

RISK-BASED GUIDELINE VALUES

MOUND PLANT MIAMISBURG, OHIO

March 1997

**Submitted to the
Miamisburg Environmental Management Project
U.S. DEPARTMENT OF ENERGY**

**Prepared by
HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
Environmental Management and Enrichment Facilities
Managed by
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400**

Revised by EG&G Mound Applied Technologies, Inc.

**FINAL
(REVISION 4)**

DOCUMENT HISTORY AND COMMENT RESPONSES

DOCUMENT HISTORY		
Document	Revision Issue Date	Comments/Notes
Draft Rev. 1	March, 1995	
Draft Rev. 2	May, 1995	Comments from OEPA received and addressed.
Draft Rev. 3*	December, 1995	Due to several typos, this document is also known as Final Rev. 0 and Final Rev. 3
Final Rev. 0*	December, 1995	Due to several typos, this document is also known as Draft Rev. 3 and Final Rev. 3. Comments from OEPA received and addressed in Final Rev. 4
Final Rev. 1	Not used	
Final Rev. 2	Not used	
Final Rev. 3*	December, 1995	Due to several typos, this document is also known as Draft Rev. 3 and Final Rev. 0
Final Rev. 4	March, 1997	Document re-issued, incorporating additional OEPA comments on Final Rev. 0 regarding dermal exposures of construction worker to groundwater.

*This is the same document

Comments on the Final Rev. 0 Document from OEPA summarized below:

3/5/97 From OEPA correspondence

Dan Carfagno is correct with regard to earlier discussions about dermal calculations to be included in the Guideline Values. We agreed late last spring that the Guideline Values should be re-calculated with the more recent USEPA dermal guidance only for the Construction Worker scenario, and that numbers need not be calculated for the Commercial/Office Worker scenario. Dermal contact was eliminated as a viable pathway for the Commercial/Office scenario as documented on Page 30 of the Mound 2000 Residual Risk Evaluation Methodology. Hence, there is no need to include dermal numbers for the Commercial/Office Worker scenario in the Guideline Values document.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF:

September 11, 1995

HSF-5J

Mr. Arthur Kleinrath
U.S. Department of Energy
Dayton Area Office
P.O. Box 66
Miamisburg, OH 45343-0066

RE: U.S. DOE Mound Plant
Risk-Based Cleanup Guideline Values

Dear Mr. Kleinrath:

The United States Environmental Protection Agency (U.S. EPA) has completed its review of the Mound Plant Risk-Based Cleanup Guideline Values. The Guideline Values incorporate the site-specific assumptions that U.S. EPA, Ohio EPA, and U.S. DOE have agreed upon for calculating the risk to future residents and workers at or near the Mound facility. U.S. EPA has no comments on the document and considers the document approvable in its present form. It is U.S. EPA's understanding that the Ohio Environmental Protection Agency will be providing comments regarding this report under separate cover.

If you have any questions, please call me at (312) 886-5787.

Sincerely,

Timothy J. Fischer
Timothy J. Fischer
Remedial Project Manager

cc: Brian Nickel, OEPA

*COPY
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Spessard*

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State of Ohio Environmental Protection Agency

Southwest District Office

401 East Fifth Street
Dayton, Ohio 45402-2911
(513) 285-6357
FAX (513) 285-6249

George V. Volnovich
Governor

October 18, 1995

RE: US DOE MOUND
MONTGOMERY COUNTY
RISK-BASED
GUIDELINE VALUES

Mr. Arthur Kleinrath
US DOE Miamisburg Area Office
1 Mound Road
P.O. Box 66
Miamisburg, Ohio 45343-0066

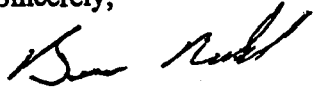
Dear Mr. Kleinrath:

The Ohio Environmental Protection Agency has reviewed the Mound *Risk-Based Guideline Values*. As Ohio EPA, US EPA and DOE Mound have agreed, the Guideline Values document is considered a primary document and will be revised in accordance with our attached comments.

A copy of equations for dermal exposure is enclosed with comments on the document. These equations are mentioned in Comment 4, and were discussed previously by Ohio EPA and DOE Mound. As indicated, the equations were obtained from the USEPA guidance mentioned in the comment. They should assist DOE Mound in responding to Comment 4.

Should there be any questions concerning the above, please contact Lisa Anderson at (513)285-6051 or me at (513)285-6468.

Sincerely,


Brian Nickel
Mound Project Manager
Office of Federal Facilities Oversight

Attachments (2)

cc: T. Fischer, USEPA Region V
M. Williams, EG&G
J. Zahora, EG&G
D. White, DOE/MB

D. Carfagno, EG&G
R. Beaumier, CO/DERR
R. Vandegrift, ODH/BRP





Department of Energy
Ohio Field Office
Miamiisburg Area Office
P.O. Box 66
Miamiisburg, Ohio 45343-0066



JAN 17 1996

Mr. Brian Nickel
Ohio Environmental Protection Agency (OEPA)
401 East Fifth Street
Dayton, OH 45402-2911

Dear Mr. Nickel:

In response to your October 18, 1995 correspondence, enclosed please find four (4) copies of comment responses for the Mound Risk-Based Guideline Values. Change pages are also enclosed to revise the document in accordance with review comments. These pages relate to the change in the document title and modification of the Soil Guideline Value Tables for the Construction/Mound Employee to reflect the change in exposure duration from 25 to 5 years.

It should be noted that preliminary copies were provided for your review on December 21, 1995. Please notify the Miamiisburg Area Office by January 31, 1996 if the responses are found to be unsatisfactory. The document and comment responses will be made available to the public.

If there are any questions, please contact Debbie White of my staff at (513) 865-5197.

Sincerely,

Arthur W. Kleinrath
Project Engineer Team Leader

Enclosures

cc w/ enclosures:
Alan Spesard, MB
Debbie White, MB
Ron Church, MB
Dick Neff, Geotech
Tim Fischer, USEPA (2)

cc w/o enclosures:
Monte Williams, EG&G
Dan Carfagno, EG&G
Jim Rigano, EG&G
Alec Bray, EG&G

US DOE MOUND
PROPOSED RISK-BASED CLEANUP GUIDELINE VALUES
OHIO EPA COMMENTS
& RESPONSE TO OHIO EPA COMMENTS
RISK-BASED GUIDELINE VALUES (REV. 2)

1. Page 9, Table 1:
Please note the discrepancies in the values for RfD/SF for the following chemicals: HMX, RDX (RfD source); Arsenic (SF missing); Cd, Cr (SFI values slightly different than in HEAST); Cu (RfD is missing but is listed in HEAST); 111-TCA (RfD in IRIS was withdrawn, but other COC withdrawn values are used - why?); Dichloromethane (SFI is listed in IRIS. Please explain in comment responses.
1. Response: As stated on p. 7 only contaminants with toxicity information have Guide Values calculated for them with only a few exceptions. The exceptions are those primary contaminants at Mound, i.e. TCE, where the last published toxicity information was used in the calculations rather than leave blanks in the tables.
2. Page 12, Table 2:
The values for SF for radionuclides do not match with the values in HEAST 1994. Please explain in comment responses.
2. Response: The November 1994 HEAST revisions to radionuclide slope factors have been incorporated in Revision 2. All radionuclide slope factors were revised in the November 1994 HEAST publication.
3. Page 18, Paragraph 3:
The text states that the uncertainty involved in the assessment of risk from the dermal pathway precludes the evaluation of the dermal pathway. However, the equations for calculation of Guideline Values for the dermal pathway have been included, on occasion. Please explain in comment responses.
3. Response: The dermal pathway has been included in the evaluation of all water exposures. The dermal pathway has not been included for soil/sediment exposures because of the uncertainties involved and a lack of values for many of the chemicals of interest.
4. Page 19, Equation 2:
Please refer to the equations in "Dermal Exposure Assessment: Principles & Applications"; EPA/600/8-91/011B, 1992 for guidance in calculating the dermally absorbed dose for contaminants of concern in surface water and ground

water. Please explain why other methods were used in calculating Guideline Values.

4. Response: The equations utilized in the Mound Guideline Value document have been under development and consideration since 1993. At that time, the dermal equations were developed to be in agreement with USEPA Region V guidance and preferred methods. The dermal methods utilized in the Mound GV document are not out of date nor are they out of favor since similar equations are used in Region I and Region IV.

There are some inherent difficulties in utilizing the equation found in the 1992 Dermal Guidance Document. The equations are not easily suited to reverse calculations for the establishment of risk-based concentrations. The square roots are particularly unwieldy to reverse. The equation as given in the dermal guidance document is also not entirely well defined. The units of tau are given in the text as "hour". This unit does not allow the equation to have a correct cancellation of units. In order to verify this equation, we had to assume that tau has units of "hours/event".

The dermal guidance document also does not have very many chemicals in the listing of values for tau and the other parameters. This will limit the usefulness of this equation as well.

We have performed some demonstration trials for a chronic residential exposure of the dermal guidance equation compared to the equations used in the Mound Guideline Value document. The inorganic equation is exactly the same as was used in the Mound document.

The use of the organic equation results in values that are generally more conservative. This is especially noted for 4,4'-DDT and bis(2-Ethylhexyl)phthalate. The justification for this need for added conservatism in a risk-based screening tool is not apparent. All other organic values are within an order of magnitude of the Mound method. The difference is not sufficient to warrant revision of the Mound Guideline Values. Also, see table (Attachment 1).

5. Page 21, Paragraph 4:
Please specify if the changes in HEAST 1994 are going to be incorporated in calculating the Guideline Values. What version (i.e. date) of HEAST and IRIS has been or will be used for the purpose of Guideline Values?

5. Response: As stated in the response to comment #2, November 1994 HEAST and March 1995 IRIS versions were used in calculating Guideline Values.
6. Tables 3.2, 3.3, 3.4, 3.5:
Please provide a reference or source for the equations used in this table, and please add as a footnote to the tables, if possible (if tables are going to be revised for other reasons).
6. Response: We assume the tables referred to are the Home Grown Produce, Beef, and Milk. The references are discussed on page 21, 3rd paragraph and are also, listed in the reference section pages 27 and 28.
7. Table 3.2.3:
Volume of house = 1200 ft²; was this value chosen through best professional judgement?
7. Response: Yes as listed on page 62 for example.
8. Table 4.1.3:
Please explain the terms ED1 and ED2 in comment responses.
8. Response: ED₁ is the exposure duration used for the inhalation and ingestion pathways. Those equations also include the exposure frequency (EF) factor of 250 days per year. ED₂ is the exposure duration used for the external exposure pathway. This equation does not include the EF factor so it is incorporated in the exposure duration factor.
9. Tables 4A through 4D:
These tables should be revised to reflect the change in Exposure duration for 25 to 5 years.
9. Response: This change is incorporated in the final version.

ATTACHMENT 1.

CATEGORY	ANALYSIS	Impact of new dermal equations water (mg/L) Risk Based Concentrations							
		10^{-1} C1DEROLD	10^{-1} C1DERNEW	10^{-4} C4DEROLD	10^{-4} C4DERNEW	10^{-5} C5DEROLD	10^{-5} C5DERNEW	10^{-6} C6DEROLD	10^{-6} C6DERNEW
Inorganics	Antimony	5.2E+00	5.8E+00						
Inorganics	Arsenic	3.9E+00	4.4E+00	2.0E+00	2.3E+00	2.0E-01	2.3E-01	2.0E-02	2.3E-02
Inorganics	Barium	9.2E+02	1.0E+03						
Inorganics	Beryllium	6.5E+01	7.3E+01	7.1E-01	7.9E-01	7.1E-02	7.9E-02	7.1E-03	7.9E-03
Inorganics	Cadmium (Water)	6.5E+00	7.3E+00						
Inorganics	Chromium III	1.3E+04	1.5E+04						
Inorganics	Chromium VI	6.5E+01	7.3E+01						
Inorganics	Cyanide	3.5E+01	3.9E+01						
Inorganics	Manganese (Water)	6.5E+01	7.3E+01						
Inorganics	Mercury	3.9E+00	4.4E+00						
Inorganics	Nickel	2.6E+02	2.9E+02						
Inorganics	Silver	6.5E+01	7.3E+01						
Inorganics	Vanadium	9.2E+01	1.0E+02						
Inorganics	Zinc	3.9E+03	4.4E+03						
Organics	1,1-Dichloroethane	1.5E+02	5.0E+01						
Organics	1,2-Dichloroethane			6.3E+00	2.2E+00	6.3E-01	2.2E-01	6.3E-02	2.2E-02
Organics	4-Methylphenol	3.6E+00	1.2E+00						
Organics	Benzene			5.0E+00	2.0E+00	5.0E-01	2.0E-01	5.0E-02	2.0E-02
Organics	Benzoic Acid	7.1E+03	2.1E+03						
Organics	Bromodichloromethane	4.5E+01	9.8E+00	8.5E+00	1.8E+00	8.5E-01	1.8E-01	8.5E-02	1.8E-02
Organics	Carbon Disulfide	5.5E+01	2.1E+01						
Organics	Carbon Tetrachloride	4.2E-01	9.6E-02	1.1E+00	2.5E-01	1.1E-01	2.5E-02	1.1E-02	2.5E-03
Organics	Chrysene			5.2E-01	7.0E-02	5.2E-02	7.0E-03	5.2E-03	7.0E-04
Organics	Di-n-butylphthalate	1.1E+01	1.1E+00						
Organics	Dibromochloromethane	6.7E+01	1.1E+01	9.3E+00	1.5E+00	9.3E-01	1.5E-01	9.3E-02	1.5E-02
Organics	Tetrachloroethene	3.5E-01	7.5E-02	1.6E-01	3.4E-02	1.6E-02	3.4E-03	1.6E-03	3.4E-04
Organics	Toluene	5.8E+01	2.1E+01						
Organics	Tribromomethane	1.0E+02	1.2E+01	1.5E+02	1.7E+01	1.5E+01	1.7E+00	1.5E+00	1.7E-01
Organics	Trichloroethylene			1.7E+01	4.7E+00	1.7E+00	4.7E-01	1.7E-01	4.7E-02
Organics	Trichlorofluoromethane	2.3E+02	6.0E+01						
Organics	Trichloromethane	1.5E+01	4.3E+00	5.6E+01	1.7E+01	5.6E+00	1.7E+00	5.6E-01	1.7E-01
Organics	bis(2-Ethylhexyl)phthalate	1.1E+01	4.9E-01	9.3E+00	4.1E-01	9.3E-01	4.1E-02	9.3E-02	4.1E-03
PAHs	Benzo(a)anthracene			5.2E-03	7.0E-04	5.2E-04	7.0E-05	5.2E-05	7.0E-06
PAHs	Benzo(a)pyrene			3.5E-04	4.1E-05	3.5E-05	4.1E-06	3.5E-06	4.1E-07
PAHs	Dibenz(a,h)anthracene			1.5E-04	1.5E-05	1.5E-05	1.5E-06	1.5E-06	1.5E-07
Pesticides/PCBs	4,4'-DDE			3.7E-02	2.7E-03	3.7E-03	2.7E-04	3.7E-04	2.7E-05
Pesticides/PCBs	4,4'-DDT	1.5E-02	8.5E-04	2.1E-02	1.2E-03	2.1E-03	1.2E-04	2.1E-04	1.2E-05



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF:

April 9, 1996

SRF-5J

Mr. Arthur Kleinrath
U.S. Department of Energy
Miamisburg Area Office
1 Mound Road
P.O. Box 66
Miamisburg, OH 45343-0066

RE: U.S. DOE Mound Plant
Guideline Values Document

RECEIVED
OHIO EPA
APR 11 1996
SOUTHWEST DISTRICT

Dear Mr. Kleinrath:

During a conversation on March 21, 1996, between DOE Mound, USEPA Region 5, and the Ohio Environmental Protection Agency (OEPA), USEPA and OEPA addressed the Mound Guideline Values document and the revision of some of the values under the Mound construction worker exposure scenario in Appendix B of the document. Based on the conversation, we request that the risk levels for dermal exposure to the groundwater exposure pathway for a construction worker be recalculated using the most recent USEPA guidance. The guidance includes chemical-specific permeability constants for numerous organic and inorganic compounds, as well as new default constants, all based on recent research.

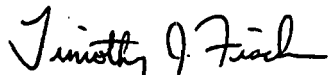
The appropriate equations are referenced in the USEPA document, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance Dermal Risk Assessment Interim Guidance, dated August 1992, on page 2. A more detailed version of the equations, along with the new chemical-specific permeability constants, are provided in the document Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B, 1992. Please use the equations found in this document to recalculate the above-mentioned Guideline Values. The proper calculation can be obtained by using Equation 6.18 in the document. If you do not have the document, we will supply it to you.

16 APR 96 9:51

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Once the calculations are complete and the Guideline Values are revised accordingly, we will consider the document to be final. Should you have any questions or need further information, please contact Tim Fischer at (312) 886-5787 or Brian Nickel at (513) 285-6468.

Sincerely,



Timothy J. Fischer
Remedial Project Manager



Brian Nickel
Mound Project Manager
Office of Federal Facilities Oversight

cc: M. Williams, EG&G
J. Zahora, EG&G
D. Carfagno, EG&G
D. White, DOE/MB
Y. Feng, OEPA/CO

RISK-BASED GUIDELINE VALUES

**MOUND PLANT
MIAMISBURG, OHIO**

March 1997

**Submitted to the
Miamisburg Environmental Management Project
U.S. DEPARTMENT OF ENERGY**

**Prepared by
HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
Environmental Management and Enrichment Facilities
Managed by
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
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Revised by EG&G Mound Applied Technologies, Inc.

**FINAL
(REVISION 4)**

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ACRONYMS AND INITIALISMS

ARARs	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
CASRN	Chemical Abstracts Service Registry Number
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	Department of Energy
EPA	Environmental Protection Agency
GVs	Guideline Values
HEAST	Health Effects Assessment Summary Tables
IRIS	Integrated Risk Information System
NFA	No Further Action
PA/SI	Preliminary Assessment/Site Inspection
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PRGs	Preliminary Remediation Goals
RAGS	Risk Assessment Guidance for Superfund
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RfD	Reference Dose
SF	Cancer Slope Factor
VF	Volatilization Factor
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

This report presents and explains risk-based cleanup guideline values (GVs) developed specifically for the Department of Energy Mound Plant in Miamisburg, Ohio. These GV's are developed by using *Risk Assessment Guidance for Superfund (RAGS): Volume 1 - Human Health Evaluation Manual, Part B - Development of Risk-Based Preliminary Remediation Goals* (EPA 1991a). In addition, the most recently published EPA toxicity data (IRIS- first quarter 1995, HEAST- November, 1994) have been incorporated into these calculations. The GV's are risk-based media-specific contaminant concentrations derived for specific carcinogenic risk levels (e.g., 10^{-4} , 10^{-5} , 10^{-6}) and noncarcinogenic chronic and subchronic effect levels (Hazard Index = 1) that are applicable to land use/exposure scenarios likely to occur at the Mound Plant.

The GV's are intended to be used as an internal site evaluation/prioritization decision-making tool for project managers, risk assessors, and others involved in making risk assessment and risk management decisions during site characterization and remediation. Once accepted by the regulators, these GV's can be used as a screening tool (for sites with adequate site characterization data) to rapidly assess the potential for "no action" decisions. The GV's alone cannot be used as final remediation levels; however, after considering the applicable or relevant and appropriate requirements (ARARs) and the results of the baseline risk assessment, final remediation levels can be established in the Record of Decision (ROD). The sitewide applicability of these GV's will significantly streamline the Preliminary Remediation Goal (PRG) development process by minimizing the efforts required to develop site-specific PRGs for each operable unit.

It is important to understand that the focus of this report is on the use of GV's for the development of PRGs. These calculations reflect Mound site-specific parameters, which include contaminants of potential concern, physical and chemical characteristics of contaminated media, potential current and future land uses, and exposure pathway assumptions. Application of these GV's, and ultimately the PRGs developed for Mound, is not directly applicable to other facilities without significant modification for site-specific parameters.

1. INTRODUCTION

1.1 INTENDED USE OF GUIDELINE VALUES

The purpose of this report is to present and explain sitewide risk-based cleanup Guideline Values (GVs) prepared for developing Preliminary Remediation Goals (PRGs) for the Department of Energy (DOE) Mound Plant in Miamisburg, Ohio. This report establishes the methodology used for developing the chemical-specific GV's based on Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) criteria for the protection of human health. The GV's developed in this document are site-specific to the Mound Plant and follow the U.S. Environmental Protection Agency (EPA) guidance, *Risk Assessment Guidance for Superfund (RAGS): Volume 1 - Human Health Evaluation Manual, Part B - Development of Risk-Based Preliminary Remediation Goals* (EPA 1991a) and revisions (Dinan 1992) hereafter referred to as *RAGS - Part B*. The EPA risk assessment guidance provides the methodology for using EPA toxicity values and exposure information to derive risk-based PRGs.

