer, with an engineered subgrade constructed in accordance with the following requirements: • The thickness of the subgrade shall be sufficient to achieve an evenly graded surface and shall be a minimum of 12 inches.		

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
Comment #37		• Be constructed of a soil with 100% of the particles have a maximum dimension not greater than 2 inches and with not more than 10% of the particles, by weight, having a dimension greater than 0.75 inches. • Be compacted to at least 95% of the maximum "Standard Proctor Density" using ASTM D-698 or at least 90% of the maximum "Modified Proctor Density" using ASTM D-1557. • After being smooth-rolled, the surface shall not have sharp edged or protruding particles. • The particle size and proctor density required shall be verified by tests performed on representative samples based on the variability and homogeneity of the material, but no less than a minimum of once for every 5,000 cubic yards of material used in the engineered subgrade. • Field density testing shall be performed at a frequency not less than 5 tests per acre. Any penetrations in the subgrade as a result of the testing must be repaired using bentonite or a bentonite-soil mixture.		
		Flexible Membrane Liner		
		The flexible membrane liner for the cap system shall be constructed on top of the soil barrier layer or geosynthetic clay liner in accordance with the specifications listed above for a flexible membrane liner for a landfill facility [OAC 3745-27-08 (C)(2)].		
		~~Granular~~ Drainage Layer		
		The ~~granular~~ drainage layer shall be: • a minimum of 1 foot ~~thick~~ of granular material; OR • a drainage net that has equivalent performance capabilities as the granular material.		

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
SOLID WASTE DISPOSAL (continued)				
Ohio Solid Waste Disposal Regulations OAC 3745-27-~~08~~ (C)(15) ~~11 (G)(1),(2)~~ (continued) Comment #37	Construction of a Landfill Cap System	• constructed on top of the flexible membrane liner ~~recompacted soil barrier layer~~ in accordance with the specifications outlined above for the drainage layer included in the leachate management system of a sanitary landfill facility ((C)(4)~~(3)~~(a) of 3745-27-08 of the OAC).	Applicable	
		Frost Protection Layer		
		The frost protection layer shall be: • placed on top of the drainage layer. • a minimum of 30 inches thick. If the drainage layer is constructed with granular material instead of a drainage net, the drainage layer may be used as part of the frost protection layer.		
		Soil Vegetative Layer		
Comment #37		The soil vegetative layer shall: • consist of soil and vegetation placed on top of the frost protection layer ~~granular drainage layer~~. • have soil of sufficient thickness and fertility to support its vegetation and to protect the ~~underlying~~ recompacted soil barrier layer and flexible membrane liner from damage due to root penetration~~ and frost~~. • have healthy grasses or other vegetation that form a complete and dense vegetative cover. Soil from the frost protection layer may be used as a part of the vegetative layer. Comparable materials and/or thicknesses for the soil barrier layer, the granular drainage layer, and the soil vegetative layer may be used if approved by the Director.		

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
Comment #37		~~Surface Water Control~~ ~~• Land surfaces shall be graded to prevent ponding of water where solid waste has been placed.~~ ~~• Drainage facilities shall be provided to direct surface water from the sanitary waste landfill facility.~~		
Ohio Solid Waste Disposal Regulations OAC 3745-27-11 (H)(5)(b) ~~(G)(5)(b)~~ Comment #37	Final Closure of Landfill Facilities	A notation must be recorded on the deed to the sanitary landfill facility property, or on some other instrument which is normally examined during title search, that will in perpetuity notify any potential purchaser of the property that the land has been used as a sanitary landfill facility. The notation shall include information describing acreage, exact location, depth, volume, and nature of the solid waste deposited in the sanitary landfill facility.	Applicable	

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
SOLID WASTE DISPOSAL (continued)				
Ohio Solid Waste Disposal Regulations OAC 3745-27-14 (A)(1), (2) Comment #37	Sanitary Landfill Post-Closure Care	Following completion of final closure activities in accordance with rule 3745-27-11 of the OAC, post-closure care activities shall be conducted at the sanitary landfill facility for a minimum of 30 years. Post-closure care activities for all sanitary landfill facilities shall include, but are not limited to: • continuing operation and maintenance of the leachate management system, the surface water management system, any explosive gas extraction and/or control system, any explosive gas monitoring system, and the groundwater monitoring system • maintaining the integrity and effectiveness of the cap system, including making repairs to the cap system as necessary to correct the effects of settling, dead vegetation, subsidence, erosion, leachate outbreaks, or other events, and preventing run-on and run-off from eroding or otherwise damaging the cap system	Applicable	
EPA Criteria for Municipal Solid Waste Landfills 40 CFR §258.61	Post-Closure Care	The Director of Ohio EPA may allow the owner or operator to stop managing leachate if the owner or operator demonstrates that leachate no longer poses a threat to human health and the environment.	Relevant and Appropriate	
INFECTIOUS WASTE MANAGEMENT				
Ohio Solid and Hazardous Waste Regulations ORC 3734.03	Open Burning or Dumping	No person shall dispose of treated or untreated infectious wastes by open burning or open dumping.	Applicable	
Ohio Infectious Waste Regulations OAC 3745-27-34 (B) and (C)	Packaging of Infectious Wastes	Sharps shall be packaged in a "SHARPS" container that is rigid, puncture resistant, leak resistant, and closed tightly. The container shall be labeled "SHARPS" and, if the waste has not been treated, with the international biohazard symbol.	Applicable	

TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
FLOODPLAINS/WETLANDS (continued)				
DOE Compliance with Floodplain/Wetlands Environmental Review Requirements 10 CFR §1022.11(a),(b),(c) (continued)	Floodplain/Wetlands	In making a floodplain determination, DOE shall utilize the Flood Insurance Rate Maps (FIRMs) or the Flood Hazard Boundary Maps (FHBMs) prepared by the Federal Insurance Administration of the Department of Housing and Urban Development to determine if a proposed action is located in the base or critical action floodplain, as appropriate. For a proposed action in an area of predominantly Federal or State land holdings where FIRM or FHBM maps are not available, information shall be sought from the land administering agency (e.g., Bureau of Land Management, Soil Conservation Service, etc.) or from agencies with floodplain analysis expertise.	Applicable	
DOE Compliance with Floodplain/Wetlands Environmental Review Requirements 10 CFR §1022.12(a)	Floodplain/Wetlands	If DOE determines, pursuant to 10 CFR §§ 1022.5 and 1022.11, that this part is applicable to the proposed action, DOE shall prepare a floodplain/wetlands assessment, according to the requirements in this section (10 CFR §1022.12).	Applicable	
DOE Compliance with Floodplain/Wetlands Environmental Review Requirements 10 CFR §1022.15(a)	Floodplain/Wetlands	If DOE finds that no practicable alternative to locating in the floodplain/wetlands is available, consistent with the policy set forth in Executive Order 11988, DOE shall, prior to taking action, design, or modify its action in order to minimize potential harm to or within the floodplain/wetlands.	Applicable	
~~Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (A)(3)~~ Comment #37	~~Floodway~~	~~A solid waste disposal facility may not be located in a floodway.~~	~~Applicable~~	
Ohio Solid Waste Disposal Regulations OAC 3745-27-20 (C)(2) ~~07 (B)(10)~~ Comment #37	Floodplain	The limits of solid waste placement and the leachate management system cannot be located in a regulatory floodplain, unless deemed acceptable by the Director.	Applicable	

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TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (H)(4)(d) ~~(B)(14)~~ Comment #37	Stream, Lake, or Wetland	The limits of waste placement cannot be located within 200 feet of a stream, lake, or natural wetland, unless deemed acceptable by the Director.	Applicable	

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TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
GROUNDWATER PROTECTION				
Safe Drinking Water Act 42 U.S.C. §1424(e)	Sole Source Aquifer	All Federal financially assisted projects constructed in the area of a sole source aquifer and its principal recharge zone will be subject to EPA's review to insure that these projects are designed and constructed so that they do not create a significant hazard to public health.	Applicable	A notice in 53 FR 15876 (May 4, 1988) designated the Buried Valley Aquifer System of the Great Miami/ Little Miami River Basins of southwestern Ohio as a sole or principal source of drinking water. The Fernald site is located above this aquifer.
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (H)(3)(a) ~~(B)(4)~~ Comment #37	Any	A sanitary landfill facility may not be located within the surface and subsurface areas surrounding a public water supply well through which contaminants may move toward and may reach the public water supply well within a period of 5 years.	Applicable	
OEPA Guidance on Solid Waste Siting Criteria: Minimum Distance From a Public Water Supply Well GD202.105	Any	To avoid the application of the siting criteria in OAC 3745-27-07 (B)(4): • It should be shown, using site-specific and publicly available information, that the nearest public water supply well hydrogeologically downgradient from the solid waste landfill facility is more than 5 years time of travel from the boundaries of the solid waste landfill facility. • The five year time of travel shall be calculated beginning at the facility boundary of the solid waste landfill facility closest to the public water supply well and proceeding in a hydraulically downgradient direction ending at the well screen of all public water supply wells intersected with the five year time of travel. • Many methods can be used to demonstrate compliance with this rule, from simple groundwater velocity equations to complex three-dimensional models. The demonstration should use the method best suited to the site-specific situation.	TBC	

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Citation	Location	Requirement	Determination	Remarks
		GROUNDWATER PROTECTION (continued)		
OEPA Guidance on Solid Waste Siting Criteria: Minimum Distance From a Public Water Supply Well GD202.105 (continued)	Any	• To be considered for an exemption from this rule, the following will need to be demonstrated: - that there is at least 50 feet of separation between the bottom of the solid waste landfill facility liner and the aquifer system in which the public water supply well is screened. - that any release of leachate shall be detected prior to reaching the aquifer system in which the public water supply well is screened. - that once leachate is released below the liner, the leachate shall not reach the aquifer system in which the public water supply well is screened within a time span of 100 years plus the anticipated life of the solid waste landfill facility which shall include the 30 year post-closure care period.	TBC	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (H)(2)(c) ~~(B)(5)~~ Comment #37	Any	A sanitary landfill facility cannot be located above an aquifer declared by the federal government under the Safe Drinking Water Act to be a sole source aquifer.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (H)(2)(d) ~~(B)(9)~~ Comment #37	Any	A sanitary landfill facility cannot be located above an unconsolidated aquifer capable of sustaining a yield of 100 gallons per minute for a 24-hour period to a water supply well located within 1,000 feet of the limits of solid waste placement, unless deemed acceptable by the Director.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (H)(3)(c) ~~(B)(11)~~ Comment #37	Water Supply Well or Developed Spring	The limits of sold waste placement cannot be located within 1,000 feet of a water supply well or developed spring unless it is deemed acceptable by the Director or it is:	Applicable	

TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
		• controlled by the applicant, is needed as a source of nonpotable water, no other reasonable alternate water source is available, and the well is constructed to prevent contamination of the groundwater, OR		

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TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
GROUNDWATER PROTECTION (continued)				
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (H)(3)(e) ~~(B)(11)~~ (continued) Comment #37	Water Supply Well or Developed Spring	• located at least 500 feet hydrogeologically upgradient from the limits of solid waste placement, OR • separated from the limits of solid waste placement by a hydrogeologic barrier, OR • constructed and used solely for monitoring groundwater quality	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (H)(2)(e) ~~(B)(15)~~ Comment #37	Any	The isolation distance between the uppermost aquifer system and the bottom of the recompacted soil liner of a sanitary landfill system cannot be less than 15 feet of in situ or added geologic material deemed acceptable by the Director.	Applicable	
OEPA Guidance on Solid Waste Siting Criteria: Material Acceptable to the Director GD202.104	Any	For geologic material to be deemed acceptable to the Director as added fill under OAC Rule 3745-27-07 (B)(15), it must be able to meet the following criteria: • the geologic material must be impermeable enough so it will not store, transmit or yield a significant amount of water to a well or spring • the geologic material must be able to impede both physically and chemically, the flow of leachate constituents through it In order to meet both criteria listed above, the added geologic material should: • be classified as CL, SC, GC, CL-ML, or CH under the Unified Soil Classification System (USCS) • be composed of particles of which at least 25% by dry weight will pass through a No. 200 (75 μm) sieve • be composed of no more than 25% by dry weight particles which will not pass through a No. 4 sieve	TBC	

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TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
GROUNDWATER PROTECTION (continued)				
OEPA Guidance on Solid Waste Siting Criteria: Material Acceptable to the Director GD202.104 (continued)	Any	• no particle should be greater than 8 inches in diameter • have a final permeability of no more than $1x10^{-8}$ cm/sec • be recompacted in a manner that when the landfill is constructed on it, no damage to the landfill liner will occur due to settling of the added material	TBC	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 ~~(H)(4)(b)~~ ~~(B)(12)~~ Comment #37	Any	The limits of waste placement cannot be located within 300 feet of the sanitary landfill facility's property line, unless deemed acceptable by the Director.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 ~~(H)(4)(c)~~ ~~(B)(13)~~ Comment #37	Any	The limits of solid waste placement cannot be located within 1,000 feet of a domicile whose owner has not consented in writing to the location of the sanitary landfill facility.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-09(Y)	Exemption from Siting Criteria	Section 3745-27-09 (Y) states the permittee shall submit to the Director, upon every tenth anniversary of the effective date of a permit to install that approved the initial construction of the facility, an analysis demonstrating that the design, construction and final closure plan of the sanitary landfill facility continue to constitute best available technology. If the Director determines that the design is no longer consistent with best available technology as being applied to the sanitary landfill industry in the state of Ohio, the permittee may be required to submit a permit to install application for necessary modifications to the landfill facilities. If a permit to install is required, the Director shall not apply the siting criteria outlined in paragraph (B) of OAC 3745-27-07, when considering the permit to install application.	Applicable	

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Appendix C

No. 91

TABLE C.1-1

SUMMARY OF BASELINE RISK ASSESSMENT RESULTS
OU2 REMEDIAL INVESTIGATION

		Current Land Use						Future Land Use, Federal Ownership		
Waste Subunit	Risk Type[a]	Trespassing Youth	On-Property Groundskeeper	Off-Property Farmer	Off-Property Child	User of Meat & Milk	GMR Rec User	Expanded Trespasser	Off-Property Farmer	Off-Property Child
Solid Waste Landfill	Carcinogenic	1.5×10^{-5}	3.4×10^{-5}	6.0×10^{-8}	2.7×10^{-9}	9.0×10^{-9}	2.8×10^{-10}	2.0×10^{-5}	6.7×10^{-8}	3.5×10^{-9}
	Noncarcinogenic	8.6	4.3×10^{-3}	1.8×10^{-6}	6.4×10^{-6}	5.8×10^{-7}	1.1×10^{-7}	2.7×10^{-1}	1.8×10^{-6}	6.4×10^{-6}
Lime Sludge Ponds	Carcinogenic	1.1×10^{-5}	4.5×10^{-5}	1.5×10^{-7}	1.4×10^{-8}	1.4×10^{-6}	NA[b]	2.4×10^{-5}	1.7×10^{-7}	1.6×10^{-8}
	Noncarcinogenic	2.1×10^{-1}	1.3×10^{-1}	2.0×10^{-5}	9.3×10^{-5}	4.3×10^{-4}	NA	2.2×10^{-1}	2.0×10^{-5}	9.3×10^{-5}
Inactive Flyash Pile	Carcinogenic	1.5×10^{-5}	5.0×10^{-5}	6.1×10^{-7}	7.9×10^{-8}	1.1×10^{-7}	8.4×10^{-9}	3.0×10^{-5}	7.5×10^{-5}	4.0×10^{-6}
	Noncarcinogenic	1.0×10^{-1}	2.0×10^{-2}	5.5×10^{-5}	2.0×10^{-4}	1.4×10^{-5}	1.9×10^{-6}	1.0×10^{-1}	1.2	2.5
South Field	Carcinogenic	1.0×10^{-4}	2.2×10^{-4}	6.4×10^{-7}	2.4×10^{-7}	4.5×10^{-6}	4.2×10^{-6}	1.4×10^{-4}	8.7×10^{-5}	4.2×10^{-6}
	Noncarcinogenic	5.3×10^{-1}	ND[c]	2.0×10^{-5}	7.2×10^{-5}	3.0×10^{-5}	8.0×10^{-07}	8.0×10^{-2}	1.1	3.1
Active Flyash Pile	Carcinogenic	2.6×10^{-5}	8.0×10^{-5}	4.7×10^{-7}	6.6×10^{-8}	4.7×10^{-7}	1.37×10^{-9}	4.9×10^{-5}	1.1×10^{-5}	7.2×10^{-7}
	Noncarcinogenic	3.6×10^{-2}	5.9×10^{-2}	6.2×10^{-4}	2.1×10^{-3}	3.7×10^{-3}	6.1×10^{-6}	4.2×10^{-2}	1.9×10^{-1}	7.9×10^{-1}

See footnotes at end of table.

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TABLE C.1-1
(Continued)

Waste Subunit	Risk Type[a]	Future Land Use, Private Ownership							
		On-Property Resident Farmer (RME)[b]	On-Property Resident Farmer (CT)[c]	On-Property Resident Child	Home Builder	Perched Groundwater User	GMR Recreational User	GMR Residential User	GMR Agricultural User
Solid Waste Landfill	Carcinogenic	2.8×10^{-3}	2.0×10^{-4}	6.4×10^{-4}	9.0×10^{-6}	2.8×10^{-3}	2.8×10^{-10}	4.2×10^{-9}	6.5×10^{-7}
	Noncarcinogenic	2.9×10^{-1}	1.2×10^{-1}	1.0	4.8×10^{-1}	ND	1.1×10^{-7}	2.2×10^{-6}	1.1×10^{-4}
Lime Sludge Ponds	Carcinogenic	1.3×10^{-5}	9.3×10^{-7}	1.2×10^{-6}	NA	7.7×10^{-5}	NA	NA	NA
	Noncarcinogenic	1.7×10^{-3}	7.3×10^{-4}	7.9×10^{-3}	NA	3.1×10^{-3}	NA	NA	NA
Inactive Flyash Pile	Carcinogenic	1.5×10^{-3}	8.6×10^{-5}	7.7×10^{-5}	NA	NA	8.4×10^{-9}	3.0×10^{-9}	5.4×10^{-10}
	Noncarcinogenic	22	9.8	65	NA	NA	1.9×10^{-6}	4.2×10^{-6}	3.6×10^{-5}
South Field	Carcinogenic	3.4×10^{-2}	2.0×10^{-3}	9.2×10^{-3}	1.1×10^{-5}	NA	4.2×10^{-6}	6.3×10^{-8}	4.2×10^{-6}
	Noncarcinogenic	23	11	63	5.4×10^{-1}	NA	2.5×10^{-6}	1.4×10^{-4}	4.0×10^{-5}
Active Flyash Pile	Carcinogenic	8.4×10^{-5}	4.8×10^{-6}	5.7×10^{-6}	NA	NA	1.4×10^{-9}	7.7×10^{-9}	3.5×10^{-9}
	Noncarcinogenic	9.9×10^{-1}	4.5×10^{-1}	2.8	NA	NA	6.1×10^{-6}	1.5×10^{-5}	6.7×10^{-6}

GMR = Great Miami River.
NA = The indicated land use is not applicable to the waste subunit.
ND = Not determined because toxicity data are not available.
[a]The carcinogenic risk value is the Incremental Lifetime Cancer Risk (ILCR), and the noncarcinogenic hazard value is the hazard index (HI).
[b]RME = Reasonable Maximum Exposure.
[c]CT = Central Tendency.

Source: OU2 RI report, Table 7-1 (DOE 1994a)

Note: Page C-1-17 now fits on this page as such there is no page C-1-17.

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TABLE C.2-2

RECEPTORS EVALUATED FOR OU2 RESIDUAL RISK

Receptors	Federal Ownership	Private Ownership	Comments
Expanded Trespasser	Yes	No	Composite adult/child who illegally uses site
Off-Property Farmer	Yes	Yes	
Off-Property Child	Yes	Yes	
On-Property Resident Farmer (GMA)	No	Yes	Ingests groundwater from Great Miami Aquifer
No. 58 On Property Resident Farmer Perched Water	No	Yes~~No~~	Ingests perched water
On-Property Resident Child	No	Yes	Ingests groundwater from Great Miami Aquifer

residual site contamination through the consumption of contaminated produce, dairy products, and meat; ingestion of contaminated water from the Great Miami Aquifer; ingestion of, dermal contact with, and direct radiation from residual contaminated soil; and inhalation of gases, vapors, and dust.

The inclusion of a central-tendency analysis does not significantly reduce the overall health risks for the adult farm receptor. An examination of the impact of including central-tendency parameters in the calculation of on-property farm adult risks has indicated that a reduction of approximately a factor of 3 can be achieved. This reduction is mainly due to the slight reduction in exposure duration (350 versus 275 days) and minor reductions in the individual pathway contact rate.

Because of the postremediation setting of the residual risk assessment, all exposure parameters have been estimated. The uncertainty inherent in all FS exposure estimates makes the additional uncertainty of central tendency inappropriate. In addition, recent discussions with EPA Region V have led to requests for exposure parameters with more conservatism than those previously used to describe the FS RME receptors. Therefore, a central-tendency analysis was not evaluated for this FS risk assessment.

C.3.0 EXPOSURE QUANTIFICATION METHODOLOGY

This section presents the equations used to quantify the magnitude of exposure expected to result from all reasonable exposure pathways at Operable Unit 2. The calculations reflect changes in the risk assessment methodology resulting from revisions to the RAWPA (DOE 1992) and comments received from the EPA and OEPA on the Operable Unit 1, 2, and 4 RI/FS risk assessments.

Section C.3.1 presents the exposure models for remedial action risks, while Section C.3.2 covers residual risks. Parameters and equations are drawn from the RAWPA unless noted otherwise. The exposure parameters used to model remedial action and residual risks are presented in Section C.3.3. Source terms (e.g., soil or air concentrations) are presented in Section C.5.1 (for remedial action risks) and Section C.5-2 (for residual risks).

C.3.1 EXPOSURE MODELS FOR REMEDIAL ACTION RISKS

This section presents the exposure models used to estimate the Operable Unit 2 remedial action risks. The section has been divided into subsections for each remedial/action exposure mode combination described in the remedial action conceptual models (Section C.2.2).

C.3.1.1 Excavation/Direct Radiation

During excavation, the remediation worker would be exposed to direct radiation from radionuclides in the soil. The 95 percent UCL subsurface soil COC concentrations, as defined in the Operable Unit 2 RI report (DOE 1994a), were used to calculate exposure doses. The majority of excavated material consists of subsurface soil. Direct radiation were calculated using the MICROSHIELD computer code (see Section C.5.1.2 for details). Direct radiation exposure is a function of the soil concentration, effective soil depth, exposure duration, and soil density. The code accounts for both buildup and self-shielding. Output is an effective dose equivalent in mrem, for each radionuclide identified as a COC.

C.3.1.2 Excavation/Direct Physical Injury

#59 The hazards from direct physical injury are calculated using risk factors from the DOT database, in terms of injuries and fatalities per hour or mile. These are discussed in detail in Section C.6.1. ~~The risk of mechanical injury, both for injuries and fatalities, is based on a risk conversion factor developed by the U.S. Department of Labor. This conversion factor translates hours worked to risk from a mechanical hazard using the following equation:~~

~~$$Risk = (MHRF)(T_T)(N_E) \qquad (C.3-1)$$~~

~~where~~

~~MHRF = mechanical hazard risk factor (injuries or fatalities per person hour worked) (see Table C.II 21),~~
~~T_T = hours worked during excavation (per person) (see Table C.II 21), and~~
~~N_E = number of persons involved in excavation (Table C.II 21).~~

C.3.1.3 Excavation/Immersion

Immersion dose rates were evaluated using the MICROSHIELD computer code (see Section C.5.1.2 for details). The immersion dose is a function of the soil concentration, the dust loading, and the radionuclides. The output is a dose rate in mrem/hr for each activity, which is multiplied by the number of hours of exposure.

~~A remediation worker would be exposed to direct radiation from immersion in contaminated air. The magnitude of immersion exposure for each radionuclide is given by the following equation:~~

~~$$H_{E,T} = (C_{a,i})(DCF_{a,i})(T_T)(UCF_T) \qquad (C.3-2)$$~~

~~where~~

~~$H_{E,T}$ = effective dose equivalent from radionuclide i (mrem),~~
~~$C_{a,i}$ = air concentration for radionuclide i (pCi/m^3) (Table C.5-5),~~
~~$DCF_{a,i}$ = dose conversion factor for immersion for radionuclide i in air (mrem/y per µCi/m^3)(DCFs can be found in Table C.3-5),~~
~~T_T = fraction of one year exposed to contaminated air (yr)(Table C.5-1), and~~
~~UCF_T = unit conversion factor (10^{-6} mCi/pCi).~~

The concentration of a radionuclide in air is based on a dust-loading factor for soil and the concentration of the radionuclide in the soil. The following equation provides the expression for the air concentration of the ith radionuclide. This concentration in soil is the 95 percent UCL of subsurface soils.

$$C_{a,i} = (DL)(C_{s,i}) \qquad (C.3-3)$$

where

$C_{a,i}$ = air concentration for radionuclide i (pCi/m^3)~~(Table C.5-5)~~,
DL = dust-loading factor for construction (g of soil/m^3 of air)(Table C.3-1), and
$C_{s,i}$ = concentration of contaminant in soil (Table C.5-4).

C.3.1.4 Excavation/Inhalation

The intake of radionuclides by a remediation worker is given by: (C.3-5)

$$I_{a,i} = (C_{a,i})(IR)(ED)(EF)(ET)$$

where

$I_{a,i}$	=	intake from inhalation for radionuclide i, pCi
$C_{a,i}$	=	Concentration in air of radionuclide i (pCi/m^3),
IR	=	Inhalation rate, (m^3/hr)
ET	=	Exposure time, (hr/day)
EF	=	Exposure frequency, (day/yr)
ED	=	Exposure duration, (yr)

~~The dose from inhalation of radionuclides by a remediation worker is given by:~~

$$\sout{H_{E,r} = (C_{E,r})(DCF_{b,r})(T_r)(UCF_r)} \quad \text{(C.3-5)}$$

~~where~~

~~$H_{E,T}$ = effective dose equivalent from radionuclide i (mrem),~~
~~$C_{a,T}$ = air concentration for radionuclide i (pCi/m^3), (Table C.5-5),~~
~~$DCF_{b,T}$ = dose conversion factor for inhalation for radionuclide i (mrem/yr per μCi/m^3), (Table C.3-5),~~
~~T_T = fraction of one year exposed to contaminated air (yr), (Table C.II-1 through 12), and~~
~~UCF_T = unit conversion factor (10^{-6} mCi/pCi).~~

The concentration of a radionuclide is given in Equation C.3-3. The intake from inhalation as a result of exposures to airborne chemical contaminants is calculated as follows:

$$I_{a,n} = (C_{a,n})(IR)(T_3)/(BW)(AT) \qquad \text{(C.3-6)}$$

where

$I_{a,n}$ = intake from air of chemical contaminant n (mg/kg/day),
IR = receptor specific inhalation rate (m^3/h)(Table C.II-1 through 12),
$C_{a,n}$ = concentration of chemical contaminant n in air (mg/m^3)(Table C.5-5),
T_3 = receptor specific exposure at time (h)(Table C.II-1 through 12),
BW = body weight (kg)(Table C.3-1), and
AT = average time (d); for noncarcinogens, AT equals (ED)(365 d/y); for chemical carcinogens, AT equals (70y)(365 d/y)(Table C.3-1).

C.3.1.5 Drying/Direct Physical Injury

Mechanical hazard impacts were calculated identically to the impacts for the Excavation/Direct Physical Injury pathway ~~(Section C.3.1.2)~~. The only difference is the total person hours for constructing the drying facility.