The general approach for developing remediation goals is to identify potential PRGs in the scoping phase of the Remedial Investigation/Feasibility Study (RI/FS), modify them as needed at the end of the RI or during the FS (based on site-specific information from the baseline risk assessment), and finally select remediation levels in the Record of Decision (ROD). To support the development of chemical-specific PRGs for the Mound Plant, information on the potential contaminants of concern present on-site, specific contaminated media of concern, land-use assumptions, and exposure assumptions were incorporated into risk-based media-specific contaminant concentrations. The GV's developed in this report represent the media-specific risk-based concentrations applicable to the Mound Plant. Throughout this report, the term "chemical-specific" is used to refer to both nonradioactive and radioactive contaminants.

Chemical-specific PRGs are concentration goals for individual chemicals for specific media and land-use combinations at hazardous waste sites. The two general sources of chemical-specific PRGs are (1) concentrations based on applicable or relevant and appropriate requirements (ARARs) and (2) concentrations based on risk assessment. ARARs include contaminant concentration limits set by other environmental regulations (e.g., nonzero Maximum Contaminant Level goals). The second source for PRGs, and the focus of this report, is risk assessment or risk-based calculations that set media-specific concentration limits using carcinogenic and/or noncarcinogenic toxicity values under specific exposure conditions. The development of GV's represents the first step in the Mound Plant PRG development process. These GV's cannot be considered PRGs until the complete PRG identification and approval process is complete. The chemical-specific GV's developed in this report are intended to be used as an internal site evaluation and prioritization decision-making tool to aid project managers, risk assessors, and others involved in site characterization and remediation in developing PRGs. Once accepted by the regulators, these GV's can also be used as a screening tool (for sites with adequate site characterization data) to rapidly assess the need for further evaluation of a site (i.e., a baseline risk assessment) or to confirm that a site is a likely candidate for "no action" consideration. The GV's presented in this report do not constitute a final or stand-alone decision-making tool. A GV is considered as a final remediation level only after appropriate analysis in the RI/FS and ROD documents.

1.2 REPORT ORGANIZATION

Section 2 presents an overview of the methodology used to develop sitewide GVs for the Mound Plant. This section also describes the application of EPA guidance in the development of GVs.

Section 3 is divided into four subsections that describe the process used to develop the GVs presented in this report. SubSection 3.1 identifies site-specific media of concern and contaminants of concern. SubSection 3.2 identifies the exposure pathways evaluated in the development of the site-specific GVs and outlines a conceptual site model for the Mound Plant. SubSection 3.3 gives a description of the exposure scenarios evaluated. SubSection 3.4 provides a discussion of exposure parameters and equations used in the development of the GVs at Mound.

Section 4 discusses the sitewide implementation and use of the GV methodology developed for the Mound Plant.

Section 5 identifies source materials cited in the report.

Appendix A contains the equations and exposure variables used to calculate the GVs. All input parameters are listed with references to document their applicability to the Mound Plant.

Appendix B presents a table of the calculated risk-based chemical- and media-specific GVs for each receptor population (i.e., residential, recreational, etc.) evaluated.

Appendix C presents a simplified method for estimating risk from inhalation of tritiated household water.

Appendix D presents groundwater exposure calculations for the construction worker incorporating revised dermal calculations.

2. USE OF EPA METHODOLOGY IN DEVELOPING GUIDELINE VALUES

The purpose of developing GVs is to assist risk assessors, remedial project managers, and others involved with risk assessment and management at CERCLA sites in the development of PRGs. EPA's *RAGS - Part B* (EPA 1991a, Dinan 1992) provides the basis for developing the PRGs and is the second part of EPA's three-part risk assessment guidance. The site-specific baseline risk assessment methodology for use at CERCLA sites is defined in *Risk Assessment Guidance for Superfund (RAGS): Volume I - Human Health Evaluation Manual, Part A* (EPA 1989). The evaluation of remedial alternatives and human health risks associated with the selected remedial alternative during and after its implementation is presented in *Risk Assessment Guidance for Superfund (RAGS): Volume I - Human Health Evaluation Manual, Part C - Risk Evaluation of Remedial Alternatives* (EPA 1991b). Much of the information in the *RAGS - Part A* (EPA 1989) guidance contains useful background information for the *RAGS - Part B* (EPA 1991a) document.

PRGs provide remedial design staff with long-term targets to use during analysis and selection of remedial alternatives. Chemical-specific concentration goals for specific media and selected land-use conditions at CERCLA sites are defined as PRGs. Ultimately, these goals, if achieved, should comply with ARARs and result in residual risks that meet regulatory requirements for the protection of human health.

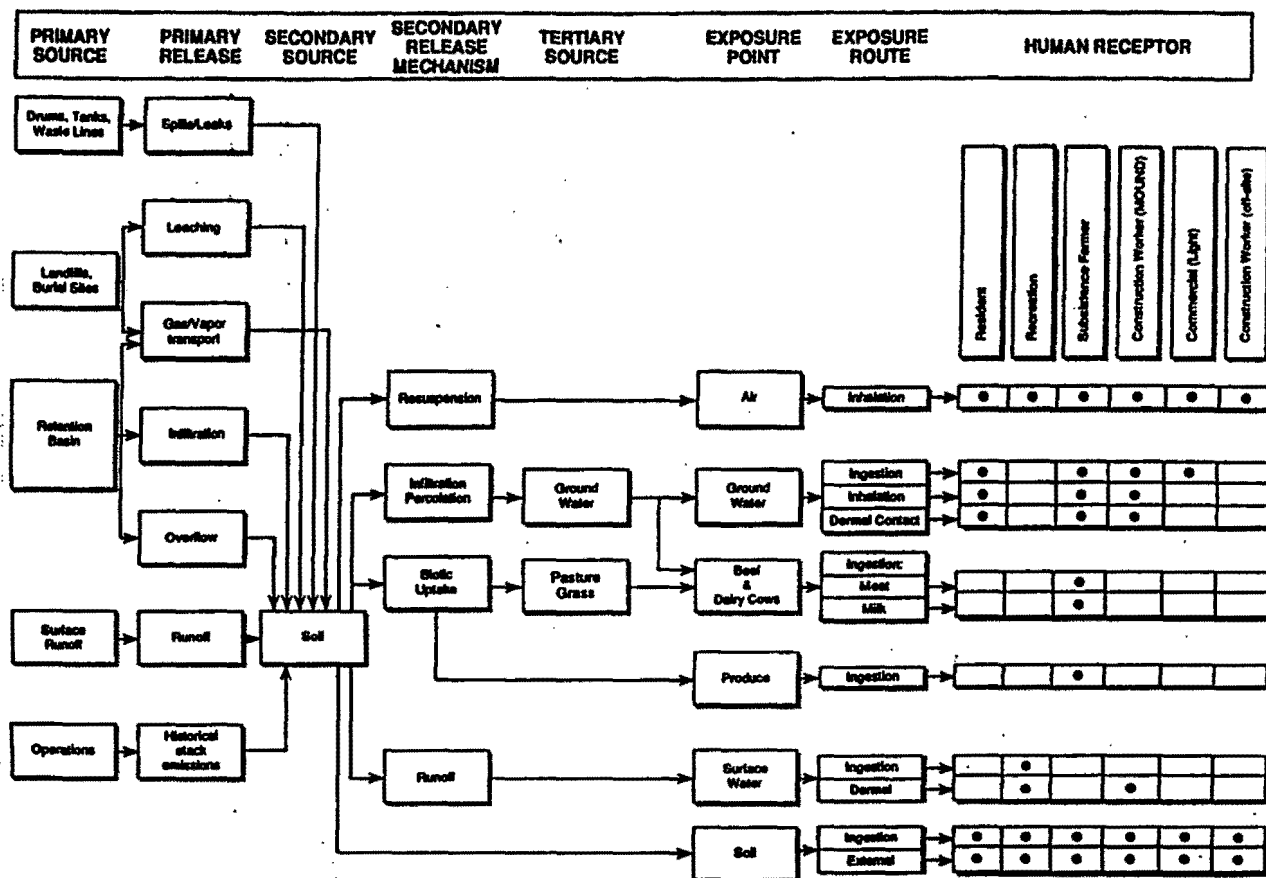
The four main steps in the initial development of chemical-specific risk-based PRGs are as follows:

Step one in the development of PRGs is to identify the media of potential concern. The media of concern can be either (1) currently contaminated media to which individuals may be exposed or through which chemicals may be transported to potential receptors or (2) currently uncontaminated media that may become contaminated in the future because of contaminant transport. Media of concern at the Mound Plant for which GVs were developed were soil, sediment, groundwater, and surface water.

A conceptual site model is useful in this initial step of the PRG process. Conceptual site models originally were developed to aid in planning site activities; however, they also contain information that is valuable for identifying PRGs. They are used to identify all potential or suspected sources of contamination, types and concentrations of contaminants detected at a site, potentially contaminated media, and potential exposure pathways, including receptors. The conceptual site model used in the development of the GVs presented in this report is shown in Figure 1.

Step two in the process involves developing an initial list of potential contaminants of concern for which PRGs need to be developed. This list should include any contaminant reasonably expected to be of concern at a site based on information available at the time of scoping. Contaminants previously detected at the site during the Preliminary Assessment/Site Inspection (PA/SI), in the conceptual site model, or during other prior site investigations that have been conducted should be included in the list. Additionally, the list may include chemicals that site history indicates are likely to be present in significant quantities, although these contaminants may not yet be detected at the site. Sources of this latter type include records of chemicals used or disposed of at a facility and interviews with current or former employees. In general, the contaminants of concern for which PRGs should be developed will correspond to the list of suspected site contaminants included in the sampling and analysis plan.

Fig. 1. Conceptual Site Model.



Step three in the development of PRGs is the identification of the most appropriate future land use for the site so that the appropriate exposure pathways, parameters, and equations can be selected to develop risk-based PRGs. *RAGS - Part A* (EPA 1989) and the EPA guidance document, *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (EPA 1991c), provide additional guidance on identifying future land use. The standard default equations for the calculation of GVs provided in *RAGS - Part B* (EPA 1991a, Dinan 1992) address the residential and commercial/industrial land uses. For land uses other than these (i.e., recreational or subsistence farmer), exposure pathways, parameters, and equations were developed specifically for the Mound Plant. As a rule, residential areas are assumed to remain residential. Sites that are surrounded by or are near operating industrial facilities are assumed to remain industrial areas.

Step four in the PRG development process involves the identification of appropriate exposure pathways at a site. This step involves the development of a conceptual site model; the identification of environmental transport pathways; the identification of exposure routes; and the identification of the most appropriate exposure scenarios, exposure equations, and input parameters. Site-specific exposure parameters are used when information is readily available.

Site-specific exposure scenarios and their corresponding assumptions were developed based on various land-use classifications. *RAGS - Part A* (EPA 1989), *RAGS - Part B* (EPA 1991a), and the EPA guidance document, *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual, Supplemental Guidance, "Standard Default Exposure Factors"* (EPA 1991d) provide guidance on the determination of appropriate exposure scenarios and assumptions useful in the development of PRGs.

The existence of completed or potential exposure pathways are evaluated for the contaminated media associated with current and future land-use conditions. It involves identifying appropriate contaminant transport pathways and routes of exposure (e.g., residential ingestion of drinking water), exposure parameters (e.g., 2 liters/day of water ingested), and exposure equations (e.g., to incorporate intake). The exposure equations include calculations of total intake from a given medium and are based on the identified exposure pathways and associated parameters. When GVs are developed, readily available site-specific information may be adequate to identify and develop the exposure pathways, parameters, and equations at a site. In the absence of readily available site-specific information, the standard default information contained in *RAGS - Part A* (EPA 1989), *RAGS - Part B* (EPA 1991a), and *RAGS - "Standard Default Exposure Factors"* (EPA 1991d) is used for the development of the GVs.

The recommended approach for the development of remediation goals at the Mound Plant is to identify risk-based PRGs at the scoping stage of the RI/FS and to modify them as needed at the end of the RI or during the FS based on ARARs and site-specific information from the baseline risk assessment. Once modified, PRGs can be finalized, allowing remediation levels to be established in the ROD. The establishment of PRGs facilitates the development of the range of appropriate remedial alternatives and can focus selection on the most effective remedy.

Throughout this report the term GV is used to emphasize that the risk-based media-specific concentrations provided in this report are not PRGs. The GVs provide the basis for site-specific PRG development and are applicable throughout the Mound Plant. As a result, risk-based PRG development during scoping is reduced from an eight-step process at each waste site to a two-step process. The two-step process consists of comparing GVs to site-specific ARARs and selecting ARARs as PRGs where appropriate. In addition, the GVs can be used out of context from the PRG development process as a tool for preliminary screening of contaminants of concern during the early

stages of an RI/FS, thus possibly resulting in the removal of specific contaminants, exposure pathways, or entire sites from further investigation.

The development of GVs for the Mound Plant required the following site-specific data: (1) media of potential concern, (2) contaminants of potential concern, and (3) probable future land use. This type of information was obtained from the *RI/FS for Mound Operable Unit 9/Sitewide Work Plan* (DOE 1992a), the *RI/FS for Mound Operable Unit 9/Sitewide Preliminary Baseline Risk Assessment* (DOE 1992b), the *Draft Work Plan for Environmental Studies in the Vicinity of the Mound Plant* (ATSDR 1993), and the conceptual site model developed for the Mound Site (Figure 1). The GVs are calculated using EPA health criteria [i.e., reference doses (RfD) and cancer slope factors (SF)] and default or site-specific exposure assumptions. An RfD is EPA's preferred toxicity value for evaluating noncarcinogenic effects resulting from exposure to environmental contaminants. The two types of RfD toxicity values used by EPA for evaluating noncarcinogenic health effects are subchronic and chronic. A subchronic RfD is an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without appreciable risk of deleterious effects during a portion of a lifetime (2 weeks to 7 years). A chronic RfD is an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects and is specifically developed to be protective for long-term exposure to a contaminant (7 years to lifetime).

An SF is EPA's preferred toxicity value for evaluating the carcinogenic effects resulting from exposure to environmental contaminants. SFs are used to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a known or potential carcinogen. Chemical-specific RfDs and SFs can be found in EPA's Health Effects Assessment Summary Tables (HEAST) (EPA 1994) and on EPA's Integrated Risk Information System (IRIS) on-line data base (EPA 1995).

GVs are initial guidelines; they do not establish that cleanup is warranted to meet these goals. As a result, during a site-specific RI/FS, the initial list of chemical-specific PRGs may need to be revised or modified as new RI/FS data become available. Upon completion of a final baseline risk assessment, it is important to review the media and contaminants of potential concern, land use, and exposure assumptions originally identified at scoping. Some chemicals may be added or dropped from the list, and PRGs may need to be recalculated using site-specific exposure factors. Ultimately, GVs are modified to be used as PRGs based on the results of a final baseline risk assessment, which establishes the threshold criteria for protection of human health and compliance with ARARs.

Final remediation levels are not determined until the site remedy is ready to be selected. PRGs are refined throughout this process, and the final remediation levels are then set out in the ROD. The ROD should include a statement identifying final remediation levels based on these goals. In the ROD, it is preferable to use the term remediation level, rather than remediation goal, to make clear that the selected remedy establishes binding requirements. When using GVs, the remedial design engineers should understand that these GVs may be modified depending on additional information gathered about the site.

The subsequent process of identifying key site contaminants, media, and other factors (i.e., during a baseline risk assessment) may require that the focus of an RI/FS be shifted (e.g., chemicals without ARARs may become more or less important). Therefore, the design of remedial alternatives should remain flexible until the GVs are modified and final PRGs are available.

3. DEVELOPMENT OF GUIDELINE VALUES

3.1 MEDIA AND CONTAMINANTS OF CONCERN

Air, groundwater, soil, sediment, and surface water were evaluated as potentially contaminated media at the Mound Plant. Contaminants of concern in these media are defined as those that are potentially site-related based on data compiled from the *RI/FS Operable Unit 9 Sitewide Work Plan* (DOE 1992a), the *RI/FS Operable Unit 9 Sitewide Preliminary Baseline Risk Assessment* (DOE 1992b), and the *Draft Work Plan for Environmental Studies in the Vicinity of the Mound Plant* (ATSDR 1993). Only contaminants with toxicity information have GVs calculated for them. The contaminants of concern are listed in Tables 1 and 2 by chemical classes:

- organic contaminants generally considered to be of human origin;
- high explosive (organic) contaminants;
- inorganic or metallic contaminants, many of which are naturally occurring;
- polycyclic aromatic hydrocarbons (PAHs), semivolatile organic compounds associated with the process of burning;
- pesticides and polychlorinated biphenyls (PCBs) commonly used in electrical equipment as insulating fluids; and
- radionuclides, some of which are naturally occurring.

This document considers radioactive decay products by using the decay chain SFs found in the HEAST (EPA 1994). The decay chain SFs are designated by the "+D" after the radionuclide. Table 3 is a reproduction of the HEAST decay chains. Radionuclide GVs are reported in activity units of picocuries (pCi) for each environmental media rather than by units of mass (grams). These radionuclide guideline values are based on risk at certain environmental levels only. No dose calculations have been performed.

3.2 IDENTIFICATION OF EXPOSURE PATHWAYS

An exposure pathway is the course that a chemical or physical agent takes from a source to an exposed organism. Exposure pathways at the Mound Plant are outlined in the conceptual site model (Figure 1). Each exposure pathway describes a unique mechanism by which a population may be exposed to the chemicals at or originating from the site. Exposure pathways are identified based on consideration of the sources, releases, types, and locations of chemicals at the site; the likely environmental fate of the chemicals; and the location and activities of the potentially exposed populations.

The conceptual site model for the Mound Plant is based on the *RI/FS Operable Unit 9 Sitewide Work Plan* (DOE 1992a) but is not an exact duplication. The model was used to assess the nature and extent of contamination. It also identifies potential contamination sources, exposure pathways, and human receptors. An additional receptor was added to allow for short-term construction work by off-site contractors. Pathways that were considered to be not significant for the screening process by virtue of uncertainties the methodology or likelihood of completion were not included.

Table 1. Parameters for Chemicals of Concern.

CHEMICAL	CASRN	Oral SF (mg/kg-day) ⁻¹	Inhalation SF (mg/kg-day) ⁻¹	Oral RfD Chronic (mg/kg-day)	Oral RfD Subchronic (mg/kg-day)	Inhalation RfC Chronic (mg/m ³)	Inhalation RfD Chronic (mg/kg-day)	Volatilization Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)	Permeability Constant (cm/hr)	Soil to Plant Uptake (B, DRY) ¹ (unitless)	Soil to Plant Uptake (B, WET) ¹ (unitless)	Transfer Coefficient for Milk (F _m) ¹ (day/kg)	Transfer Coefficient for Beef (F _b) ¹ (day/kg)
High Explosives														
HMX	002691-41-0			5.0E-02							1.8E+01	4.4E+00	3.1E-08	9.8E-08
PETN														
RDX	000121-82-4	1.1E-01		3.0E-03	3.0E-03						4.9E-01	1.2E-01	1.5E-05	4.8E-05
Inorganics														
Aluminum														
Antimony	007440-36-0			4.0E-04	4.0E-04					1.0E-03	5.0E-02 ^a	1.0E-02 ^a	2.5E-05 ¹	4.0E-05 ¹
Arsenic	007440-38-2		5.0E+01	3.0E-04	3.0E-04					1.0E-03	6.0E-03	1.5E-03	6.0E-05	2.0E-03
Barium	007440-39-3			7.0E-02	7.0E-02	5.0E-04	1.4E-04			1.0E-03	1.0E-01 ^a	1.0E-02 ^a	4.8E-04 ¹	2.3E-04 ¹
Beryllium	007440-41-7	4.3E+00	8.4E+00	5.0E-03	5.0E-03					1.0E-03	1.9E-03	4.7E-04	2.0E-06	8.0E-04
Cadmium (Diet)	007440-43-9		6.1E+00	1.0E-03						1.0E-03	1.5E-01	3.8E-02	1.0E-03	4.0E-04 ¹
Cadmium (Water)	007440-43-9		6.1E+00	5.0E-04						1.0E-03	1.5E-01	3.8E-02	1.0E-03	4.0E-04 ¹
Chromium III	016063-83-1			1.0E+00	1.0E+00					1.0E-03	4.0E-02 ^a	1.0E-02 ^a	1.0E-05 ¹	9.0E-03 ¹
Chromium VI	018540-29-9		4.1E+01	5.0E-03	2.0E-02					1.0E-03	4.0E-02 ^a	1.0E-02 ^a	1.0E-05 ¹	9.0E-03 ¹
Cobalt														
Copper	007440-50-8									1.0E-03	2.5E-01	6.3E-02	1.5E-03	9.0E-03 ¹
Cyanide	000057-12-3			2.0E-02	2.0E-02					7.5E-03	5.4E+01	1.4E+01	4.4E-09	1.4E-08
Iron														
Lead	007439-92-1									1.0E-03	3.2E-03	8.0E-04	2.5E-04	4.0E-04 ¹
Lithium														
Manganese (Diet)	007439-96-5			1.4E-01	1.4E-01	5.0E-05	1.4E-05			1.0E-03	3.0E+00 ^a	4.0E-01 ^a	3.0E-05 ¹	5.0E-04 ¹
Manganese (Water)	007439-96-5			5.0E-03	5.0E-03	5.0E-05	1.4E-05			1.0E-03	3.0E+00 ^a	4.0E-01 ^a	3.0E-05 ¹	5.0E-04 ¹
Mercury	007439-97-6			3.0E-04	3.0E-04	3.0E-04	8.6E-05			1.0E-03	1.0E+00 ^a	3.0E-01 ^a	4.7E-04 ¹	1.0E-02 ^a
Nickel	007440-02-0			2.0E-02	2.0E-02					1.0E-03	2.0E-01 ^a	5.0E-02 ^a	1.6E-02 ¹	5.2E-03 ¹

Table 1. (continued)

CHEMICAL	CASRN	Oral SF (mg/kg-day) ⁻¹	Inhalation SF (mg/kg-day) ⁻¹	Oral RfD Chronic (mg/kg-day)	Oral RfD Subchronic (mg/kg-day)	Inhalation RfC Chronic (mg/m ³)	Inhalation RfD Chronic (mg/kg-day)	Volatilization Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)	Permeability Constant (cm/hr)	Soil to Plant Uptake (B, DRY) ¹ (unitless)	Soil to Plant Uptake (B, WET) ¹ (unitless)	Transfer Coefficient for Milk (F _m) ¹ (day/kg)	Transfer Coefficient for Beef (F _b) ¹ (day/kg)
Silver	007440-22-4			5.0E-03	5.0E-03					1.0E-03	1.0E+00 ^a	2.0E-01 ^a	5.0E-05 ¹	3.0E-03 ¹
Thallium														
Vanadium	007440-62-2			7.0E-03	7.0E-03					1.0E-03	5.2E-03	1.3E-03	1.0E-03	2.3E-03
Zinc	007440-66-6			3.0E-01	3.0E-01					1.0E-03	1.0E+00 ^a	4.0E-01 ^a	1.0E-02 ^a	1.0E-01 ^a
Organics														
1,1,1-Trichloroethane	000071-55-6							1.7E+04		1.7E-02	1.4E+00	3.5E-01	2.5E-06	7.9E-06
1,1-Dichloroethane	000075-34-3			1.0E-01	1.0E+00	5.0E-01	1.4E-01	1.1E+01	1.4E+05	8.9E-03	3.6E+00	8.9E-01	4.9E-07	1.5E-06
1,2-Dichloroethane	000107-06-2	9.1E-02	9.1E-02					2.1E+04	6.7E+02	5.3E-03	5.4E+00	1.4E+00	2.4E-07	7.6E-07
1,2-trans-Dichloroethylene	000156-60-5			2.0E-02	2.0E-01						2.0E+01	5.1E+00	2.4E-08	7.6E-08
2-Butanone	000078-93-3			6.0E-01	2.0E+00	1.0E+00	2.9E-01	2.5E+04	9.3E+03	1.1E-03	2.7E+01	6.7E+00	1.5E-08	4.7E-08
2-Hexanone														
2-Methylnaphthalene														
4-Methyl-2-Pentanone	000108-10-1			8.0E-02	8.0E-01	8.0E-02	2.3E-02	6.5E+04	7.0E+02	3.3E-03	1.5E+01	3.7E+00	4.2E-08	1.3E-07
4-Methylphenol	000106-44-5			5.0E-03	5.0E-03					1.8E-02	3.0E+00	7.4E-01	6.8E-07	2.1E-06
Acetone	000067-64-1			1.0E-01	1.0E+00					5.7E-04	5.3E+01	1.3E+01	4.6E-09	1.5E-08
Benzene	000071-43-2	2.9E-02	2.9E-02					1.9E+04	4.9E+02	2.1E-02	2.3E+00	5.8E-01	1.0E-06	3.3E-06
Benzoic Acid	000065-83-0			4.0E+00	4.0E+00					7.3E-03	3.2E+00	8.0E-01	5.9E-07	1.9E-06
Bromodichloromethane	000075-27-4	6.2E-02		2.0E-02	2.0E-02					5.8E-03	2.0E+00	4.9E-01	1.4E-06	4.4E-06
Butyl benzyl phthalate	000085-68-7			2.0E-01	2.0E+00									
Carbon Disulfide	000075-15-0			1.0E-01	1.0E-01	1.0E-02	2.9E-03	2.0E+04	1.7E+03	2.4E-02	2.7E+00	6.8E-01	7.9E-07	2.5E-06
Carbon Tetrachloride	000056-23-5	1.3E-01	5.3E-02	7.0E-04	7.0E-03			1.9E+04	1.0E+03	2.2E-02	1.2E+00	2.9E-01	3.5E-06	1.1E-05
Chloroethane	000075-00-3					1.0E+01	2.9E+00	1.9E+03	1.6E+02	8.0E-03	5.8E+00	1.4E+00	2.1E-07	6.8E-07
Chrysene	000218-01-9	7.3E-03								8.1E-01	2.2E-02	5.5E-03	3.2E-03	1.0E-02
Cresols														
Di-n-butylphthalate	000084-74-2			1.0E-01	1.0E+00					1.2E-01	2.2E-02	5.6E-03	3.2E-03	1.0E-02

Table 1. (continued)

CHEMICAL	CASRN	Oral SF (mg/kg-day) ⁻¹	Inhalation SF (mg/kg-day) ⁻¹	Oral RfD Chronic (mg/kg-day)	Oral RfD Subchronic (mg/kg-day)	Inhalation RfC Chronic (mg/m ³)	Inhalation RfD Chronic (mg/kg-day)	Volatilization Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)	Permeability Constant (cm/hr)	Soil to Plant Uptake (B, DRY) ¹ (unitless)	Soil to Plant Uptake (B, WET) ¹ (unitless)	Transfer Coefficient for Milk (F _m) ¹ (day/kg)	Transfer Coefficient for Meat (F _m) ¹ (day/kg)
Di-n-octylphthalate	000117-84-0			2.0E-02	2.0E-02						7.6E-05	1.9E-05	5.9E+01	1.9E+02
Dibromochloromethane	000124-48-1	8.4E-02		2.0E-02	2.0E-01					3.9E-03	2.4E+00	6.0E-01	9.8E-07	3.1E-06
Dichloromethane	000075-09-2	7.5E-03		6.0E-02	6.0E-02	3.0E+00	8.6E-01	9.3E+03	1.0E+03	4.5E-03	6.9E+00	1.7E+00	1.6E-07	5.0E-07
Diethyl benzene, 1,4-														
Ethyl benzene	000100-41-4			1.0E-01		1.0E+00	2.9E-01	2.1E+04	4.8E-01	7.4E-02	5.9E-01	1.5E-01	1.1E-05	3.5E-05
Hexane	000110-54-3			6.0E-02	6.0E-01	2.0E-01	5.7E-02	6.1E+03	9.1E+01		2.4E-01	5.9E-02	5.4E-05	1.7E-04
Isophorone	000078-59-1	9.5E-04		2.0E-01	2.0E+00					4.4E-03	1.9E+00	4.8E-01	1.4E-06	4.6E-06
Methyl iodide														
N-nitroso-diphenylamine	000086-30-6	4.9E-03								2.0E-02	6.0E-01	1.5E-01	1.1E-05	3.4E-05
Pentachlorophenol	000087-86-5	1.2E-01		3.0E-02	3.0E-02					6.5E-01	5.0E-02	1.2E-02	7.9E-04	2.5E-03
Phenol	000108-93-2			6.0E-01	6.0E-01					5.5E-03	5.6E+00	1.4E+00	2.3E-07	7.2E-07
Tetrachloroethene	000127-18-4			1.0E-02	1.0E-01					3.7E-01	1.2E+00	3.0E-01	3.2E-06	1.0E-05
Toluene	000108-88-3			2.0E-01	2.0E+00	4.0E-01	1.1E-01	2.5E+04	2.5E+02	4.5E-02	1.0E+00	2.6E-01	4.3E-06	1.3E-05
Tri bromomethane	000075-23-2	7.9E-03	3.9E-03	2.0E-02	2.0E-01					2.6E-03	1.6E+00	4.0E-01	2.0E-06	6.3E-06
Trichloroethylene	000079-01-6	1.1E-02	6.0E-03					1.9E+04	4.4E+02	1.6E-02	1.6E+00	4.1E-01	1.9E-06	6.0E-06
Trichlorofluoromethane	000075-69-4			3.0E-01	7.0E-01	7.0E-01	2.0E-01	5.8E+03	7.3E+02	1.7E-02	1.3E+00	3.3E-01	2.7E-06	8.5E-06
Trichloromethane	000067-66-3	6.1E-03	8.1E-02	1.0E-02	1.0E-02			1.8E+04	1.5E+03	8.9E-03	2.8E+00	7.0E-01	7.4E-07	2.3E-06
Xylene	001330-20-7			2.0E+00							5.1E-01	1.3E-01	1.4E-05	4.6E-05
bis(2-Ethylhexyl)phthalate	000117-81-7	1.4E-02		2.0E-02	2.0E-02					2.3E-02	1.7E+01	4.3E+00	3.3E-08	1.0E-07
PAHs														
Acenaphthylene														
Anthracene	000120-12-7			3.0E-01	3.0E+00					2.2E-01	1.0E-01	2.6E-02	2.2E-04	7.1E-04
Benzo(a)anthracene	000056-53-3	7.3E-01								8.1E-01	2.2E-02	5.6E-03	3.2E-03	1.0E-02
Benzo(a)pyrene	000050-32-8	7.3E+00								1.2E+00	1.2E-02	3.0E-03	9.1E-03	2.9E-02
Benzo(b)fluoranthene	000205-99-3	7.3E-01								1.2E+00	1.2E-02	3.0E-03	9.1E-03	2.9E-02

Table 1. (continued)

CHEMICAL	CASRN	Oral SF (mg/kg-day) ¹	Inhalation SF (mg/kg-day) ¹	Oral RfD Chronic (mg/kg-day)	Oral RfD Subchronic (mg/kg-day)	Inhalation RfC Chronic (mg/m ³)	Inhalation RfD Chronic (mg/kg-day)	Volatilization Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)	Permeability Constant (cm/hr)	Soil to Plant Uptake (B, DRY) ¹ (unitless)	Soil to Plant Uptake (B, WET) ¹ (unitless)	Transfer Coefficient for Milk (F _m) ¹ (day/kg)	Transfer Coefficient for Beef (F _b) ¹ (day/kg)
Benzo(a,h)perylene	000191-24-2									1.8E+00				
Benzo(k)fluoranthene	000207-08-9	7.3E-02								6.0E-01	1.2E-02	3.0E-03	9.1E-03	2.9E-02
Dibenz(a,h)anthracene	000053-70-3	7.3E+00								2.7E+00	2.2E-02	5.5E-03	3.2E-03	1.0E-02
Fluoranthene	000206-44-0			4.0E-02	4.0E-01					3.6E-01	5.7E-02	1.4E-02	6.3E-04	2.0E-03
Indeno(1,2,3-cd)pyrene	000193-39-5	7.3E-01								1.9E+00	6.8E-03	1.7E-03	2.5E-02	7.9E-02
Phenanthrene	000085-01-8									2.7E-01	1.0E-01	2.6E-02	2.3E-04	7.2E-04
Pyrene	000129-00-0			3.0E-02	3.0E-01					3.2E-01	3.3E-02	8.1E-03	1.7E-03	5.2E-03
Pesticides/PCBs														
4,4'-DDE	000072-55-9	3.4E-01								2.4E-01	3.5E-03	8.7E-04	9.6E-03	4.9E-02
4,4'-DDT	000050-29-3	3.4E-01	3.4E-01	5.0E-04	5.0E-04					4.3E-01	1.0E-02	2.6E-03	1.1E-02	2.8E-02
Aroclor 1248	012672-29-6	7.7E+00									1.8E-02	4.5E-03	4.6E-03	1.4E-02
Aroclor 1254	011097-69-1			2.0E-05	5.0E-05						1.2E-02	3.1E-03	1.1E-02	5.3E-02
Aroclor 1260	011096-82-5	7.7E+00									2.9E-03	7.1E-04	1.1E-01	3.5E-01
Beta-BHC	000319-83-7	1.8E+00	1.8E+00								2.2E-01	5.4E-02	6.3E-05	2.0E-04
Dieldrin	000060-57-1	1.6E+01	1.6E+01	5.0E-05	5.0E-05					1.6E-02	3.7E-01	9.2E-02	1.1E-02	7.9E-03
Endrin Ketone														

¹ All values in this column, except those that are footnoted, can be referenced in Streuge, D.L. and Peterson, S.R. 1989 (updated through 1993). *Chemical Data Bases for the Multimedia Environmental Pollutant Assessment System (MEPAS)*. Prepared for the U.S. Department of Energy, Pacific Northwest Labor

² Value can be referenced in National Council on Radiation Protection Measurement (NCRP). January 1989. *Screening Techniques for Determining Compliance with Environmental Standards. Releases of Radionuclides to the Atmosphere*. Bethesda, Maryland.

³ Value can be referenced in International Atomic Energy Agency (IAEA). 1982. *Generic Models Parameters for Assessing the Environmental Transfer of Radionuclides from Routine Releases: Exposures of Critical Groups*.

Table 2. Parameters for Radionuclides of Concern.

RADIONUCLIDE	CASRN	Oral SF (risk/pCi)	Inhalation SF (risk/pCi)	External SF (risk/yr per pCi/g soil)	Soil to Plant Uptake (B _v Dry) (unitless)	Soil to Plant Uptake (B _v Wet) (unitless)	Transfer Coeff. for Milk (F _M) (day/kg)	Transfer Coeff. for Beef (F _B) (day/kg)
Actinium-227+D	014952-40-0	6.3E-10	7.9E-08	6.0E-07	2.6E-01*	5.1E-02*	3.4E-03*	4.6E-02*
Americium-241	014596-10-2	3.3E-10	3.9E-08	4.6E-09	4.0E-03*	1.0E-03*	1.5E-06 [†]	4.0E-05 [†]
Bismuth-207	013982-38-2	5.1E-12	9.4E-12	5.5E-06	1.4E-01 [‡]	3.5E-02 [‡]	5.0E-04 [‡]	4.0E-04 [‡]
Cesium-137+D	010045-97-3	3.2E-11	1.9E-11	2.1E-06	2.0E-01*	4.0E-02*	8.4E-03*	5.1E-02*
Cobalt-60	010198-40-0	1.9E-11	6.9E-11	9.8E-06	4.0E-01*	3.0E-02*	7.0E-05 [†]	1.0E-04 [†]
Plutonium-238	013981-16-3	3.0E-10	2.7E-08	1.9E-11	1.0E-03*	5.0E-04*	1.1E-06 [†]	1.8E-05 [†]
Plutonium-239	015117-48-3	3.2E-10	2.8E-08	1.3E-11	1.0E-03*	5.0E-04*	1.1E-06 [†]	1.8E-05 [†]
Plutonium-240	014119-33-6	3.2E-10	2.8E-08	1.9E-11	1.0E-03*	5.0E-04*	1.1E-06 [†]	1.8E-05 [†]
Radium-226+D	013982-63-3	3.0E-10	2.8E-09	6.7E-06	4.5E-01*	8.8E-02*	3.0E-03*	1.2E-02*
Strontium-90+D	010098-97-2	5.6E-11	6.9E-11	0.0E+00	4.0E+00*	3.0E-01*	2.8E-03*	9.0E-03*
Thorium-228+D	014274-82-9	2.3E-10	9.7E-08	9.9E-07	4.7E-01*	9.2E-02*	5.0E-03*	5.2E-02*
Thorium-230	014269-63-7	3.8E-11	1.7E-08	4.4E-11	1.0E-03*	5.0E-04*	5.0E-06*	1.0E-04*
Thorium-232	007440-29-1	3.3E-11	1.9E-08	2.0E-11	1.0E-03*	5.0E-04*	5.0E-06*	1.0E-04*
Tritium	010028-17-8	7.2E-14	9.6E-14	0.0E+00	0.0E+00 [‡]	0.0E+00 [‡]	1.5E-02*	0.0E+00 [‡]
Uranium-233	013968-55-3	4.5E-11	1.4E-08	3.5E-11	1.0E-02*	2.0E-03*	4.0E-04 [†]	3.4E-04 [†]
Uranium-234	013966-29-5	4.4E-11	1.4E-08	2.1E-11	1.0E-02*	2.0E-03*	4.0E-04 [†]	3.4E-04 [†]
Uranium-235+D	015117-96-1	4.7E-11	1.3E-08	2.7E-07	1.1E-02*	2.5E-03*	4.1E-04*	4.4E-04*
Uranium-238+D	007440-61-1	6.2E-11	1.2E-08	5.3E-08	1.1E-02*	2.6E-03*	4.1E-04*	4.5E-04*

[†] Value can be referenced in International Atomic Energy Agency (IAEA). 1982. *Generic Models Parameters for Assessing the Environmental Transfer of Radionuclides from Routine Releases: Exposures of Critical Groups*.

[‡] Value can be referenced in Streng, D.L. and Peterson, S.R. 1989 (updated through 1993). *Chemical Data Bases for the Multimedia Environmental Pollutant Assessment System (MEPAS)*. Prepared for the U.S. Department of Energy, Pacific Northwest Laboratory.

* Value can be referenced in National Council on Radiation Protection Measurement (NCRP). January 1989. *Screening Techniques for Determining Compliance with Environmental Standards. Releases of Radionuclides to the Atmosphere*. Bethesda, Maryland.

* Additive value from individual chain members

Table 3. Radioactive Decay Chains Included in HEAST (1994).

Principal Radionuclide ^a		Associated Decay Chain ^b	Terminal Nuclide or Radionuclide ^c	
Nuclide	Half-life (yr)		Nuclide	Half-life (yr)
Ac-227+D	22	[Th-227 (98.6%, 19 d)] Fr-223 (1.4%, 22 min) Ra-223 (11 d) Rn-219 (4 s) Po-215 (2 ms) Pb-211 (36 min) Bi-211 (2 min) [Tl-207 (99.7%, 5 min)] Po-211 (0.3%, 0.5 s)]	Pb-207	•
Ag-108m+D	127	^d Ag-108 (9%, 2 min)	Pd-108 (91%) [Cd-108 (98%) Pd-108 (2%)]	• • •
Ag-110m+D	0.7	• Ag-110 (1%, 25 s)	Cd-110 (99%) [Cd-110 (99.7%) Pd-110 (0.3%)]	• • •
Am-243+D	7.4×10^3	Np-239 (2 d)	Pu-239	2.4×10^4
Ce-144+D	0.8	[Pr-144 (9%, 17 min) Pr-144m (2%, 7 min)]	Nd-144	•
Cs-137+D	30	Ba-137m (95%, 3 min)	Ba-137	•
Np-237+D	2.1×10^6	Pa-233 (27 d)	U-233	1.6×10^5
Pb-210+D	22	Bi-210 (5 d) Po-210 (138 d)	Pb-206	•
Pu-241+D	14	[Am-241 (~100%, 432 y) U-237 (7 d)] ^e	Np-237	2.1×10^6
Pu-244+D	8.3×10^7	U-240 (~100%, 14 h) Np-240	Pu-240	6.5×10^3
Ra-226+D	1.6×10^3	Rn-222 (4 d) Po-218 (3 min) Pb-214 (~100%, 27 min) Bi-214 (20 min) Po-214 (~100%, 1 min)	Pb-210	22
Ra-228+D	8	Ac-228 (6 h)	Th-228	2
Ru-106+D	1	Rh-106 (30 s)	Pd-106	•
Sb-125+D	3	Te-125m (23%, 58 d)	Te-125	•

Table 3. (continued)

Principal Radionuclide ^a		Associated Decay Chain ^b	Terminal Nuclide or Radionuclide ^c	
Nuclide	Half-life (yr)		Nuclide	Half-life (yr)
Sr-90+D	29	Y-90 (64 h)	Zr-90	*
Th-228+D	2	Ra-224 (4 d) Rn-220 (56 s) Po-216 (0.2 s) Pb-212 11 h Bi-212 (61 min) [Po-212 (64%, 0.3 μ s) Tl-208 (36%, 3 min)]	Pb-208	*
Th-229+D	7.3×10^3	Ra-225 (15 d) Ac-225 (10 d) Fr-221 (5 min) At-217 (32 ms) Bi-213 (46 min) [Po-213 (98%, 4 μ s) Tl-209 (2%, 2 min)] Pd-209 (3 h)	Bi-209	*
U-235+D	7.0×10^8	Th-231 (26 h)	Pa-231	3.4×10^4
U-238+D	4.5×10^9	Th-234 (24 d) [Pa-234m (99.8%, 1 min) Pa-234 (0.2%, 7 h)]	U-234	2.4×10^5

- ^a Radionuclides with half-lives greater than six months. "+D" designates principal radionuclides with associated decay chains.
- ^b The chain of decay products of a principal radionuclide extending to (but not including) the next principal radionuclide or a stable radionuclide. Half-lives are given in parentheses. Branches are indicated by square brackets with branching ratios in parentheses.
- ^c The principal radionuclide or stable nuclide that terminates an associated decay chain. Stable nuclides are indicated by an asterisk (*) in place of a half-life.
- ^d A hyphen indicates that there are no associated decay products.
- ^e The branching decay for Pu-241 and Cm-243 involves multiple principal radionuclides and associated radionuclides.