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C.3.1.6 Drying/Inhalation and/or Immersion

A Gaussian plume dispersion model was used to estimate the concentration at the receptor location. The concentrations in air as a result of dryer activities are located in Table C.5-10. Immersion doses for remedial workers are provided in Table C.5-12. Dose equivalent intake from VOCs were calculated as described for the Excavation/Inhalation Equation C.3-6.

C.3.1.7 Transportation

The magnitude of the transportation impacts was calculated by the RADTRAN 4 computer code (see Section C.5.2).

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A detailed discussion of the transportation impacts, including the risk factors used, is contained in Section C.6.1.

Mechanical hazards are based on miles traveled. ~~The following equation presents the calculation for the mechanical hazard impacts for both workers and members of the public:~~

~~$Risk = (RCF_m)(DST_m)$ (C.3-9)~~

~~where~~

~~RCF_m = risk conversion factor for worker or member of the public for rail transportation (fatalities or injuries per mile)(see Table C.II-23), and~~
~~DST_m = distance traveled by transportation mode m, (i.e., truck or rail miles)(Table C.II-23).~~

Risks to package handlers were assessed similarly to other remediation workers. Dose rates were calculated by MICROSHIELD, and for mechanical hazards, time variables were used for the person hours worked loading trains.

C.3.1.8 On-property Disposal/Direct Physical Injury

Mechanical hazard impacts were calculated identically to the impacts for the Excavation/Direct Physical Injury pathway (Section C.3.1.2). The only difference is the total person hours worked.

Restoration/Direct Physical Injury

Mechanical hazard impacts were calculated identically to the impacts for the Excavation/Direct Physical Injury pathway (Section C.3.1.2). The only difference is the total person hours worked.

C.3.2 EXPOSURE MODELS FOR RESIDUAL RISKS

To quantify risk as a result of residual COCs, several equations were used. This section presents the equations used according to exposure media. All parameters and equations were taken from the RAWPA and the Supplemental Guidance to RAWPA unless otherwise noted. The exposure media considered for residual risks are groundwater, air, and soil. Exposures from sediment are included in the group detailing the soil exposure pathways. Exposure to surface water is not a viable pathway to potential Operable Unit 2 receptors and is therefore not provided for discussion in this section. Equations for quantifying risk through the food pathway (e.g., ingestion of vegetables, fruit, milk, and meat) are provided. The development of concentration terms for air, groundwater, soil, and food products are presented in Section C.5.2. These concentrations were used to quantify intake. The parameters used in the following equations are provided in Tables C.3-2 and 3 or the Tables in C.III.

C.3.3.1 <u>Exposure Parameters for Remedial Action Risks</u>

This section presents parameter values for the remedial action risk models (Section C.3.1). Each presentation includes the parameter, its value or values, units, and reference. Many of the parameter values are from the RAWPA.

Table C.3-1 presents most of the noncontaminant-specific parameters. Toxicity values are presented in Section C.4.0. Exposure point concentrations are presented by receptor in Section C.5.1.

TABLE C.3-1

NONCONTAMINANT-SPECIFIC EXPOSURE PARAMETERS FOR REMEDIAL ACTION RISK

Parameter	Value	Unit	Reference
Effective Soil Depth - ESD	1	m	DOE 1988a
Dust Loading (Remediation Worker) - DL	6×10^{-4}	g/m^3	RAWPA
Average Soil Density for FEMP - ρ	1.7×10^{6}	g/m^3	RAWPA
Soil Density For Shielding	1.5×10^{6}	g/m^3	
Inhalation Rate - IR (Remediation)[a]	2	m^3/hr	RAWPA
Inhalation Rate - IR (Off-property Individual)	0.83	m^3/hr	RAWPA
Body Weight - BW	70	kg	RAWPA
Averaging Time - AT (Carcinogens)	25550	days	RAWPA
~~Ave. Time - AT (Noncarcinogens)~~	~~T_5 or T_8~~	~~See Table C.3-2~~	~~RAWPA~~
Mean wind speed - U_m	4.6	m/sec	RAWPA

C.3.3.2 <u>Exposure Parameters for Residual Risks</u>

This section presents parameter values for the residual risk models (Section C.3.2). Each presentation includes the parameter, its value or values, units, and reference. Many of the parameter values are from the RAWPA.

TABLE C.3-4

DERMAL SOIL ABSORPTION COEFFICIENTS USED IN EXPOSURE MODEL

COC	ABS
Antimony	1.00×10^{-2}
Aroclor-1254	~~0.06~~ 6.00×10^{-2}
Aroclor-1260	~~0.06~~ 6.00×10^{-2}
Arsenic	1.00×10^{-3}
Benzo(a)pyrene	N/A[a]
Beryllium	1.00×10^{-2}
Carbazole	3.00×10^{-1}
Dieldrin	3.00×10^{-1}
Uranium-Total	1.00×10^{-3}

SOURCE: OU2 RI report (DOE 1994a)

[a]Dermal Exposure to PAHs: Current policy indicates it is inappropriate to extrapolate dermal slope factors from oral slope factors for PAHs. Also, extrapolation from other routes of exposure is inappropriate due to varied absorption, metabolic transformations, and target organ end point responses. However, PAHs are potent skin carcinogens. Current information on the contribution to cancer risk from dermal exposure to PAHs indicates the toxicity from the dermal pathway may be as toxic as from oral route of exposure. To estimate the risk contribution from PAHs via dermal exposure for all direct contact pathways, the risk posed for dermal exposure was assumed equal to the risk from oral exposure.

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Slope factors are specific to a chemical and route of exposure and expressed in units of $(mg/kg/day)^{-1}$ for both oral and inhalation routes. The induction of cancer by dermal absorption is evaluated using oral slope factors. Inhalation cancer toxicity values are usually expressed as inhalation unit risks in units of reciprocal $\mu g/m^3$ ($1/\mu g/m^3$). Because cancer risk characterization requires an estimate of reciprocal dose in units of 1/mg/kg/day, the inhalation unit risk must be converted to the mathematical equivalent of an inhalation cancer slope factor, or risk per unit dose (mg/kg/day). This conversion is performed by assuming humans weigh 70 kilograms and inhale 20 cubic meters of air per day; that is, the inhalation unit risk ($1/\mu g/m^3$) divided by 20 m^3/day, multiplied by 70 kilograms and multiplied by 1000 μg/mg yields the mathematical equivalent of an inhalation slope factor (1/mg/kg/day).

Slope factors for COCs are presented in Table C.4-2. The primary sources of these toxicity values are EPA's IRIS and the quarterly updated HEAST. Other EPA sources of cancer slope factors were also consulted when available. Surrogate chemicals were not used for cancer slope factor derivation unless the chemical similarity was close and the derivation was highly defensible.

The following exceptions, where information from one chemical was used to model a compound class, are noted:

- The carcinogenicity of all polychlorinated biphenyl (PCB) isomers is assumed to be equal to the carcinogenicity of Aroclor-1260.
- The carcinogenicity of polycyclic aromatic hydrocarbons (PAHs) is determined using a relative potency approach (Clement International 1988, 1990).

Carcinogenic risks associated with PAHs are evaluated using the relative potency approach described by
o. 62 Clement International (1988 and 1990). This approach, approved by EPA Region V, in comments on the OU1 FS Risk Assessment, considers the relative potency of the individual PAHs and allows site-specific relative concentrations to be expressed in the risk assessment. The relative potency factors for PAHs are presented in Table C.4-3.

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TABLE C.4-4

DERMAL REFERENCE DOSES AND CANCER SLOPE FACTORS FOR COCs

Chemical	Gastrointestinal Absorption Fraction	Dermal Reference Dose (mg/kg/day)	Dermal Slope Factor $(mg/kg/day)^{-1}$
Inorganics			
Antimony	0.15[a]	6.00×10^{-5}	ND
Arsenic	0.95[b]	2.85×10^{-4}	1.90×10^{0}
Beryllium	1.00[c]	5.00×10^{-3}	4.30×10^{0}
Uranium	0.05[d]	1.50×10^{-4}	ND
Semivolatiles			
Carbazole	0.90	ND	2.22×10^{-2}
Polycyclic aromatic hydrocarbons (PAHs)[f]	NA	NA	NA
Pesticides/PCBs			
No. 61 Aroclors	0.75[a]	~~5.30×10^{-5}~~ NA	1.03×10^{1}
Dieldrin	0.90	4.50×10^{-5}	1.78×10^{1}

ND = Not derived
NA = Not applicable

[a] See the Toxicity Profile for this chemical in Section C.4.5.
[b] EPA 1993f
No. 94 [c] Region 5 suggested that a review of the IRIS database showed no evidence that the administered dose was adjusted for absorption in the calculation of the RfD and Cancer Slope Factors for beryllium, and therefore, a value of 1.0 should be used in calculating the dermal toxicity values (Comment #19 on Operable Unit 2 CRARE, USEPA Region V, Pat Van Leeuwen, Toxicologist, October 3, 1994).
~~[c] EPA Region V guidance, July 1994 (Saunders 1994)~~
[d] RAGS, pp. A-2 to A-3: Recommended default Gastrointestinal Absorption Fraction for inorganic chemicals = 0.05.
[e] Jones and Owen 1989
[f] Dermal Exposures to PAHs: Reliable cancer slope factors for dermal exposure to PAHs are currently unavailable. Current policy indicates it is inappropriate to extrapolate dermal slope factors from oral slope factors for PAHs. Also, extrapolation from other routes of exposure is inappropriate due to varied absorption, metabolic transformations, and target organ end point responses. However, PAHs are potent skin carcinogens. Current information on the contribution to cancer risk from dermal exposure to PAHs indicates the toxicity from the dermal pathway may be as toxic as from oral route of exposure. To estimate the risk contribution from PAHs via dermal exposure for all direct contact pathways, the risk posed for dermal exposure was assumed equal to the risk from oral exposure (OU2 RI report, DOE 1994a).

~~SOURCE: OU2 RI report (DOE 1994a)~~

Chinese exposed to naturally occurring arsenic in well water (EPA 1992d). Similar effects were observed in persons exposed to high levels of arsenic in water in the western hemisphere. Occupational (predominantly inhalation) exposure was also associated with neurological deficits, anemia, and cardiovascular effects (Ishinishi et al. 1986). The EPA (1991c) has presented an RfD of 0.0003 mg/kg/day for chronic oral exposure, based on a NOAEL from the Chinese data and an uncertainty factor of 1 (Table C.4-1). The principal target organs for arsenic are the skin, nervous system, blood and cardiovascular system.

Carcinogenicity

Inorganic arsenic is clearly a carcinogen in humans (EPA 1992d). Inhalation exposure was associated with increased risk of lung cancer in persons employed as smelter workers, in arsenical pesticide applicators, and in a population residing near a pesticide manufacturing plant. Oral exposure to high levels in well water was associated with increased risk of skin cancer. The EPA (1991c) has classified inorganic arsenic in cancer weight-of-evidence Group A (human carcinogen). An inhalation slope factor of 50 per mg/kg/day, based on absorbed arsenic, was derived from occupational data. Applying an absorption factor of 0.3 yielded an inhalation slope factor of 15 per mg/kg/day, based on an ambient or inhaled dose. The slope factor based on the inhaled, rather than absorbed, dose is the correct parameter to use in risk assessments. Assuming a human inhales 20 m^3 of air per day and weighs 70 kilograms, the EPA (1991c) estimated an inhalation unit risk of 0.0043 $\mu g/m^3$. EPA (1993c) proposed an inorganic arsenic ingestion unit risk of 5.0 x 10^{-5} per mg/l. The equivalent oral slope factor is 1.8 per mg/kg/day assuming a 70 kg adult ingests 2 liters per day (Table C.4-2). "The uncertainties associated with ingested inorganic arsenic are such that estimates could be revised downward as much as an order of magnitude, relative to the risk estimates associated with most other carcinogens" (EPA 1993c).

C.4.5.4 Beryllium

Pharmacokinetics

Absorption of beryllium from the GI tract is low, probably not exceeding 20 percent of an ingested dose, because the metal forms insoluble precipitates with phosphate and is eliminated in the feces (Reeves 1986).
0. 94 ~~EPA Region V guidance is to use a GI absorption factor of 1.00 (Saunders 1994).~~

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TABLE C.5-4
COCs SUBSURFACE SOIL CONCENTRATIONS
(95% UCL)

COC	Solid Waste Landfill	Lime Sludge Ponds[a]	South Field/ Inactive Flyash Pile[a]	Active Flyash Pile
Chemicals (mg/kg)				
Antimony	22.000	23.200	18.700	2.000
Aroclor-1254	0.048	0.043	0.430	NA
Aroclor-1260	0.077	NA	0.089	NA
Arsenic	13.800	6.777	12.060	64.27
Benzo(a)pyrene[b]	10.72	0.190	0.180	NA
Beryllium	1.075	1.267	1.438	3.375
Carbazole	4.200	NA	0.001	NA
Dieldrin	NA	NA	0.016	NA
~~Pyrene~~				
Radionuclides (pCi/g)				
Cs-137	0.250	0.168	0.237	NA
Np-237	0.351	0.323	0.300	0.450
Pu-238	0.328	0.199	0.040	0.123
Ra-226	1.550	1.562	2.919	5.240
Ra-228	2.560	1.800	1.656	4.336
Sr-90	1.580	0.841	1.360	0.964
Tc-99	0.754	1.050	0.900	NA
Th-228	3.390	1.540	1.704	5.790
Th-230	12.300	8.381	4.263	5.717
Th-232	3.590	1.070	1.531	3.866
U-234	97.000	6.176	30.19	8.903
U-235	9.93	0.435	18.460	4.720
U-238	170.000	7.468	32.300	6.911
U-Total	446.000	22.198	104.400	29.960

NA = Not Applicable
[a]Values for South Field and Inactive Flyash Pile are identical.
lo. 62 [b]PAH COCs have been expressed as benzo(a)pyrene equivalents using the toxicity equivalency factor approach (Clement International, 1990). In this approach, benzo(a)pyrene has a relative potency of 1.0 and other PAHs are expressed as benzo(a)pyrene equivalents.

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TABLE C.5-5
COC AIR CONCENTRATIONS FOR EACH SUBUNIT

COC	Solid Waste Landfill	Lime Sludge Ponds	South Field/ Inactive Flyash Pile[a]	Active Flyash Pile
Chemicals ($\mu g/m^3$)				
Antimony	1.32×10^{-2}	1.39×10^{-2}	1.12×10^{-2}	1.20×10^{-3}
Aroclor-1254	2.88×10^{-5}	2.58×10^{-5}	2.58×10^{-5}	---
Aroclor-1260	4.62×10^{-5}	---	5.34×10^{-5}	---
Arsenic	8.28×10^{-3}	4.02×10^{-3}	7.24×10^{-3}	3.86×10^{-2}
Benzo(a)pyrene[b]	6.43×10^{-3}	1.13×10^{-4}	1.10×10^{-4}	---
Beryllium	6.45×10^{-4}	7.60×10^{-4}	8.63×10^{-4}	2.03×10^{-3}
Carbazole	2.52×10^{-3}	0.00×10^{0}	6.00×10^{-7}	---
Dieldrin	---	---	9.60×10^{-6}	---
Radionuclides (pCi/m^3)				
Cs-137	1.50×10^{-4}	1.01×10^{-4}	1.42×10^{-4}	---
Np-237	2.11×10^{-4}	1.94×10^{-4}	1.80×10^{-4}	2.70×10^{-4}
Pu-238	1.97×10^{-4}	1.19×10^{-4}	2.40×10^{-5}	7.38×10^{-5}
Ra-226	9.30×10^{-4}	9.37×10^{-4}	1.75×10^{-3}	3.14×10^{-3}
Ra-228	1.54×10^{-3}	1.08×10^{-3}	9.94×10^{-4}	2.60×10^{-3}
Sr-90	9.48×10^{-4}	5.05×10^{-4}	8.16×10^{-4}	5.78×10^{-4}
Tc-99	4.52×10^{-4}	6.30×10^{-4}	5.40×10^{-4}	---
Th-228	2.03×10^{-3}	9.24×10^{-4}	1.02×10^{-3}	3.47×10^{-3}
Th-230	7.38×10^{-3}	5.03×10^{-3}	2.56×10^{-3}	3.43×10^{-3}
Th-232	2.15×10^{-3}	6.42×10^{-4}	9.19×10^{-4}	2.32×10^{-3}
U-234	5.82×10^{-2}	3.71×10^{-3}	1.81×10^{-2}	5.34×10^{-3}
U-235	5.96×10^{-3}	2.61×10^{-4}	1.11×10^{-2}	2.83×10^{-3}
U-238	1.02×10^{-1}	4.48×10^{-3}	1.94×10^{-2}	4.15×10^{-3}
U-Total	2.68×10^{-1}	1.33×10^{-2}	6.26×10^{-2}	1.80×10^{-2}

[a]Values for South Field and Inactive Flyash Pile are identical.

[b]PAH COCs have been expressed as benzo(a)pyrene equivalents using the toxicity equivalency factor approach (Clement International, 1990). In this approach, benzo(a)pyrene has a relative potency of 1.0 and other PAHs are expressed as benzo(a)pyrene equivalents.

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TABLE C.5-11
MICROSHIELD INPUT PARAMETERS

Source volume of direct exposure to remedial worker during excavation:
Diameter = 20 m; Depth = 2 m; Volume = 6.28×10^8 cc;
Mass = 1.07×10^9g (1.7 g/cc for source strength);
Density = 1.5 g/cc (for self shielding).

Roll-off Truck:
Length = 4.57 m; Width = 2.44 m; Height = 1.37 m;
Volume = 1.53×10^7 cc;
Mass = 2.60×10^7 g (1.7 g/cc for source strength);
Density = 1.5 g/cc (for self shielding).

Train Gondola Car:
Length = 16.0 m; Width = 2.90 m; Height = 1.37 m;
Volume = 6.36×10^7 cc;
Mass = 8.85×10^7 g;
Density = 1.5 g/cc (for self shielding only).

Remediation crews work 10 hours/day, 4 days/week.

Remedial activities produce mechanical suspension of soil particles in air at a concentration of 600 $\mu g/m^3$.

Note: COC soil concentrations are presented in Table C.5-4.

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TABLE C.5-12
MICROSHIELD OUTPUT ~~(mR/hr)~~(mrem/hr)

	Direct Exposure			Immersion
Subunit	On-property Rail Remedial Worker	On-property Transportation	Excavation Remedial Worker	Excavation Remedial Worker
Solid Waste Landfill	5.16×10^{-3}	1.11×10^{-2}	1.59×10^{-2}	7.10×10^{-10}
Lime Sludge Ponds	2.65×10^{-3}	5.66×10^{-3}	8.18×10^{-3}	3.52×10^{-10}
South Field/Inactive Flyash Pile	4.48×10^{-3}	9.63×10^{-3}	1.38×10^{-2}	6.51×10^{-10}
Active Flyash Pile	8.48×10^{-3}	1.82×10^{-2}	2.63×10^{-2}	1.13×10^{-9}

C.6.0 REMEDIAL ACTION RISK ASSESSMENT

Each remedial alternative involves a set of work activities. These activities incur varying degrees of physical hazards and human-health risks. This section presents the results of the risk estimates calculated for remedial action activities.

C.6.1 REMEDIAL ACTION RISK CHARACTERIZATION METHODOLOGY

The methods established in the RAWPA (DOE 1992) were employed to estimate potential physical hazards and human-health impacts from carcinogens and noncarcinogens to remediation workers, on-property nonremediation workers, off-property workers and individuals, and the public along the transportation route (for off-site disposal). The remedial action risk assessment evaluated receptor exposures via pathways from media impacted by remedial activities. Construction risks and transportation risks were evaluated for each remedial alternative.

Construction risks are the risks associated with the industrial hazards posed by construction operations during the implementation of remedial activities, except those related the transportation of waste material off-site (i.e., by rail). Construction risks include risks related to excavation, waste processing, and waste packaging. The following equation was used to calculate risks due to construction:

$$\text{Risk} = (PH)(RC) \qquad (C.6\text{-}1)$$

where

Risk	=	risk of injury or fatality expressed as a probability,
PH	=	person-hours of construction work, (see Attachment II, See page C-62 ~~Table C.II-21~~) and
RC	=	injury or fatality risk coefficient (risk/person/hr).

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Risk factors (RCs) used are from the RAWPA:

- Injuries per man-hour = 3.4×10^{-5}
- Fatalities per man-hour = 5.0×10^{-7}

Construction risks from on-site trucking accidents were calculated separately, using the formula and risk factors presented in the RAWPA:

$$\text{Risk} = (TM)(AC) \qquad (C.6\text{-}2)$$

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where

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Risk	=	risk of injury or fatality expressed as a probability,
TM	=	truck miles for construction work, (see Attachment II~~, Table C.II-22~~), and
AC	=	injury or fatality risk coefficient (risk/mile).

Risk (ACs) factors are:

- Injuries per mile = 2.1×10^{-9}
- Fatalities per 4.1×10^{-8}

Transportation risks were evaluated separately for the rail transportation activities. These risks include exposure of the train crew to direct radiation, exposure of the public living along or using the transportation route to direct radiation, exposure of the public to material released from a transportation accident, and exposure of train crews and the public to nonradiological hazards from accidents. The RADTRAN model (Section C.5.1.3), which was used to quantify transportation risks, takes into account emergency response activities. The following equation was used to calculate risks due to transportation of waste to an off-site disposal facility:

$$\text{Risk} = (N)(CF)(RC) \qquad \text{(C.6-1)}$$

where

Risk	=	risk of injury or fatality expressed as a unitless probability,
N	=	number of roundtrips made,
CF	=	mileage per round trip, and
RC	=	injury or fatality risk coefficient (risk/mile).

See Attachment C.II, Tables C.II-23 and 24 for CF values. Risk factors (RCs) are:

- Public injuries per mile = 6.8×10^{-6}
- Public fatalities per mile = 1.8×10^{-6}
- Rail Worker injuries per mile = 4.6×10^{-6}
- Rail Worker fatalities per mile = 4.6×10^{-8}

The sections below present the remedial action risks quantified for construction and transportation activities for each alternative.

Exposure durations for the calculations were determined using the total hours estimated for each work activity. These total hours correspond to the product of ET, ED, and EF in Equation C.3-5. However because of the duration of the remediation activity (a few years) and the duration of the various activities, the specific values for ET, ED, and EF did not need to be evaluated; therefore, the product of those values, which represent total project hours for each activity, has been used.

C.6.2 REMEDIAL ACTION RISKS

Remedial action risks were evaluated for impacts to potential human receptors from implementation of each remedial alternative. This section presents the remedial action risks quantified for the four remedial alternatives. For each alternative, construction risks are presented first, then transportation risks. Tables summarizing risk and hazards to potential receptors are provided by alternative. Complete calculation sheets of the risk values are presented in Attachment C.II. Note that Alternative 1, No Action, has no short-term impacts and was not evaluated in this section.

Evaluations for on-site activities are discussed in order of airborne pathways, dermal pathways, direct radiation, and industrial hazards for each alternative. Transportation risks were evaluated for incident-free transportation (i.e., no accidents) and for accidents during rail transport. The risks from activities conducted in the South Field and Inactive Flyash Pile have been combined because the analytical information on COC concentrations was combined in the RI.

Estimates of excavation duration were developed from engineering estimates for each phase of the remediation activities. The time spent at actual physical remediation was the longest time period for any direct exposure to contaminated materials by airborne pathways, dermal pathways or direct radiation exposure. This activity was evaluated in most cases, as the bounding remediation activity for each alternative. Workers may be involved in more than one remediation activity, but because this activity will be occurring over a long period of time, workers may be limited to only this activity. Risks at the majority of other activities will be considerably less because of factors such as shielding, limited volumes, limited activity duration, etc. In those cases where a possibility existed for significant risks, the other activities were also evaluated.

No. 20 & 95 Evaluations for Alternative 2 have been made for the Federal Ownership Scenario, since it is the only scenario under evaluation. For the other alternatives, based on assessment of South Field data, it would require 3 to 4 times less volumes and hours required to remediate under federal ownership land use, than under private ownership. Therefore, only the Private Ownership land use has been evaluated for risks from COCs. It can be expected that risks under the Federal Ownership land use will be only a fraction of the Private Ownership land use risks.

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C.6.2.1 Alternative 2: Consolidation and Capping

For Alternative 2, risks are calculated for on-site activities. No transportation activities are envisioned.

On-Site Activities

Airborne Pathways. Inhalation pathways were evaluated for excavation activities for each subunit. Calculations are detailed in Tables C.II-1 through C.II-4, in Attachment C.II. Results are summarized in Table C.6-1.

TABLE C.6-1

No. 90 **ALTERNATIVE 2, FEDERAL OWNERSHIP, INHALATION RISK RESULTS FROM EXCAVATION ACTIVITIES**

Subunit	Risk Source	Risk[a]
Solid Waste Landfill	Chemical COCs	2.1×10^{-7}
	Radionuclides	1.0×10^{-5}
Lime Sludge Pond	Chemical COCs	7.6×10^{-8}
	Radionuclides	9.1×10^{-7}
South Field/Inactive Flyash Pile	Chemical COCs	1.6×10^{-6}
	Radionuclides	7.6×10^{-6}
Active Flyash Pile	Chemical COCs	1.7×10^{-6}
	Radionuclides	4.0×10^{-6}

No. 96 [a]Risks calculated assuming no PPE or shielding

These risks were calculated using the dust loading factor (600 $\mu g/m^3$) and the soil concentrations for the various COCs. The worker was assumed to inhale the entire available concentration of dust (i.e., given by soil concentration x dust loading) regardless of particle size. The dispersion of particulate matter from excavation activities was based on EPA guidance for superfund sites (EPA 1993f, Figure C). It was assumed that the active excavation area was approximately 0.5 acres and that the side of the excavation area was approximately 50 m. The distance to the nonremediation worker was assumed to be 300 m (1000 ft.) and the distance to the nearest fenceline was measured from the approximate center of each subunit. The remedial worker was assumed to be immersed in air laden with a dust concentration of 6.0×10^{-4} g/m^3 No. 63 (DOE, 1992). ~~The ratio of the dispersion factor for 300 m to the factor for the 50m was multiplied by the remedial worker dust concentration to obtain the nonremediation worker dust concentration.~~ The ratio of the dispersion factor for each fenceline

TABLE C.6-2
94 ALTERNATIVE 2, FEDERAL OWNERSHIP
SUMMARY OF INHALATION RISKS FROM EXCAVATION~~, ALTERNATIVE 2,~~

Subunit	Receptor[a]	Total Risk[b]
Solid Waste Landfill	Remediation Workers	1.0×10^{-5}
	Nonremediation Workers	1.3×10^{-6}
	Public	7.4×10^{-7}
Lime Sludge Pond	Remediation Workers	9.9×10^{-7}
	Nonremediation Workers	1.3×10^{-7}
	Public	4.4×10^{-8}
South Field/ Inactive Flyash Pile	Remediation Workers	9.2×10^{-6}
	Nonremediation Workers	1.2×10^{-6}
	Public	1.0×10^{-6}
Active Flyash Pile	Remediation Workers	5.7×10^{-6}
	Nonremediation Workers	7.5×10^{-7}
	Public	5.7×10^{-7}

[a]For public receptor, see Tables C.II-1, 2, 3, and 4, (Attachment C.II), Footnote 1.
No. 96 [b]Risks calculated assuming no PPE or shielding

The chemical COCs responsible for the majority of the risk from inhalation are based solely on the relative soil concentration of each COC; no single COC determines the risk. For radionuclides, the risks are driven by the thorium and uranium concentrations, which are in the highest concentrations. Risks from radon emissions during excavation were calculated separately for a remediation worker, using calculations more appropriate to radon, in Table C.II-13, (Attachment C.II) and the results indicate risks in the 9.1×10^{-8} (for the Lime Sludge Pond) to 2.3×10^{-6} (for the Active Flyash Pile). The radon exposures to the nonremediation workers and the public would be reduced in the same fashion as the particulate inhalation.

Dermal exposure routes include contact with contaminated soils and airborne dust. Risks are both carcinogenic and noncarcinogenic. These risks are presented in Table C.II-14 (Attachment C.II) and are summarized in Table C.6-3. Risks from dermal exposure to PAHs were not calculated. The EPA *currently recommends using the oral exposure assessment to determine dermal exposure risk since it is currently inappropriate to extrapolate dermal slope factors from the oral slope factors for PAHs. There is no oral exposure route associated with the short-term risks from the remediation activities. This does not imply that there is no risk from dermal exposure to PAHs for this activity. Since all risks are very low, it may be expected that the risk from PAHs would also be minimal.

TABLE C.6-3
REMEDIATION WORKER RISKS FROM DERMAL EXPOSURES FOR ALTERNATIVE 2

Subunit	Cancer Risk[a]	HI
Solid Waste Landfill	6.0×10^{-8}	2.3×10^{-3}
Lime Sludge Pond	2.9×10^{-8}	1.3×10^{-3}
South Field/ Inactive Flyash Pile	2.1×10^{-7}	3.4×10^{-3}
Active Flyash Pile	1.0×10^{-7}	2.9×10^{-4}

No. 96 [a]Risks calculated assuming no PPE or shielding

Direct Radiation. Direct radiation risks were calculated for excavation activities for each subunit. Calculations are shown in Table C.II-28 (Attachment II) and summarized in Table C.6-4. ~~Risks to public~~ No. 63 ~~were calculated by apportioning the risk at 1 m (i.e., the remediation worker) to that at 305 m (1000 ft) using the inverse square law applicable to direct penetrating radiation.~~ Risks to the public from direct radiation were estimated using the same calculation for the nonremediation worker, that is by apportioning the risk at 1 m (i.e., the remediation worker) to that at 300 m (1000 ft) using the inverse square law applicable to direct penetrating radiation. Since the risks calculated at this distance were less than 10^{-8}, this is a reasonable approach. This yields a conservative approximation; risks from the air transport pathways were calculated using actual distances to the fence line (i.e., 335 to 701 m), since the risks were higher than those from direct radiation. The risks presented have been calculated using this ~~the~~ methodology and values presented in HEAST, as opposed to MICROSHIELD. Risks calculated using MICROSHIELD were in the same order of magnitude as those presented.

TABLE C.6-4
DIRECT RADIATION RISKS FOR ALTERNATIVE 2

Subunit	Receptors	Cancer Risk[a]
Solid Waste Landfill	Remediation Worker	5.9×10^{-6}
	Public	2.7×10^{-10}
Lime Sludge Pond	Remediation Worker	2.7×10^{-6}
	Public	1.2×10^{-10}
South Field/ Inactive Flyash Pile	Remediation Worker	1.8×10^{-5}
	Public	5.3×10^{-10}
Active Flyash Pile	Remediation Worker	2.3×10^{-5}
	Public	1.1×10^{-9}

96 [a]Risks calculated assuming no PPE or shielding

Immersion doses from exposure to direct radiation of radionuclides suspended in a cloud were calculated by subunit using MICROSHIELD. The results are shown in Table C.II-18 (Attachment C.II) and are summarized in Table C.6-5. Dose rates shown for the public and nonremediation workers are the same as those calculated for a remediation worker during excavation activities and would be expected to be lower in reality, but were not specifically performed for the public or nonremediation workers because of the very low dose levels.

TABLE C.6-5
RISKS FROM IMMERSION IN A CONTAMINATED CLOUD, ALTERNATIVE 2

Subunit	Receptors	Dose (mrem)	Fatal Cancer Risk[a]
Solid Waste Landfill	Remediation Worker	2.9×10^{-6}	1.8×10^{-12}
	Nonremediation Worker/Public	7.8×10^{-7}	4.8×10^{-12}
Lime Sludge Pond	Remediation Worker	1.2×10^{-6}	7.4×10^{-13}
	Nonremediation Worker/Public	3.5×10^{-7}	2.2×10^{-13}
South Field/ Inactive Flyash Pile	Remediation Worker	4.8×10^{-6}	3.0×10^{-12}
	Nonremediation Worker/Public	1.8×10^{-6}	1.1×10^{-12}
Active Flyash Pile	Remediation Worker	8.8×10^{-6}	5.5×10^{-12}
	Nonremediation Worker/Public	3.0×10^{-6}	1.9×10^{-12}

No. 96 [a]Risks calculated assuming no PPE or shielding

Industrial and Mechanical Hazards. Injury and fatality rates for standard industrial hazards associated with construction activities were used to estimate these risks for remediation activities. Table C.II-21 and C.II-22 (Attachment C.II) show the calculations for on-the-job construction accidents, and for those associated with on-site trucking activities in support of remediation. Calculations were made for volumes estimated from the PRLs for both land-use scenarios federal and private ownership. Table C.6-6 contains a summary of these results. These risks have been summed for all subunits and all remediation activities. The general accident risk rates may include a contribution from trucking accidents, but this information was not specified in the RAWPA.

TABLE C.6-6
RISKS FROM ON-SITE INDUSTRIAL HAZARDS, ALTERNATIVE 2

Source	Injury Risk		Fatality Risk	
	Private	Federal	Private	Federal
General Accidents	NC	4.0	NC	5.8×10^{-2}
Trucking Accidents	0	3.0×10^{-4}	0	1.5×10^{-5}

NC = Not calculated

C.6.2.2 Alternative 3: Excavation and Off-Site Disposal

For Alternative 3, risks were calculated for on-site activities and transportation.

Airborne Pathways. Inhalation pathways were evaluated for excavation activities for each subunit. Calculations are detailed in Tables C.II-5 through C.II-8 (Attachment C.II). Results are summarized in Table C.6-7.

TABLE C.6-7
ALTERNATIVE 3 INHALATION RESULTS FROM EXCAVATION ACTIVITIES

Subunit	Risk Source	Risk[a]
Solid Waste Landfill	Chemical COCs	3.3×10^{-7}
	Radionuclides	1.6×10^{-5}
Lime Sludge Pond	Chemical COCs	1.7×10^{-7}
	Radionuclides	1.9×10^{-6}
South Field/Inactive Flyash Pile	Chemical COCs	5.0×10^{-7}
	Radionuclides	1.1×10^{-5}
Active Flyash Pile	Chemical COCs	4.1×10^{-7}
	Radionuclides	2.0×10^{-5}

No. 96 [a]Risks calculated assuming no PPE or shielding

These risks were calculated using the dust loading factor (600 $\mu g/m^3$) and the soil concentrations for the various COCs. The worker was assumed to inhale the entire available concentration of dust (i.e., given by soil concentration x dust loading) regardless of particle size. These risks to the nonremediation worker and the general public were calculated by applying a linear downwind

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dispersion factor (EPA 1993f). A summary of the inhalation risks for the receptors is included in Table C.6-8.

TABLE C.6-8
SUMMARY OF INHALATION RISKS FROM EXCAVATION, ALTERNATIVE 3

Subunit	Receptor	Total Risk[a]
Solid Waste Landfill	Remediation	1.6×10^{-5}
	Nonremediation Workers	2.1×10^{-6}
	Public	1.2×10^{-6}
Lime Sludge Pond	Remediation	2.6×10^{-6}
	Nonremediation Workers	3.4×10^{-7}
	Public	1.2×10^{-7}
South Field/ Inactive Flyash Pile	Remediation	1.2×10^{-5}
	Nonremediation Workers	1.6×10^{-6}
	Public	1.3×10^{-6}
Active Flyash Pile	Remediation	2.0×10^{-5}
	Nonremediation Workers	2.6×10^{-6}
	Public	2.0×10^{-6}

96 [a]Risks calculated assuming no PPE or shielding

The chemical COCs responsible for the majority of the risk from inhalation are based solely on the relative soil concentration of each COC; no single COC determines the risk. For radionuclides, the risks are driven by the thorium and uranium concentrations, which also are in the highest concentrations. Doses from radon emissions during excavation were calculated separately for a remediation worker, using calculations more appropriate to radon, in Table C.II-13 (Attachment C.II) and the results indicate risks in the 3.1 x 10-6 to 1.9×10^{-7} range. The risk to the nonremediation worker and the general public are reduced by dispersion of radon concentrations in the same way as the particulate concentrations.
Dermal exposure routes include contact with contaminated soils and airborne dust. Risks are from carcinogens and noncarcinogens. These risks are presented in Table C.II-15 (Attachment C.II) and summarized Table C.6-9. Risks from dermal exposure to PAHs were not calculated. The EPA currently recommends using the oral exposure assessment to determine dermal exposure risk since it is currently inappropriate to extrapolate dermal slope factors from the oral slope factors for PAHs. There is no oral exposure route associated with the short-term risks from the remediation activities. This does not imply that there is no risk from dermal exposure to PAHs for this activity.

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TABLE C.6-9
REMEDIATION WORKER RISKS FROM DERMAL EXPOSURES FOR ALTERNATIVE 3

Subunit	Cancer Risk[a]	HI
Solid Waste Landfill	1.2×10^{-7}	4.6×10^{-3}
South Field/ Inactive Flyash Pile	5.4×10^{-7}	8.9×10^{-3}
Lime Sludge Pond	6.1×10^{-8}	2.7×10^{-3}
Active Flyash Pile	2.8×10^{-7}	8.1×10^{-4}

No. 96 [a]Risks calculated assuming no PPE or shielding

Calculations for VOC emissions from the dryer are shown in Table C.II-17 (Attachment C.II) and the results are summarized in Table C.6-10. Because of the very low risks, the off-site public was conservatively assumed to receive the same dose as the nonremediation worker, even though the public's dose would be much lower.

TABLE C.6-10
CANCER RISKS FROM VOCS EMITTED FROM THE DRYER, ALTERNATIVE 3

Subunit	Receptor	Inhalation Risk[a]	Dermal Risk
Solid Waste Landfill	Nonremediation Worker/ Public	7.5×10^{-14}	3.5×10^{-9}
Lime Sludge Pond	Nonremediation Worker/ Public	1.5×10^{-12}	4.0×10^{-9}
South Field/ Inactive Flyash Pile	Nonremediation Worker/ Public	3.2×10^{-11}	1.0×10^{-8}
Active Flyash Pile	Nonremediation Worker/ Public	0	0

No. 96 [a]Risks calculated assuming no PPE or shielding

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TABLE C.6-11
DIRECT RADIATION RISKS FOR ALTERNATIVE 3

Subunit	Receptors	Risk[a]
Solid Waste Landfill	Remediation Worker	1.2×10^{-5}
	Nonremediation Worker/ Public	5.4×10^{-10}
Lime Sludge Pond	Remediation Worker	5.8×10^{-6}
	Nonremediation Worker/ Public	2.6×10^{-10}
South Field/ Inactive Flyash Pile	Remediation Worker	1.7×10^{-5}
	Nonremediation Worker/ Public	7.6×10^{-10}
Active Flyash Pile	Remediation Worker	3.1×10^{-5}
	Nonremediation Worker/Public	1.4×10^{-9}

No. 96 [a]Risks calculated assuming no PPE or shielding

Direct Radiation. Direct radiation risks were calculated for excavation activities for each subunit. Calculations are shown in Table C.II-29 (Attachment II) and summarized in Table C.6-11. Risks to nonremediation workers were calculated by apportioning the risk at 1 m (i.e., the remediation worker) to No. 63 that at 300 ~~305~~ m using the inverse square law applicable to direct penetrating radiation. Risks have been calculated using the methodology and values presented in HEAST, as opposed to MICROSHIELD. Risks calculated using MICROSHIELD were in the same order of magnitude as those presented.

Immersion doses from exposure to direct radiation of radionuclides suspended in a cloud were calculated by subunit using MICROSHIELD. The results are shown in Table C.II-19 (Attachment C.II) and are summarized in Table C.6-12. Dose rates shown for the public and nonremediation workers are the same as those calculated for a remediation worker during excavation activities and would be expected to be lower in reality, but were not specifically performed for the public or nonremediation workers because of the very low dose levels.

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TABLE C.6-12
RISKS FROM IMMERSION IN A CONTAMINATED CLOUD, ALTERNATIVE 3

Subunit	Receptors	Dose (mrem)	Fatal Cancer Risk[a]
Solid Waste Landfill	Remediation Worker	4.4×10^{-6}	2.7×10^{-12}
	Nonremediation Worker Public	1.6×10^{-6}	9.9×10^{-13}
Lime Sludge Pond	Remediation Worker	2.3×10^{-6}	1.4×10^{-12}
	Nonremediation Worker Public	7.4×10^{-7}	4.6×10^{-13}
South Field/Inactive Flyash Pile	All Receptors	2.5×10^{-6}	1.5×10^{-12}
Active Flyash Pile	All Receptors	3.9×10^{-6}	2.4×10^{-12}

No. 96 [a]Risks calculated assuming no PPE or shielding

Industrial and Mechanical Hazards. Injury and fatality rates for standard industrial hazards associated with construction activities were used to estimate these risks for remediation activities. Table C.II-21 and C.II-22 (Attachment C.II) show the calculations for on-the-job construction accidents, and for those associated with on-site trucking activities in support of remediation. Calculations were made for volumes estimated from the PRLs for both land-use scenarios federal and private ownership. Table C.6-13 contains a summary of these results. These risks have been summed for all subunits and all remediation activities. The general accident risk rates may include a contribution from trucking accidents, but this information was not specified in the RAWPA.

TABLE C.6-13
RISKS FROM ON-SITE INDUSTRIAL HAZARDS, ALTERNATIVE 3

Source	Injury Risk[a]		Fatality Risk[a]	
	Private	Federal	Private	Federal
General Accidents	NC	11.0	NC	1.6×10^{-1}
Trucking Accidents	2.4×10^{-3}	1.1×10^{-3}	1.25×10^{-4}	5.8×10^{-5}

NC = Not calculated
No. 96 [a]Risks calculated assuming no PPE or shielding

Transportation Risks

Transportation risks are those associated with the shipment of contaminated materials off-site by rail. Risks presented include those based on standard accident rates for the rail transport industry, doses to workers and the public along the route from normal shipping conditions, and doses to workers and the public from accidents along the route. Impacts from accidents were calculated using the

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RADTRAN code and include direct radiation, inhalation, ingestion and immersion exposure routes. These results have been left in terms of doses rather than risks because of the complexity of the combined exposure routes.

Risks from accidents expected in the normal operation of a rail system are presented in Table C.II-23 (Attachment C.II) and summarized in Table C.6-14. Calculations were made for volumes estimated from the PRLs for both land-use scenarios, federal and private ownership and are based on the number of trips required to transport the minimum number of railcars (159) at one time. Since rates are based on mileage, these risks would decrease as the number of cars increase in a train.

TABLE C.6-14
RISKS FROM EXPECTED ACCIDENTS FROM RAIL TRANSPORT, ALTERNATIVE 3

Receptor	**Injury Risk**[a]		**Fatality Risk**[a]	
	Private	Federal	Private	Federal
Rail Workers	1.2	5.0×10^{-1}	1.2×10^{-2}	5.0×10^{-3}
Public	1.8	7.3×10^{-1}	4.8×10^{-1}	1.9×10^{-1}

No. 96 [a]Risks calculated assuming no PPE or shielding

Doses received by the public from rail transportation are presented in Table C.II-25 (Attachment C.II) for incident-free transportation (i.e., no accidents) and in Table C.II-26 (Attachment C.II) for accidents. Table C.6-15 summarizes the risks for various receptors for the incident-free transportation. Two worker-receptors were calculated using RADTRAN. These workers are associated with the train and are not considered remediation workers. The public consists of four groups, as calculated with the built-in code assumptions described in Section C.5.1. All doses are based on 159 cars per shipment. As the number of railcars increases, the number of shipments would decrease, causing a net increase in dose per shipment, but no change in the total dose per subunit. The RADTRAN estimated maximum individual dose per shipment is 2.2×10^{-7} rem (based on 159 cars per shipment).

The calculations for incident-free transportation used the soil concentration levels found in the Active Flyash Pile as a source term for all subunit calculations, since this provided the maximum individual railcar dose rate. Other subunit source terms may be lower by a factor of 3 or more, which would have no significant impact on the total risks. The population total for the calculation was 549,760 persons encountered in the various RADTRAN scenarios.

TABLE C.6-15
RISKS FROM INCIDENT-FREE RAIL TRANSPORTATION, ALTERNATIVE 3

Receptors[a]		Person-rem	Rem per person
Rail Workers	Rail Crew	0.00029	NC
	Handlers	1.53	NC
Public	Along route	0.34	NC
	On other trains	0.04	NC
	At stops	0.6	NC
	At storage depots	0.06	NC
Total		2.5	4.6×10^{-6}

NC = Not calculated
No. 96 [a]Risks calculated assuming no PPE or shielding

Accident analyses performed with RADTRAN calculated the expected accident frequencies per severity group, which is described in Section C.5.1. Frequencies per shipment range from 10^{-3} to 10^{-8} according to the severity of the postulated accident and associated release. The most frequently expected accident occurs in the frequency range of 10^{-3} but has no associated release (i.e., railcars are not breach). The next severity category has a postulated 0.1 fraction release and so on, up to a 100 percent release for the highest category. Accidents are calculated for urban, suburban, and rural populations. Table C.II-26 (Attachment C.II) contains the calculations for resulting doses from the postulated accidents. The highest dose levels result from the lowest frequency accidents.

Table C.6-16 summarizes the results of the postulated accidents along with the expected frequency per shipment from Table C.5-17 for those accidents with an expected per shipment frequency of greater than 10^{-6}. For Alternate 3, the total number of train trips is estimated at 70, based on 159 railcar trains. The total number of accidents that would be expected based on a frequency of 10^{-6} accident per shipment, for 70 shipments, is 7.0×10^{-5} for the entire waste disposal process. Results were calculated for both the federal and private PRL waste volumes. The federal ownership doses are approximately 2 orders of magnitude lower than those for the private ownership scenarios.

C.6.2.3 Alternative 6: Excavation and On-Site Disposal With Off-Site Disposal of Fraction Exceeding WAC

For Alternative 6, risks were calculated for on-site activities and transportation.

TABLE C.6-16
SUMMARY OF ACCIDENT RESULTS FOR TRAIN SHIPMENT FOR PRIVATE OWNERSHIP VOLUMES, ALTERNATIVE 3

Population[a]	Severity Group	Expected Frequency per Shipment	Total Dose for All Shipments (person-rem)	Total Dose per Member of the Public (rem)
Urban	1	1.1×10^{-3}	0	0
	2	6.4×10^{-4}	2.0×10^{3}	4.1×10^{-3}
	3	1.4×10^{-4}	4.0×10^{3}	8.2×10^{-3}
	4	1.4×10^{-4}	5.9×10^{3}	1.2×10^{-2}
Suburban	1	2.0×10^{-3}	0	0
	2	1.6×10^{-4}	4.6×10^{2}	6.8×10^{-3}
	3	3.7×10^{-4}	9.2×10^{2}	1.4×10^{-2}
	4	3.7×10^{-5}	1.4×10^{3}	2.0×10^{-2}
	5	2.8×10^{-6}	1.8×10^{3}	2.7×10^{-2}
Rural	1	9.1×10^{-5}	0	0
	2	5.5×10^{-5}	8.5×10^{0}	6.8×10^{-3}
	3	9.8×10^{-5}	1.7×10^{1}	1.4×10^{-2}
	4	9.8×10^{-6}	2.6×10^{1}	2.0×10^{-2}
	5	1.6×10^{-6}	3.4×10^{1}	2.7×10^{-2}

96 [a]Risks calculated assuming no PPE or shielding

C.6.2.3.1 On-Site Activities

Airborne Pathways. Inhalation pathways were evaluated for excavation activities for each subunit. Calculations are detailed in Tables C.II-9 through C.II-12 (Attachment C.II). Results are summarized in Table C.6-17.

TABLE C.6-17
ALTERNATIVE 6 INHALATION RESULTS FROM EXCAVATION ACTIVITIES

Subunit	Risk Source	Risk[a]
Solid Waste Landfill	Chemical COCs	3.8×10^{-7}
	Radionuclides	1.8×10^{-5}
Lime Sludge Pond	Chemical COCs	1.8×10^{-7}
	Radionuclides	2.2×10^{-6}
South Field/Inactive Flyash Pile	Chemical COCs	4.6×10^{-7}
	Radionuclides	9.9×10^{-6}
Active Flyash Pile	Chemical COCs	1.2×10^{-6}
	Radionuclides	2.8×10^{-6}

No. 96 [a]Risks calculated assuming no PPE or shielding

These risks were calculated using the dust loading factor (600 μg/m^3) and the soil concentrations for the various COCs. The worker was assumed to inhale the entire available concentration of dust (i.e., given by soil concentration x dust loading) regardless of particle size. The risks to the nonremediation worker and the general public were calculated by applying a linear downwind dispersion factor (EPA 1993f). A summary of inhalation risks for the receptors is included in Table C.6-18.

TABLE C.6-18
SUMMARY OF INHALATION RISKS FROM EXCAVATION, ALTERNATIVE 6

Subunit	Receptor	Total Risk[a]
Solid Waste Landfill	Remediation Worker	1.8×10^{-5}
	Nonremediation Worker	2.4×10^{-6}
	Public	1.3×10^{-6}
Lime Sludge Pond	Remediation Worker	2.6×10^{-6}
	Nonremediation Worker	3.4×10^{-7}
	Public	1.2×10^{-7}
South Field/ Inactive Flyash Pile	Remediation Worker	1.4×10^{-5}
	Nonremediation Worker	1.8×10^{-6}
	Public	1.5×10^{-6}
Active Flyash Pile	Remediation Worker	4.0×10^{-6}
	Nonremediation Worker	5.3×10^{-7}
	Public	4.0×10^{-7}

No. 96 [a]Risks calculated assuming no PPE or shielding

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The chemical COCs responsible for the majority of the risk from inhalation are based solely on the relative soil concentration of each COC; no single COC determines the risk. For radionuclides, the risks are driven by the thorium and uranium concentrations, which also are in the highest concentrations. Doses from radon emissions during excavation were calculated separately for a remediation worker, using calculations more appropriate to radon, in Table C.II-13 (Attachment C.II) and the results indicate risks in the 2.2×10^{-7} to 1.8×10^{-6} range. The risk to the nonbremediation worker and general public are reduced by dispersion of radon concentrations in the same way as the particulate concentrations.

Dermal exposure routes include contact with contaminated soils and airborne dust. Risks are from carcinogens and noncarcinogens. These risks are presented in Table C.II-16 (Attachment C.II) and summarized in Table C.6-19. Risks from dermal exposures to PAHs were not calculated. The EPA currently recommends using the oral exposure assessment to determine dermal exposure risk since it is currently inappropriate to extrapolate dermal slope factors from the oral slope factors for PAHs. There is no oral exposure route associated with the short-term risks from the remediation activities. This does not imply that there is no risk from dermal exposure to PAHs for this activity. Since all risks are so very low, it may be expected that the risk from PAHs will also be minimal.

TABLE C.6-19
REMEDIATION WORKER RISKS FROM DERMAL EXPOSURES FOR ALTERNATIVE 6

Subunit	Cancer Risk[a]	HI
Solid Waste Landfill	1.0×10^{-7}	3.8×10^{-3}
Lime Sludge Pond	2.9×10^{-8}	1.3×10^{-3}
South Field/ Inactive Flyash Pile	1.9×10^{-7}	3.0×10^{-3}
Active Flyash Pile	1.0×10^{-7}	2.9×10^{-4}

No. 96 [a]Risks calculated assuming no PPE or shielding

Direct Radiation. Direct radiation risks were calculated for excavation activities for each subunit. Calculations are shown in Table C.II-30 (Attachment II) and summarized in Table C.6-20. Risks to public were calculated by apportioning the risk at 1 m (i.e., the remediation worker) to that at 305m (1000 ft) using the inverse square law applicable to direct penetrating radiation. Risks have been calculated using the methodology and values presented in HEAST, as opposed to MICROSHIELD. Risks calculated using MICROSHIELD were in the same order of magnitude as those presented. Immersion doses from exposure to direct radiation of radionuclides suspended in a cloud were calculated using MICROSHIELD by subunit. The results are shown in Table C.II-20 (Attachment II) and are summarized in Table C.6-21. Dose rates shown for the public and nonremediation workers

TABLE C.6-20
DIRECT RADIATION RISKS FOR ALTERNATIVE 6

Subunit	Receptors	Risk[a]
Solid Waste Landfill	Remediation Worker	1.1×10^{-5}
	Nonremediation Worker	4.9×10^{-10}
Lime Sludge Pond	Remediation Worker	6.6×10^{-6}
	Nonremediation Worker	3.0×10^{-10}
South Field/ Inactive Flyash Pile	Remediation Worker	1.6×10^{-5}
	Nonremediation Worker	7.0×10^{-10}
Active Flyash Pile	Remediation Worker	1.6×10^{-5}
	Nonremediation Worker	7.3×10^{-10}

No. 96 [a]Risks calculated assuming no PPE or shielding

are the same as those calculated for a remediation worker during excavation activities and would be expected to be lower in reality, but were not specifically performed for the public or nonremediation workers because of the very low dose levels.

TABLE C.6-21
RISKS FROM IMMERSION IN A CONTAMINATED CLOUD, ALTERNATIVE 6

Subunit	Receptors	Dose (mrem)	Fatal Cancer Risk[a]
Solid Waste Landfill	Remediation Worker	2.4×10^{-6}	1.5×10^{-12}
	Nonremediation Worker Public	1.4×10^{-6}	8.7×10^{-13}
Lime Sludge Pond	All Receptors	8.4×10^{-7}	5.2×10^{-13}
South Field/ Inactive Flyash Pile	Remediation Worker	5.3×10^{-6}	3.3×10^{-12}
	Nonremediation Worker Public	2.3×10^{-6}	1.4×10^{-12}
Active Flyash Pile	Remediation Worker	6.0×10^{-6}	3.7×10^{-12}
	Nonremediation Worker Public	2.0×10^{-6}	1.2×10^{-12}

No. 96 [a]Risks calculated assuming no PPE or shielding

Industrial and Mechanical Hazards. Injury and fatality rates for standard industrial hazards associated with construction activities were used to estimate these risks for remediation activities. Table C.II-21 and C.II-22 (Attachment C.II) show the calculations for on-the-job construction accidents, and for those associated with on-site trucking activities in support of remediation. Calculations were made for volumes estimated from the PRLs for both land-use scenarios federal and private ownership. Table C.6-22 contains a summary of these results. These risks have been summed for all subunits and all remediation activities. The general accident risk rates may include a contribution from trucking accidents, but this information was not specified in the RAWPA.

TABLE C.6-22
RISKS FROM ON-SITE INDUSTRIAL HAZARDS, ALTERNATIVE 6

Source	Injury Risk[a]		Fatality Risk[a]	
	Private	Federal	Private	Federal
General Accidents	11.5	NC	0.17	NC
Trucking Accidents	2.8×10^{-3}	1.1×10^{-3}	1.4×10^{-4}	5.5×10^{-5}

NC = Not calculated

No. 96 [a]Risks calculated assuming no PPE or shielding

$$\text{Risk} = (\text{DE})(\text{SF}) \qquad (\text{C.7-6})$$

where

Risk	=	risk of cancer incidence, expressed as a unitless probability,
DE	=	direct exposure defined in equation C.3-19 in Section C.3.0, and
SF	=	slope factor $(\text{pCi})^{-1}$.