^f Table adapted from: C. Yu, et al. (1994), "Manual for Implementing Residual Radioactive Materials Guidelines Using RESRAD, Version 5.0," Argonne National Laboratory.

3.3 DESCRIPTION OF EXPOSURE SCENARIOS

The exposure scenarios developed for this report are for the purpose of developing GVs and ultimately PRGs for future land uses (Table 4). Therefore, these scenarios may not be as multifaceted as those that would be used in a baseline risk assessment. The GV equations cannot combine exposures from different environmental media as can the forward risk equation in a baseline risk assessment; therefore, exposure scenarios are separated for these presentations. Only in the baseline risk assessment is it possible to integrate exposures across media and fully address the total sitewide risk to potential receptors.

The major assumption about future land use in this report is that the Mound Plant will remain an industrial facility of some type in the future. No residential land use in the currently developed industrial areas is expected. Future use of the site may include residents, subsistence farmers, recreational users, or workers associated with light industry. If land uses other than these are to be assumed, additional exposure pathways, parameters, and equations will need to be developed.

In this study, the following scenarios are evaluated: residential child and adult, recreational child and adult, subsistence farmer child and adult, on- and off-site construction workers, and commercial office workers. No scenarios will consider the consumption of fish or aquatic biota because the fishing ponds are considered to be too small to support a large quantity of fish of a sufficient size for consumption. The exposures for radionuclides and carcinogens are time-weighted exposures based on 6 years and 24 years of exposure for a child and adult, respectively. The exposures to noncarcinogenic contaminants are separated for the child and adult because of the nonlinearity of the RfD. Following are descriptions of the scenarios selected for the development of GVs for the Mound Plant.

Residential

The residential scenario characterizes potential exposures to someone who resides on the property 24 hours per day, 350 days per year (assuming 2 weeks vacation per year) for 30 years (including 6 years as a child). The resident is assumed to ingest (accidentally eat) a small amount of soil, inhale small amounts of dust from the soil, and be externally exposed to possible radiation from the soil. The resident is assumed to drink about a half-gallon (2 liters) of water per day from a groundwater well on the property, bathe or shower daily in the well water, and inhale small amounts of water vapor while showering.

Recreational

The recreational scenario characterizes potential exposures to someone who visits the property (e.g., the park) for 4 hours per day, 52 days per year (i.e., 1 day per week) for 30 years (including 6 years as a child). The person is assumed to ingest a small amount of soil/sediment in the park, inhale small amounts of dust from the soil/sediment, and be externally exposed to possible radiation from the soil/sediment. In addition, the park visitor is assumed to wade or play in surface water on the property 4 hours per day, 52 days per year for 30 years, and ingest (accidentally drink) small amounts of water while wading or playing.

Subsistence Farmer (Agricultural Exposure)

The subsistence farmer scenario characterizes potential exposures to someone who resides and works on a farm 24 hours per day, 350 days per year for 30 years (including 6 years as a child). Three-

Table 4. Exposure Scenarios and Pathways for Future Land Use.

EXPOSURE PATHWAY	EXPOSURE SCENARIO					
	<u>Residential</u>	<u>Recreational</u> ^a	<u>Subsistence Farmer</u>	<u>Construction</u> ^{a,c}	<u>Commercial</u>	<u>Construction Off-site</u>
<u>Soil</u>						
Ingestion	•	•	•	•	•	•
Inhalation of fugitive dusts	•	•	•	•	•	•
External radiation exposure	•	•	•	•	•	•
<u>Groundwater</u>						
Ingestion	•		•	•	•	
Inhalation of vapors (showering)	•		•	•		
Dermal contact (showering)	•		•	•		
<u>Surface Water</u>						
Ingestion (wading)		•				
Dermal contact (wading)		•		•		
<u>Food</u>^b						
Ingestion (homegrown produce)			•			
Ingestion (beef)			•			
Ingestion (dairy products)			•			

^a Exposure pathway for soil for this receptor population also includes exposure to sediment in surface water bodies.

^b Indirect ingestion of contaminants present in soil via ingestion of produce, beef, or dairy products grown on the property.

^c Occupational exposure to surface water is conservatively estimated by the recreational scenario.

fourths of the beef and dairy products and more than one-third of the produce that the farmer eats are assumed to be grown on the property. Consequently, the farmer is assumed to indirectly ingest contaminants present in soil through the ingestion of produce, beef, or dairy products grown on-site. The farmer is also assumed to ingest a small amount of soil, inhale small amounts of dust from the soil, and be externally exposed to possible radiation from the soil. Because of the nature of farm work, the farmer is assumed to ingest and inhale greater amounts of soil and dust than a resident of a city or suburb. The farmer is assumed to drink about a half-gallon (2 liters) of water per day from a groundwater well on the property, bathe or shower daily in the well water, and inhale small amounts of water vapor while showering.

Commercial (Mound Office Worker)

This scenario characterizes potential exposures to persons who work primarily indoors at the property 8 hours per day for 250 days per year for 25 years. These workers are assumed to ingest a small amount of soil on the property, inhale small amounts of dust from the soil, and be externally exposed to possible radiation from the soil only while they walk between buildings or take breaks outdoors. The worker is also assumed to drink about a quart (1 liter) of water per day from a groundwater well on the property. Worker exposures will vary depending on the type of work performed.

Heavy Industry (Mound Construction Worker)

This scenario characterizes potential exposures to persons who work primarily outdoors at the property 8 hours per day for 250 days per year for 5 years. An outdoor construction worker may be assumed to ingest and inhale greater amounts of soil/sediment and dust, and, in addition to the above assumptions, may also bathe or shower daily in the water from a well on the property, and inhale small amounts of water vapor while showering. Occupational exposure to surface water by the outdoor worker may be infrequent and is estimated by the recreational exposure to surface water.

Heavy Industry Exposure (Off-Site Private Contractor/Construction Worker)

There may be occasion in the future to construct office buildings on Mound property. These construction activities would require worker exposure to residual soil and subsurface soil contamination. This scenario characterized the potential exposures to off-site private contractors construction workers and some utility workers who may work on the property 8 hours per day for 250 days per year over the period of one year. These workers are assumed to ingest soil/sediment on the property, inhale dust from soil/sediment, and be externally exposed to possible radiation from the soil/sediment. In addition, it is logical to assume that unlike a Mound construction worker, private off-site construction workers will consume and shower in municipal water, eliminating exposure to on-site groundwater as a potential exposure pathway.

3.4 EXPOSURE PARAMETERS AND EQUATIONS

Parameters used in calculating GVs are derived from *RAGS - Part A* (EPA 1989), *RAGS - Part B* (EPA 1991a), and *RAGS - "Standard Default Exposure Factors"* (EPA 1991d) and revisions (Dinan 1992). Whenever available, site-specific information was used for the calculation of GVs. In the absence of readily available site-specific information, standard default values from the above EPA documents are used. These parameters are defined and referenced in Appendix A. The EPA toxicity values for all of the contaminants of concern that were evaluated at the Mound Plant are presented in Tables 2 and 3.

In developing GV_s, target risks for chemicals and radionuclides of concern are identified. Risks are usually expressed as a probability of adverse effects associated with exposure to contaminants. For carcinogens, these probabilities are expressed as excess cancer incidence over a human lifetime, which is the probability of an individual having one case of cancer above the normal background cancer rate observed in the general population. For this study, concentrations are calculated corresponding to incremental lifetime cancer risks of 10^{-4} , 10^{-5} , and 10^{-6} , which are within the EPA target risk range of 10^{-4} to 10^{-6} . A cancer risk of 10^{-4} to 10^{-6} indicates a probability of one chance in 10,000 to one chance in 1,000,000, respectively, of an individual developing cancer (Hammonds et al. 1992). For noncarcinogenic effects, a concentration is calculated that corresponds to a Hazard Index of 1, which is the level of exposure to a chemical from significant exposure pathways in a given medium for the human population, including sensitive subpopulations, that are likely to be without an appreciable risk of deleterious effects during a lifetime or portion of a lifetime.

Most equations used in this study are based on *RAGS - Part B* (EPA 1991a). As stated above, cleanup GV equations cannot combine exposures to contaminants from different environmental media as can the forward risk equations; therefore, exposure scenarios are addressed separately for these presentations. Figure 2 gives an example of the exposure equations and parameters used in the calculation of GV_s in this report. A sample calculation of the GV for the chemical carcinogen, benzene, is also presented in Figure 2. The equations and parameters used to calculate GV_s for the various exposure scenarios applicable to the Mound Plant are presented in Appendix A. The calculated GV_s for the ingestion [Eq. (1)], dermal [Eq. (2)], and inhalation [Eq. (3)] routes of exposure are represented by the contaminant concentration in that particular media of concern (e.g., CW_{ING} , CW_{DER} , CW_{INH}). The equations include calculations of total contaminant concentrations [CW_{TOTAL} - Eq. (4)] for a given medium and are based on the identified exposure pathways and associated parameters.

EPA standard default equations do not address pathways such as plant and animal uptake of contaminants from soil with subsequent human ingestion (agricultural exposure). These equations were derived from other sources that are identified in Appendix A. Where default values are given in *RAGS - Part B* (EPA 1991a) for a constant ingestion rate, GV_s are calculated for chronic effects only. Because of the differences in skin surface areas for children and adults, both chronic and subchronic effects are evaluated for dermal water contact calculations. Revision 2 incorporates many changes in guidance that have occurred since the initial release of this document. The *RAGS - Part B* (EPA 1991a) does not address dermal contact with soil as a significant pathway. Much uncertainty exists in determining the toxicology values and absorption factors used in the evaluation of this pathway and this is generally expressed in the uncertainty section of a baseline risk assessment. In this document, the uncertainty precludes an evaluation of the pathway.

In general, standard default exposure equations and parameters used to calculate GV_s for radionuclides are similar in structure and function to those equations and parameters used for nonradioactive chemical carcinogens. The following are some areas in which GV equations and assumptions for radionuclides differ from those used for chemical contaminants: (1) units are in pCi/g and pCi/liter rather than mg/g or mg/liter; (2) only carcinogenic effects are considered for radionuclides because EPA classifies all radionuclides as human carcinogens based on their property of emitting ionizing radiation and on the extensive weight of epidemiological evidence of radiation-induced cancer in humans; and (3) SFs are used that are best estimates of the age-averaged, lifetime excess total cancer risk per unit of a radionuclide to gamma-emitting radionuclides. The equation presented in Appendix A of this report for the calculation of GV_s for external radiation exposure to soil differs slightly from the ones [Eq. (11) or Eq. (13)] presented in Chapter 4 (pp. 37 and 39) of *RAGS - Part B* (1991a). These equations use the parameters D (depth of radionuclides in soil) and Residential - Groundwater Exposure Pathway (Chemical - Carcinogens):

Ingestion: (1)

$$CW_{ING} = \frac{(TR)(BW_A)(AT)(365 \text{ days/yr})}{(SF_o)(IR_w)(EF)(ED)}$$

Dermal: (2)

$$CW_{DERM} = \frac{(TR)(BW_A)(BW_C)(AT)(365 \text{ days/yr})}{(SF_o)(PC)(CF)(EF)(ET)[(SA_A)(ED_A)(BW_C) + (SA_C)(ED_C)(BW_A)]}$$

Inhalation: (3)

$$CW_{INH} = \frac{(TR)(BW_A)(AT)(365 \text{ days/yr})}{(SF_I)(K)(IR_{AIR})(EF)(ED)(TF)}$$

Ingestion + Dermal + Inhalation: (4)

$$CW_{TOTAL} = \frac{(TR)(BW_A)(BW_C)(AT)(365 \text{ days/yr})}{(EF)[(BW_C)(SF_o)(IR_w)(ED) + (SF_o)(PC)(CF)(ET)[(SA_A)(ED_A)(BW_C) + (SA_C)(ED_C)(BW_A)] + (BW_C)(SF_I)(K)(IR_{AIR})(ED)(TF)]}$$

Parameters:

Definitions and Units:

Default Values:

CW _{ING}	Contaminant concentration in water (ingestion) (mg/l)	Calculated Value
CW _{DER}	Contaminant concentration in water (dermal) (mg/l)	Calculated Value
CW _{INH}	Contaminant concentration in water (inhalation) (mg/l)	Calculated Value
CW _{TOTAL}	Total contaminant concentration in water (mg/l)	Calculated Value
TR	Target excess individual lifetime cancer risk (unitless)	(1 x 10 ⁻⁶ - 1 x 10 ⁻⁴)
SF _o	Oral cancer slope factor (mg/kg-day) ⁻¹	Chemical-specific
SF _I	Inhalation cancer slope factor (mg/kg-day) ⁻¹	Chemical-specific
IR _w	Daily water ingestion rate (l/day)	2.0
PC	Permeability constant (cm/hr)	Chemical-specific
CF	Conversion factor (l/1000 cm ³)	1
SA _A	Skin surface available for contact with water (Adult) (cm ²)	19,400
SA _C	Skin surface available for contact with water (Child) (cm ²)	7,280
K	Volatilization factor (l/m ³)	0.0005 X 1000
IR _a	Daily inhalation rate (m ³ /day)	20
ET	Exposure time (hr/day)	0.167
EF	Exposure frequency (days/yr)	350
BW _A	Body weight (7-31 yrs) (kg)	70
BW _C	Body weight (1-6 yrs) (kg)	15
ED	Exposure duration (yrs)	30
ED _A	Exposure duration (7-31 yrs) (yrs)	24
ED _C	Exposure duration (1-6 yrs) (yrs)	6
AT	Averaging time (yrs)	70
TF	Time fraction spent in house	15/24

Figure 2. Example Guideline Value Calculations.

Residential - Groundwater Exposure Pathway (Chemical - Carcinogens/Sample Calculation of the GV for Benzene):

Ingestion:

$$CW_{ING} = \frac{(1 \times 10^{-4})(70 \text{ kg})(70 \text{ yrs})(365 \text{ days/yr})}{(2.9 \times 10^{-2} \text{ mg/kg} \cdot \text{day}^{-1})(2 \text{ l/day})(350 \text{ days/yr})(30 \text{ yrs})}$$

$$CW_{ING} = 2.9 \times 10^{-1} \text{ mg/l}$$

Dermal:

$$CW_{DERM} = \frac{(1 \times 10^{-4})(70 \text{ kg})(15 \text{ kg})(70 \text{ yrs})(365 \text{ days/yr})}{(2.9 \times 10^{-2} \text{ mg/kg} \cdot \text{day}^{-1})(2.1 \times 10^{-2} \text{ cm/hr})(1/1000 \text{ l/cm}^3)(350 \text{ days/yr})(0.167 \text{ hr/day})[(19400 \text{ cm}^2)(24 \text{ yrs})(15 \text{ kg}) + (7280 \text{ cm}^2)(6 \text{ yrs})(70 \text{ kg})]}$$

$$CW_{DER} = 7.5 \times 10^0 \text{ mg/l}$$

Inhalation:

$$CW_{DERM} = \frac{(1 \times 10^{-4})(70 \text{ kg})(70 \text{ yrs})(365 \text{ days/yr})}{(2.9 \times 10^{-2} \text{ mg/kg} \cdot \text{day}^{-1})(0.0005 \times 1000 \text{ l/m}^3)(350 \text{ days/yr})(20 \text{ m}^3/\text{day})(30 \text{ yrs})(15/24)}$$

$$CW_{INH} = 9.4 \times 10^{-2} \text{ mg/l}$$

Ingestion + Dermal + Inhalation:

$$CW_{TOTAL} = \frac{(1 \times 10^{-4})(70)(15)(350)(365 \text{ days/yr})}{(350)[(15)(2.9 \times 10^{-2})(2)(30) + (2.9 \times 10^{-2})(2.1 \times 10^{-2})(1/1000)(0.167)[(19400)(24)(15) + (7280)(6)(70)] + (15)(2.9 \times 10^{-2})(0.0005 \times 1000)(20)(30)(15/24)]}$$

$$CW_{TOTAL} = 7.1 \times 10^{-2} \text{ mg/l}$$

Figure 2. (continued)

SD (soil density) for the calculation of PRGs for this route of exposure. The radionuclide-specific parameter for the external radiation exposure slope factor (SF_e) reported in HEAST (EPA 1994) incorporates the D and SD parameters within this toxicity value. Therefore, these two parameters were left out of the GV equations for the calculation of the external radiation exposure to soil. These are in agreement with the revisions of 1992 (Dinan 1992).

Revision 2 of the GVs incorporates a simplified method for assessing the risk from the inhalation of tritiated water vapors while showering and inside a residence (Appendix C). Previous versions of this document have utilized the Andelman equation as given in RAGS Part B (1991a) for volatile chemicals and radionuclides. While this equation will perform adequately for radon and volatile organic chemicals in water, it seriously overestimates the volatilization of water itself. We have also incorporated a simplified dermal exposure route for tritium. This methodology, found in Appendix C, was developed at Oak Ridge National Laboratory by Dr. Keith Eckerman, Dr. Richard Gammage, Emran Dawoud and Dr. Robin Brothers of the Health Sciences Research Division. The methodology has been developed with input from Mike Boyd of the Office of Radiation and Indoor Air of USEPA but a final review by USEPA headquarters is not complete at this time.

Previous revisions of this document have incorporated methods to calculate the biological uptake or transfer coefficients for metals, radionuclides and organic contaminants. Experimentally derived transfer coefficients for metals and radionuclides have been released and these values have been used in the produce, beef and milk pathways. The organic contaminants are calculated as they have been previously with the use of the MEPAS model (Streng and Peterson 1989). The transfer coefficients for milk and beef have been obtained and used in the following preference International Atomic Energy Agency (IAEA 1982), United States Nuclear Regulatory Commission (NRC 1989), MEPAS (Streng and Peterson 1989).

The slope factors for radionuclides in HEAST (EPA 1994) have undergone significant modification since the last revision of the GVs. Some of the changes made by EPA include: revision of risk models to be consistent with the National Academy of Sciences Biological Effects of Ionizing Radiation (BEIR V) report, change in low dose effectiveness factors, revision of relative biological effectiveness for alpha particles, change of survival and vital statistics for population comparisons, increase in the EPA estimate of lifetime fatal cancer risk associated with whole-body irradiation, and increase in the EPA cancer morbidity risk estimate from 623 to 761 per 10^6 person-rad (EPA 1994).

One other soil-specific exposure parameter that needs further explanation is the soil-to-air volatilization factor (VF) and its relationship to the soil saturation concentration. The VF is used to estimate contaminant concentrations in air based on contaminant concentrations in soil. The basic principle behind the use of the VF is that the soil contaminant concentration is at or below saturation. Saturation is the soil contaminant concentration at which the adsorptive limits of the soil particles and the solubility limits of the existing soil moisture have been reached. Above saturation, it is assumed that pure liquid-phase contaminant is present in the soil, thus making it difficult to accurately calculate a PRG or GV based on volatilization. Because of this limitation, the chemical concentration in soil calculated using the VF must be compared with the soil saturation concentration as calculated using the 1992 revisions of Eq. 6a or Eq. 7a on pp. 27 and 28 of *RAGS - Part B* (EPA 1991a, Dinan 1992). If the chemical concentration in soil calculated using the VF is greater than the soil saturation concentration, then the PRG or GV is set equal to the soil saturation concentration. The soil saturation concentration appears in the parameter tables presented in Appendix B and in Tables 1 and 2 of this text. This value is only used for VOCs when and if applicable.