The slope factor is either a HEAST value for a particular radionuclide or the sum of the HEAST slope factors for that radionuclide and its short-lived progeny to account for ingrowth during storage and/or environmental transport.

C.7.2 Residual Risks

Residual risks were evaluated for potential impacts to human receptors based on postremediation conditions. This section presents the residual risks quantified for each receptor, pathway, and land-use scenario for Alternatives 2, 3, and 6 (Alternative 1, No Action, is summarized in Section C.1.4; for details, see the RI baseline risk assessment). Tables are provided to summarize the ILCR and hazards calculated. Complete calculation sheets of the risk values are presented in Attachment C.III.

Residual risks at the Lime Sludge Ponds are quantified in Tables C.7-1 through C.7-19, below. Under Alternative 2 for this subunit the risks for all receptors are well below the 1.0 level of concern for HI, and No. 64 ~~better~~less than the ILCR target risk range of 10^{-4} to 10^{-6}. For Alternative 3 the HI for all receptors are similarly well below the 1.0 level of concern. The ILCR for most receptors is also ~~better~~ less than the target risk range. For the perched groundwater user (Table C.7-9), the ILCR is within the lower end of this range (4.6×10^{-6}). Similarly, the on-property adult farmer (Table C.7-10) has an ILCR of 3.4×10^{-6}. The same pattern can be seen under Alternative 6 as under Alternative 3. The HI for all receptors are well below the 1.0 level of concern. The ILCR is ~~better~~less than the target risk range, except for the perched groundwater user (Table C.7-17) at 4.6×10^{-6}, and the on-property adult farmer (Table C.7-18) at 3.4×10^{-6}.

Tables C.7-20 through C.7-38 present the residual risks at the Solid Waste Landfill for Alternatives 2, 3, and 6. Under Alternative 2 the risks for all receptors are well below the 1.0 level of concern for HI, and ~~better~~less than the ILCR target risk range of 10^{-4} to 10^{-6}. Alternative 3 has HI levels ~~below~~ less than the 1.0 level of concern, with the highest level being 7.6×10^{-1} for the on-property child (Table C.7-30). This level is primarily due to the ingestion of vegetables and fruit. ILCR levels are generally ~~below~~less than

No. 64 the target risk range of 10^{-4} to 10^{-6}. The exceptions are ILCR levels of 4.8×10^{-6} for the perched groundwater user (Table C.7-28) and 3.4×10^{-6} for the on-property adult farmer (Table C.7-29). These levels are due to the combined effects of several pathways. Alternative 6 presents similar risk levels to those calculated for Alternative 3. HI levels are also ~~below~~less than the 1.0 level of concern, with the highest level being 7.6×10^{-1} for the on-property child (Table C.7-38). This level is primarily due to the ingestion of vegetables and fruit. ILCR levels are also ~~below~~less than the target risk range of 10^{-4} to 10^{-6}, with the exception of 4.8×10^{-6} for the perched groundwater user (Table C.7-36) and 3.4×10^{-6} for the on-property adult farmer (Table C.7-37). These levels are due to the combined effects of several pathways.

The three southern subunits of Operable Unit 2 (South Field, Active Flyash Pile, and Inactive Flyash Pile) have been combined into one area for risk assessment purposes, due to their proximity. This combined area is identified as the South Field Area in the Tables C.7-39 through C.7-55 below. For Alternative 2 the HI levels are all ~~below~~less than the 1.0 level of concern, with the highest level being 1.3×10^{-1} for the expanded trespasser (Table C.7-39). Dermal contact is the only significant pathway for determining this value. ILCR values range from 9.3×10^{-8} for the off-property child (Table C.7-41) to 1.6×10^{-6} for the off-property adult farmer (Table C.7-40). HI values under Alternative 3 are all ~~below~~less than the 1.0 standard, with the highest level being 7.2×10^{-2} for the off-property child with federal ownership (Table C.7-44). The ingestion of vegetables, fruit and drinking water are the principal contributors to this risk. ILCR levels are all in the 10^{-6} range or ~~below~~less. The highest ILCR value for Alternative 3 is 6.4×10^{-6} for the on-property adult farmer (Table C.7-47). The ingestion of particulates, vegetables, and fruit are the principal pathways for this receptor.

Alternative 6 for the South Field area has uniformly low HI values. The highest HI is only 7.2×10^{-2} for the off-property child with federal ownership (Table C.7-51). The ingestion of vegetables, fruit, and drinking water are the principal contributors to this risk. Similar to Alternative 3, the highest ILCR for Alternative 6 is 6.4×10^{-6} for the on-property adult farmer (Table C.7-54). The ingestion of particulates, vegetables, and fruit are the principal pathways for this receptor.

The final source area included in this risk assessment is the proposed disposal cell. Tables C.7-56 through C.7-61 present the risks for this area, which was only evaluated under Alternative 6. HI values are all well below the 1.0 level of concern, with the maximum value of 6.9×10^{-2} being calculated for both the off-property child with federal ownership (Table C.7-58), and the off-property

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No. 64 child with private ownership (Table C.7-61). The ingestion of vegetables, fruit, and drinking water are the principal pathways for both these receptors. ILCR values are ~~below~~less than 10^{-6}, with the exception of 1.6 x 10^{-6} being calculated for both the off-property adult farmer with federal ownership (Table C.7-57), and the off-property adult farmer with private ownership (Table C.7-60). The ingestion of drinking water is the primary contributor to risk for both of these receptors.

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TABLE C.7-1
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: LIME SLUDGE PONDS WITH FEDERAL OWNERSHIP, ALTERNATIVE 2, EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	NA

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	5.9×10^{-15}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	NA
Total Receptor ILCR =	5.9×10^{-15}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-2
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
LIME SLUDGE PONDS WITH FEDERAL OWNERSHIP, ALTERNATIVE 2,
OFF PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.5×10^{-11}
Ingestion of Dairy Products (Chemicals)	4.9×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	2.7×10^{-8}
Ingestion of Drinking Water (Chemicals)	9.1×10^{-8}
Dermal Contact While Bathing (Chemicals)	5.3×10^{-9}
Total Receptor HI =	1.2×10^{-7}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.3×10^{-14}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	2.5×10^{-11}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	9.7×10^{-15}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.4×10^{-13}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	7.6×10^{-12}
Direct Radiation	
Total Receptor ILCR =	3.3×10^{-11}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-3
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: LIME SLUDGE PONDS WITH FEDERAL OWNERSHIP, ALTERNATIVE 2, OFF-PROPERTY FARMER CHILD

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	6.2×10^{-11}
Ingestion of Dairy Products (Chemicals)	5.2×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	1.0×10^{-7}
Ingestion of Drinking Water (Chemicals)	2.1×10^{-7}
Dermal Contact While Bathing (Chemicals)	8.5×10^{-9}
Total Receptor HI =	3.3×10^{-7}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	6.6×10^{-16}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.1×10^{-12}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	3.2×10^{-16}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	2.7×10^{-14}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	5.3×10^{-13}
Direct Radiation	
Total Receptor ILCR =	1.7×10^{-12}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-4
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: LIME SLUDGE POND WITH FEDERAL OWNERSHIP, ALTERNATIVE 3, EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	3.9×10^{-4}
Dermal Contact with Residual Soils (Chemicals)	2.8×10^{-2}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	2.8×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.0×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	1.8×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	2.4×10^{-8}
Total Receptor ILCR =	2.6×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-5
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: LIME SLUDGE POND WITH FEDERAL OWNERSHIP, ALTERNATIVE 3, OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.1×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	3.4×10^{-4}
Ingestion of Drinking Water (Chemicals)	1.1×10^{-3}
Dermal Contact While Bathing (Chemicals)	6.5×10^{-5}
Total Receptor HI =	1.5×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	4.4×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	7.1×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.7×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.9×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	2.1×10^{-8}
Direct Radiation	
Total Receptor ILCR =	9.3×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-6
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: LIME SLUDGE POND WITH FEDERAL OWNERSHIP, ALTERNATIVE 3, OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	7.7×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.4×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	1.3×10^{-3}
Ingestion of Drinking Water (Chemicals)	2.6×10^{-3}
Dermal Contact While Bathing (Chemicals)	1.0×10^{-4}
Total Receptor HI =	4.1×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.3×10^{-11}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.0×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	8.9×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	7.4×10^{-11}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.5×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	4.6×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-7
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	8.0×10^{-10}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-8}
Ingestion of Vegetables and Fruit (Chemicals)	6.3×10^{-7}
Ingestion of Drinking Water (Chemicals)	2.1×10^{-6}
Dermal Contact While Bathing (Chemicals)	1.2×10^{-7}
Total Receptor HI =	2.9×10^{-6}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	4.7×10^{-9}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.4×10^{-10}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	8.2×10^{-14}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.2×10^{-12}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	5.7×10^{-11}
Direct Radiation	NA
Total Receptor ILCR =	4.9×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-8
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 3, OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.4×10^{-9}
Ingestion of Dairy Products (Chemicals)	1.2×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	2.4×10^{-6}
Ingestion of Drinking Water (Chemicals)	4.9×10^{-6}
Dermal Contact While Bathing (Chemicals)	2.0×10^{-7}
Total Receptor HI =	7.6×10^{-6}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.4×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.8×10^{-12}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.7×10^{-15}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	2.2×10^{-13}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	4.0×10^{-12}
Direct Radiation	NA
Total Receptor ILCR =	2.5×10^{-10}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-9
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 3, PERCHED GROUNDWATER USER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.1×10^{-8}
Ingestion of Dairy Products (Chemicals)	3.0×10^{7}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-5}
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	1.7×10^{-5}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.3×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	5.8×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.6×10^{-8}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.7×10^{-6}
Direct Radiation	9.9×10^{-7}
Total Receptor ILCR =	4.6×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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No. 97

TABLE C.7-10
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
ON-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.1×10^{-8}
Ingestion of Dairy Products (Chemicals)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-5}
Ingestion of Drinking Water (Chemicals)	5.5×10^{-5}
Dermal Contact While Bathing (Chemicals)	3.2×10^{-6}
Total Receptor HI =	7.5×10^{-5}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.3×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	5.8×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.5×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.6×10^{-8}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.7×10^{-6}
Direct Radiation	9.9×10^{-7}
Total Receptor ILCR =	3.4×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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No. 97

TABLE C.7-11
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 3, ON-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.7×10^{-8}
Ingestion of Dairy Products (Chemicals)	3.1×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	6.3×10^{-5}
Ingestion of Drinking Water (Chemicals)	1.3×10^{-4}
Dermal Contact While Bathing (Chemicals)	5.1×10^{-6}
Total Receptor HI =	2.0×10^{-4}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	5.5×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.5×10^{-10}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	5.3×10^{-10}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	5.8×10^{-8}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.2×10^{-7}
Direct Radiation	7.4×10^{-8}
Total Receptor ILCR =	2.7×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-12
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: LIME SLUDGE POND WITH FEDERAL OWNERSHIP, ALTERNATIVE 6, EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	3.9×10^{-4}
Dermal Contact with Residual Soils (Chemicals)	2.8×10^{-2}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	2.8×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.0×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	1.8×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	2.4×10^{-8}
Total Receptor ILCR =	2.6×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-13
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
LIME SLUDGE POND WITH FEDERAL OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.1×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	3.4×10^{-4}
Ingestion of Drinking Water (Chemicals)	1.1×10^{-3}
Dermal Contact While Bathing (Chemicals)	6.5×10^{-5}
Total Receptor HI =	1.5×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	4.4×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	7.1×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.7×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.9×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	2.1×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	9.3×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-14
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
LIME SLUDGE POND WITH FEDERAL OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	7.7×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.4×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	1.3×10^{-3}
Ingestion of Drinking Water (Chemicals)	2.6×10^{-3}
Dermal Contact While Bathing (Chemicals)	1.0×10^{-4}
Total Receptor HI =	4.1×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.3×10^{-11}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.0×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	8.9×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	7.4×10^{-11}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.5×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	4.6×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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No. 97

TABLE C.7-15
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	8.0×10^{-10}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-8}
Ingestion of Vegetables and Fruit (Chemicals)	6.3×10^{-7}
Ingestion of Drinking Water (Chemicals)	2.1×10^{-6}
Dermal Contact While Bathing (Chemicals)	1.2×10^{-7}
Total Receptor HI =	2.9×10^{-6}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	4.7×10^{-9}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.4×10^{-10}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	8.2×10^{-14}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.2×10^{-12}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	5.7×10^{-11}
Direct Radiation	NA
Total Receptor ILCR =	4.9×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-16
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.4×10^{-9}
Ingestion of Dairy Products (Chemicals)	1.2×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	2.4×10^{-6}
Ingestion of Drinking Water (Chemicals)	4.9×10^{-6}
Dermal Contact While Bathing (Chemicals)	2.0×10^{-7}
Total Receptor HI =	7.6×10^{-6}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.4×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.8×10^{-12}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.7×10^{-15}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	2.2×10^{-13}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	4.0×10^{-12}
Direct Radiation	NA
Total Receptor ILCR =	2.5×10^{-10}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000274

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TABLE C.7-17
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
PERCHED GROUNDWATER USER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.1×10^{-8}
Ingestion of Dairy Products (Chemicals)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-5}
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	1.7×10^{-5}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.3×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	5.8×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.6×10^{-8}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.7×10^{-6}
Direct Radiation	9.9×10^{-7}
Total Receptor ILCR =	4.6×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-18
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
ON-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.1×10^{-8}
Ingestion of Dairy Products (Chemicals)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-5}
Ingestion of Drinking Water (Chemicals)	5.5×10^{-5}
Dermal Contact While Bathing (Chemicals)	3.2×10^{-6}
Total Receptor HI =	7.5×10^{-5}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.3×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	5.8×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.5×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.6×10^{-8}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.7×10^{-6}
Direct Radiation	9.9×10^{-7}
Total Receptor ILCR =	3.4×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000276

No. 97

TABLE C.7-19
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
ON-PROPERTY FARMER (CHILD)

Exposure Pathway	**Pathway HI**
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.7×10^{-8}
Ingestion of Dairy Products (Chemicals)	3.1×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	6.3×10^{-5}
Ingestion of Drinking Water (Chemicals)	1.3×10^{-4}
Dermal Contact While Bathing (Chemicals)	5.1×10^{-6}
Total Receptor HI =	2.0×10^{-4}

Exposure Pathway	**Pathway ILCR**
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	5.5×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.5×10^{-10}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	5.3×10^{-10}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	5.8×10^{-8}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.2×10^{-7}
Direct Radiation	7.4×10^{-7}
Total Receptor ILCR =	2.7×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000277

No. 97

TABLE C.7-20
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 2, EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	NA

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.0×10^{-14}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	NA
Total Receptor ILCR =	1.0×10^{-14}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000278

No. 97

TABLE C.7-21
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP,
ALTERNATIVE 2, OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	6.9×10^{-9}
Ingestion of Dairy Products (Chemicals)	9.9×10^{-8}
Ingestion of Vegetables and Fruit (Chemicals)	5.5×10^{-6}
Ingestion of Drinking Water (Chemicals)	1.8×10^{-5}
Dermal Contact While Bathing (Chemicals)	1.1×10^{-6}
Total Receptor HI =	2.5×10^{-5}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	4.2×10^{-14}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.8×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	6.8×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	9.6×10^{-12}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	5.3×10^{-10}
Direct Radiation	NA
Total Receptor ILCR =	2.3×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

No. 97

TABLE C.7-22
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 2,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.2×10^{-8}
Ingestion of Dairy Products (Chemicals)	1.0×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	2.1×10^{-5}
Ingestion of Drinking Water (Chemicals)	4.3×10^{-5}
Dermal Contact While Bathing (Chemicals)	1.7×10^{-6}
Total Receptor HI =	6.6×10^{-5}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.2×10^{-15}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	7.6×10^{-11}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.2×10^{-14}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.9×10^{-12}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	3.7×10^{-11}
Direct Radiation	NA
Total Receptor ILCR =	1.2×10^{-10}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000280

No. 97

TABLE C.7-23
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 3, EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	5.2×10^{-4}
Dermal Contact with Residual Soils (Chemicals)	2.0×10^{-2}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	2.0×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	3.1×10^{-11}
Inhalation of Particulates (Radionuclides)	8.8×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	9.2×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	6.4×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	1.7×10^{-7}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	1.3×10^{-7}
Total Receptor ILCR =	4.0×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000281

TABLE C.7-24

No. 97 SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.4×10^{-6}
Ingestion of Dairy Products (Chemicals)	3.4×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	1.9×10^{-3}
Ingestion of Drinking Water (Chemicals)	6.3×10^{-3}
Dermal Contact While Bathing (Chemicals)	3.6×10^{-4}
Total Receptor HI =	8.6×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	9.0×10^{-11}
Inhalation of Particulates (Radionuclides)	3.6×10^{-9}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	4.0×10^{-7}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.6×10^{-10}
Ingestion of Meat (Radionuclides)	1.5×10^{-10}
Ingestion of Dairy Products (Chemicals)	4.3×10^{-10}
Ingestion of Dairy Products (Radionuclides)	2.2×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	5.3×10^{-10}
Ingestion of Vegetables and Fruit (Radionuclides)	1.2×10^{-7}
Direct Radiation	NA
Total Receptor ILCR =	5.3×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000282

No. 97

TABLE C.7-25
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 3, OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-6}
Ingestion of Dairy Products (Chemicals)	3.6×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	7.2×10^{-3}
Ingestion of Drinking Water (Chemicals)	1.5×10^{-2}
Dermal Contact While Bathing (Chemicals)	5.9×10^{-4}
Total Receptor HI =	2.3×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	2.2×10^{-11}
Inhalation of Particulates (Radionuclides)	1.9×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.7×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	5.6×10^{-11}
Ingestion of Meat (Radionuclides)	5.0×10^{-12}
Ingestion of Dairy Products (Chemicals)	3.9×10^{-10}
Ingestion of Dairy Products (Radionuclides)	4.2×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	1.8×10^{-10}
Ingestion of Vegetables and Fruit (Radionuclides)	8.4×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	2.7×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000283

TABLE C.7-26

No. 97 SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.2×10^{-7}
Ingestion of Dairy Products (Chemicals)	1.0×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	1.3×10^{-5}
Ingestion of Drinking Water (Chemicals)	2.5×10^{-5}
Dermal Contact While Bathing (Chemicals)	1.4×10^{-6}
Total Receptor HI =	1.4×10^{-4}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	2.1×10^{-12}
Inhalation of Particulates (Radionuclides)	1.4×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.5×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.3×10^{-11}
Ingestion of Meat (Radionuclides)	6.9×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.5×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-11}
Ingestion of Vegetables and Fruit (Radionuclides)	6.2×10^{-19}
Direct Radiation	NA
Total Receptor ILCR =	2.2×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000284

6351

TABLE C.7-27

No. 97 SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 3, OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	5.8×10^{-7}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	5.0×10^{-5}
Ingestion of Drinking Water (Chemicals)	5.8×10^{-5}
Dermal Contact While Bathing (Chemicals)	2.3×10^{-6}
Total Receptor HI =	1.2×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	5.1×10^{-13}
Inhalation of Particulates (Radionuclides)	7.1×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	6.6×10^{-11}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.6×10^{-12}
Ingestion of Meat (Radionuclides)	2.3×10^{-14}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.3×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	5.1×10^{-12}
Ingestion of Vegetables and Fruit (Radionuclides)	4.4×10^{-11}
Direct Radiation	NA
Total Receptor ILCR =	2.1×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000285

No. 97

TABLE C.7-28
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
PERCHED GROUNDWATER USER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	8.2×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.7×10^{-2}
Ingestion of Meat (Chemicals)	6.9×10^{-3}
Ingestion of Dairy Products (Chemicals)	3.4×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	1.7×10^{-1}
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	2.0×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	7.7×10^{-11}
Inhalation of Particulates (Radionuclides)	5.0×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	2.7×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	2.9×10^{-7}
Dermal Contact with Residual Soils (Chemicals)	3.4×10^{-9}
Ingestion of Drinking Water (Chemicals)	2.6×10^{-7}
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	8.2×10^{-9}
Ingestion of Meat (Chemicals)	3.9×10^{-7}
Ingestion of Meat (Radionuclides)	1.5×10^{-9}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.4×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	2.9×10^{-7}
Ingestion of Vegetables and Fruit (Radionuclides)	4.2×10^{-7}
Direct Radiation	7.7×10^{-7}
Total Receptor ILCR =	4.8×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000286

No. 97

TABLE C.7-29
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
ON-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	8.2×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.7×10^{-2}
Ingestion of Meat (Chemicals)	6.9×10^{-3}
Ingestion of Dairy Products (Chemicals)	3.4×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	1.7×10^{-1}
Ingestion of Drinking Water (Chemicals)	7.3×10^{-4}
Dermal Contact While Bathing (Chemicals)	4.2×10^{-5}
Total Receptor HI =	2.0×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	7.7×10^{-11}
Inhalation of Particulates (Radionuclides)	5.0×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	2.7×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	2.9×10^{-7}
Dermal Contact with Residual Soils (Chemicals)	3.4×10^{-9}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	4.5×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.9×10^{-7}
Ingestion of Meat (Radionuclides)	1.5×10^{-9}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.4×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	2.9×10^{-7}
Ingestion of Vegetables and Fruit (Radionuclides)	4.2×10^{-7}
Direct Radiation	7.7×10^{-7}
Total Receptor ILCR =	3.4×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000287

No. 97

TABLE C.7-30
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
ON-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	4.3×10^{-2}
Dermal Contact with Residual Soils (Chemicals)	2.8×10^{-2}
Ingestion of Meat (Chemicals)	1.2×10^{-2}
Ingestion of Dairy Products (Chemicals)	3.6×10^{-2}
Ingestion of Vegetables and Fruit (Chemicals)	6.4×10^{-1}
Ingestion of Drinking Water (Chemicals)	1.7×10^{-3}
Dermal Contact While Bathing (Chemicals)	6.8×10^{-5}
Total Receptor HI =	7.6×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	1.8×10^{-11}
Inhalation of Particulates (Radionuclides)	2.6×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	1.2×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	2.7×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	4.7×10^{-10}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.9×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	6.0×10^{-8}
Ingestion of Meat (Radionuclides)	5.0×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.2×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	9.5×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	2.9×10^{-8}
Direct Radiation	5.8×10^{-8}
Total Receptor ILCR =	4.3×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000238

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TABLE C.7-31
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 6, EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	5.2×10^{-4}
Dermal Contact with Residual Soils (Chemicals)	2.0×10^{-2}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	2.0×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	3.1×10^{-11}
Inhalation of Particulates (Radionuclides)	8.8×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	9.2×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	6.4×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	1.7×10^{-7}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	1.3×10^{-7}
Total Receptor ILCR =	4.0×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000289

No. 97

TABLE C.7-32
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 6, OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.4×10^{-6}
Ingestion of Dairy Products (Chemicals)	3.4×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	1.9×10^{-3}
Ingestion of Drinking Water (Chemicals)	6.3×10^{-3}
Dermal Contact While Bathing (Chemicals)	3.6×10^{-4}
Total Receptor HI =	8.6×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	9.0×10^{-11}
Inhalation of Particulates (Radionuclides)	3.6×10^{-9}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	4.0×10^{-7}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.6×10^{-10}
Ingestion of Meat (Radionuclides)	1.5×10^{-10}
Ingestion of Dairy Products (Chemicals)	4.3×10^{-10}
Ingestion of Dairy Products (Radionuclides)	2.2×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	5.3×10^{-10}
Ingestion of Vegetables and Fruit (Radionuclides)	1.2×10^{-7}
Direct Radiation	NA
Total Receptor ILCR =	5.3×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000290

6351

No. 97

TABLE C.7-33
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 6, OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-6}
Ingestion of Dairy Products (Chemicals)	3.6×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	7.2×10^{-3}
Ingestion of Drinking Water (Chemicals)	1.5×10^{-2}
Dermal Contact While Bathing (Chemicals)	5.9×10^{-4}
Total Receptor HI =	2.3×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	2.2×10^{-11}
Inhalation of Particulates (Radionuclides)	1.9×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.7×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	5.6×10^{-11}
Ingestion of Meat (Radionuclides)	5.0×10^{-12}
Ingestion of Dairy Products (Chemicals)	3.9×10^{-10}
Ingestion of Dairy Products (Radionuclides)	4.2×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	1.8×10^{-10}
Ingestion of Vegetables and Fruit (Radionuclides)	8.4×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	2.7×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000231

No. 97

TABLE C.7-34
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.2×10^{-7}
Ingestion of Dairy Products (Chemicals)	1.0×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	1.3×10^{-5}
Ingestion of Drinking Water (Chemicals)	2.5×10^{-5}
Dermal Contact While Bathing (Chemicals)	1.4×10^{-6}
Total Receptor HI =	1.4×10^{-4}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	2.1×10^{-12}
Inhalation of Particulates (Radionuclides)	1.4×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.5×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.3×10^{-11}
Ingestion of Meat (Radionuclides)	6.9×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.5×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-11}
Ingestion of Vegetables and Fruit (Radionuclides)	6.2×10^{-10}
Direct Radiation	NA
Total Receptor ILCR =	2.2×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000292

No. 97

TABLE C.7-35
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	5.8×10^{-7}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	5.0×10^{-5}
Ingestion of Drinking Water (Chemicals)	5.8×10^{-5}
Dermal Contact While Bathing (Chemicals)	2.3×10^{-6}
Total Receptor HI =	1.2×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	5.1×10^{-13}
Inhalation of Particulates (Radionuclides)	7.1×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	6.6×10^{-11}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.6×10^{-12}
Ingestion of Meat (Radionuclides)	2.3×10^{-14}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.3×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	5.1×10^{-12}
Ingestion of Vegetables and Fruit (Radionuclides)	4.4×10^{-11}
Direct Radiation	NA
Total Receptor ILCR =	2.1×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000293

TABLE C.7-36
No. 97 SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
PERCHED GROUNDWATER USER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Résidual Soils (Chemicals)	8.2×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.7×10^{-2}
Ingestion of Meat (Chemicals)	6.9×10^{-3}
Ingestion of Dairy Products (Chemicals)	3.4×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	1.7×10^{-1}
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	2.0×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	7.7×10^{-11}
Inhalation of Particulates (Radionuclides)	5.0×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	2.7×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	2.9×10^{-7}
Dermal Contact with Residual Soils (Chemicals)	3.4×10^{-7}
Ingestion of Drinking Water (Chemicals)	2.6×10^{-7}
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	8.2×10^{-9}
Ingestion of Meat (Chemicals)	3.9×10^{-7}
Ingestion of Meat (Radionuclides)	1.5×10^{-9}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.4×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	2.9×10^{-7}
Ingestion of Vegetables and Fruit (Radionuclides)	4.2×10^{-7}
Direct Radiation	7.7×10^{-7}
Total Receptor ILCR =	4.8×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000294

No. 97

TABLE C.7-37
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 6
ON-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	8.2×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.7×10^{-2}
Ingestion of Meat (Chemicals)	6.9×10^{-3}
Ingestion of Dairy Products (Chemicals)	3.4×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	1.7×10^{-1}
Ingestion of Drinking Water (Chemicals)	7.3×10^{-4}
Dermal Contact While Bathing (Chemicals)	4.2×10^{-5}
Total Receptor HI =	2.0×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	7.7×10^{-11}
Inhalation of Particulates (Radionuclides)	5.0×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	2.7×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	2.9×10^{-7}
Dermal Contact with Residual Soils (Chemicals)	3.4×10^{-9}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	4.5×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.9×10^{-7}
Ingestion of Meat (Radionuclides)	1.5×10^{-9}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.4×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	2.9×10^{-7}
Ingestion of Vegetables and Fruit (Radionuclides)	4.2×10^{-7}
Direct Radiation	7.7×10^{-7}
Total Receptor ILCR =	3.4×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000295