At the request of the Ohio Environmental Protection Agency (OEPA), the dermal calculation for groundwater exposure for the construction worker was changed from the default *RAGS – Part B* (EPA 1991a) methodology to the equations and methodology presented in *Dermal Exposure Assessment: Principles and Application, Interim Report* (EPA 1992a). The primary dermal exposure pathway has been determined to be from groundwater exposure during showering for a construction worker, for this reason incidental dermal exposure from surface water is not calculated.

Only the tables for the construction worker have been revised in this Final, Revision 0 document because the construction worker and office worker exposure scenarios are the scenarios that DOE, USEPA, OEPA, and stakeholders have agreed best represent the Mound Plant future use. The tables for the office worker do not change from the draft revision 3 document because office workers do not have a significant dermal exposure pathway to the groundwater because they are not expected to shower at the Mound Plant.

4. IMPLEMENTATION OF FACILITYWIDE GUIDELINE VALUE METHODOLOGY

The GV methodology is designed to streamline the EPA approach for developing waste-site-specific PRGs at the Mound Plant by eliminating duplication of effort required to calculate risk-based PRGs for each waste site. Figure 3 illustrates the waste site-specific steps of the EPA PRG development approach and their relationship to the scoping phase of a site-specific RI/FS. Using the *RI/FS Operable Unit 9 Sitewide Work Plan* (DOE 1992a), the *RI/FS Operable Unit 9 Sitewide Preliminary Baseline Risk Assessment* (DOE 1992b), and the *Draft Work Plan for Environmental Studies in the Vicinity of the Mound Plant* (ATSDR 1993), the EPA methodology for developing risk-based PRGs was applied on a sitewide scale by following steps similar to those used during the scoping phase of an RI/FS (Figure 4). As a result, contaminants and media of concern, current and future land-use assumptions, and likely exposure scenarios used in developing the GVs will be applicable to the development of site-specific risk-based PRGs for the waste-sites at the Mound Plant, thus eliminating the need to repeat these calculations each time an RI/FS is conducted. This approach reduces the PRG development steps of RI/FS scoping to a simple comparison of GVs to ARARs. Figure 5 conceptualizes the application of the sitewide guideline values and illustrates how the sitewide methodology will modify the waste site-specific PRG components in the RI/FS.

The GV methodology is used for the development of risk-based media-specific contaminant concentrations (PRGs) that can be used as a risk-based screening tool to rapidly identify potential contaminants of concern, determine the need for further evaluation (i.e., a baseline risk assessment), or to confirm that a site is a likely candidate for "no action." The PRGs can be used to screen existing data prior to conducting an RI or during various phases of site characterization to identify the potential for regulatorily unacceptable human health risks.

Generally, the GVs are compared to media-specific maximum contaminant concentrations. Concentrations exceeding the GVs verify that a site is a potential human health concern requiring the completion of an RI/FS and baseline risk assessment. With regulator approval, sites that have no contaminant concentrations exceeding the GVs may be considered for no action, and RI/FS activities can be limited appropriately (Figure 6). Because the GVs can be used as a basis for proposing no action, sites considered for no action based solely on the use of GVs should have adequate site characterization data (historical or current) and no evidence of past practices that generated significant quantities of waste.

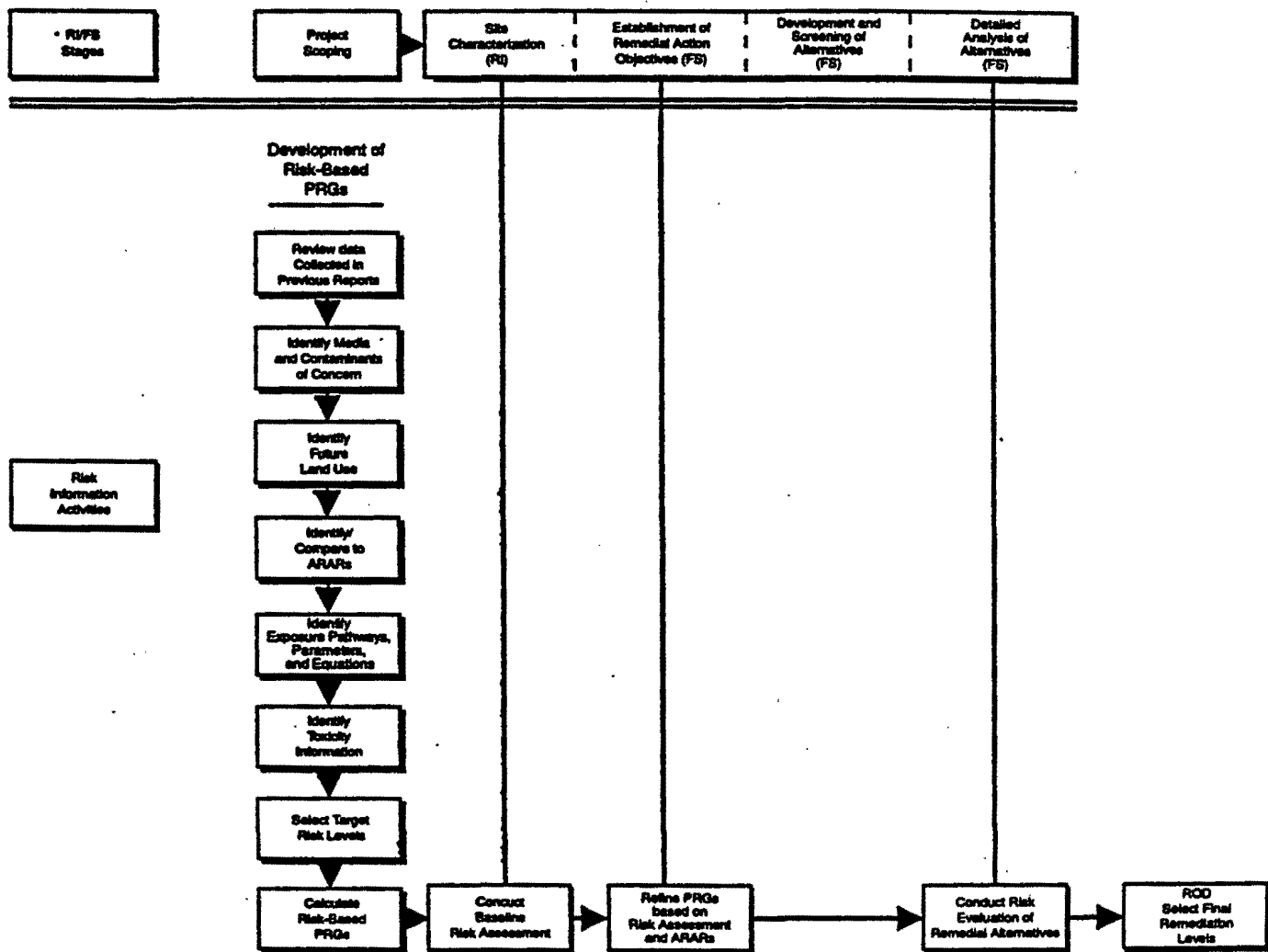


Figure 3. EPA Methodology for Development of Risk-Based PRGs.

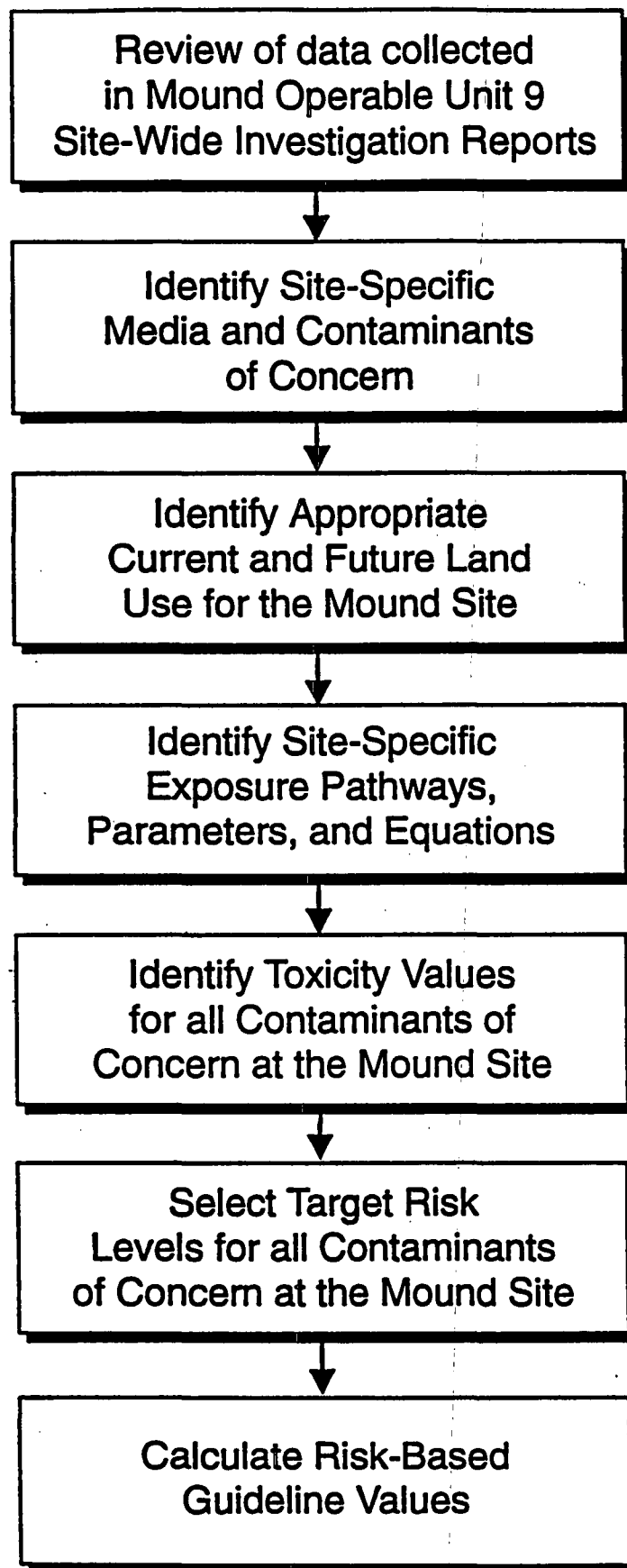


Figure 4. Sitewide Guideline Value Methodology.

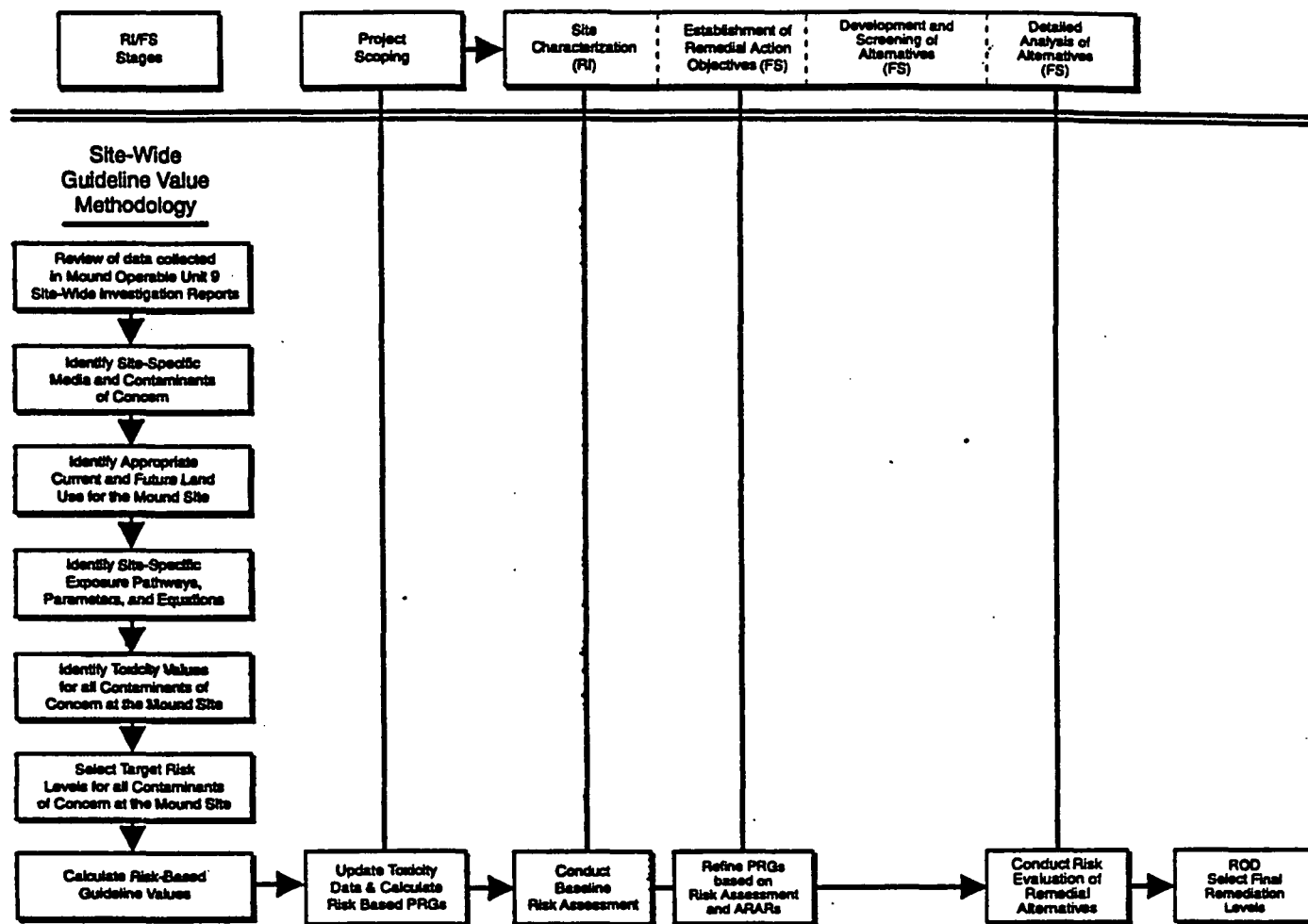


Figure 5. Streamlining EPA Methodology for the Development of Site-Specific PRGs.

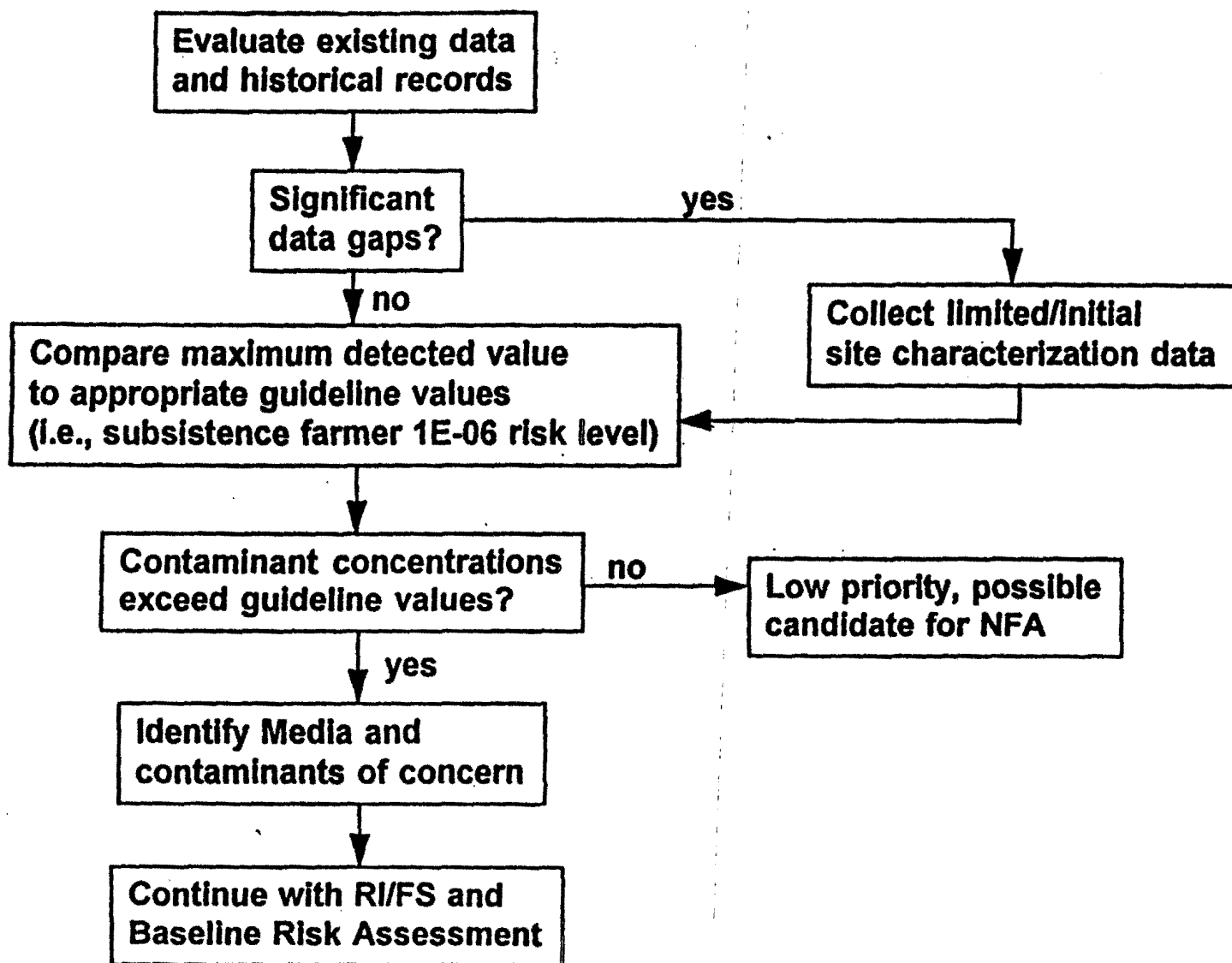


Figure 6. GV in Preliminary Site Screening.

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RISK-BASED GUIDELINE VALUES

**MOUND PLANT
MIAMISBURG, OHIO**

**APPENDIX A
EXPOSURE SCENARIO EQUATIONS AND EXPOSURE VARIABLE DOCUMENTATION**

March 1997

**Submitted to the
Miamisburg Environmental Management Project
U.S. DEPARTMENT OF ENERGY**

**Prepared by
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U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400**

Revised by EG&G Mound Applied Technologies, Inc.

**FINAL
(REVISION 4)**

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Table 1.1.1

Residential - Soil Exposure Pathway (Chemical - Carcinogens)

$$CS_{ING} = \frac{(TR) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(EF) (SF_o) (CF) [(IR_{soilC}) (ED_C) (BW_A) + (IR_{soilA}) (ED_A) (BW_C)]}$$

$$CS_{INH} = \frac{(TR) (BW_A) (AT) (365 \text{ days/yr})}{(EF) (SF_i) (ED) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)}$$

$$CS_{TOTAL} = \frac{(TR) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(EF) [(SF_o) (CF) [(IR_{soilC}) (ED_C) (BW_A) + (IR_{soilA}) (ED_A) (BW_C)] + (SF_i) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right) (ED) (BW_C)]}$$

Table 1.1.1 Residential (Chemical - Carcinogens)
Exposure variable explanations for the soil exposure pathway

Variable	Definition	Value Used	Explanation/Source
CS _{ING}	Contaminant Concentration in Soil (Ingestion)	mg/kg	Calculated Guideline Values (GVs) ¹
CS _{INH}	Contaminant Concentration in Soil (Inhalation)	mg/kg	Calculated Guideline Values (GVs) ¹
CS _{TOTAL}	Total Contaminant Concentration in Soil for all Exposure Pathways	mg/kg	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1 x 10 ⁻⁶ 1 x 10 ⁻³ 1 x 10 ⁻⁴ (Unitless)	OSWER Directive 9285.7-01B
BW _C	Body Weight (1 - 6 yrs)	15 kg	OSWER Directive 9285.6-03
BW _A	Body Weight (7 - 31 yrs)	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03
SF _o	Oral Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
SF _i	Inhalation Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
CF	Conversion Factor	10 ⁻⁶ kg/mg	EPA/540/1-89/002
IR _{soilC}	Soil Ingestion Rate (1 - 6 yrs)	200 mg/day	OSWER Directive 9285.6-03
IR _{soilA}	Soil Ingestion Rate (7 - 31 yrs)	100 mg/day	OSWER Directive 9285.6-03
IR _{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03

Table 1.1.1 Residential (Chemical - Carcinogens) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
VF	Soil-to-Air Volatilization Factor	Chemical-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28 x 10 ⁹ m ³ /kg	OSWER Directive 9285.7-01B, revision
EF	Exposure Frequency	350 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
ED _c	Exposure Duration	6 yrs	OSWER Directive 9285.6-03
ED _A	Exposure Duration	24 yrs	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

The calculated guideline values for soil inhalation are compared to the soil saturation concentration, and the lesser of the values is the guideline value.

Table 1.1.2

Residential - Soil Exposure Pathway (Chemical - Noncarcinogens - Chronic)

$$CS_{ING(Chronic)} = \frac{(THI) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(EF) (CF) \left(\frac{1}{RfD_{oc}}\right) [(IR_{soilC}) (ED_C) (BW_A) + (IR_{soilA}) (ED_A) (BW_C)]}$$

$$CS_{INH(Chronic)} = \frac{(THI) (BW_A) (AT) (365 \text{ days/yr})}{(EF) \left(\frac{1}{RfD_{ic}}\right) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF}\right) (ED)}$$

$$CS_{TOTAL(Chronic)} = \frac{(THI) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(EF) \left[\left(\frac{1}{RfD_{oc}}\right) (CF) [(IR_{soilC}) (ED_C) (BW_A) + (IR_{soilA}) (ED_A) (BW_C)] + \left(\frac{1}{RfD_{ic}}\right) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF}\right) (ED) (BW_C)\right]}$$

Table 1.1.2

Residential - Soil Exposure Pathway (Chemical - Noncarcinogens - Subchronic)

$$CS_{TOTAL(Subchronic)} = CS_{ING(Subchronic)} = \frac{(THI) (BW_C) (365 \text{ days/yr})}{(EF) (CF) \left(\frac{1}{RfD_{OSC}}\right) (IR_{soilC})}$$

Table 1.1.2 Residential (Chemical - Noncarcinogens) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
$CS_{ING(Chronic)}$	Contaminant Concentration in Soil (Ingestion) for Chronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
$CS_{INH(Chronic)}$	Contaminant Concentration in Soil (Inhalation) for Chronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
$CS_{ING(Subchronic)}$	Contaminant Concentration in Soil (Ingestion) for Subchronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
$CS_{TOTAL(Chronic)}$	Total Contaminant Concentration in Soil for Chronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
$CS_{TOTAL(Subchronic)}$	Total Contaminant Concentration in Soil for Subchronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
BW_C	Body Weight (1 - 6 yrs)	15 kg	OSWER Directive 9285.6-03
BW_A	Body Weight (7 - 31 yrs)	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	Equal to ED	OSWER Directive 9285.6-03
RfD_{oc}	Chronic Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
RfD_{osc}	Subchronic Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
RfD_{ic}	Chronic Inhalation Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
CF	Conversion Factor	10^{-6} kg/mg	EPA/540/1-89/002

Table 1.1.2 Residential (Chemical - Noncarcinogens) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
IR_{soilC}	Soil Ingestion Rate (1 - 6 yrs)	200 mg/day	OSWER Directive 9285.6-03
IR_{soilA}	Soil Ingestion Rate (7 - 31 yrs)	100 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Chemical-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28×10^9 m ³ /kg	OSWER Directive 9285.7-01B, revision
EF	Exposure Frequency	350 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
ED _C	Exposure Duration	6 yrs	OSWER Directive 9285.6-03
ED _A	Exposure Duration	24 yrs	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

The calculated guideline values for soil inhalation are compared to the soil saturation concentration, and the lesser of the values is the guideline value.

Table 1.1.3

Residential - Soil Exposure Pathway (Radionuclides)

$$CS_{ING} = \frac{(TR)}{(SF_o) (CF_1) (EF) [(IR_{soilC}) (ED_C) + (IR_{soilA}) (ED_A)]}$$

$$CS_{INH} = \frac{(TR)}{(SF_i) (CF_2) (EF) (ED) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)}$$

$$CS_{EX} = \frac{(TR)}{(SF_e) (ED) (1-S_e) (T_e)}$$

$$CS_{TOTAL} = \frac{(TR)}{(SF_o) (CF_1) (EF) [(IR_{soilC}) (ED_C) + (IR_{soilA}) (ED_A)] + (SF_i) (CF_2) (EF) (ED) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right) + (SF_e) (ED) (1-S_e) (T_e)}$$

Table 1.1.3 Residential (Radionuclides)
Exposure variable explanations for the soil exposure pathway

Variable	Definition	Value Used	Explanation/Source
CS_{ING}	Radionuclide Concentration in Soil (Ingestion)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{INH}	Radionuclide Concentration in Soil (Inhalation)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{EX}	Radionuclide Concentration in Soil (External Exposure)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{TOTAL}	Total Radionuclide Concentration in Soil for all Exposure Pathways	pCi/g	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
ED_C	Exposure Duration	6 yrs	OSWER Directive 9285.6-03
ED_A	Exposure Duration	24 yrs	OSWER Directive 9285.6-03
SF_o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF_i	Inhalation Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF_e	External Exposure Cancer Slope Factor	Radionuclide-specific (risk/yr per pCi/g)	HEAST
CF_1	Conversion Factor 1	10^{-3} g/mg	OSWER Directive 9285.7-01B
CF_2	Conversion Factor 2	10^3 g/kg	OSWER Directive 9285.7-01B

Table 1.1.3 Residential (Radionuclides) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
EF	Exposure Frequency	350 days/yr	OSWER Directive 9285.6-03
IR_{soilC}	Soil Ingestion Rate (1 - 6 yrs)	200 mg/day	OSWER Directive 9285.6-03
IR_{soilA}	Soil Ingestion Rate (7 - 31 yrs)	100 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m³/day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Radionuclide-specific (m³/kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28 x 10⁹ m³/kg	OSWER Directive 9285.7-01B, revision
S_γ	Gamma Shielding Factor	0.2 (Unitless)	OSWER Directive 9285.7-01B
T_γ	Gamma Exposure Time Factor	9/24 (Unitless)	EPA/600/8-89/403 (time spent outside of home)

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 1.2.1

Residential - Groundwater Exposure Pathway (Chemical - Carcinogens)

$$CW_{ING} = \frac{(TR) (BW_A) (AT) (365 \text{ days/yr})}{(SF_o) (IR_{water}) (EF) (ED)}$$

$$CW_{DER} = \frac{(TR) (BW_A) (BW_C) (AT) (365 \text{ days/yr})}{(SF_o) (PC) (CF) (EF) (ET) [(SA_A) (ED_A) (BW_C) + (SA_C) (ED_C) (BW_A)]}$$

$$CW_{INH} = \frac{(TR) (BW_A) (AT) (365 \text{ days/yr})}{(SF_i) (K) (IR_{air}) (EF) (ED) (TF)}$$

$$CW_{TOTAL} = \frac{(TR) (BW_A) (BW_C) (AT) (365 \text{ days/yr})}{(EF) [(BW_C) (SF_o) (IR_{water}) (ED) + (SF_o) (PC) (CF) (ET) [(SA_A) (ED_A) (BW_C) + (SA_C) (ED_C) (BW_A)] + (BW_C) (SF_i) (K) (IR_{air}) (ED) (TF)]}$$

Table 1.2.1 Residential (Chemical - Carcinogens)
Exposure variable explanations for the groundwater exposure pathway.

Variable	Definition	Value Used	Explanation/Source
CW_{ING}	Contaminant Concentration in Water (Ingestion)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{DER}	Contaminant Concentration in Water (Dermal)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{INH}	Contaminant Concentration in Water (Inhalation)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{TOTAL}	Total Contaminant Concentration in Water for all Exposure Pathways	mg/l	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
SF_o	Oral Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
SF_i	Inhalation Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
IR_{water}	Daily Water Ingestion Rate	2.0 l/day	OSWER Directive 9285.6-03
IR_{air}	Daily Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
K	Volatilization Factor	0.0005 X 1000 l/m ³	OSWER Directive 9285.7-01B
SA_C	Skin Surface Area Available for Contact - Child	7,280 cm ²	Whole body (age 3 to 6) 50th percentile EPA/600/8-89/043
SA_A	Skin Surface Area Available for Contact - Adult	19,400 cm ²	Whole body EPA/600/8-89/043

Table 1.2.1 Residential (Chemical - Carcinogens) Exposure variable explanations for the groundwater exposure pathway.			
Variable	Definition	Value Used	Explanation/Source
PC	Permeability Constant	Chemical-specific (cm/hr)	Literature
CF	Conversion Factor	1 l/1000 cm ³	EPA/540/1-89/002
ET	Exposure Time	0.167 hours/day	EPA Dermal Risk Assessment Supplemental Guidance August 1992
EF	Exposure Frequency	350 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
ED _C	Exposure Duration (1-6 yrs)	6 yrs	OSWER Directive 9285.6-03
ED _A	Exposure Duration (7-31 yrs)	24 yrs	OSWER Directive 9285.6-03
BW _C	Body Weight (1-6 yrs)	15 kg	OSWER Directive 9285.6-03
BW _A	Body Weight (7-31 yrs)	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03
TF	Time Fraction Spent in House	15/24	EPA/600/8-89/043

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 1.2.2

Residential - Groundwater Exposure Pathway (Chemical - Noncarcinogens - Chronic)

$$CW_{ING(Chronic)} = \frac{(THI) (BW_A) (365 \text{ days/yr})}{(IR_{water}) (EF) (\frac{1}{RfD_{oc}})}$$

$$CW_{DER(Chronic)} = \frac{(THI) (BW_C) (AT) (365 \text{ days/yr}) (BW_A)}{(PC) (CF) (ET) (EF) (\frac{1}{RfD_{oc}}) [(SA_C) (ED_C) (BW_A) + (SA_A) (ED_A) (BW_C)]}$$

$$CW_{INH(Chronic)} = \frac{(THI) (BW_A) (365 \text{ days/yr})}{(K) (IR_{air}) (EF) (TF) (\frac{1}{RfD_{ic}})}$$

$$CIV_{TOTAL(Chronic)} = \frac{(THI) (BW_C) (BW_A) (365 \text{ days/yr}) (AT)}{(EF) [(IR_{water}) (\frac{1}{RfD_{oc}}) (BW_C) (ED) + (PC) (CF) (ET) (\frac{1}{RfD_{oc}}) [(SA_C) (ED_C) (BW_A) + (SA_A) (ED_A) (BW_C)] + (ED) (K) (IR_{air}) (\frac{1}{RfD_{ic}}) (BW_C) (TF)]}$$

Table 1.2.2 (Cont.)

Residential - Groundwater Exposure Pathway (Chemical - Noncarcinogens - Subchronic)

$$CW_{TOTAL(Subchronic)} = CW_{DER(Subchronic)} = \frac{(THI) (BW_C) (365 \text{ days/yr})}{(PC) (CF) (ET) (EF) \left(\frac{1}{RfD_{oSC}}\right) (SA_C)}$$

Table 1.2.2 Residential (Chemical - Noncarcinogens)
Exposure variable explanations for the groundwater exposure pathway.

Variable	Definition	Value Used	Explanation/Source
CW _{ING} (Chronic)	Contaminant Concentration in Water (Ingestion) for Chronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
CW _{INH} (Chronic)	Contaminant Concentration in Water (Inhalation) for Chronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
CW _{DER} (Chronic)	Contaminant Concentration in Water (Dermal) for Chronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
CW _{DER} (Subchronic)	Contaminant Concentration in Water (Dermal) for Subchronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
CW _{TOTAL} (Chronic)	Total Contaminant Concentration in Water for Chronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
CW _{TOTAL} (Subchronic)	Total Contaminant Concentration in Water for Subchronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
IR _{water}	Daily Water Ingestion Rate	2.0 l/day	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 days/yr	OSWER Directive 9285.6-03
K	Volatilization Factor	0.0005 X 1000 l/m ³	OSWER Directive 9285.7-01B
IR _{air}	Daily Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
RfD _{IC}	Chronic Inhalation Reference Dose	Chemical specific (mg/kg-day)	IRIS, HEAST

Table 1.2.2 Residential (Chemical - Noncarcinogens)
Exposure variable explanations for the groundwater exposure pathway.

Variable	Definition	Value Used	Explanation/Source
PC	Permeability Constant	Chemical-specific (cm/hr)	Literature
CF	Conversion Factor	1 l/1000 cm ³	EPA/540/1-89/002
ET	Exposure Time	0.167 hr/day	EPA Dermal Risk Assessment Supplemental Guidance August 1992
ED	Exposure Duration	30 years	OSWER Directive 9285.6-03
ED _A	Exposure Duration Adult	24 years	OSWER Directive 9285.6-03
ED _C	Exposure Duration Child	6 years	OSWER Directive 9285.6-03
RfD _{oc}	Chronic Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
RfD _{asc}	Subchronic Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
SA _C	Skin Surface Area Available for Contact (1-6 yrs)	7,280 cm ²	Whole body (age 3 - 6 yrs) EPA/600/8-89/043
SA _A	Skin Surface Area Available for Contact (7-31 yrs)	19,400 cm ²	Whole body EPA/600/8-89/043
TF	Time Fraction Spent in House	15/24	EPA 600/8-89/043
BW _C	Body Weight (1-6 yrs)	15 kg	OSWER Directive 9285.6-03
BW _A	Body Weight (7-31 yrs)	70 kg	OSWER Directive 9285.6-03

Table 1.2.2 Residential (Chemical - Noncarcinogens) Exposure variable explanations for the groundwater exposure pathway.			
Variable	Definition	Value Used	Explanation/Source
AT	Averaging Time	Equal to ED	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

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Table 1.2.3

Residential - Groundwater Pathway (Radionuclides)

$$CW_{ING} = \frac{TR}{(SF_o) (IR_{water}) (EF) (ED)}$$

For Tritium also add:

$$CW_{INITRIT} = \frac{TR}{(SF_i) (IR_{air}) (EF) (ED) (M_{TOTAL}) (CF_1) \left[(ET_s) + \frac{(F) (N_P) (N_{SV}) (V_s)}{\lambda (V_H)} \right]}$$

$$CW_{DERMTRIT} = \frac{TR}{(SF_o) (SA) (K_{PTRIT}) (ET_s) (EF) (CF_2) (ED)}$$

$$CW_{TOTALTRIT} = \frac{TR}{(EF) (ED) [(SF_o) (IR_{water}) + (SF_i) (IR_{air}) (M_{TOTAL}) (CF_1) \left[(ET_s) + \frac{(F) (N_P) (N_{SV}) (V_s)}{\lambda (V_H)} \right] + (SF_o) (SA) (K_{PTRIT}) (ET_s) (CF_2)]}$$

Table 1.2.3 Residential (Radionuclides) Exposure variable explanations for the groundwater exposure pathway.			
Variable	Definition	Value Used	Explanation/Source
CW_{ING}	Radionuclide Concentration in Water (Ingestion)	pCi/l	Calculated Guideline Values (GVs) ¹
$CW_{INHTRIT}$	Tritium Concentration in Water (Inhalation)	pCi/l	Calculated Guideline Values (GVs) ¹
$CW_{DERMTRIT}$	Tritium Concentration in Water (Dermal)	pCi/l	Calculated Guideline Values (GVs) ¹
CW_{TOTAL}	Total Radionuclide Concentration in Water for all Exposure Pathways	pCi/l	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
SF_o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF_i	Inhalation Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
IR_{water}	Daily Water Ingestion Rate	2.0 l/day	OSWER Directive 9285.6-03
IR_{air}	Daily Inhalation Rate	0.83m ³ /hr	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03

Table 1.2.3 Residential (Radionuclides) Exposure variable explanations for the groundwater exposure pathway.			
Variable	Definition	Value Used	Explanation/Source
M_{TOTAL}	Airborne Mass Concentration of Water in Shower Stall	66.96 g/m ³	ORNL Tritium Methodology
CF_1	Conversion Factor for Mass of Water	1 l/1000g	ORNL Tritium Methodology
ET_s	Exposure Time in Shower	0.167 hours/day	EPA Dermal Risk Assessment Supplemental Guidance 1992
F	Fraction of Day Spent Inside House	15 hours/24 hours	EPA/600/8-89/043
N_p	Number of Household Members Showering per Day	4	Best Professional Judgement ORNL Tritium Methodology
N_{sv}	Number of Shower Volumes Expelled into Home per Shower	6	Best Professional Judgement ORNL Tritium Methodology
V_s	Volume of Shower Stall	5 m ³	Best Professional Judgement ORNL Tritium Methodology
λ	Functional Air Exchange Rate of House	2.76/ hour	McKone and Bogen, 1992
V_H	Volume of House (1200 ft ³)	272 m ³	Best Professional Judgement ORNL Tritium Methodology
SA	Skin Surface Area Available for Absorption	1.9 m ²	Whole Body EPA/600/8-89/043
K_{PTRIT}	Dermal Permeability Constant for Tritium	1.5 X 10 ⁻⁵ m/hour	Bronaugh et al, 1980

Table 1.2.3 Residential (Radionuclides) Exposure variable explanations for the groundwater exposure pathway.			
Variable	Definition	Value Used	Explanation/Source
CF₂	Conversion Factor for Volume	10³ l/m³	ORNL Tritium Methodology

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 2.1.1

Recreational - Soil/Sediment Exposure Pathway (Chemical - Carcinogens)

$$CS_{ING} = \frac{(TR) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(EF) (SF_o) (CF) [(IR_{soilC}) (ED_C) (BW_A) + (IR_{soilA}) (ED_A) (BW_C)]}$$

$$CS_{INH} = \frac{(TR) (BW_A) (AT) (365 \text{ days/yr})}{(EF) (SF_i) (ED) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)}$$

$$CS_{TOTAL} = \frac{(TR) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(EF) [(SF_o) (CF) [(IR_{soilC}) (ED_C) (BW_A) + (IR_{soilA}) (ED_A) (BW_C)] + (SF_i) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right) (ED) (BW_C)]}$$

Table 2.1.1 Recreational (Chemical - Carcinogens) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CS_{ING}	Contaminant Concentration in Soil (Ingestion)	mg/kg	Calculated Guideline Values (GVs) ¹
CS_{INH}	Contaminant Concentration in Soil (Inhalation)	mg/kg	Calculated Guideline Values (GVs) ¹
CS_{TOTAL}	Total Contaminant Concentration in Soil for all Exposure Pathways	mg/kg	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
BW_C	Body Weight (1 - 6 yrs)	15 kg	OSWER Directive 9285.6-03
BW_A	Body Weight (7 - 31 yrs)	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03
SF_o	Oral Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
SF_i	Inhalation Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
CF	Conversion Factor	10 ⁻⁶ kg/mg	EPA/540/1-89/002
IR_{soilC}	Soil Ingestion Rate (1 - 6 yrs)	200 mg/day	OSWER Directive 9285.6-03
IR_{soilA}	Soil Ingestion Rate (7 - 31 yrs)	100 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03

Table 2.1.1 Recreational (Chemical - Carcinogens) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
VF	Soil-to-Air Volatilization Factor	Chemical-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28 x 10 ⁹ m ³ /kg	OSWER Directive 9285.7-01B, revision
EF	Exposure Frequency	52 x 1/6 days/yr	OSWER Directive 9285.6-03 (4/24 hr exposure)
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
ED _C	Exposure Duration	6 yrs	OSWER Directive 9285.6-03
ED _A	Exposure Duration	24 yrs	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

The calculated guideline values for soil inhalation are compared to the soil saturation concentration, and the lesser of the values is the guideline value.