No. 97

TABLE C.7-38
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 6 ON-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	4.3×10^{-2}
Dermal Contact with Residual Soils (Chemicals)	2.8×10^{-2}
Ingestion of Meat (Chemicals)	1.2×10^{-2}
Ingestion of Dairy Products (Chemicals)	3.6×10^{-2}
Ingestion of Vegetables and Fruit (Chemicals)	6.4×10^{-1}
Ingestion of Drinking Water (Chemicals)	1.7×10^{-3}
Dermal Contact While Bathing (Chemicals)	6.8×10^{-5}
Total Receptor HI =	7.6×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	1.8×10^{-11}
Inhalation of Particulates (Radionuclides)	2.6×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	1.2×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	2.7×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	4.7×10^{-10}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.9×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	6.0×10^{-8}
Ingestion of Meat (Radionuclides)	5.0×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.2×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	9.5×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	2.9×10^{-8}
Direct Radiation	5.8×10^{-8}
Total Receptor ILCR =	4.3×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000296

No. 97

TABLE C.7-39
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 2, EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	2.9×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.3×10^{-1}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	1.3×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	2.5×10^{-9}
Inhalation of Particulates (Radionuclides)	5.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	1.5×10^{-7}
Incidental Ingestion of Residual Soils (Radionuclides)	1.4×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	2.0×10^{-7}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	8.2×10^{-7}
Total Receptor ILCR =	1.2×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000297

No. 97

TABLE C.7-40
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 2, OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.2×10^{-5}
Ingestion of Dairy Products (Chemicals)	7.7×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	4.1×10^{-3}
Ingestion of Drinking Water (Chemicals)	1.4×10^{-2}
Dermal Contact While Bathing (Chemicals)	7.8×10^{-4}
Total Receptor HI =	1.8×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	1.2×10^{-8}
Inhalation of Particulates (Radionuclides)	4.3×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	8.6×10^{-7}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-9}
Ingestion of Meat (Radionuclides)	3.5×10^{-10}
Ingestion of Dairy Products (Chemicals)	1.0×10^{-9}
Ingestion of Dairy Products (Radionuclides)	4.9×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	3.1×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	2.6×10^{-7}
Direct Radiation	NA
Total Receptor ILCR =	1.6×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000298

No. 97

TABLE C.7-41
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 2, OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.2×10^{-5}
Ingestion of Dairy Products (Chemicals)	8.1×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-2}
Ingestion of Drinking Water (Chemicals)	3.2×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.3×10^{-3}
Total Receptor HI =	4.9×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	2.9×10^{-9}
Inhalation of Particulates (Radionuclides)	2.2×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.7×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	6.6×10^{-10}
Ingestion of Meat (Radionuclides)	1.1×10^{-11}
Ingestion of Dairy Products (Chemicals)	9.2×10^{-10}
Ingestion of Dairy Products (Radionuclides)	9.4×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	1.0×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	1.8×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	9.3×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000299

6351

No. 97

TABLE C.7-42
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 3, EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	1.1×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.2×10^{-2}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	1.3×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	3.5×10^{-9}
Inhalation of Particulates (Radionuclides)	5.9×19^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	2.3×10^{-7}
Incidental Ingestion of Residual Soils (Radionuclides)	1.2×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	9.5×10^{-7}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	MA
Ingestion of Meat (Radionuclides)	MA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	1.2×10^{-6}
Total Receptor ILCR =	2.5×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000300

6351

No. 97

TABLE C.7-43
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.8×10^{-5}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	6.0×10^{-3}
Ingestion of Drinking Water (Chemicals)	2.0×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.1×10^{-3}
Total Receptor HI =	2.7×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	1.9×10^{-8}
Inhalation of Particulates (Radionuclides)	4.5×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.3×10^{-8}
Ingestion of Meat (Radionuclides)	5.0×10^{-10}
Ingestion of Dairy Products (Chemicals)	3.5×10^{-8}
Ingestion of Dairy Products (Radionuclides)	$7.0 \text{ X } 10^{-9}$
Ingestion of Vegetables and Fruit (Chemicals)	5.9×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	$3.7 \text{ X } 10^{-7}$
Direct Radiation	NA
Total Receptor ILCR =	2.2×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-44
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 3, OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.2×10^{-5}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	2.3×10^{-2}
Ingestion of Drinking Water (Chemicals)	4.6×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.8×10^{-3}
Total Receptor HI =	7.2×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	4.6×10^{-9}
Inhalation of Particulates (Radionuclides)	2.3×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.3×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-9}
Ingestion of Meat (Radionuclides)	1.6×10^{-11}
Ingestion of Dairy Products (Chemicals)	2.6×10^{-8}
Ingestion of Dairy Products (Radionuclides)	1.4×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	1.8×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	2.6×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	1.6×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000302

No. 97

TABLE C.7-45
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.4×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.0×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	2.9×10^{-4}
Ingestion of Drinking Water (Chemicals)	9.4×10^{-4}
Dermal Contact While Bathing (Chemicals)	5.4×10^{-5}
Total Receptor HI =	1.3×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	6.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.9×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.5×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.6×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.8×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	1.4×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000303

6351

No. 97

TABLE C.7-46
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	7.8×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.3×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	1.1×10^{-3}
Ingestion of Drinking Water (Chemicals)	2.2×10^{-3}
Dermal Contact While Bathing (Chemicals)	8.8×10^{-5}
Total Receptor HI =	3.5×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.4×10^{-9}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	2.5×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	8.4×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.9×10^{-11}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.3×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	7.3×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000304

No. 97

TABLE C.7-47
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 3, ON-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	6.5×10^{-4}
Dermal Contact with Residual Soils (Chemicals)	4.2×10^{-3}
Ingestion of Meat (Chemicals)	5.4×10^{-5}
Ingestion of Dairy Products (Chemicals)	6.5×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	5.5×10^{-3}
Ingestion of Drinking Water (Chemicals)	5.5×10^{-3}
Dermal Contact While Bathing (Chemicals)	3.2×10^{-4}
Total Receptor HI =	1.7×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.3×10^{-6}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	2.8×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.5×10^{-7}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	3.3×10^{-8}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.4×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	3.7×10^{-6}
Direct Radiation	3.4×10^{-7}
Total Receptor ILCR =	6.4×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

6357

No. 97

TABLE C.7-48
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
ON-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	3.4×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	6.8×10^{-3}
Ingestion of Meat (Chemicals)	9.8×10^{-5}
Ingestion of Dairy Products (Chemicals)	6.8×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	2.1×10^{-2}
Ingestion of Drinking Water (Chemicals)	1.3×10^{-2}
Dermal Contact While Bathing (Chemicals)	5.2×10^{-4}
Total Receptor HI =	5.2×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	6.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	2.7×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.5×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.1×10^{-9}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.2×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	2.6×10^{-7}
Direct Radiation	2.5×10^{-8}
Total Receptor ILCR =	4.9×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000306

No. 97

TABLE C.7-49
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 6, EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	1.1×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.2×10^{-2}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	1.3×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	3.5×10^{-9}
Inhalation of Particulates (Radionuclides)	5.9×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	2.3×10^{-7}
Incidental Ingestion of Residual Soils (Radionuclides)	1.2×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	9.5×10^{-7}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	MA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	1.2×10^{-6}
Total Receptor ILCR =	2.5×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000307

No. 97

TABLE C.7-50
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.8×10^{-5}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	6.0×10^{-3}
Ingestion of Drinking Water (Chemicals)	2.0×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.1×10^{-3}
Total Receptor HI =	2.7×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	1.9×10^{-8}
Inhalation of Particulates (Radionuclides)	4.5×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.3×10^{-8}
Ingestion of Meat (Radionuclides)	5.0×10^{-10}
Ingestion of Dairy Products (Chemicals)	3.5×10^{-8}
Ingestion of Dairy Products (Radionuclides)	7.0×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	5.9×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	3.7×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	2.2×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000308

No. 97

TABLE C.7-51
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 6, OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.2×10^{-5}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	2.3×10^{-2}
Ingestion of Drinking Water (Chemicals)	4.6×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.8×10^{-3}
Total Receptor HI =	7.2×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	4.6×10^{-9}
Inhalation of Particulates (Radionuclides)	2.3×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.3×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-9}
Ingestion of Meat (Radionuclides)	1.6×10^{-11}
Ingestion of Dairy Products (Chemicals)	2.6×10^{-8}
Ingestion of Dairy Products (Radionuclides)	1.4×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	1.8×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	2.6×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	1.6×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000309

No. 97

TABLE C.7-52
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 6, OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.4×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.0×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	2.9×10^{-4}
Ingestion of Drinking Water (Chemicals)	9.4×10^{-4}
Dermal Contact While Bathing (Chemicals)	5.4×10^{-5}
Total Receptor HI =	1.3×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	6.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.9×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.5×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.6×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.8×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	1.4×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

No. 97

TABLE C.7-53
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	7.8×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.3×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	1.1×10^{-3}
Ingestion of Drinking Water (Chemicals)	2.2×10^{-3}
Dermal Contact While Bathing (Chemicals)	8.8×10^{-5}
Total Receptor HI =	3.5×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.4×10^{-9}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	2.5×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	8.4×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.9×10^{-11}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.3×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	7.3×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000311

No. 97

TABLE C.7-54
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
ON-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	6.5×10^{-4}
Dermal Contact with Residual Soils (Chemicals)	4.2×10^{-3}
Ingestion of Meat (Chemicals)	5.4×10^{-5}
Ingestion of Dairy Products (Chemicals)	6.5×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	5.5×10^{-3}
Ingestion of Drinking Water (Chemicals)	5.5×10^{-3}
Dermal Contact While Bathing (Chemicals)	3.2×10^{-4}
Total Receptor HI =	1.7×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.3×10^{-6}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	2.8×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.5×10^{-7}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	3.3×10^{-8}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.4×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	3.7×10^{-6}
Direct Radiation	3.4×10^{-7}
Total Receptor ILCR =	6.4×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000312

TABLE C.7-55
No. 97 SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
ON-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	3.4×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	6.8×10^{-3}
Ingestion of Meat (Chemicals)	9.8×10^{-5}
Ingestion of Dairy Products (Chemicals)	6.8×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	2.1×10^{-2}
Ingestion of Drinking Water (Chemicals)	1.3×10^{-2}
Dermal Contact While Bathing (Chemicals)	5.2×10^{-4}
Total Receptor HI =	5.2×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	6.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	2.7×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.5×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.1×10^{-9}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.2×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	2.6×10^{-7}
Direct Radiation	2.5×10^{-8}
Total Receptor ILCR =	4.9×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000313

No. 97

TABLE C.7-56
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: DISPOSAL CELL WITH FEDERAL OWNERSHIP*, ALTERNATIVE 6, EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	NA

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.4×10^{-13}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	NA
Total Receptor ILCR =	1.4×10^{-13}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

* Assumes federal ownership of FEMP, with federal ownership of disposal cell.

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TABLE C.7-57
No. 97 **SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: DISPOSAL CELL WITH FEDERAL OWNERSHIP*, ALTERNATIVE 6, OFF-PROPERTY FARMER (ADULT)**

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	7.2×10^{-6}
Ingestion of Dairy Products (Chemicals)	1.0×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	5.7×10^{-3}
Ingestion of Drinking Water (Chemicals)	1.9×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.1×10^{-3}
Total Receptor HI =	2.6×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	7.7×10^{-12}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	4.6×10^{-10}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.5×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	3.6×10^{-7}
Direct Radiation	NA
Total Receptor ILCR =	1.6×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

* Assumes federal ownership of FEMP, with federal ownership of disposal cell.

000315

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No. 97

TABLE C.7-58
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: DISPOSAL CELL WITH FEDERAL OWNERSHIP*, ALTERNATIVE 6, OFF-PROPERTY (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.3×10^{-5}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	2.2×10^{-2}
Ingestion of Drinking Water (Chemicals)	4.4×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.8×10^{-3}
Total Receptor HI =	6.9×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.9×10^{-13}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.2×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.5×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.3×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	2.5×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	7.8×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

* Assumes federal ownership of FEMP, with federal ownership of disposal cell.

000316

No. 97

TABLE C.7-59
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
DISPOSAL CELL WITH PRIVATE OWNERSHIP*, ALTERNATIVE 6,
EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	NA

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	7.3×10^{-14}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	
Total Receptor ILCR =	7.3×10^{-14}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

* Assumes private ownership of FEMP, with federal ownership of disposal cell.

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No. 97

TABLE C.7-60
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS:
DISPOSAL CELL WITH PRIVATE OWNERSHIP*, ALTERNATIVE 6,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	7.2×10^{-6}
Ingestion of Dairy Products (Chemicals)	1.0×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	5.7×10^{-3}
Ingestion of Drinking Water (Chemicals)	1.9×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.1×10^{-3}
Total Receptor HI =	2.6×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	4.0×10^{-12}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	4.6×10^{-10}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.5×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	3.6×10^{-7}
Direct Radiation	NA
Total Receptor ILCR =	1.6×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

* Assumes private ownership of FEMP, with federal ownership of disposal cell.

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No. 97

TABLE C.7-61
SUMMARY OF POTENTIAL ~~HEALTH EFFECTS~~RESIDUAL RISKS: DISPOSAL CELL WITH PRIVATE OWNERSHIP*, ALTERNATIVE 6, OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.3×10^{-5}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	2.2×10^{-2}
Ingestion of Drinking Water (Chemicals)	4.4×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.8×10^{-3}
Total Receptor HI =	6.9×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.0×10^{-13}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.2×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.5×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.3×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	2.5×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	7.8×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

* Assumes private ownership of FEMP with federal ownership of disposal cell.

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C.8.1 COC SELECTION

A major concern of this FS risk assessment is the reliability of COC identification, both in terms of ensuring that all chemicals or radionuclides have been correctly identified as COCs and that their potential concentrations are adequately quantified. The accuracy of COC identification is directly related to the quality of COC characterization data, including information on contaminant identification, location, and concentrations. Characterization was controlled by the CERCLA sampling and analysis plan, which identified sampling locations and analytical protocols.

The source of COC data for this risk assessment was the Operable Unit 2 RI report (DOE 1994a), particularly the baseline risk assessment. The RI report was prepared according to CERCLA guidelines, and the data were validated. Whenever possible, COC identification was based on risk results in the baseline risk assessment from data collected according to the CERCLA sampling plan. However, uncertainty is inherently high in the Solid Waste Landfill data due to the heterogeneity of the waste forms. Uncertainty of soil data is inherently higher than groundwater data because soils are heterogeneous.

It is unlikely that major COC contributors to risk for Operable Unit 2 have been overlooked. Any shortcomings in the chemical data that have been gathered at the FEMP site are compensated for by a large database of contaminant type and concentration data. Evaluation of these data have identified a large number of COCs which are present in Operable Unit 2 wastes and associated materials, and confirm general contamination patterns indicated by past site operations. There is a high degree of certainty that the major COCs (uranium and other radionuclides, arsenic and other metals, and organics) which could credibly contribute to site risks have been identified.

According to RAGS (EPA 1989a), the UCLs are used for all exposure concentrations. This means that 95 percent of the time, the actual mean concentration can be less than the value used in the exposure assessment. Conversely, 5 percent of the time the actual mean concentration can be greater than the value used in the exposure assessment.

No. 77 Uncertainty in Laboratory Detection Limits

The use of Contract Required Detection Limits (CRDL) and Contract Detection Limits (CDL), instead of Sample Quantitation Limits (SQL) and Minimum Detectable Activities (MDA), can cause the following uncertainties:

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- One half the CRDL/CDL could be as much as an order of magnitude greater than one half the SQL/MDA. This may affect the statistical distribution (normal or lognormal) causing a potential for overestimation or underestimation of the concentration term (and the risk). This could affect the estimated risk by up to an order of magnitude.

- High detection limits could mask the existence of contaminants present at low levels. When non-parametric tests are performed on a data set, the ranking methodology lists the detections above the non-detects even if the numerical value of the detection limit is higher. The potential exists for a non-detected result to actually have a concentration higher than the detected values in the ranking and thus results in an underestimate of the risk by up to an order of magnitude. However, this potential is low as shown by the fact that laboratories could and did report detected values at levels well below the CRDL.

The statistical analysis reported in Appendix A contains these uncertainties. However, the remedial alternatives remove a significant portion of the COCs through remediation and post remedial concentrations will be lower than those currently present. All constituents, except for a few COCs (for example, see Table C.II-1) will be reduced to background concentrations. An assessment of the COCs remaining after remediation indicates that these data sets contain relatively few non-detects, and this will limit the impact of the above uncertainties on the residual risk assessment. The majority of risk comes from uranium, radium, and thorium, and these contaminants have relatively few non-detects. The overall impact of these uncertainties on the residual risk assessment is considered to be less than an order of magnitude.

REMEDIAL ACTION RISKS*

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE	2. INACTIVE FLYASH PILE**	3. SOUTH FIELD**	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL
1 NO ACTION	ILCR					
	HI					
	PI/F					
	p-rem					
2 CONSOLIDATION AND CAPPING	ILCR	$2.09x10^{-5}$	$2.7x10^{-5}$	$2.7x10^{-5}$	$3.7x10^{-6}$	$1.6x10^{-5}$
	HI	$2.9x10^{-4}$	$3.4x10^{-3}$	$3.4x10^{-3}$	$1.3x10^{-3}$	$2.3x10^{-3}$
	PI/F	$1.77/2.6x10^{-2}$	$1.27/1.9x10^{-2}$	$0.38/5.5x10^{-3}$	$0.14/2.0x10^{-3}$	$0.41/6.0x10^{-3}$
	p-rem					
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	$5.1x10^{-5}$	$2.9x10^{-5}$	$2.9x10^{-5}$	$8.4x10^{-6}$	$2.7x10^{-5}$
	HI	$8.1x10^{-4}$	$8.9x10^{-3}$	$8.9x10^{-3}$	$2.7x10^{-3}$	$4.6x10^{-3}$
	PI/F	$1.4/2.1x10^{-2}$	$1.8/2.6x10^{-2}$	$4.9/7.1x10^{-2}$	$1.4/2.1x10^{-2}$	$1.5/2.2x10^{-2}$
	p-rem					
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	$2.0x10^{-5}$	$3.0x10^{-5}$	$3.0x10^{-5}$	$9.2x10^{-6}$	$9.2x10^{-5}$
	HI	$2.9x10^{-4}$	$3.0x10^{-3}$	$3.0x10^{-3}$	$1.3x10^{-3}$	$3.8x10^{-3}$
	PI/F	$1.2/1.8x10^{-2}$	$2.0/3.0x10^{-2}$	$5.3/7.8x10^{-2}$	$2.4/3.6x10^{-2}$	$0.5/7.0x10^{-3}$
	p-rem					

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC =INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

[shaded box] = NOT APPLICABLE

* For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

** For remedial action risks, these subunits are modeled as one combined subunit, because the soil concentration data presented in the RI is for a combined subunit.

No 98 *Risks calculated assuming no PPE or shielding.

TABLE C.9-1
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
REMEDIAL WORKER

REMEDIAL ACTION RISKS[a]

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE	2. INACTIVE FLYASH PILE**	3. SOUTH FIELD**	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL
1 NO ACTION	ILCR					
	HI					
	PI/F					
	p-rem					
2 CONSOLIDATION AND CAPPING	ILCR	$7.5x10^{-7}$	$1.3x10^{-6}$	$1.3x10^{-6}$	$1.3X10^{-6}$	$1.3x10^{-6}$
	HI	ND	ND	ND	ND	ND
	PI/F					
	p-rem					
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	$2.6x10^{-6}$	$1.6x10^{-6}$	$1.6x10^{-6}$	$3.4x10^{-7}$	$2.1x10^{-6}$
	HI	ND	ND	ND	ND	ND
	PI/F					
	p-rem					
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	$5.3x10^{-7}$	$1.8x10^{-6}$	$1.8x10^{-6}$	$3.4x10^{-7}$	$2.4x10^{-6}$
	HI	ND	ND	ND	ND	ND
	PI/F					
	p-rem					

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

[shaded box] = NOT APPLICABLE

* For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

** For remedial action risks, these subunits are modeled as one combined subunit, because the soil concentration data presented in the RI is for a combined subunit.

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[a]Risks calculated assuming no PPE or shielding.

TABLE C.9-2
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
NONREMEDIAL WORKER

REMEDIAL ACTION RISKS*

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE	2. INACTIVE FLYASH PILE**	3. SOUTH FIELD**	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL
1 NO ACTION	ILCR					
	HI					
	PI/F					
	p-rem					
2 CONSOLIDATION AND CAPPING	ILCR	$5.7X10^{-7}$	$1.0X10^{-6}$	$1.0X10^{-6}$	$4.4X10^{-8}$	$7.4X10^{-7}$
	HI	ND	ND	ND	ND	ND
	PI/F					
	p-rem					
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	2.0×10^{-6}	1.3×10^{-6}	1.3×10^{-6}	1.7×10^{-7}	1.2×10^{-6}
	HI	ND	ND	ND	ND	ND
	PI/F					
	p-rem					
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	4.0×10^{-7}	1.5×10^{-6}	1.5×10^{-6}	1.2×10^{-7}	1.3×10^{-6}
	HI	ND	ND	ND	ND	ND
	PI/F					
	p-rem					

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

* For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

** For remedial action risks, these subunits are modeled as one combined subunit, because the soil concentration data presented in the RI is for a combined subunit.

No. 98 *Risks calculated assuming no PPE or shielding.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

[shaded box] = NOT APPLICABLE

TABLE C.9-7
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
GENERAL PUBLIC

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REMEDIAL ACTION RISKS*

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE	2. INACTIVE FLYASH PILE	3. SOUTH FIELD	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL
1 NO ACTION	ILCR					
	HI					
	PI/F					
	p-rem					
2 CONSOLIDATION AND CAPPING	ILCR					
	HI					
	PI/F					
	p-rem					
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	ND	ND	ND	ND	ND
	HI	ND	ND	ND	ND	ND
	PI/F	$0.13/1.3\times10^{-3}$	$0.18/1.8\times10^{-3}$	$0.59/5.9\times10^{-3}$	$0.14/1.4\times10^{-3}$	$0.18/1.8\times10^{-3}$
	p-rem	3.2×10^{-5}	4.2×10^{-5}	1.4×10^{-4}	3.4×10^{-5}	4.3×10^{-5}
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	ND	ND	ND	ND	ND
	HI	ND	ND	ND	ND	ND
	PI/F		$0.018/1.8\times10^{-4}$	$0.018/1.8\times10^{-4}$		
	p-rem		1.2×10^{-6}	1.1×10^{-7}		

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

(shaded) = NOT APPLICABLE

* For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

5. 98 *Risks calculated assuming no PPE or shielding.

TABLE C.9-11
RISK SUMMARIES FOR OU2 ALTERNATIVES AND SUBUNITS
TRANSPORTATION - RAILWORKERS

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REMEDIAL ACTION RISKS*

REMEDIAL ALTERATIVE	RISK	1. ACTIVE FLYASH PILE	2. INACTIVE FLYASH PILE	3. SOUTH FIELD	4. LIME POND	5. SOLID WASTE LANDFILL
1 NO ACTION	ILCR					
	HI					
	PI/F					
	p-rem					
2 CONSOLIDATION AND CAPPING	ILCR					
	HI					
	PI/F					
	p-rem					
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	ND	ND	ND	ND	ND
	HI	ND	ND	ND	ND	ND
	PI/F	$0.20/5.2 \times 10^{-2}$	$0.26/7.0 \times 10^{-2}$	$0.87/2.3 \times 10^{-1}$	$0.21/5.6 \times 10^{-2}$	$0.26/7.0 \times 10^{-2}$
	p-rem	8.2×10^{3}	1.1×10^{4}	3.6×19^{4}	8.9×10^{3}	1.1×10^{4}
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	ND	ND	ND	ND	ND
	HI	ND	ND	ND	ND	ND
	PI/F	0×10^{0}	6.9×10^{-3}	$0.026/6.9 \times 10^{-3}$		
	p-rem	0×10^{0}	3.0×10^{2}	2.9×10^{1}		

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

[shaded box] = NOT APPLICABLE

- For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

3. 98 *Risks calculated assuming no PPE or shielding.

TABLE C.9-12
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
OFF-PROPERTY PUBLIC RECEPTOR ALONG TRANSPORTATION
ROUTE FEDERAL OWNERSHIP WITH ACCESS CONTROL

TABLE C.9-15

SUMMARY OF GREATEST REMEDIAL ACTION AND RESIDUAL RISKS[a] BY ALTERNATIVE ESTIMATED FOR OPERABLE UNIT 2

RECEPTORS	**REMEDIAL ALTERNATIVES**							
	Alternative 1: No Action		**Alternative 2: Consolidation & Capping**		**Alternative 3: Excavation & Off-Site Disposal**		**Alternative 6: Excavation & On-Site Disposal with Off-Site Disposal of Fraction Exceeding WAC**	
	ILCR	**HI**	**ILCR**	**HI**	**ILCR**	**HI**	**ILCR**	**HI**
	REMEDIAL ACTION RISKS							
Remedial Worker	NA	NA	2.9E-5[d]	3.4E-3[e,f]	5.1E-5[d]	8.9E-3[e,f]	3.0E-5[e,f]	3.8E-3[h]
Nonremedial Worker	NA	NA	1.3E-6[h]	ND	2.6E-6[d]	ND	2.4E-6[h]	ND
General Public	NA	NA	1.0E-6[e,f]	ND	2.0E-6[d]	ND	1.5E-6[e,f]	ND
Transportation-Railworkers	NA	NA	NA	NA	ND	ND	ND	ND
Off-Property Public Along Transportation Route	NA	NA	NA	NA	ND	ND	ND	ND
	RESIDUAL RISKS							
	Federal Ownership							
Off-Property Farmer	8.7E-5[f]	1.2[e]	1.6E-6[i]	1.8E-2[i]	2.2E-6[i]	2.7E-2[i]	2.2E-6[i]	2.7E-2[i]
Off-Property Child	4.2E-6[f]	3.1[f]	9.3E-8[i]	4.9E-2[i]	1.6E-7[i]	7.2E-2[i]	1.6E-7[i]	7.2E-2[i]
Expanded Trespasser	1.4E-4[f]	0.27[h]	1.2E-6[i]	0.13[i]	2.5E-6[i]	2.8E-2[g]	2.5E-6[i]	2.8E-2[g]

TABLE C.9-15
(CONTINUED)

RECEPTORS	REMEDIAL ALTERNATIVES							
	Alternative 1: No Action		Alternative 2: Consolidation & Capping		Alternative 3: Excavation & Off-Site Disposal		Alternative 6: Excavation & On-Site Disposal with Off-Site Disposal of Fraction Exceeding WAC	
	ILCR	HI	ILCR	HI	ILCR	HI	ILCR	HI
	Private Ownership							
Off-Property Farmer	1.1E-4[f]	1.2[e]	NA	NA	1.4E-7[i]	1.3E-3[i]	1.6E-6[j]	2.6E-2[j]
Off-Property Child	1.5E-5[f]	3.1[f]	NA	NA	7.3E-9[i]	3.5E-3[i]	7.8E-8[i]	6.9E-2[j]
On-Property Resident Farmer	3.4E-2[f]	23[f]	NA	NA	6.4E-6[i]	0.2[h]	6.4E-6[i]	0.2[h]
On-Property Resident Child	9.2E-3[f]	65[f]	NA	NA	4.9E-7[i]	0.76[h]	4.9E-7[i]	0.76[h]
Perched Water User	2.8E-3[h]	3.1E-3[g]	NA	NA	4.8E-6[h]	0.2[h]	4.8E-6[h]	0.2[h]

No. 98

[a] The estimated risks and hazards presented in this table represent the greatest risk and hazard calculated for the specified alternative. The subunit which poses the greatest risk and/or hazard is denoted by a footnote. Risks were calculated assuming no PPE or shielding.