Table 2.1.2

Recreational - Soil/Sediment Exposure Pathway (Chemical - Noncarcinogens - Chronic)

$$CS_{ING(Chronic)} = \frac{(THI) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(EF) (CF) \left(\frac{1}{RfD_{oC}}\right) [(IR_{soilC}) (ED_C) (BW_A) + (IR_{soilA}) (ED_A) (BW_C)]}$$

$$CS_{INH(Chronic)} = \frac{(THI) (BW_A) (AT) (365 \text{ days/yr})}{(EF) \left(\frac{1}{RfD_{iC}}\right) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF}\right) (ED)}$$

$$CS_{TOTAL(Chronic)} = \frac{(THI) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(EF) \left[\left(\frac{1}{RfD_{oC}}\right) (CF) [(IR_{soilC}) (ED_C) (BW_A) + (IR_{soilA}) (ED_A) (BW_C)] + \left(\frac{1}{RfD_{iC}}\right) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF}\right) (ED) (BW_C)\right]}$$

Table 2.1.2

Recreational - Soil/Sediment Exposure Pathway (Chemical - Noncarcinogens - Subchronic)

$$CS_{TOTAL(Subchronic)} = CS_{ING(Subchronic)} = \frac{(THI) (BW_C) (365 \text{ days/yr})}{(EF) (CF) \left(\frac{1}{RfD_{OSC}}\right) (IR_{soilC})}$$

Table 2.1.2 Recreational (Chemical - Noncarcinogens)
Exposure variable explanations for the soil/sediment exposure pathway

Variable	Definition	Value Used	Explanation/Source
$CS_{ING(Chronic)}$	Contaminant Concentration in Soil (Ingestion) for Chronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
$CS_{INH(Chronic)}$	Contaminant Concentration in Soil (Inhalation) for Chronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
$CS_{ING(Subchronic)}$	Contaminant Concentration in Soil (Ingestion) for Subchronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
$CS_{TOTAL(Chronic)}$	Total Contaminant Concentration in Soil for Chronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
$CS_{TOTAL(Subchronic)}$	Total Contaminant Concentration in Soil for Subchronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
BW_c	Body Weight (1 - 6 yrs)	15 kg	OSWER Directive 9285.6-03
BW_A	Body Weight (7 - 31 yrs)	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	Equal to ED	OSWER Directive 9285.6-03
RfD_{oc}	Chronic Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
RfD_{osc}	Subchronic Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST

Table 2.1.3

Recreational - Soil/Sediment Exposure Pathway (Radionuclides)

$$CS_{ING} = \frac{(TR)}{(SF_o) (CF_1) (EF) [(IR_{soilC}) (ED_C) + (IR_{soilA}) (ED_A)]}$$

$$CS_{INH} = \frac{(TR)}{(SF_1) (CF_2) (EF) (ED_1) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)}$$

$$CS_{EX} = \frac{(TR)}{(SF_e) (ED_2) (1-S_e) (T_e)}$$

$$CS_{TOTAL} = \frac{(TR)}{(SF_o) (CF_1) (EF) [(IR_{soilC}) (ED_C) + (IR_{soilA}) (ED_A)] + (SF_1) (CF_2) (EF) (ED_1) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right) + (SF_e) (ED_2) (1-S_e) (T_e)}$$

Table 2.1.2 Recreational (Chemical - Noncarcinogens) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
RfD_{IC}	Chronic Inhalation Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
CF	Conversion Factor	10 ⁻⁶ kg/mg	EPA/540/1-89/002
IR_{soilC}	Soil Ingestion Rate (1 - 6 yrs)	200 mg/day	OSWER Directive 9285.6-03
IR_{soilA}	Soil Ingestion Rate (7 - 31 yrs)	100 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Chemical-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28 x 10 ⁹ m ³ /kg	OSWER Directive 9285.7-01B, revision
EF	Exposure Frequency	52 x 1/6 days/yr	OSWER Directive 9285.6-03 (4/24 hr exposure)
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
ED_C	Exposure Duration	6 yrs	OSWER Directive 9285.6-03
ED_A	Exposure Duration	24 yrs	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

The calculated guideline values for soil inhalation pathways are compared to the soil saturation concentration, and the lesser of the values is the guideline value.

Table 2.1.3 Recreational (Radionuclides) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CS_{ING}	Radionuclide Concentration in Soil (Ingestion)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{INH}	Radionuclide Concentration in Soil (Inhalation)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{EX}	Radionuclide Concentration in Soil (External Exposure)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{TOTAL}	Total Radionuclide Concentration in Soil for all Exposure Pathways	pCi/g	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
ED_1	Exposure Duration 1	30 yrs	OSWER Directive 9285.6-03
ED_2	Exposure Duration 2	30 yrs x 0.142	OSWER Directive 9285.6-03 (52 days/yr + 365 days/yr)
ED_C	Exposure Duration	6 yrs	OSWER Directive 9285.6-03
ED_A	Exposure Duration	24 yrs	OSWER Directive 9285.6-03
SF_o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF_i	Inhalation Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST

Table 2.1.3 Recreational (Radionuclides)
Exposure variable explanations for the soil/sediment exposure pathway

Variable	Definition	Value Used	Explanation/Source
SF_e	External Exposure Slope Factor	Radionuclide-specific (risk/yr per pCi/g)	HEAST
CF_1	Conversion Factor 1	10^{-3} g/mg	OSWER Directive 9285.7-01B
CF_2	Conversion Factor 2	10^3 g/kg	OSWER Directive 9285.7-01B
EF	Exposure Frequency	52 x 1/6 days/yr	OSWER Directive 9285.6-03 (4/24 hr exposure)
IR_{soilC}	Soil Ingestion Rate (1 - 6 yrs)	200 mg/day	OSWER Directive 9285.6-03
IR_{soilA}	Soil Ingestion Rate (7 - 31 yrs)	100 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Radionuclide-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28×10^9 m ³ /kg	OSWER Directive 9285.7-01B, revision
S_e	Gamma Shielding Factor	0.2 (Unitless)	OSWER Directive 9285.7-01B
T_e	Gamma Exposure Time Factor	1/6 (Unitless)	OSWER Directive 9285.7-01B (4/24 hr exposure)

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 2.2.1

Recreational - Surface Water Exposure Pathway (Chemical - Carcinogens)

$$CW_{ING} = \frac{(TR) (BW_A) (AT) (365 \text{ days/yr})}{(ET) (EF) (SF_o) (IR_{water}) (ED) (ET) (CF_T)}$$

$$CW_{DER} = \frac{(TR) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(ET) (EF) (SF_o) (CF) (PC) [(SA_C) (ED_C) (BW_A) + (SA_A) (ED_A) (BW_C)]}$$

$$CW_{TOTAL} = \frac{(TR) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(ET) (EF) [(SF_o) (IR_{water}) (BW_C) (ED) (CF_T)] + (SF_o) (CF) (PC) [(SA_C) (ED_C) (BW_A) + (SA_A) (ED_A) (BW_C)]}$$

Table 2.2.1 Recreational (Chemical - Carcinogens)
Exposure variable explanations for the surface water exposure pathway

Variable	Definition	Value Used	Explanation/Source
CW_{ING}	Contaminant Concentration in Water (Ingestion)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{DER}	Contaminant Concentration in Water (Dermal)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{TOTAL}	Total Contaminant Concentration in Water for all Exposure Pathways	mg/l	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
BW_C	Body Weight (1 - 6 yrs)	15 kg	OSWER Directive 9285.6-03
BW_A	Body Weight (7 - 31 yrs)	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03
SF_o	Oral Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
IR_{water}	Ingestion Rate - Water	l/hour 0.05	EPA/540/1-89/002
SA_C	Skin Surface Area Available for Contact - Child	4,368 cm ²	Hands, Arms, Legs, Head EPA/600/8-89/043

Table 2.2.1 Recreational (Chemical - Carcinogens) Exposure variable explanations for the surface water exposure pathway			
Variable	Definition	Value Used	Explanation/Source
SA_A	Skin Surface Area Available for Contact - Adult	11,310 cm ²	Whole body EPA/600/8-89/043 Hands, Arms, Legs, Head EPA/600/8-89/043
CF	Volumetric Conversion Factor for Water	1 l/1000 cm ³	EPA/540/1-89/002
CF_T	Conversion Factor for Time	1 day/24 hours	OSWER Directive 9285.6-03
PC	Dermal Permeability Constant	Chemical-specific (cm/hour)	Literature
ET	Exposure Time	4 hours/day	OSWER Directive 9285.6-03
EF	Exposure Frequency	52 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
ED_c	Exposure Duration	6 yrs	OSWER Directive 9285.6-03
ED_A	Exposure Duration	24 yrs	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 2.2.2

Recreational - Surface Water Exposure Pathway (Chemical - Noncarcinogens - Chronic)

$$CW_{ING(Chronic)} = \frac{(THI) (BW_A) (365 \text{ days/yr})}{(ET) (EF) \left(\frac{1}{RfD_{sc}}\right) (IR_{water}) (CF_T)}$$

$$CW_{DER(Chronic)} = \frac{(THI) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(ET) (EF) (CF) (PC) \left(\frac{1}{RfD_{sc}}\right) [(SA_C) (ED_C) (BW_A) + (SA_A) (ED_A) (BW_C)]}$$

$$CW_{TOTAL(Chronic)} = \frac{(THI) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(ET) (EF) \left[\left(\frac{1}{RfD_{sc}}\right) (IR_{water}) (BW_C) (ED) (CF_T) + (CF) (PC) \left(\frac{1}{RfD_{sc}}\right) [(SA_C) (ED_C) (BW_A) + (SA_A) (ED_A) (BW_C)]\right]}$$

Table 2.2.2

Recreational - Surface Water Exposure Pathway (Chemical - Noncarcinogens - Subchronic)

$$CW_{TOTAL(Subchronic)} = CW_{DER(Subchronic)} = \frac{(THI) (BW_c) (365 \text{ days/yr})}{(ET) (EF) (CF) (PC) \left(\frac{1}{RfD_{OSC}}\right) (SA_c)}$$

Table 2.2.2 Recreational (Chemical - Noncarcinogens) Exposure variable explanations for the surface water exposure pathway			
Variable	Definition	Value Used	Explanation/Source
$CW_{ING(Chronic)}$	Contaminant Concentration in Water (Ingestion) for Chronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
$CW_{DER(Chronic)}$	Contaminant Concentration in Water (Dermal) for Chronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
$CW_{DER(Subchronic)}$	Contaminant Concentration in Water (Dermal) for Subchronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
$CW_{TOTAL(Chronic)}$	Total Contaminant Concentration in Water for Chronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
$CW_{TOTAL(Subchronic)}$	Total Contaminant Concentration in Water for Subchronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
BW_C	Body Weight (1 - 6 yrs)	15 kg	OSWER Directive 9285.6-03
BW_A	Body Weight (7 - 31 yrs)	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	Equal to ED	OSWER Directive 9285.6-03
RfD_{oc}	Chronic Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
RfD_{osc}	Subchronic Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST

Table 2.2.2 Recreational (Chemical - Noncarcinogens) Exposure variable explanations for the surface water exposure pathway			
Variable	Definition	Value Used	Explanation/Source
IR_{water}	Ingestion Rate - Water	ℓ/hour 0.05	EPA/540/1-89/002
CF	Volumetric Conversion Factor for Water	1ℓ/1000 cm ³	EPA/540/1-89/002
CF _T	Conversion Factor for Time	1 day/24 hours	OSWER Directive 9285.6-03
PC	Dermal Permeability Constant	Chemical-specific (cm/hour)	Literature
SA _C	Skin Surface Area Available for Contact - Child	4,368 cm ²	Hands, Arms, Legs, Head EPA/600/8-89/043
SA _A	Skin Surface Area Available for Contact - Adult	11,310 cm ²	Hands, Arms, Legs, Head EPA/600/8-89/043
ET	Exposure Time	4 hours/day	OSWER Directive 9285.6-03
EF	Exposure Frequency	52 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
ED _C	Exposure Duration	6 yrs	OSWER Directive 9285.6-03
ED _A	Exposure Duration	24 yrs	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 2.2.3

Recreational - Surface Water Exposure Pathway (Radionuclides)

$$CW_{TOTAL} = CW_{ING} = \frac{(TR)}{(SF_o) (IR_{water}) (ET) (EF) (ED) (CF_T)}$$

For tritium also add:

$$CW_{DERMTRIT} = \frac{TR}{(SF_o) (SA) (K_{PTRIT}) (ET) (EF) (CF) (ED)}$$

$$CW_{TOTALTRIT} = \frac{TR}{(EF) (ED) (ET) [(SF_o) (IR_{water}) (CF_T) + (SF_o) (SA) (K_{PTRIT}) (CF)]}$$

Table 2.2.3 Recreational (Radionuclides)
Exposure variable explanations for the surface water exposure pathway

Variable	Definition	Value Used	Explanation/Source
CW_{ING}	Radionuclide Concentration in Water (Ingestion)	pCi/l	Calculated Guideline Values (GVs) ¹
$CW_{DERMTRIT}$	Tritium Concentration in Water (Dermal)	pCi/l	Calculated Guideline Values (GVs) ¹
$CW_{TOTALTRIT}$	Tritium Concentration in Water (Ingestion) for all Exposure Pathways	pCi/l	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
SF_o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
IR_{water}	Ingestion Rate - Water	l/hour 0.05	EPA/540/1-89/002
ET	Exposure Time	4 hours/day	OSWER Directive 9285.6-03
EF	Exposure Frequency	52 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
SA	Skin Surface Area Available-Adult	1.13 m ²	Hands, arms, legs, head EPA/600/8-89/043
K_{PTRIT}	Dermal Permeability Constant for Tritium	1.5×10^{-5} m/hr	Bronaugh et al , 1980

Table 2.2.3 Recreational (Radionuclides) Exposure variable explanations for the surface water exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CF	Conversion Factor for Volume	10^3 l/m^3	OSWER Directive 9285.7-01B
CF_T	Conversion Factor for Time	1 day/24 hours	OSWER Directive 9285.7-01B

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.1.1

Subsistence Farmer - Soil Exposure Pathway (Chemical - Carcinogens)

$$CS_{ING} = \frac{(TR) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(EF) (SF_o) (CF) [(IR_{soilC}) (ED_C) (BW_A) + (IR_{soilA}) (ED_A) (BW_C)]}$$

$$CS_{INH} = \frac{(TR) (BW_A) (AT) (365 \text{ days/yr})}{(EF) (SF_i) (ED) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)}$$

$$CS_{TOTAL} = \frac{(TR) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(EF) [(SF_o) (CF) [(IR_{soilC}) (ED_C) (BW_A) + (IR_{soilA}) (ED_A) (BW_C)] + (SF_i) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right) (ED) (BW_C)]}$$

Table 3.1.1 Subsistence Farmer (Chemical - Carcinogens) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CS_{ING}	Contaminant Concentration in Soil (Ingestion)	mg/kg	Calculated Guideline Values (GVs) ¹
CS_{INH}	Contaminant Concentration in Soil (Inhalation)	mg/kg	Calculated Guideline Values (GVs) ¹
CS_{TOTAL}	Total Contaminant Concentration in Soil for all Exposure Pathways	mg/kg	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
BW_C	Body Weight (1 - 6 yrs)	15 kg	OSWER Directive 9285.6-03
BW_A	Body Weight (7 - 31 yrs)	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03
SF_o	Oral Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
SF_i	Inhalation Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
CF	Conversion Factor	10 ⁻⁶ kg/mg	EPA/540/1-89/002
IR_{soilC}	Soil Ingestion Rate (1 - 6 yrs)	200 mg/day	OSWER Directive 9285.6-03
IR_{soilA}	Soil Ingestion Rate (7 - 31 yrs)	480 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03

Table 3.1.1 Subsistence Farmer (Chemical - Carcinogens) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
VF	Soil-to-Air Volatilization Factor	Chemical-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28 x 10 ⁹ m ³ /kg	OSWER Directive 9285.7-01B, revision
EF	Exposure Frequency	350 Days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
ED _c	Exposure Duration 1 - 6 yrs	6 yrs	OSWER Directive 9285.6-03
ED _A	Exposure Duration 7 - 31 yrs	24 yrs	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

The calculated guideline values for soil inhalation are compared to the soil saturation concentration, and the lesser of the values is the guideline value.

Table 3.1.2

Subsistence Farmer - Soil Exposure Pathway (Chemical - Noncarcinogens - Chronic)

$$CS_{ING(Chronic)} = \frac{(THI) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(EF) (CF) \left(\frac{1}{RfD_{oC}}\right) [(IR_{soilC}) (ED_C) (BW_A) + (IR_{soilA}) (ED_A) (BW_C)]}$$

$$CS_{INH(Chronic)} = \frac{(THI) (BW_A) (AT) (365 \text{ days/yr})}{(EF) \left(\frac{1}{RfD_{iC}}\right) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF}\right) (ED)}$$

$$CS_{TOTAL(Chronic)} = \frac{(THI) (BW_C) (BW_A) (AT) (365 \text{ days/yr})}{(EF) \left[\left(\frac{1}{RfD_{oC}}\right) (CF) [(IR_{soilC}) (ED_C) (BW_A) + (IR_{soilA}) (ED_A) (BW_C)] + \left(\frac{1}{RfD_{iC}}\right) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF}\right) (ED) (BW_C)\right]}$$

Table 3.1.2

Subsistence Farmer - Soil Exposure Pathway (Chemical - Noncarcinogens - Subchronic)

$$CS_{TOTAL(Subchronic)} = CS_{ING(Subchronic)} = \frac{(THI) (BW_C) (365 \text{ days/yr})}{(EF) (CF) \left(\frac{1}{RfD_{oSC}}\right) (IR_{soilC})}$$

Table 3.1.2 Subsistence Farmer (Chemical - Noncarcinogens)
Exposure variable explanations for the soil exposure pathway

Variable	Definition	Value Used	Explanation/Source
$CS_{INO(Chronic)}$	Contaminant Concentration in Soil (Ingestion) for Chronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
$CS_{INH(Chronic)}$	Contaminant Concentration in Soil (Inhalation) for Chronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
$CS_{INO(Subchronic)}$	Contaminant Concentration in Soil (Ingestion) for Subchronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
$CS_{TOTAL(Chronic)}$	Total Contaminant Concentration in Soil for Chronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
$CS_{TOTAL(Subchronic)}$	Total Contaminant Concentration in Soil for Subchronic Exposure	mg/kg	Calculated Guideline Values (GVs) ¹
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
BW_c	Body Weight (1 - 6 yrs)	15 kg	OSWER Directive 9285.6-03
BW_A	Body Weight (7 - 31 yrs)	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	Equal to ED	OSWER Directive 9285.6-03
RfD_{oc}	Chronic Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
RfD_{osc}	Subchronic Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST

Table 3.1.2 Subsistence Farmer (Chemical - Noncarcinogens) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
RfD_{IC}	Chronic Inhalation Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
CF	Conversion Factor	10^{-6} kg/mg	EPA/540/1-89/002
IR_{soilC}	Soil Ingestion Rate (1 - 6 yrs)	200 mg/day	OSWER Directive 9285.6-03
IR_{soilA}	Soil Ingestion Rate (7 - 31 yrs)	480 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Chemical-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28×10^9 m ³ /kg	OSWER Directive 9285.7-01B, revision
EF	Exposure Frequency	350 Days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
ED_c	Exposure Duration 1 - 6 yrs	6 yrs	OSWER Directive 9285.6-03
ED_A	Exposure Duration 7 - 31 yrs	24 yrs	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report. The calculated guideline values for soil inhalation are compared to the soil saturation concentration, and the lesser of the values is the guideline value.

Table 3.1.3

Subsistence Farmer - Soil Exposure Pathway (Radionuclides)

$$CS_{ING} = \frac{(TR)}{(SF_o) (CF_1) (EF) [(IR_{soilC}) (ED_C) + (IR_{soilA}) (ED_A)]}$$

$$CS_{INH} = \frac{(TR)}{(SF_i) (CF_2) (EF) (ED) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)}$$

$$CS_{EX} = \frac{(TR)}{(SF_e) (ED) (1-S_e) (T_e)}$$

$$CS_{TOTAL} = \frac{(TR)}{(SF_o) (CF_1) (EF) [(IR_{soilC}) (ED_C) + (IR_{soilA}) (ED_A)] + (SF_i) (CF_2) (EF) (ED) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right) + (SF_e) (ED) (1-S_e) (T_e)}$$

Table 3.1.3 Subsistence Farmer (Radionuclides) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CS_{ING}	Radionuclide Concentration in Soil (Ingestion)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{INH}	Radionuclide Concentration in Soil (Inhalation)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{EX}	Radionuclide Concentration in Soil (External Exposure)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{TOTAL}	Total Radionuclide Concentration in Soil for all Exposure Pathways	pCi/g	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
ED_c	Exposure Duration 1 - 6 yrs	6 yrs	OSWER Directive 9285.6-03
ED_A	Exposure Duration 7 - 31 yrs	24 yrs	OSWER Directive 9285.6-03
SF_o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF_i	Inhalation Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF_e	External Exposure Slope Factor	Radionuclide-specific (risk/yr per pCi/g)	HEAST
CF_i	Conversion Factor 1	10^{-3} g/mg	OSWER Directive 9285.7-01B

Table 3.1.3 Subsistence Farmer (Radionuclides) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CF₂	Conversion Factor 2	10 ³ g/kg	OSWER Directive 9285.7-01B
EF	Exposure Frequency	350 Days/yr	OSWER Directive 9285.6-03
IR_{soilC}	Soil Ingestion Rate (1 - 6 yrs)	200 mg/day	OSWER Directive 9285.6-03
IR_{soilA}	Soil Ingestion Rate (7 - 31 yrs)	480 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Radionuclide-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28 x 10 ⁹ m ³ /kg	OSWER Directive 9285.7-01B, revision
S_γ	Gamma Shielding Factor	0.2 (Unitless)	OSWER Directive 9285.7-01B, revision
T_γ	Gamma Exposure Time Factor	9/24 (Unitless)	OSWER Directive 9285.7-01B, revision

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.2.1

Subsistence Farmer - Groundwater Exposure Pathway (Chemical - Carcinogens)

$$CW_{ING} = \frac{(TR) (BW_A) (AT) (365 \text{ days/yr})}{(SF_o) (IR_{water}) (EF) (ED)}$$

$$CW_{DER} = \frac{(TR) (BW_A) (BW_C) (AT) (365 \text{ days/yr})}{(SF_o) (PC) (CF) (EF) (ET) [(SA_A) (ED_A) (BW_C) + (SA_C) (ED_C) (BW_A)]}$$

$$CW_{INH} = \frac{(TR) (BW_A) (AT) (365 \text{ days/yr})}{(SF_i) (K) (IR_{air}) (EF) (ED) (TF)}$$

$$CW_{TOTAL} = \frac{(TR) (BW_A) (BW_C) (AT) (365 \text{ days/yr})}{(EF) [(BW_C) (SF_o) (IR_{water}) (ED) + (SF_o) (PC) (CF) (ET) [(SA_A) (ED_A) (BW_C) + (SA_C) (ED_C) (BW_A)] + (BW_C) (SF_i) (K) (IR_{air}) (ED) (TF)]}$$

Table 3.2.1 Subsistence Farmer (Chemical - Carcinogens)
Exposure variable explanations for the groundwater exposure pathway.