[b] Incremental Lifetime Cancer Risk

[c] Hazard Index

[d] Active Flyash Pile

[e] Inactive Flyash Pile

[f] South Field

[g] Lime Sludge Ponds

[h] Solid Waste Landfill

[i] Southern Subunit (AFP/IFP/SF)

[j] Disposal Cell

NA - Not Applicable

ND - Not Determined

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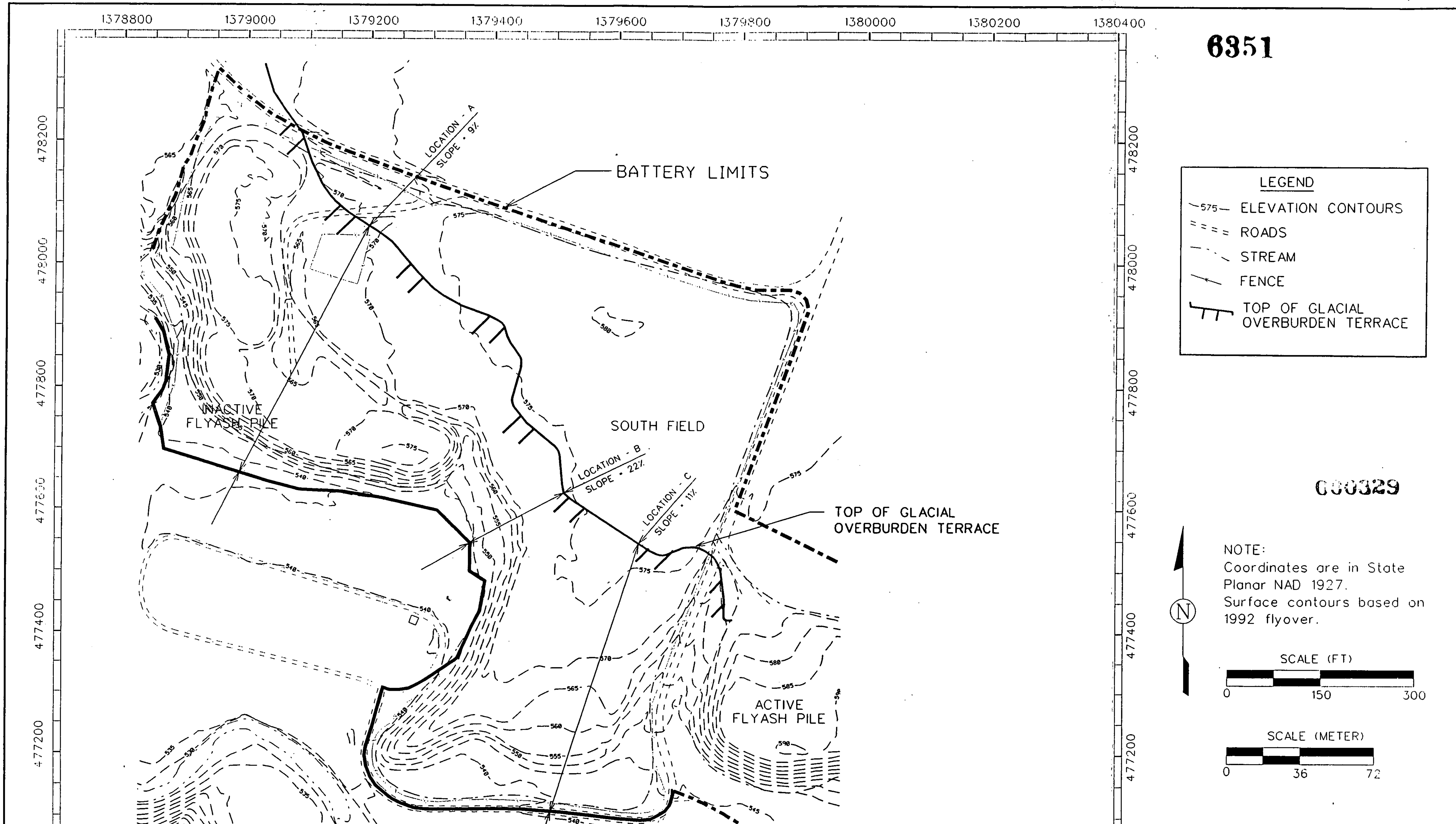
6351

Appendix D

6351



000329

FIGURE D.1-1
SOUTH FIELD LOCATIONS AND SLOPES FOR SOIL EROSION CALCULATIONS

the soils of the subunits of Operable Unit 2. Areas overlying each SWIFT III grid block in all subunits were modeled separately with individual stratigraphy, contaminant concentration, and infiltration rate parameters, and each COC was simulated using retardation and decay factors taken from literature studies or site-specific data.

Contributions to COC concentrations from other FEMP sources and from soils at background concentrations were not included in the modeling and results presented in this appendix. The results presented here represent the incremental change in COC concentrations in the Great Miami Aquifer due to loading from Operable Unit 2 areas only.

D.1.3 TECHNICAL APPROACH

This section describes the technical approach used for defining parameters required for groundwater modeling. Section D.1.4 provides a brief description of the models used in groundwater fate and No. 43 transport modeling. ~~The groundwater COCs identified in the final RI Report for Operable Unit 2 were uranium isotopes.~~ Table 2-1 in Section 2 provides the list of COCs identified in the Final RI report for Operable Unit 2. Table 2-1 lists that only uranium isotopes were identified as COCs for the groundwater pathway. Of these isotopes, only uranium-238 was modeled in order to more efficiently utilize computation time. Uranium-238 was selected for modeling because more samples were analyzed for uranium-238 than any other uranium isotope, and uranium-238 constitutes more than 99 percent of total uranium mass. All uranium isotopes are assumed to have the same flow and transport properties (for example, adsorption) as uranium-238. Furthermore, the radioactive half-lives of uranium-234, uranium-235, uranium-236, and uranium-238 exceed 200,000 years. Therefore, modeling results for uranium-238 can be used to predict concentrations of uranium-234, uranium-235/236, and total uranium. Preliminary remediation goals (PRGs) for other uranium isotopes were estimated by applying scaling factors proportional to their groundwater incremental lifetime cancer risk (ILCR) concentration. For example, 10^{-6} ILCR groundwater concentrations for uranium-238 and uranium-234 are 0.72 pCi/L and 1.10 pCi/L, respectively. Therefore, if the modified soil PRG for uranium-238 was 5 pCi/g, then the modified soil PRG for uranium-234 was 7.64 [=(5)(1.1)/(.72)] pCi/g.

The modified soil PRGs were first estimated using the ECTran model. Results of the ECTran modeling were used as the initial estimates of the modified soil PRGs to be used in the ODAST/SWIFT models. These concentrations were adjusted so that groundwater concentrations at the receptor points do not exceed risk-based concentrations. If the predicted groundwater concentration at the receptor point was close to the desired concentration level, the modified soil

With Source Controls

Consolidation and capping was another alternative for which PRGs were developed. Table D.1-5 provides the physical parameters of various layers for each of the blocks modeled. The HELP model was used to estimate infiltration as 2.9 cm/yr (1.14 in./yr). Infiltration is controlled by the cap, and glacial overburden properties have negligible influence on the infiltration rate.

Based on the parameters shown in Table D.1-5, the predicted maximum uranium-238 concentration was 4.3 x 10^{-7} pCi/L. This run assumed that none of the waste was removed. In other words, current uranium-238 concentration under a cap at the Solid Waste Landfill will not cause the Great
No. 44 Miami Aquifer concentrations to exceed the 10^{-6} ILCR level. Predicted maximum fenceline concentration is below 10^{-6} ILCR because of low infiltration rate, low maximum uranium concentration (below WAC developed in Section D.1.6), and relatively large distance between the Solid Waste Landfill and the downgradient receptor at the fenceline. Table D.1-6 provides a summary of modified soil PRGs with source controls for the off-property resident farmer.

D.1.5.2 Lime Sludge Ponds

Without Source Controls

Figure D.1-8 shows the SWIFT III grid blocks directly beneath the waste at the Lime Sludge Ponds. Table D.1-7 presents the physical parameters for the SWIFT grid cells impacted by the Lime Sludge Ponds. The HELP model was used to estimate the infiltration rate (see Attachment D.1-I as 24 cm/yr (9.61 in./yr). Calculated seepage rates were 153 and 320 cm/yr (60.4 and 124 in./yr) in the glacial till and unsaturated Great Miami Aquifer, respectively. The vadose zone and the perched water infiltration pathways were applicable for this alternative. Based on the Operable Unit 2 RI data, initial perched water concentration was set to 2.72 pCi/L.

Figure D.1-9 shows the loading curve for the Lime Sludge Ponds without source controls. Based on the parameters shown in Table D.1-7, the FEMP fenceline maximum uranium-238 concentration predicted by the SWIFT model was 0.041 pCi/L. This run used current source uranium-238
No. 44 concentration. Predicted maximum fenceline concentration is below 10^{-6} ILCR because of low maximum uranium concentration (below WAC developed in Section D.1.6) and relatively large distance between the Lime Sludge Ponds and the downgradient receptor at the fenceline. Because maximum FEMP fenceline uranium-238 concentrations does not exceed 0.72 pCi/L (10^{-6} ILCR level), the modified soil PRG for the off-property resident farmer is greater than current source

concentrations. Table D.1-8 provides a summary of modified soil PRGs for the off-property resident farmer without source controls.

The maximum on-subunit concentration predicted by the SWIFT model was 1.07 pCi/L for the parameters shown in Table D.1-7. Therefore, for uranium-238 concentrations at the subunit not to exceed 0.72 pCi/L (10^{-6} ILCR level), the source concentration should not exceed 4.66 pCi/g

(= 6.94*0.72/1.07). In other words, the modified soil PRG for the on-property resident farmer is 4.66 pCi/g. Modified soil PRGs for other risk levels were similarly calculated. Table D.1-8 also provides a summary of modified soil PRGs for the on-property resident farmer without source controls.

With Source Controls

On-property resident farmer PRGs are not applicable for the consolidation and capping alternative.
No. 44 Furthermore, ~~current uranium 238 concentrations~~ predicted uranium-238 concentrations without source controls are less than the 10^{-6} ILCR level for the off-property resident farmer. Therefore, modified soil PRGs for source control alternatives were not developed for the Lime Sludge Ponds.

D.1.5.3 Inactive Flyash Pile/South Field

Figure D.1-10 shows the areal extent of the waste in the South Field/Inactive Flyash Pile and the SWIFT III grid cells impacted by direct loading from these subunits. The vadose zone pathway, the perched water infiltration pathway, and the perched water subsurface seep pathway were applicable for FS modeling for the South Field/Inactive Flyash Pile. The lithology of the South Field/Inactive Flyash Pile area is variable. The southwestern portion contains virtually no glacial overburden, while the glacial overburden thicknesses increase to 6.7 m (22 ft) toward the northeastern side. The thickness of the unsaturated zone in the Great Miami Aquifer (Layer 2) ranges from 4.9 to 10.1 m (16 to 33 ft). Therefore, the vadose zone model depicting flow in the subsurface soils at the South Field/Inactive Flyash Pile used two layers in the area where till is present and used one layer (unsaturated Great Miami Aquifer) where till is not present. The HELP model was used to estimate infiltration through the residual soils and the composite cap. Results from the HELP run are presented in Attachment D.1-I.

D.1.5.3.1 Impact of the Perched Water Subsurface Seep Pathway

Fate and transport modeling for the Operable Unit 2 RI indicated that the perched water subsurface seep pathway has a major impact on the Great Miami Aquifer. This modeling scenario quantifies the impact of the perched water subsurface seep pathway on the Great Miami Aquifer. Figure D.1-10 identifies grid cells that may receive perched water from the subsurface seep pathways. Figure D.1-5 shows the conceptual model for perched water subsurface seeps. Perched water has been observed in 0 to 1 m (0 to 3 ft) thick sand and gravel layers in the glacial overburden. Perched water not only represents a source for vertical infiltration, it also serves as a source for the current surface seeps and resident farmer. Table D.1-15 provides a summary of modified soil PRGs for the off-property resident farmer with source controls for lateral migration of perched water.

D.1.5.3.4 <u>Consolidation and Capping with Source Controls for Lateral Migration of Perched Water</u>

Figure D.1-19 shows the areal extent of the South Field, Inactive Flyash Pile, and Active Flyash Pile waste consolidation area and the SWIFT III grid cells impacted by direct loading from this area. For this alternative, waste containing uranium-238 at concentrations greater than 5 pCi/g was consolidated and capped as shown in Figure D.1-19. This modeling scenario evaluates the impact of the consolidation area on the Great Miami Aquifer from the South Field, Inactive Flyash Pile, and Active Flyash Pile. These three units are evaluated together, because wastes from these areas will be placed under one capped consolidation area. The fate and transport modeling assumed that the lateral migration of the perched water will be controlled and, therefore, will not require seepage modeling. However, the perched water still represents a source for-vertical infiltration, and was modeled.

Table D.1-22 shows the physical parameters for this alternative. To be conservative, all source material form a subunit was assumed to be at its maximum concentration. In other words, all source from the Inactive Flyash Pile was assumed to be at 1,570 pCi/g, while all source material from the South Field was assumed to be at 397 pCi/g, and all source material from the Active Flyash Pile was assumed to be at 12.6 pCi/g. These assumptions were made because exact placement of the waste is not known and to calculate worst-case modified soil PRGs. The maximum predicted loading concentration and maximum on-subunit Great Miami Aquifer concentrations were 2.17×10^{-4} pCi/L and 1.46×10^{-6} pCi/L, respectively. These concentrations are well below 0.72 pCi/L (10^{-6} ILCR
No. 44 level) due to low infiltration rate. Therefore, consolidation and capping should be protective of the Great Miami Aquifer. Table D.1-23 provides a summary of modified soil PRGs for the off-property resident farmer for consolidation and capping with source controls for lateral migration of perched water.

D.1.5.4 <u>Active Flyash Pile</u>

Two alternatives were considered for the Active Flyash Pile. The first alternative (Alternative 3) deals with excavation and disposal away from the subunit. The Operable Unit 2 RI modeling indicated that the Active Flyash Pile is nearly homogenous with respect to the uranium-238 concentrations. Furthermore, the Active Flyash Pile is either underlain by the Great Miami Aquifer, or it is on the terrace face. Therefore, PRGs developed for the similar scenario for the South Field/Inactive Flyash Pile are applicable to the Active Flyash Pile. Table D.1-24 provides a summary of modified soil PRGs for the Active Flyash Pile for excavation.

The second alternative (Alternative 2) considered was consolidation and capping. Figure D.1-19 shows the SWIFT III grid blocks directly beneath the flyash from the Active Flyash Pile after consolidation. As shown in Section D.1.5.3.4, impact of the Active Flyash Pile source was included in the modeling for the Inactive Flyash Pile and South Field. Modeling indicated that modified soil PRGs are much higher than the maximum soil concentrations detected in the Active Flyash Pile.

D.1.6 PRELIMINARY WASTE ACCEPTANCE CRITERIA FOR ON-SITE DISPOSAL OF OPERABLE UNIT 2 MATERIALS

Figure D.1-20 shows the proposed Operable Unit 2 disposal cell in relation to the area available for an overall disposal facility for the FEMP. The proposed Operable Unit 2 disposal cell is relatively small compared to this area. Figures D.1-21 and D.1-22 show the gray till and unsaturated Great Miami Aquifer thicknesses. The minimum gray till thickness in the proposed disposal cell area is 3.7 m (12 ft). Furthermore, groundwater flow is from the west toward the east-southeast under the disposal cell. To consider cumulative impacts on the groundwater, preliminary WAC were developed from modeling an area which included the proposed Operable Unit 2 disposal cell and areas to the east and west of the proposed cell (see Figure D.1-20).

No. 15 The following conservative assumptions were made to provide a margin of safety in the WAC development:

- Evaluating the MCL criterion anywhere under the facility rather than at the edge of the facility where additional dilution, adsorption, and dispersion in the aquifer would have occurred,
- Ignoring the geomembrane in the capping system and liner system,
- Ignoring the contributions of the liner, leachate collection, and leak detection systems,
- Ignoring adsorption and transport time through the brown till, and
- Utilizing assumptions for moisture content and infiltration that result in conservative values of contaminant travel time.

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Wastes from the Lime Sludge Ponds, South Field, Inactive Flyash Pile, Active Flyash Pile, and Solid Waste Landfill were considered for containment at the disposal cell. If a contaminant was not a
No. 43 groundwater COC for subunits based on the Baseline Risk Assessment, it did not become a groundwater COC at the disposal cell because the infiltration rate is much less at the disposal cell than at the unremediated subunits. Because uranium isotopes were the only groundwater COCs at the Operable Unit 2 subunits, the only COCs for groundwater at the proposed disposal cell were uranium isotopes. It was assumed that waste will not be treated before disposal; this represents the worst-case scenario. Furthermore, wastes from other operable units might be placed in a site-wide disposal facility. Due to the unknown nature of the geochemistry of wastes from other sources, 3.1 mL/g was used as the K_d of the gray till. Only the vadose zone pathway was applicable for the disposal cell.

The vadose zone model depicting flow in the subsurface soils at the disposal cell considers two layers. Layer 1 soils consist of gray tills with thickness ranging from 3.6 to 6.1 m (11.9 to 20 ft). Brown till and interbedded sand and gravel stringers within the glacial overburden were not considered as a barrier layer in the vadose zone pathway. Beneath the till layer is more than 10.7 m (35 ft) of unsaturated sand and gravel as Layer 2. Figures D.1-21 and D.1-22 show the thicknesses of the two layers used in the modeling. The HELP model was used to estimate infiltration through the composite cap. Outputs of the HELP model are included in Attachment D.1-I. Infiltration through the cap was estimated to be 3.1 cm/yr (1.2 in./yr). The seepage velocity in the gray till was 19.6 cm/yr (7.7 in./yr) and in the unsaturated Great Miami Aquifer was 77.5 cm/yr (30.5 in./yr).

Using a constant leachate concentration of 10 mg/L (3,360 pCi/L), the maximum concentration in the Great Miami Aquifer was predicted to be 0.93 pCi/L (2.78 μg/L). The maximum predicted fenceline concentration was 0.032 pCi/L. If uranium-238 leachate concentration is 71.38 mg/L (23,980 pCi/L), the maximum on-site concentration in the Great Miami Aquifer will be 20 μg/L of total uranium (19.85 μg/L uranium-238 or 6.67 pCi/L uranium-238) and the maximum FEMP fenceline
No. 65 concentration will be 0.23 pCi/L uranium-238. Note that 0.23 pCi/L is below the 10^{-6} ILCR value of 0.72 pCi/L. However, 20 ug/L is the MCL for total uranium. Thus, to be acceptable for on-site disposal, waste should not result in uranium-238 leachate concentrations exceeding 71.38 mg/L. The waste concentrations are a function of waste leachability, which can be quantified with use of the
No. 66 distribution coefficient for leaching or desorption (K_L). Table D.1-25 presents WAC as a function of K_L. The Operable Unit 2 waste with the lowest K_L is flyash (see Appendix D.3). For flyash, K_L is 37.5 mL/g; this results in a preliminary WAC of 2,677 mg/Kg uranium-238 or 900 pCi/g uranium-238. If K_L was 15 mL/g, the WAC would be 1,070 mg/Kg or 360 pCi/g uranium-238.

To confirm the protectiveness of the preliminary WAC, an alternate modeling approach was utilized. That modeling is presented in Attachment D.5-IV. That alternate approach ignores any contribution of the unsaturated Great Miami Aquifer to the retardation of uranium. However, it does include the contribution of a clay liner having a K_d of 24 mL/g. Also, the alternate approach uses a recalculated infiltration rate that accounts for all layers in the disposal cell cross-section except for geomembranes. This alternate approach results in an even lower loading to the Great Miami Aquifer than the original modeling simulates.

D.1.7 SENSITIVITY TO THE DISTRIBUTION COEFFICIENT

No. 20 Distribution coefficient (K_d) of soils under the waste is the most important parameter in PRG and preliminary WAC development. Distribution coefficients developed from different tests/studies for the glacial overburden indicate that the K_d for this layer may vary from about 3.1 mL/g to more than 200 mL/g. All of the PRGs developed in this appendix are based on a K_d of 24 mL/g for the glacial till. If the K_d for the glacial till is set at 200 mL/g while holding all other parameters (including K_L) constant, the PRGs for all areas with more than 2.1 m (7 ft) of gray till would be more than the maximum source concentrations in the Operable Unit 2 subunits. On the other hand, if a K_d of 3.1 mL/g is selected, the PRGs would decrease significantly. Table D.1-26 shows the sensitivity of the PRGs (at 10^{-6} ILCR) to the glacial till K_d values. ~~Table D.1-26 also shows that at~~

Sensitivity of preliminary WAC to the K_d of glacial till was also investigated. Due to a low infiltration rate at the engineered disposal cell, WAC are more sensitive to the value of K_d for the glacial till. At the disposal cell the preliminary WAC would increase to a large number for a glacial till K_d of 24 mL/g and higher. This would be due to no breakthrough of the uranium-238 from the soil layers beneath the disposal cell.

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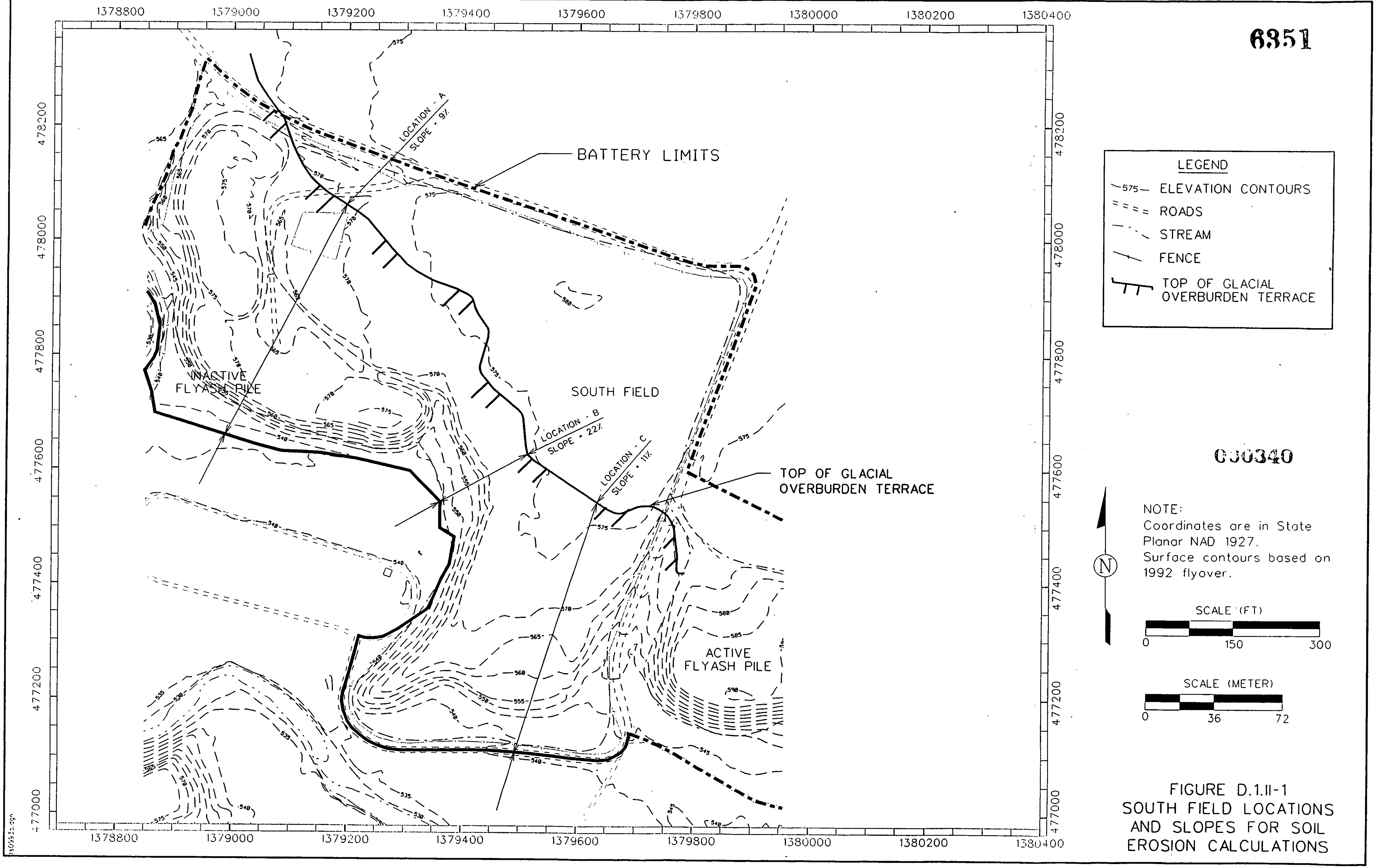


000340

FIGURE D.1.II-1
SOUTH FIELD LOCATIONS AND SLOPES FOR SOIL EROSION CALCULATIONS

D.1-III - CALIBRATION OF FATE AND TRANSPORT MODEL AGAINST LYSIMETER DATA

Three pairs of lysimeters were installed at the FEMP site by Operable Unit 5. At each location, one lysimeter was installed in the gray till and another in the unsaturated Great Miami Aquifer. Details of lysimeter installation and data collected from these lysimeters are reported in the Operable Unit 5 RI Report. Typically, lysimeters were installed 0.9 m (3 ft) above and 0.9 m (3 ft) below the contact between the gray till and the Great Miami Aquifer. Lysimeter pair 11130/11131 is in the area of the proposed disposal cell for Operable Unit 2. Lysimeter pair 11129/11234 is close to the South Field, and lysimeter pair 11132/11133 is located in the northeast part of the FEMP. Table D.1-III-1 shows the uranium concentrations measured in the water samples collected from the lysimeters. With one exception, this data show that the uranium concentration is higher in the lysimeter in the unsaturated Great Miami Aquifer than in the one in the gray till. Average uranium concentrations in the water samples collected from the unsaturated Great Miami Aquifer are approximately 4.8 times higher than water samples collected from the gray till. Typical barrier layer (i.e., gray clay) thickness is about 3 m (10 ft).

The ODAST model was used to simulate the fate and transport of uranium in the glacial overburden
No. 21 and unsaturated Great Miami Aquifer. ~~Under similar conditions to what has occurred at the lysimeters.~~ To match uranium concentrations detected in lysimeter samples, ~~the model was first set up to simulate average hydrogeologic conditions for all 3 of the lysimeter sites. T~~the infiltration rate was estimated to be 8.4 inch/year at the lysimeters (Operable Unit 5 RI Report). Soil properties shown in Table D.1-2 of Appendix D.1 were used. Seepage velocities, dispersion coefficients, and retardation factors were calculated as described in Section D.1.3.3. For example, the seepage velocity in the glacial till was calculated to be 52.8 in/yr.

No. 22 Large quantities of the soluble forms of uranium were dispersed and deposited over the site during the first 5 years of operations at the FEMP (see Appendix D.4). This was simulated by using a source term with constant loading for the initial 5 year period of the model. ~~I~~ The model was then run, and current measured concentrations were compared to the model predictions at 40 years. This is the approximate time period that has elapsed since the operations began at the FEMP and initial uranium release occurred.

000341

o. 21 The model was first set up to simulate average hydrogeologic conditions for all three of the lysimeter sites. Typical barrier layer (i.e., grey clay) thickness is about 3 m (10 ft). Table D.1-III-2 shows model predictions based on the assumption that the distribution coefficient (K_d) is 3.1 mL/g for the gray till and 1.78 mL/g for the unsaturated Great Miami Aquifer. The ODAST model predicted that the ratio of uranium concentration between the unsaturated Great Miami Aquifer lysimeter and gray till lysimeter is 5 at 40 years. This is considered a good agreement between No. 21 model predictions (concentration ratio of 5) and field measured data (concentration ratio of 4.8). Observed average concentration data were matched by assuming the leachate concentration at the source to be constant at 175 μg/L.

The model was also calibrated against data from a specific lysimeter pair instead of average data. Lysimeter pair 11129/11234 was selected for calibration because of good soil sample recovery during installation of lysimeters and clear indications of breaks in lithology. At this location, soil boring data indicate that gray till thickness is approximately 2.4 m (8 ft). Lysimeter 11234 was installed approximately 1.4 m (4.5 ft) into gray clay [approximately 1.1 m (3.5 ft) above the unsaturated Great Miami Aquifer and gray till interface]. Lysimeter 11129 was installed in the unsaturated Great Miami Aquifer approximately 0.96 m (3 ft) below gray till. Average uranium concentrations in the unsaturated Great Miami Aquifer were about 4.9 times that in the gray till at these lysimeters (Table D.1-III-1). Table D.1-III-3 shows model predictions based on the assumption that the distribution coefficient (K_d) is 4.3 mL/g for the gray till and 1.78 mL/g for the unsaturated Great Miami Aquifer. The ODAST model predicted that the ratio of uranium concentration between the unsaturated Great Maim Aquifer lysimeter and gray till lysimeter is 4.7 at 40 years. This is considered a good agreement between model predictions and field-measured data. Observed concentration data were matched by using 375 μg/L as the leachate concentration.

Model calculations indicate that lysimeter data can be explained by glacial till K_d values in the range of 3.1 to 4.3 mL/g and leachate concentrations in the range of 175 to 375 μg/L for first the 5 years of operations at the FEMP.

TABLE D.1-III-1

URANIUM CONCENTRATIONS MEASURED IN THE WATER SAMPLES COLLECTED FROM THE LYSIMETERS

Date	Southwest Lysimeters			Southeast Lysimeters			Northeast Lysimeters		
	Unsaturated GMA[a] Lysimeter 11129 (μg/L)	Gray Till Lysimeter 11234 (μg/L)	Ratio of Unsaturated GMA to Gray Till Concentration	Unsaturated GMA Lysimeter 11131 (μg/L)	Gray Till Lysimeter 11130 (μg/L)	Ratio of Unsaturated GMA to Gray Till Concentration	Unsaturated GMA Lysimeter 11133 (μg/L)	Gray Till Lysimeter 11132 (μg/L)	Ration of Unsaturated GMA to Gray Till Concentration
9/93	15.0	ND[b]	NA[c]	11.0	7.9	1.4	52.0	ND	NA
3/21/94	16.0	4.1	3.9	3.4	13.0	0.3	47.0	4.6	10.2
3/22/94	29.0	3.9	7.4	12.0	2.9	4.1	16.0	2.5	6.4
3/23/94	28.0	4.6 (4.2)	6.1	12.0 (12.0)	2.8	4.3	17.0 (14.0)	2.3	7.4
3/24/94	ND	4.9	NA	ND	2.8	NA	16.0	3.5	4.6
5/06/94	28.0	5.6	5.0	10.0	2.4	4.2	12.0	2.9	4.1
5/13/94	27.0	5.2	5.2	9.1	2.5	3.6	12.0	2.8	4.3
5/20/94	26.0	5.4	4.8	8.9	3.0	3.0	13.0	2.8	4.6
5/27/94	ND	5.1	NA	ND	2.4	NA	ND	2.6	NA
6/03/94	24.0	5.2	4.6	8.1	2.4	3.4	12.0	2.6	4.6
6/10/94	ND	5.4	NA	ND	2.4	NA	ND	2.6	NA
6/17/94	23.0	5.3	4.3	8.3	2.6	3.2	12.0	2.4	5.0
Average	24.0	4.9	4.9	9.5	3.9	2.4	20.3	2.9	7.1

Overall average unsaturated GMA concentration = 17.9 μg/L.
Overall average gray till concentration = 3.9 μg/L.
Overall average ratio = 4.8.

[a]GMA = Great Miami Aquifer
[b]ND = No data available
[c]NA = Not applicable

Comment No. 24

000344

TABLE D.1-III-2

PREDICTED URANIUM CONCENTRATIONS FOR TYPICAL LYSIMETER INSTALLATION

Time (Years)	Predicted Uranium Concentrations		
	Unsaturated GMA[a] Lysimeter (μg/L)	Gray Till Lysimeter (μg/L)	Ration of Unsaturated GMA to Gray Till Concentration
5	0.0	0.0	0.0
10	0.0	0.0	0.0
15	0.0	1.6	0.0
20	0.0	31.0	0.0
25	0.0	71.3	0.0
30	0.1	49.6	0.0
35	3.1	17.0	0.2
40	18.9	3.8	5.0
45	50.3	0.1	584.8

[a]GMA = Great Miami Aquifer

TABLE D.1-III-3

PREDICTED URANIUM CONCENTRATIONS FOR SOUTHWEST LYSIMETER PAIR 11129/11234

Time (Years)	Predicted Uranium Concentrations		
	Unsaturated GMA[a] Lysimeter 11129 (μg/L)	Gray Till Lysimeter 11234 (μg/L)	Ration of Unsaturated GMA to Gray Till Concentration
5	0.0	0.0	0.0
10	0.0	0.4	0.0
15	0.0	32.6	0.0
20	0.0	128.3	0.0
25	0.0	126.9	0.0
30	0.2	60.9	0.0
35	3.6	19.6	0.2
40	23.3	5.0	4.7
45	63.8	1.1	59.4

[a]GMA = Great Miami Aquifer

Comment No 24

ATTACHMENT D.1-IV

ALTERNATE MODELING APPROACH FOR PRELIMINARY WASTE ACCEPTANCE CRITERIA

In order to evaluate the protectiveness of the proposed waste acceptance criteria (WAC), additional modeling was performed using a conceptual model for the vadose zone that differed from the model used throughout the remainder of the groundwater modeling. The differences were as follows:

- The infiltration was recalculated using less conservative assumptions than those used in the original HELP modeling.
- The 3 feet thick disposal cell liner, which was not used in the original modeling, was included in the ODAST simulation.
- The unsaturated sand and gravel layer in the Great Miami Aquifer, which was used in the original modeling, was not included in the ODAST simulation.

Infiltration was calculated by the HELP model using the entire disposal cell cross section. The HELP model output indicates that the infiltration rate would be 0.89 in./yr which is lower than the original value of 1.22 in./yr. A summary of the HELP model input and output is presented in Table D.5-IV-1. In contrast to the original infiltration calculation, the current calculation includes the overburden waste material layer and the underlying natural material beneath the disposal cell. Also, while the original calculation included only a 1-foot lateral drainage layer with a hydraulic conductivity of 1×10^{-2} cm/s, which does not provide much lateral drainage, the updated HELP model simulation includes a 4.5-foot combined lateral drainage layer consisting of the sand filter (0.5 feet of sand), biotic barrier (3 feet of cobbles), and the drainage layer (1 foot of sand) functioning together as a unit. Together these layers are capable of sufficiently draining water above the infiltration barrier, thus preventing the buildup of excessive hydraulic head above the infiltration barrier. The hydraulic conductivity in this combined lateral drainage layer is estimated to be 1×10^{-1} cm/s. All of the layers utilized in the updated HELP run are present in the disposal cell cap cross section and can be accounted for in the simulation. However, conservatism is still maintained by omission of the geomembranes in the system.

The clay liner was set at 3 feet thick and assumed to consist of clay with a K_d value of 24 L/Kg.

25 This K_d value, which is higher than that ~~in the original modeling~~ of the gray glacial till, was based on the assumption that the quality of clay from a borrow source would be controlled to ensure the higher value.

to 25 clay liner was the first of two layers in the ODAST model.

The second layer in the ODAST model consisted of gray till (clay). Properties of the gray till are shown in Table D.1-IV-1. The moisture content of the gray till from the HELP modeling was 19 percent. Therefore, the retardation factor in the gray till was recalculated using the simulated moisture content of 19 percent . Because of the updated infiltration rate and moisture content, the retardation factor is 31.2, higher than the original value of 14.99, which was based on the original, higher infiltration rate and moisture content.

The thickness of the unsaturated sand and gravel layer in the Great Miami Aquifer was assumed to be zero (compared to approximately 35 feet in the original modeling). Thus, any retardation in the sand and gravel is eliminated.

Using the updated layers, infiltration rate, and retardation factor, an ODAST/SWIFT modeling run was completed. The source leachate concentration was assumed to be 24,000 pCi/L. The simulated maximum uranium concentration in the Great Miami Aquifer in 1,000 years was about 1.4 ug/L, well below the target MCL value of 20 ug/L. The uranium plume at the end of the simulation is shown in the Figure D.5-IV-1. This result serves to support the current preliminary WAC proposed in this FS. Confirmation of the preliminary WAC by a different modeling approach also serves to demonstrate that the proposed criteria are robust.

6351

Appendix E

APPENDIX E.2.2

PRELIMINARY WASTE ACCEPTANCE CRITERIA FOR ON-SITE DISPOSAL

An on-site engineered disposal facility is an option for disposal of contaminated material from Operable Unit 2. To be protective of groundwater in the Great Miami Aquifer over the 1,000 year modeling timeframe, the contaminated material must meet certain acceptance criteria. Preliminary
No. 40 WAC were developed for uranium. As discussed in Appendix D, the only COCs for groundwater at the disposal cell were uranium isotopes. This is because uranium isotopes were the only groundwater COCs identified at the individual subunits and the infiltration rate is much lower at the disposal cell then at the unremediated subunits.

The preliminary WAC were developed based on a conservative groundwater modeling approach that is presented in Appendix D.1.6. The final WAC will be determined during design of the disposal
No. 27 facility. ~~Due to cap or liner modifications during design and the conservatism employed in the current modeling, the final WAC could be higher than the preliminary WAC that are presented.~~ During design, additional information that will allow finalization of the WAC will be available from the following studies:

- The predesign investigation that has begun in the area where a site-wide disposal facility could potentially be located,

- Infiltration studies during final cap design,

- The RI/FS reports from other operable units (which will identify additional COCs).

Table E.2.2-1 presents the preliminary WAC for the on-site disposal facility and compares it with maximum levels of the respective contaminants detected in the Operable Unit 2 subunits. As indicated in the table, only material from the Solid Waste Landfill, Inactive Flyash Pile, and South Field is expected to exceed the criteria. It is estimated that a maximum of 3100 cubic yards of material will require off-site disposal or treatment prior to disposal in the on-site cell (see Appendix E.1).

No. 28 The preliminary WAC presented here are based on a desorption distribution coefficient of 15 mL/g, which is lower than any actually measured in the Operable Unit 2 materials. Therefore, the assumed

o. 29 leachability is considerably higher than the measured leachability and results in a lower WAC for uranium concentration in soil ~~associated uranium concentration~~. Hence, the assumption of the lower desorption distribution coefficient serves to cause a conservative WAC and minimize concerns about the relationship between leachability and uranium concentration for Operable Unit 2 wastes during remediation.

TABLE E.2.2-1

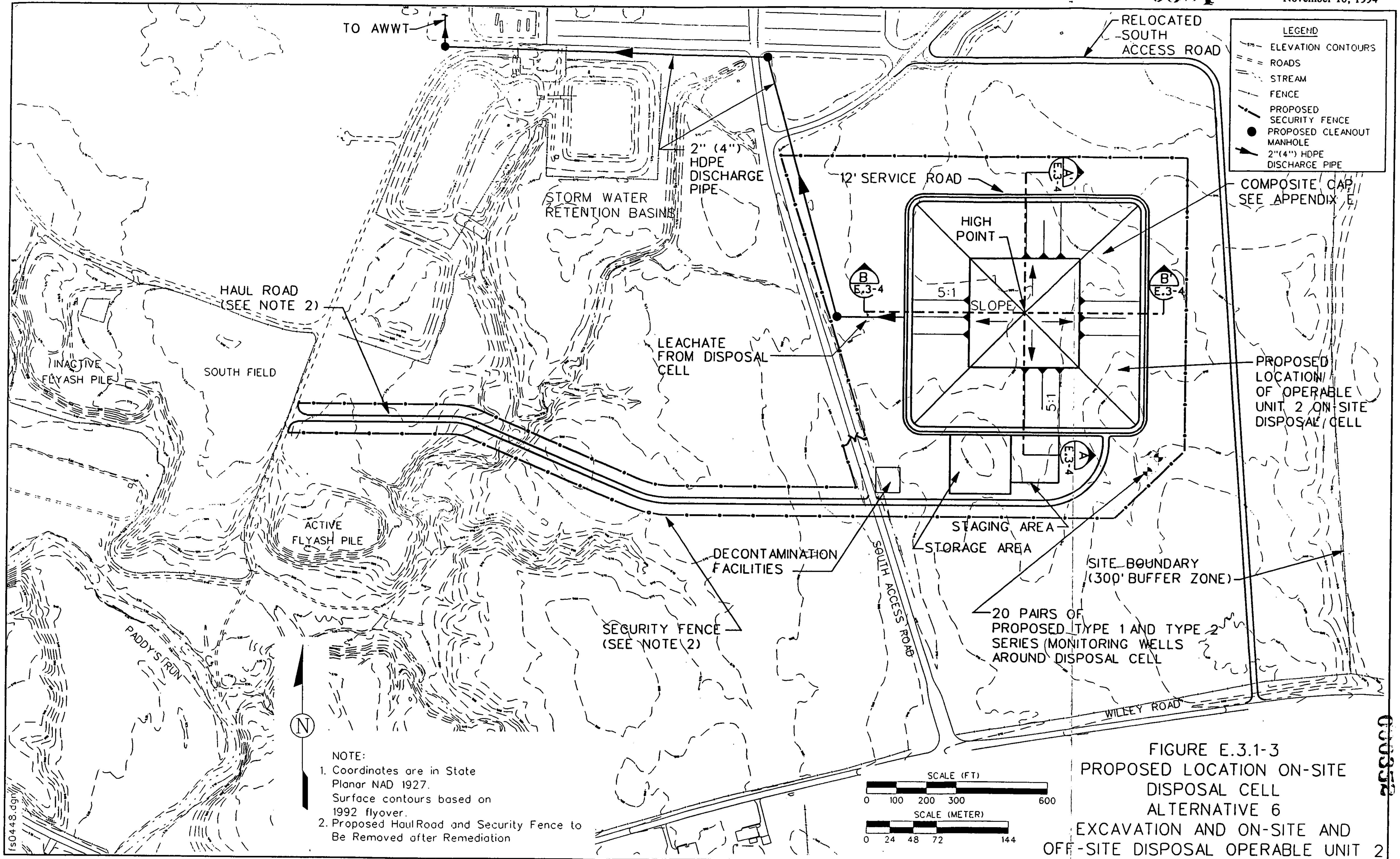
PRELIMINARY WASTE ACCEPTANCE CRITERIA FOR ON-SITE DISPOSAL COMPARED TO MAXIMUM DETECTED VALUE

Contaminant of Concern	Units	Preliminary Waste Acceptance Criteria for On-Site Disposal ~~(pCi/g)~~	Maximum Detected Value by Operable Unit 2 Subunit [a]				
			Solid Waste Landfill	Lime Sludge Pond	Inactive Flyash Pile	South Field	Active Flyash Pile
Uranium-238	pCi/g	< 3.6E+02	5.77E+02	8.40E+01	1.57E+03	3.97E+02	1.26E+01
Total Uranium	ppm	< 1.1E+03	1.77E+03	2.44E+02	3.58E+03	1.17E+03	3.13E+01

(shaded box) Contaminant of Concern

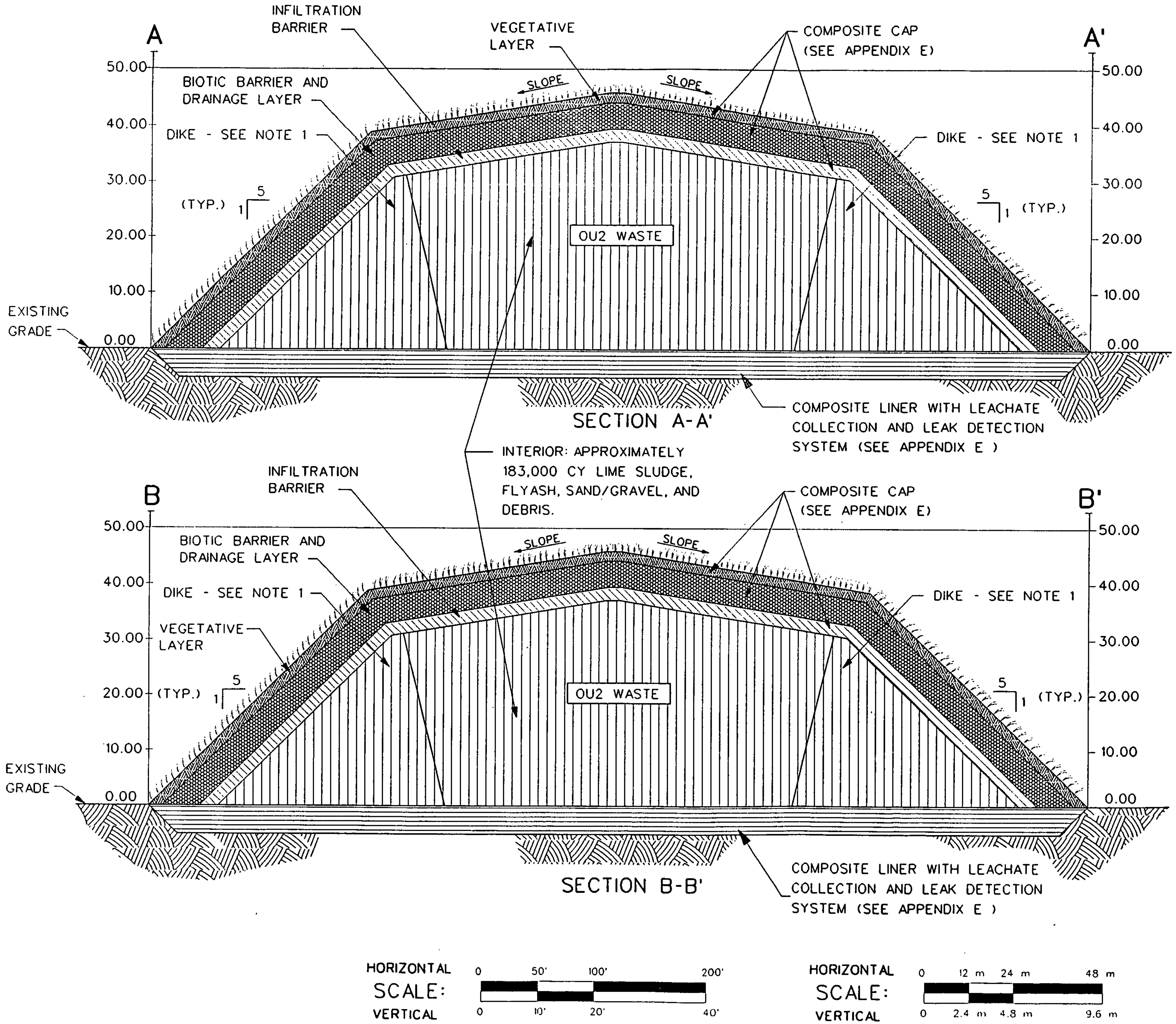
[a] Activity levels represent maximum detected value for surface soil, subsoil, or sediment for each subunit.
[b] Acceptance criteria for on-site disposal is the maximum value permitted (see Appendix D.1 for development).

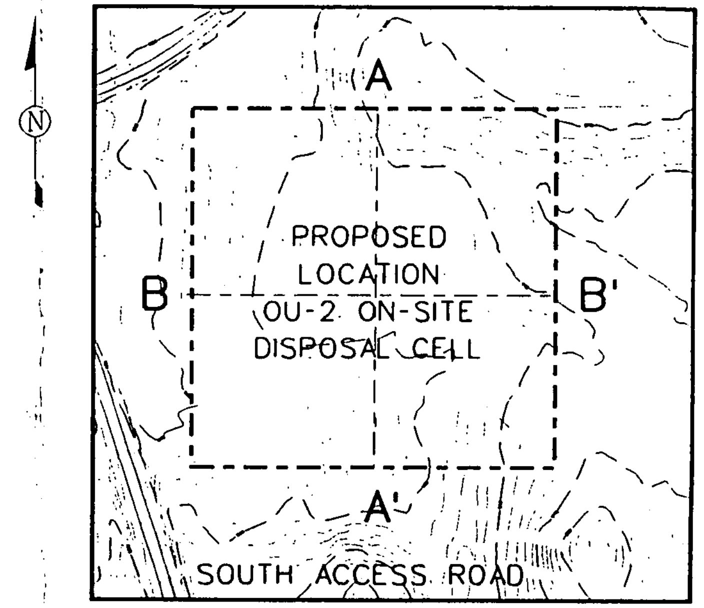
Comment No. 30



NOTE:
1. Coordinates are in State Planar NAD 1927. Surface contours based on 1992 flyover.
2. Proposed Haul Road and Security Fence to Be Removed after Remediation

FIGURE E.3.1-3
PROPOSED LOCATION ON-SITE DISPOSAL CELL
ALTERNATIVE 6
EXCAVATION AND ON-SITE AND OFF-SITE DISPOSAL OPERABLE UNIT 2





LOCATION KEY (1" = 400')

NOTE:

1. Dike shall be constructed of suitable fill and till material excavated from the waste units.
2. Surface contours based on 1992 flyover.

LEGEND

- VEGETATIVE LAYER
- INFILTRATION BARRIER
- BIOTIC BARRIER AND DRAINAGE LAYER
- OU2 WASTE
- COMPOSITE LINER
- EXISTING GRADE/ PREPARED SUBGRADE

000353

FIGURE E.3.1-4
TYPICAL SECTIONS
OPERABLE UNIT 2
ON-SITE DISPOSAL CELL

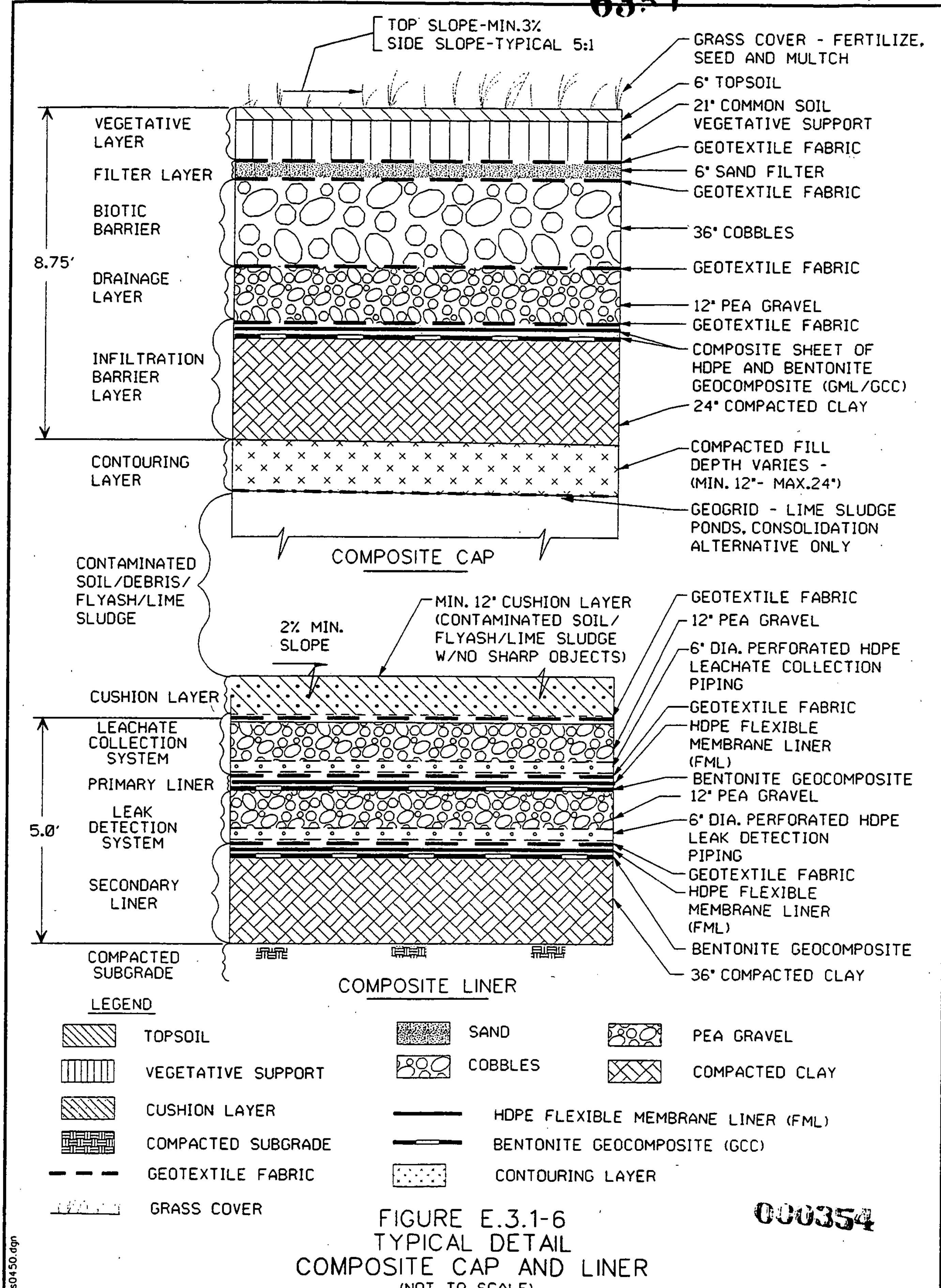
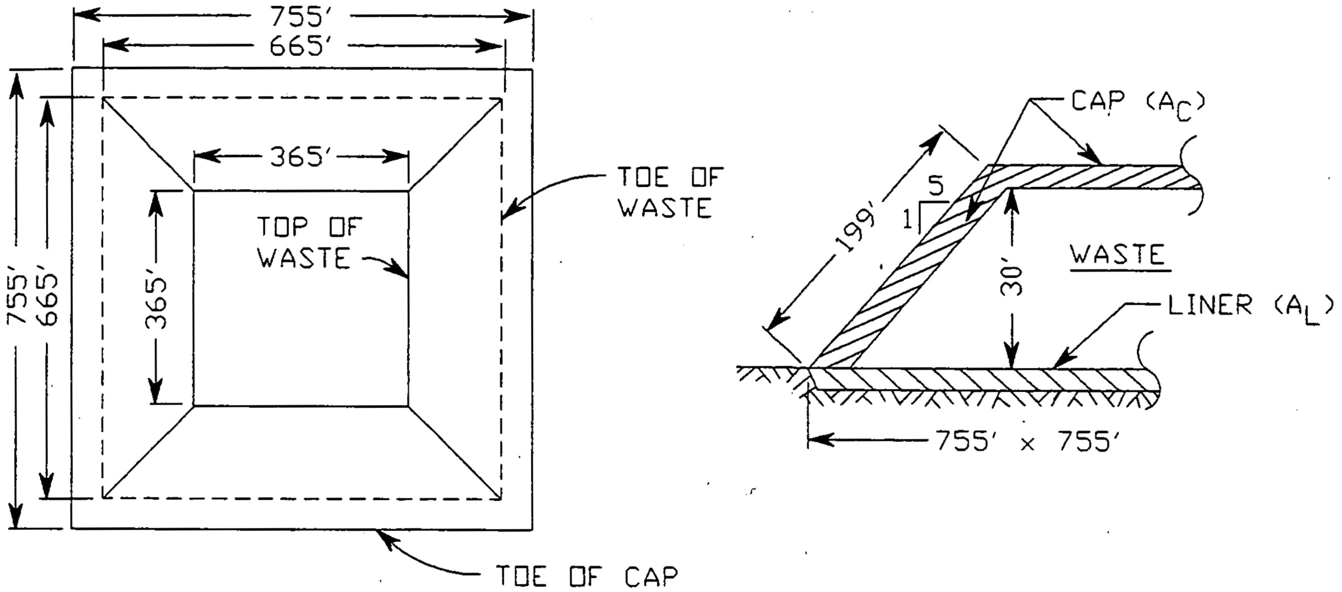


FIGURE E.3.1-6
TYPICAL DETAIL
COMPOSITE CAP AND LINER
(NOT TO SCALE)

000354

ALT. 6A -- EXCAVATION AND ON-SITE DISPOSAL (EXPANDED TRESPASSER)



OU2 DISPOSAL CELL

1. Volume of Disposal Cell

$$V = \frac{(665' \times 665') + (365' \times 365')}{2} \times 30' \times \frac{CY}{27'} = 319,700\ CY$$

Since the cell capacity for this design (319,700 CY) is greater than the estimated volume of waste (314,200 CY) to be disposed, the capacity of this cell is sufficient.

2. Liner Area

$$A_L = (755' \times 755') \times \frac{SY}{9'} = 63,336\ SY$$

3. Cap Area

$$A_C = (365' \times 365' + (4 \times 199' \times \frac{365' + 755'}{2})) \times \frac{SY}{9'} = 64,331\ SY$$

000355

ALTERNATIVE 6: EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC
RECEPTOR: EXPANDED TRESPASSER

CLEAR & GRUB AREA = 23 AC
STAGING AREA = 670 CY
TOTAL # OF WELLS = 20
TOTAL LINER AREA = 63,336 SY
TOTAL CAP AREA = 64,331 SY

			CELL LINER			CELL CAP								
SUBUNIT	WASTE* VOLUME TO CELL (CY)	PERCENT OF TOTAL WASTE VOLUME	LINER AREA (SY)	(3 FEET) CLAY QUANTITY (CY)	(12 IN.) PEA GRAVEL (CY)	CAP AREA (SY)	(18 IN.) CONTOURING LAYER (CY)	(2 FEET) CLAY CAP (CY)	(1.75') COMMON SOIL (CY)	(6 IN.) TOP SOIL (CY)	(12 IN.) PEA GRAVEL (CY)	(3 FEET) COBBLES (CY)	(6 IN) SAND LAYER (CY)	NUMBER OF MONITORING WELLS
SWL	27,100	8	5,067	5,067	1,689	5,146	2,573	3,431	3,002	858	1,715	5,146	858	2
LSP	21,200	7	4,434	4,434	1,478	4,503	2,252	3,002	2,627	751	1,501	4,503	751	1
IFP	103,300	33	20,901	20,901	6,966	21,229	10,615	14,154	12,383	3,539	7,076	21,229	3,539	7
SF	88,000	28	17,734	17,734	5,911	18,013	9,006	12,009	10,507	3,003	6,004	18,013	3,003	6
AFP	74,600	24	15,201	15,201	5,066	15,439	7,720	10,293	9,006	2,574	5,146	15,439	2,574	5
TOTAL	314,200	100	63,336	63,336	21,110	64,331	32,166	42,889	37,524	10,724	21,442	30,879	5,148	20

* WASTE VOLUME = REMEDIATION VOLUME + ADDITIONAL EXCAVATION REQUIRED TO REMOVE REMEDIATION VOLUME**
+ 3,000 CY OF GENERATED WASTE (15,000 CY/5 = 3,000 CY)

** 14% FOR SWL AND 10% FOR LSP, IFP, SF, AND AFP

ALTERNATIVE 6A: EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC
RECEPTOR: EXPANDED TRESPASSER

FENCE	=	4,000 LF	BORROW FOR DIKE	=	0 CY
6" PERFORATED PIPE	=	4,000 LF	GEOTEXTILE	=	0 SY
6/10 HDPE PIPE TO AWWT	=	3,500 LF	COBBLES	=	0 CY
HDPE MANHOLES	=	10	DRAINAGE PIPE	=	0 LF

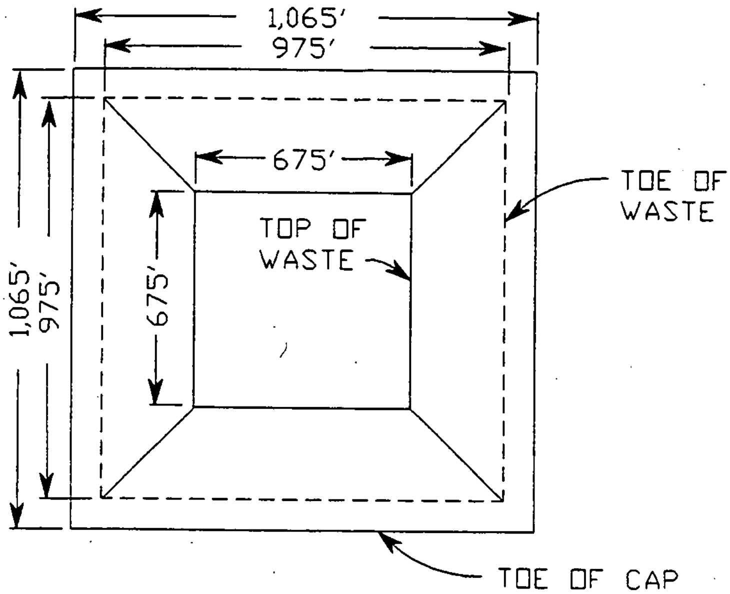
SUBUNIT	PERCENT OF TOTAL WASTE VOLUME	LEACHATE COLLECTION SYSTEM 6" PIPE PERFORATED (LF)	10/6-HDPE PIPE TO AWWT (CY)	MANHOLES (EA)	FENCE (LF)	SIDE SLOPE DIKE BORROW FOR DIKE (CY)	GEOTEXTILE (SY)	COBBLES (CY)	DRAINAGE PIPE (LF)
SWL	8	320	280	1	320	0	0	0	0
LSP	7	280	245	1	280	0	0	0	0
IFP	33	1,320	1,155	2	1320	0	0	0	0
SF	28	1,120	980	4	1120	0	0	0	0
AFP	24	960	840	2	960	0	0	0	0
TOTAL	100	4,000	3,500	10	4,000	0	0	0	0

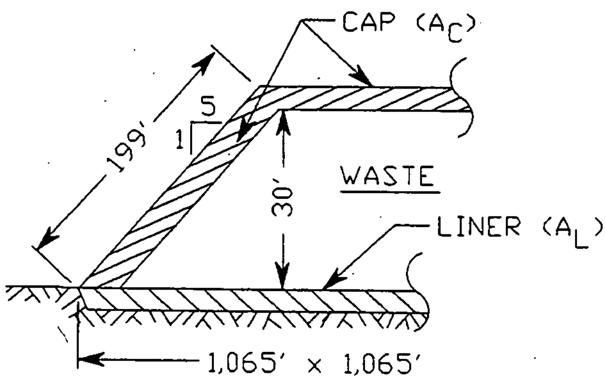
E-3-4-3 *Comments #14 and 31*

000357

6351

ALT. 6B -- EXCAVATION AND ON-SITE DISPOSAL (RESIDENT FARMER) 6351





OU2 DISPOSAL CELL

1. Volume of Disposal Cell

$$V = \frac{(975' \times 975') + (675' \times 675')}{2} \times 30' \times \frac{CY}{27'} = 781,250 \text{ CY}$$

Since the cell capacity for this design (781,250 CY) is greater than the estimated volume of waste (780,700 CY) to be disposed, the capacity of this cell is sufficient.

2. Liner Area

$$A_L = (1,065' \times 1,065') \times \frac{SY}{9'} = 126,025 \text{ SY}$$

3. Cap Area

$$A_C = (675' \times 675' + (4 \times 199' \times \frac{675' + 1,065'}{2})) \times \frac{SY}{9'} = 127,571 \text{ SY}$$

000358

ALTERNATIVE 6B: EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC
RECEPTOR: RESIDENT FARMER

CLEAR & GRUB AREA = 37 AC
STAGING AREA = 670 CY
TOTAL # OF WELLS = 28
TOTAL LINER AREA = 126,025 SY
TOTAL CAP AREA = 127,571 SY

			CELL LINER			CELL CAP								
SUBUNIT	WASTE* VOLUME TO CELL (CY)	PERCENT OF TOTAL WASTE VOLUME	LINER AREA (SY)	(3 FEET) CLAY QUANTITY (CY)	(12 IN.) PEA GRAVEL (CY)	CAP AREA (SY)	(18 IN.) CONTOURING LAYER (CY)	(2 FEET) CLAY CAP (CY)	(1.75') COMMON SOIL (CY)	(6 IN.) TOP SOIL (CY)	(12 IN.) PEA GRAVEL (CY)	(3 FEET) COBBLES (CY)	(6 IN) SAND LAYER (CY)	NUMBER OF MONITORING WELLS
SWL	115,200	15	18,904	18,904	6,301	19,136	9,568	12,758	11,162	3,190	6,378	19,136	3,190	4
LSP	92,800	12	15,123	15,123	5,041	15,309	7,654	10,206	8,929	2,552	5,102	15,309	2,552	3
IFP	110,900	14	17,644	17,644	5,881	17,860	8,930	11,907	10,418	2,977	5,953	17,860	2,977	4
SF	376,400	48	60,492	60,492	20,164	61,234	30,617	40,825	35,718	10,208	20,409	61,234	10,208	13
AFP	85,400	11	13,863	13,863	4,621	14,033	7,016	9,356	8,185	2,339	4,677	14,033	2,339	3
TOTAL	780,700	100	126,025	126,025	42,008	127,571	63,786	85,052	74,412	21,266	42,519	52,304	8,719	28

* WASTE VOLUME = REMEDIATION VOLUME + ADDITIONAL EXCAVATION REQUIRED TO REMOVE REMEDIATION VOLUME**
+ 3,000 CY OF GENERATED WASTE (15,000 CY/5 = 3,000 CY)

** 14% FOR SWL AND 10% FOR LSP, IFP, SF, AND AFP

000359

6351

ALTERNATIVE 6B: EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC
RECEPTOR: RESIDENT FARMER

FENCE = 5,500 LF
6" PERFORATED PIPE = 7,000 LF
6/10 HDPE PIPE TO AWWT = 3,500 LF
HDPE MANHOLES = 10

BORROW FOR DIKE = 0 CY
GEOTEXTILE = 0 SY
COBBLES = 0 CY
DRAINAGE PIPE = 0 LF

		LEACHATE COLLECTION SYSTEM				SIDE SLOPE DIKE			
SUBUNIT	PERCENT OF TOTAL WASTE VOLUME	6" PIPE PERFORATED (LF)	10/6-HDPE PIPE TO AWWT (CY)	MANHOLES (EA)	FENCE (LF)	BORROW FOR DIKE (CY)	GEOTEXTILE (SY)	COBBLES (CY)	DRAINAGE PIPE (LF)
SWL	15	1,050	525	1	825	0	0	0	0
LSP	12	840	420	1	660	0	0	0	0
IFP	14	980	490	2	770	0	0	0	0
SF	48	3,360	1,680	4	2640	0	0	0	0
AFP	11	770	385	2	605	0	0	0	0
TOTAL	100	7,000	3,500	10	5,500	0	0	0	0

6351

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LOW LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY FOR OU-2
COMPOSITE CAP OVER THE BERM - NO HDPE LINER
COBBLE AND P-GRAVEL LAYERS MODELED SEPERATLY          October 26, 1994

**************************************************************************
**************************************************************************


                              FAIR GRASS

                               LAYER  1
                               --------

                     VERTICAL PERCOLATION LAYER
  THICKNESS                              =       6.00 INCHES
  POROSITY                               =       0.4530 VOL/VOL
  FIELD CAPACITY                         =       0.1901 VOL/VOL
  WILTING POINT                          =       0.0848 VOL/VOL
  INITIAL SOIL WATER CONTENT             =       0.3208 VOL/VOL
  SATURATED HYDRAULIC CONDUCTIVITY       =       0.001000000047 CM/SEC


                               LAYER  2
                               --------

                     VERTICAL PERCOLATION LAYER
  THICKNESS                              =      21.00 INCHES
  POROSITY                               =       0.4570 VOL/VOL
  FIELD CAPACITY                         =       0.1309 VOL/VOL
  WILTING POINT                          =       0.0580 VOL/VOL
  INITIAL SOIL WATER CONTENT             =       0.2428 VOL/VOL
  SATURATED HYDRAULIC CONDUCTIVITY       =       0.000500000024 CM/SEC


                               LAYER  3
                               --------

                     VERTICAL PERCOLATION LAYER
  THICKNESS                              =       6.00 INCHES
  POROSITY                               =       0.4370 VOL/VOL
  FIELD CAPACITY                         =       0.0624 VOL/VOL
```

000361

WILTING POINT = 0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1577 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.001000000047 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS = 36.00 INCHES
POROSITY = 0.4170 VOL/VOL
FIELD CAPACITY = 0.0454 VOL/VOL
WILTING POINT = 0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0381 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 10.000000000000 CM/SEC

LAYER 5

LATERAL DRAINAGE LAYER

THICKNESS = 12.00 INCHES
POROSITY = 0.4170 VOL/VOL
FIELD CAPACITY = 0.0454 VOL/VOL
WILTING POINT = 0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0827 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.009999999776 CM/SEC
SLOPE = 20.00 PERCENT
DRAINAGE LENGTH = 200.0 FEET

LAYER 6

BARRIER SOIL LINER

THICKNESS = 0.25 INCHES
POROSITY = 0.4000 VOL/VOL
FIELD CAPACITY = 0.3560 VOL/VOL
WILTING POINT = 0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000010000 CM/SEC

LAYER 7

VERTICAL PERCOLATION LAYER

THICKNESS = 2.00 INCHES
POROSITY = 0.4170 VOL/VOL
FIELD CAPACITY = 0.0454 VOL/VOL
WILTING POINT = 0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0531 VOL/VOL

000362

SATURATED HYDRAULIC CONDUCTIVITY = 10.000000000000 CM/SEC

LAYER 8

BARRIER SOIL LINER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000100000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	1102500. SQ FT
EVAPORATIVE ZONE DEPTH	=	18.00 INCHES
UPPER LIMIT VEG. STORAGE	=	8.2020 INCHES
INITIAL VEG. STORAGE	=	4.8384 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	20.8600 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.006	0.000	0.000	0.000	0.000
	0.000	0.000	0.001	0.000	0.000	0.005
STD. DEVIATIONS	0.000	0.013	0.000	0.000	0.000	0.000
	0.000	0.000	0.001	0.000	0.000	0.011
EVAPOTRANSPIRATION						
TOTALS	0.844	1.518	2.382	2.794	2.983	4.954
	4.537	4.351	2.312	1.977	1.645	0.890
STD. DEVIATIONS	0.189	0.323	0.148	0.391	1.563	1.091
	1.396	1.298	1.628	0.510	0.152	0.188
LATERAL DRAINAGE FROM LAYER 5						
TOTALS	1.7790	1.5642	1.1466	1.3283	0.5503	0.2754
	0.3083	0.1928	0.3616	0.2700	0.2059	1.1108
STD. DEVIATIONS	1.2458	0.9454	1.2831	1.1944	0.3389	0.1618
	0.2066	0.1356	0.5858	0.4403	0.2240	1.4274
PERCOLATION FROM LAYER 6						
TOTALS	0.0549	0.0486	0.0392	0.0434	0.0243	0.0171
	0.0182	0.0154	0.0192	0.0173	0.0153	0.0383
STD. DEVIATIONS	0.0311	0.0236	0.0320	0.0298	0.0085	0.0040
	0.0052	0.0034	0.0146	0.0110	0.0056	0.0356
PERCOLATION FROM LAYER 8						
TOTALS	0.0579	0.0479	0.0397	0.0436	0.0243	0.0171
	0.0182	0.0154	0.0192	0.0173	0.0153	0.0351
STD. DEVIATIONS	0.0316	0.0226	0.0331	0.0303	0.0085	0.0040
	0.0051	0.0034	0.0145	0.0111	0.0056	0.0294

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	3733984.	100.00
RUNOFF	0.011	(0.014)	1035.	0.03
EVAPOTRANSPIRATION	31.186	(2.865)	2865230.	76.73
LATERAL DRAINAGE FROM LAYER 5	9.0932	(3.2958)	835439.	22.37
PERCOLATION FROM LAYER 6	0.3512	(0.0822)	32264.	0.86
PERCOLATION FROM LAYER 8	0.3512	(0.0851)	32263.	0.86
CHANGE IN WATER STORAGE	0.000	(3.475)	17.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	220500.0
RUNOFF	0.028	2581.9
LATERAL DRAINAGE FROM LAYER 5	0.2289	21032.3
PERCOLATION FROM LAYER 6	0.0061	556.2
HEAD ON LAYER 6	4.2	
PERCOLATION FROM LAYER 8	0.0034	313.3
HEAD ON LAYER 8	0.1	
SNOW WATER	1.18	108843.8

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3405

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0667

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FINAL WATER STORAGE AT END OF YEAR 78

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LAYER	(INCHES)	(VOL/VOL)
1	1.92	0.3208
2	5.10	0.2428
3	0.95	0.1577
4	1.37	0.0381
5	0.99	0.0827
6	0.10	0.4000
7	0.11	0.0531
8	10.32	0.4300
SNOW WATER	0.00	

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LOW LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY FOR OU-2
TYPE A CAP AND LINER - NO HDPE LINER AND FAILED LEACHATE COLLECTION SY
Combined Cobble + Gravel Layer October 26, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4530 VOL/VOL
FIELD CAPACITY	=	0.1901 VOL/VOL
WILTING POINT	=	0.0848 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3208 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	21.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2428 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000500000024 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0624 VOL/VOL

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WILTING POINT	=	0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1577 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

LAYER 4

LATERAL DRAINAGE LAYER

THICKNESS	=	48.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0669 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.100000001490 CM/SEC
SLOPE	=	4.00 PERCENT
DRAINAGE LENGTH	=	800.0 FEET

LAYER 5

BARRIER SOIL LINER

THICKNESS	=	0.25 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC

LAYER 6

VERTICAL PERCOLATION LAYER

THICKNESS	=	2.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0791 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	10.000000000000 CM/SEC

LAYER 7

BARRIER SOIL LINER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL

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SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC

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LAYER 8

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.3808 VOL/VOL
FIELD CAPACITY	=	0.1924 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2352 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000026000000 CM/SEC

LAYER 9

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2570 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 10

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0454 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.009999999776 CM/SEC

LAYER 11

BARRIER SOIL LINER

THICKNESS	=	60.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000100000 CM/SEC

000369

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	1102500. SQ FT
EVAPORATIVE ZONE DEPTH	=	18.00 INCHES
UPPER LIMIT VEG. STORAGE	=	8.2020 INCHES
INITIAL VEG. STORAGE	=	4.8384 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	54.0104 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
NOFF						
TOTALS	0.000	0.006	0.000	0.000	0.000	0.000
	0.000	0.000	0.001	0.000	0.000	0.005

STD. DEVIATIONS	0.000	0.013	0.000	0.000	0.000	0.000
	0.000	0.000	0.001	0.000	0.000	0.011

EVAPOTRANSPIRATION

TOTALS	0.844	1.518	2.382	2.794	2.983	4.954
	4.536	4.351	2.312	1.978	1.645	0.890
STD. DEVIATIONS	0.189	0.323	0.148	0.391	1.563	1.091
	1.396	1.298	1.628	0.510	0.152	0.188

LATERAL DRAINAGE FROM LAYER 4

TOTALS	1.7186	1.5337	1.1785	1.2984	0.5949	0.2766
	0.2938	0.1688	0.3173	0.2829	0.2101	1.0189
STD. DEVIATIONS	1.1420	0.8777	1.2454	1.1669	0.4056	0.1824
	0.2145	0.1286	0.5286	0.4778	0.2498	1.2274

PERCOLATION FROM LAYER 5

TOTALS	0.0931	0.0833	0.0672	0.0726	0.0391	0.0235
	0.0247	0.0187	0.0255	0.0241	0.0203	0.0595
STD. DEVIATIONS	0.0549	0.0422	0.0599	0.0561	0.0195	0.0088
	0.0103	0.0062	0.0254	0.0230	0.0120	0.0590

PERCOLATION FROM LAYER 7

TOTALS	0.0785	0.0782	0.0774	0.0644	0.0521	0.0371
	0.0311	0.0187	0.0235	0.0261	0.0203	0.0444
STD. DEVIATIONS	0.0404	0.0382	0.0391	0.0396	0.0374	0.0372
	0.0202	0.0062	0.0210	0.0274	0.0120	0.0324

PERCOLATION FROM LAYER 11

TOTALS	0.0416	0.0381	0.0435	0.0448	0.0491	0.0495
	0.0521	0.0514	0.0478	0.0472	0.0437	0.0431
STD. DEVIATIONS	0.0114	0.0100	0.0108	0.0117	0.0138	0.0156
	0.0184	0.0190	0.0172	0.0160	0.0140	0.0130

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	3733984.	100.00
RUNOFF	0.011	(0.014)	1035.	0.03
EVAPOTRANSPIRATION	31.186	(2.865)	2865250.	76.73
LATERAL DRAINAGE FROM	8.8925	(3.3084)	816995.	21.88

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LAYER 4

PERCOLATION FROM LAYER 5	0.5517	(0.1590)	50689.	1.36
PERCOLATION FROM LAYER 7	0.5517	(0.1792)	50690.	1.36
PERCOLATION FROM LAYER 11	0.5519	(0.1592)	50708.	1.36
CHANGE IN WATER STORAGE	0.000	(3.536)	-4.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	220500.0
RUNOFF	0.028	2582.0
LATERAL DRAINAGE FROM LAYER 4	0.1638	15050.7
PERCOLATION FROM LAYER 5	0.0082	754.8
HEAD ON LAYER 5	5.8	
PERCOLATION FROM LAYER 7	0.0035	317.8
HEAD ON LAYER 7	0.4	
PERCOLATION FROM LAYER 11	0.0026	236.5
HEAD ON LAYER 11	0.0	
SNOW WATER	1.18	108843.8

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3405

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0667

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	1.92	0.3208

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2	5.10	0.2428
3	0.95	0.1577
4	3.21	0.0669
5	0.10	0.4000
6	0.16	0.0791
7	10.32	0.4300
8	2.82	0.2352
9	3.08	0.2570
10	0.54	0.0454
11	25.80	0.4300
SNOW WATER	0.00	

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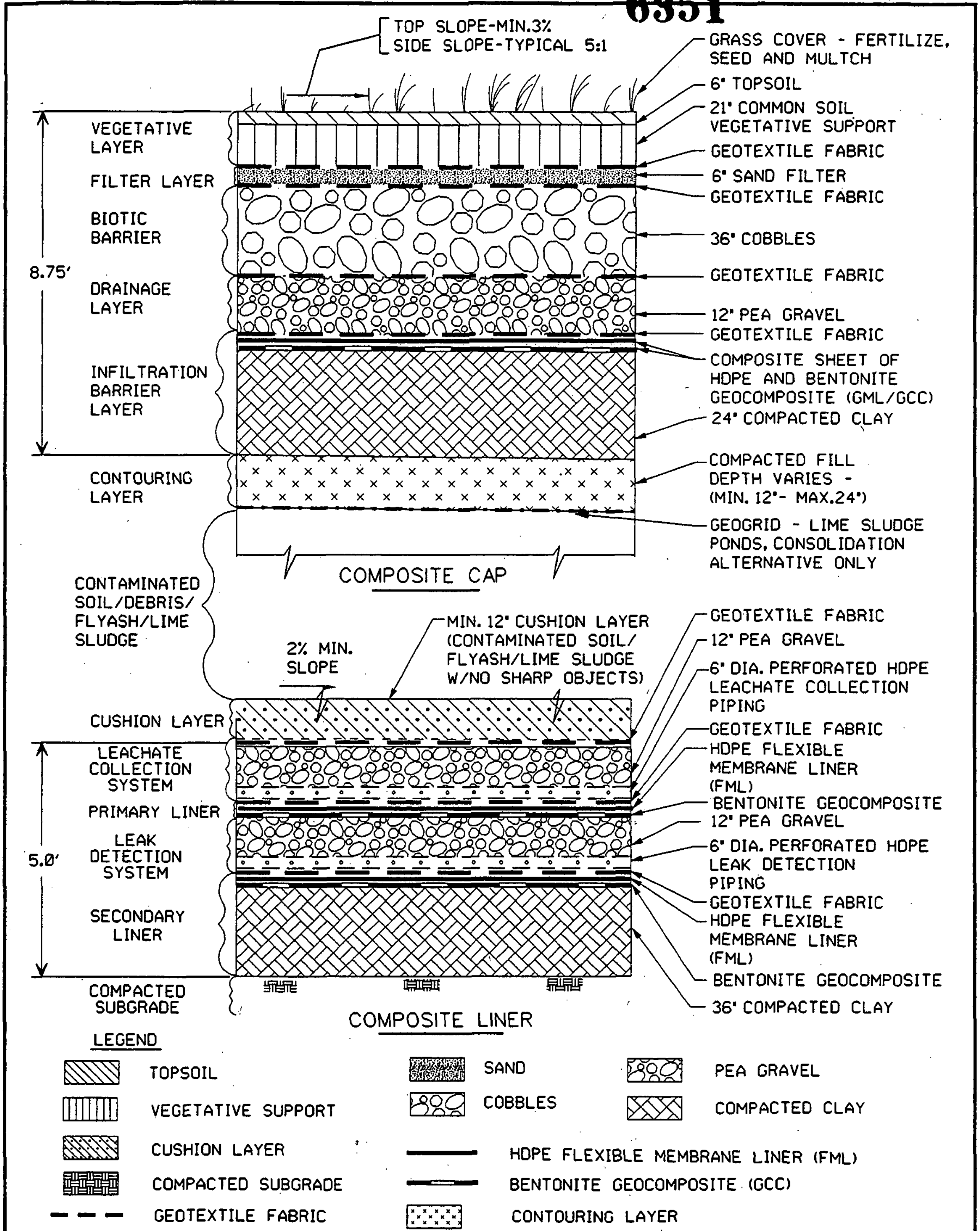

FIGURE E.6-6
TYPICAL DETAIL
COMPOSITE CAP AND LINER
(NOT TO SCALE)

000374

APPENDIX E.7

ON-SITE BORROW SOURCE

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No. 32 ~~An on-site borrow source is being considered for material to be used in the proposed on-site disposal cell.~~ An on-site borrow source is being considered for soils to be used during the construction of the proposed on-site disposal facility and for restoration of the subunits. Soils from the borrow source will be investigated for use as site restoration backfill, disposal facility cap components, and disposal facility liner components. A location in the northwest portion of the FEMP (see Figure E.7-1) has been identified as a prospective source area. As indicated by the cross sections (Figure E.7-2) the soils in this area consist of clay, gravelly clay, silt, and sand. The boring logs on which the cross sections are based are included following Figure E.7.2. Additional information is needed to adequately describe the lithology and geotechnical properties in the prospective borrow source area. Therefore, additional soil borings will be considered to obtain this information. If it is determined that this area is not adequate as a borrow source, then other on-site or off-site locations may be considered.

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