Variable	Definition	Value Used	Explanation/Source
CW_{ING}	Contaminant Concentration in Water (Ingestion)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{DER}	Contaminant Concentration in Water (Dermal)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{INH}	Contaminant Concentration in Water (Inhalation)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{TOTAL}	Total Contaminant Concentration in Water for all Exposure Pathways	mg/l	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
SF_o	Oral Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
SF_i	Inhalation Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
K	Volatilization Factor	$0.0005 \times 1000 \text{ l/m}^3$	OSWER Directive 9285.7-01B
IR_{water}	Daily Water Ingestion Rate	2.0 l/day	OSWER Directive 9285.6-03
IR_{air}	Daily Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
SA_C	Skin Surface Area Available for Contact - Child	7,280 cm ²	Whole body (age 3 to 6) 50th percentile EPA/600/8-89/043
SA_A	Skin Surface Area Available for Contact - Adult	19,400 cm ²	Whole body EPA/600/8-89/043

Table 3.2.1 Subsistence Farmer (Chemical - Carcinogens) Exposure variable explanations for the groundwater exposure pathway.			
Variable	Definition	Value Used	Explanation/Source
PC	Permeability Constant	Chemical-specific (cm/hr)	Literature
CF	Conversion Factor	1 l/1000 cm ³	EPA/540/1-89/002
ET	Exposure Time	0.167 hr/day	EPA Dermal Risk Assessment Supplemental Guidance August 1992
EF	Exposure Frequency	350 Days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
ED _A	Exposure Duration (7-31 yrs)	24 yrs	OSWER Directive 9285.6-03
ED _C	Exposure Duration (1-6 yrs)	6 yrs	OSWER Directive 9285.6-03
BW _A	Body Weight (7-31 yrs)	70 kg	OSWER Directive 9285.6-03
BW _C	Body Weight (1-6 yrs)	15 kg	OSWER Directive 9285.6-03
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03
TF	Time Fraction Spent in House	15/24	EPA/600/8-89/043

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.2.2.

Subsistence Farmer - Groundwater Exposure Pathway (Chemical - Noncarcinogens - Chronic)

$$CW_{ING(Chronic)} = \frac{(THI) (BW_A) (365 \text{ days/yr})}{(IR_{water}) (EF) \left(\frac{1}{RfD_{oc}}\right)}$$

$$CW_{DER(Chronic)} = \frac{(THI) (BW_C) (AT) (365 \text{ days/yr}) (BW_A)}{(PC) (CF) (ET) (EF) \left(\frac{1}{RfD_{oc}}\right) [(SA_C) (ED_C) (BW_A) + (SA_A) (ED_A) (BW_C)]}$$

$$CW_{INH(Chronic)} = \frac{(THI) (BW_A) (365 \text{ days/yr})}{(K) (IR_{air}) (EF) (TF) \left(\frac{1}{RfD_{ic}}\right)}$$

$$CW_{TOTAL(Chronic)} = \frac{(THI) (BW_C) (BW_A) (365 \text{ days/yr}) (AT)}{(EF) [(IR_{water}) \left(\frac{1}{RfD_{oc}}\right) (BW_C) (ED) + (PC) (CF) (ET) \left(\frac{1}{RfD_{oc}}\right) [(SA_C) (ED_C) (BW_A) + (SA_A) (ED_A) (BW_C)] + (ED) (K) (IR_{air}) \left(\frac{1}{RfD_{ic}}\right) (BW_C) (TF)]}$$

Table 3.2.2.

Subsistence Farmer - Groundwater Exposure Pathway (Chemical - Noncarcinogens - Subchronic)

$$CW_{TOTAL(Subchronic)} = CW_{DER(Subchronic)} = \frac{(THI) (BW_C) (365 \text{ days/yr})}{(PC) (CF) (ET) (EF) \left(\frac{1}{RfD_{OSC}}\right) (SA_C)}$$

Table 3.2.2 Subsistence Farmer (Chemical - Noncarcinogens)
Exposure variable explanations for the groundwater exposure pathway.

Variable	Definition	Value Used	Explanation/Source
$CW_{ING(Chronic)}$	Contaminant Concentration in Water (Ingestion) for Chronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
$CW_{DER(Chronic)}$	Contaminant Concentration in Water (Dermal) for Chronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
$CW_{INH(Chronic)}$	Contaminant Concentration in Water (Inhalation) for Chronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
$CW_{DER(Subchronic)}$	Contaminant Concentration in Water (Dermal) for Subchronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
$CW_{TOTAL(Chronic)}$	Total Contaminant Concentration in Water for Chronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
$CW_{TOTAL(Subchronic)}$	Total Contaminant Concentration in Water for Subchronic Exposure	mg/l	Calculated Guideline Values (GVs) ¹
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
IR_{water}	Daily Water Ingestion Rate	2.0 l/day	OSWER Directive 9285.6-03
IR_{air}	Daily Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
K	Volatilization Factor	0.0005 X 1000 l/m ³	OSWER Directive 9285.7-01B
PC	Permeability Constant	Chemical-specific (cm/hr)	Literature

Table 3.2.2 Subsistence Farmer (Chemical - Noncarcinogens) Exposure variable explanations for the groundwater exposure pathway.			
Variable	Definition	Value Used	Explanation/Source
CF	Conversion Factor	1 l/1000 cm ³	EPA/540/1-89/002
ED	Exposure Duration	30 years	OSWER Directive 9285.6-03
ED _A	Exposure Duration Adult	24 years	OSWER Directive 9285.6-03
ED _C	Exposure Duration Child	6 years	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 Days/yr	OSWER Directive 9285.6-03
ET	Exposure Time	Hours/day 0.167	EPA Dermal Risk Assessment Supplemental Guidance August 1992
RfD _{oc}	Chronic Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
RfD _{osc}	Subchronic Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
RfD _{ic}	Chronic Inhalation Reference Dose	Chemical specific (mg/kg-day)	IRIS, HEAST
SA _C	Skin Surface Area Available for Contact - Child	7,280 cm ²	Whole body (age 3 - 6 yrs) EPA/600/8-89/043
SA _A	Skin Surface Area Available for Contact - Adult	19,400 cm ²	Whole body EPA/600/8-89/043
BW _C	Body Weight (1-6 yrs)	15 kg	OSWER Directive 9285.6-03
BW _A	Body Weight (7-31 yrs)	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	Equal to ED	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.2.3

Subsistence Farmer - Groundwater Pathway (Radionuclides)

$$CW_{ING} = \frac{TR}{(SF_o) (IR_{water}) (EF) (ED)}$$

For Tritium also add:

$$CW_{INHTRIT} = \frac{TR}{(SF_i) (IR_{air}) (EF) (ED) (M_{TOTAL}) (CF_1) \left[(ET_s) + \frac{(F) (N_p) (N_{sv}) (V_s)}{\lambda (V_H)} \right]}$$

$$CW_{DERMTRIT} = \frac{TR}{(SF_o) (SA) (K_p) (ET_s) (EF) (CF_2) (ED)}$$

$$CW_{TOTALTRIT} = \frac{TR}{(EF) (ED) [(SF_o) (IR_{water}) + (SF_i) (IR_{air}) (M_{TOTAL}) (CF_1) \left[(ET_s) + \frac{(F) (N_p) (N_{sv}) (V_s)}{\lambda (V_H)} \right] + (SF_o) (SA) (K_p) (ET_s) (CF_2)]}$$

Table 3.2.3 Subsistence Farmer (Radionuclides)
Exposure variable explanations for the groundwater exposure pathway.

Variable	Definition	Value Used	Explanation/Source
CW_{ING}	Radionuclide Concentration in Water (Ingestion)	pCi/ℓ	Calculated Guideline Values (GVs) ¹
$CW_{INHTRIT}$	Tritium Concentration in Water (Inhalation)	pCi/ℓ	Calculated Guideline Values (GVs) ¹
$CW_{DERMTRIT}$	Tritium Concentration in Water (Dermal)	pCi/ℓ	Calculated Guideline Values (GVs) ¹
CW_{TOTAL}	Total Radionuclide Concentration in Water for all Exposure Pathways	pCi/ℓ	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
SF_o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF_i	Inhalation Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
IR_{water}	Daily Water Ingestion Rate	2.0 ℓ/day	OSWER Directive 9285.6-03
IR_{air}	Daily Inhalation Rate	0.83m ³ /hr	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
M_{TOTAL}	Airborne Mass Concentration of Water in Shower Stall	66.96 g/m ³	ORNL Tritium Methodology

Table 3.2.3 Subsistence Farmer (Radionuclides) Exposure variable explanations for the groundwater exposure pathway.			
Variable	Definition	Value Used	Explanation/Source
CF_1	Conversion Factor for Mass of Water	1 ℓ /1000g	ORNL Tritium Methodology
ET_s	Exposure Time in Shower	0.167 hours/day	EPA Dermal Risk Assessment Supplemental Guidance 1992
F	Fraction of Day Spent Inside House	15 hours/24 hours	EPA/600/8-89/043
N_p	Number of Household Members Showering per Day	4	Best Professional Judgement ORNL Tritium Methodology
N_{sv}	Number of Shower Volumes Expelled into Home per Shower	6	Best Professional Judgement ORNL Tritium Methodology
V_s	Volume of Shower Stall	5 m^3	Best Professional Judgement ORNL Tritium Methodology
λ	Functional Air Exchange Rate of House	2.76/ hour	McKone and Bogen, 1992
V_H	Volume of House (1200 ft^3)	272 m^3	Best Professional Judgement ORNL Tritium Methodology
SA	Skin Surface Area Available for Absorption	1.9 m^2	Whole Body EPA/600/8-89/043
K_{PTRIT}	Dermal Permeability Constant for Tritium	1.5×10^{-5} m/hour	Bronaugh et al, 1980
CF_2	Conversion Factor for Volume	10^3 ℓ/m^3	ORNL Tritium Methodology

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.3.1

Subsistence Farmer - Soil/Home Grown Produce Exposure Pathway (Chemical - Carcinogens)

$$CS = \frac{C_h}{B_{10^{-6}}}$$

$$C_h = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(SF_o) (IR_h) (FI_h) (EF) (ED)}$$

Table 3.3.1. Subsistence Farmer (Chemical - Carcinogens)
Exposure variable explanations for the calculation of the target concentration of contaminants in soil used to grow homegrown produce.

Variable	Definition	Value Used	Explanation/Source
CS	Concentration of Chemical in Soil	Chemical-specific (mg/kg)	Calculated Guideline Values (GVs) ¹
C _{iv}	Concentration of the Chemical in the Edible Portion of the Crop	Chemical-specific (mg/kg)	Calculated Values
TR	Target Excess Individual Lifetime Cancer Risk	1 x 10 ⁻⁶ 1 x 10 ⁻⁵ 1 x 10 ⁻⁴ (Unitless)	OSWER Directive 9285.7-01B
SF _o	Oral Cancer Slope Factor	Chemical specific (mg/kg-day) ⁻¹	IRIS, HEAST
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 Days/year	OSWER Directive 9285.6-03
FI _{iv}	Fraction of Diet Produce Ingested from Site	0.36 (Unitless)	OSWER Directive 9285.6-03
IR _{iv}	Ingestion Rate	0.340 kg/day	OSWER Directive 9285.6-03
B _{vwet}	Soil to wet plant concentration factor, the ratio of the concentration of an element in vegetation divided by its concentration in soil.	Chemical-specific (Unitless)	MEPAS

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.3.2

Subsistence Farmer - Soil/Home Grown Produce Exposure Pathway (Chemical - Noncarcinogens)

$$CS = \frac{C_b}{B_{\text{soil}}}$$

$$C_b = \frac{(THI) (BW) (AT) (365 \text{ days/yr})}{(IR_b) (FI_b) (EF) \left(\frac{1}{RfD_o}\right) (ED)}$$

Table 3.3.2. Subsistence Farmer (Chemical - Noncarcinogens)
Exposure variable explanations for the calculation of the target concentration of contaminants in soil used to grow homegrown produce.

Variable	Definition	Value Used	Explanation/Source
CS	Concentration of the Chemical in Soil	Chemical-specific (mg/kg)	Calculated Guideline Values (GVs) ¹
C _w	Concentration of the Chemical in the Edible Portion of the Crop	Chemical-specific (mg/kg)	Calculated Value
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
RfD _o	Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
AT	Averaging Time	30 yrs	OSWER Directive 9285.6-03
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 Days/year	OSWER Directive 9285.6-03
FI _{iv}	Fraction of Diet Produce Ingested from Site	0.36 (Unitless)	OSWER Directive 9285.6-03
IR _{iv}	Ingestion Rate	0.340 kg/day	OSWER Directive 9285.6-03
B _{vwet}	Soil to wet plant concentration factor, the ratio of the concentration of a chemical in vegetation divided by its concentration in soil.	Chemical-specific (Unitless)	MEPAS

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.3.3

Subsistence Farmer - Soil/Home Grown Produce Exposure Pathway (Radionuclides)

$$CS = \frac{C_h}{B_{USW1}}$$

$$C_h = \frac{(TR)}{(SF_o) (CF) (IR_h) (FI_h) (EF) (ED)}$$

Table 3.3.3 Subsistence Farmer (Radionuclides)
Exposure variable explanations for the calculation of the target concentration of contaminants in soil used to grow homegrown produce.

Variable	Definition	Value Used	Explanation/Source
C_s	Concentration of the Radionuclide in Soil	Radionuclide-specific (pCi/g)	Calculated Guideline Values (GVs) ¹
C_w	Concentration of the Radionuclide in the Edible Portion of the Crop	Radionuclide-specific (pCi/g)	Calculated Values
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
SF_o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 Days/year	OSWER Directive 9285.6-03
FI_w	Fraction of Diet Produce Ingested from Site	0.36 (Unitless)	OSWER Directive 9285.6-03
IR_w	Ingestion Rate	0.340 kg/day	OSWER Directive 9285.6-03
CF	Conversion Factor	10^3 g/kg	OSWER Directive 9285.7-01B
B_{vwet}	Soil to wet plant concentration factor, the ratio of the concentration of a Radionuclide in vegetation divided by its concentration in soil.	Radionuclide-specific (Unitless)	NCRP, MEPAS

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.4.1

Subsistence Farmer - Soil/Beef Exposure Pathway (Chemical - Carcinogens)

$$CS = \frac{C_b}{(F_b) [(B_{wy}(dy)) (Q_f) + (Q_s)]}$$

$$C_b = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(SF_o) (IR_b) (FI_b) (EF) (ED)}$$

Table 3.4.1 Subsistence Farmer (Chemical - Carcinogens)
Exposure variable explanations for the ingestion of beef.

Variable	Definition	Value Used	Explanation/Source
CS	Contaminant Concentration in Soil	Chemical-specific (mg/kg)	Calculated Guideline Values (GVs) ¹
C _b	Concentration of the Chemical in Beef	Chemical-specific (mg/kg)	Calculated Values
TR	Target Excess Individual Lifetime Cancer Risk	1 x 10 ⁻⁶ 1 x 10 ⁻⁵ 1 x 10 ⁻⁴ (Unitless)	OSWER Directive 9285.7-01B
SF _o	Oral Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 days/year	OSWER Directive 9285.6-03
FI _b	Fraction of Diet Beef Ingested from Site	0.75 (unitless)	OSWER Directive 9285.6-03
IR _b	Ingestion Rate (Beef)	0.100 (kg/day)	OSWER Directive 9285.6-03
F _b	Feed-to-beef transfer coefficient	Chemical-specific (days/kg)	MEPAS, NCRP, IAEA
B _{vdry}	Soil-to-plant concentration factor	Chemical-specific (Unitless)	MEPAS, NCRP, IAEA

Table 3.4.1 Subsistence Farmer (Chemical - Carcinogens) Exposure variable explanations for the ingestion of beef.			
Variable	Definition	Value Used	Explanation/Source
Q_r	Quantity of feed/silage ingested daily by cattle (dry matter)	8.2 kg DM/day	Stockdale & King 1983
Q_s	Quantity of soil ingested daily by cattle	0.8 kg/day	Mayland <i>et al.</i> 1975

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.4.2

Subsistence Farmer - Soil/Beef Exposure Pathway (Chemical - Noncarcinogens)

$$CS = \frac{C_b}{(F_b) [(B_{sa(days)}) (Q_f) + (Q_s)]}$$

$$C_b = \frac{(THI) (BW) (AT) (365 \text{ days/yr})}{(IR_b) (FI_b) (EF) \left(\frac{1}{RfD_o}\right) (ED)}$$

Table 3.4.2 Subsistence Farmer (Chemical - Noncarcinogens)
Exposure variable explanations for the ingestion of beef.

Variable	Definition	Value Used	Explanation/Source
CS	Contaminant Concentration in Soil	Chemical-specific (mg/kg)	Calculated Guideline Values (GVs) ¹
C _b	Concentration of the Chemical in Beef	Chemical-specific (mg/kg)	Calculated Values
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
RfD _o	Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
AT	Averaging Time	30 yrs	OSWER Directive 9285.6-03
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 Days/year	OSWER Directive 9285.6-03
FI _b	Fraction of Diet Beef Ingested from Site	0.75 (Unitless)	OSWER Directive 9285.6-03
IR _b	Ingestion Rate (Beef)	0.100 kg/day	OSWER Directive 9285.6-03
F _b	Feed-to-beef transfer coefficient	Chemical-specific (days/kg)	MEPAS, NCRP, IAEA
B _{vt(dry)}	Soil-to-plant concentration factor	Chemical-specific (Unitless)	MEPAS, NCRP, IAEA
Q _r	Quantity of feed/silage ingested daily by cattle (dry matter)	8.2 kg DM/day	Stockdale & King 1983

Table 3.4.2 Subsistence Farmer (Chemical - Noncarcinogens) Exposure variable explanations for the ingestion of beef.			
Variable	Definition	Value Used	Explanation/Source
Q _i	Quantity of soil ingested daily by cattle	0.8 kg/day	Mayland <i>et al.</i> 1975

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.4.3

Subsistence Farmer - Soil/Beef Exposure Pathway (Radionuclides)

$$CS = \frac{C_b}{F_b[(B_{vs(dry)}) (Q_f) + (Q_s)]}$$

$$C_b = \frac{(TR)}{(SF_o) (IR_b) (FI_b) (EF) (ED) (CF)}$$

Table 3.4.3 Subsistence Farmer (Radionuclides)
Exposure variable explanations for the ingestion of beef.

Variable	Definition	Value Used	Explanation/Source
CS	Contaminant Concentration in Soil	Radionuclide-specific (pCi/g)	Calculated Guideline Values (GVs) ¹
C _b	Concentration of the Radionuclide in Beef	Radionuclide-specific (pCi/g)	Calculated Values
TR	Target Excess Individual Lifetime Cancer Risk	1 x 10 ⁻⁶ 1 x 10 ⁻⁵ 1 x 10 ⁻⁴ (Unitless)	OSWER Directive 9285.7-01B
SF _o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 Days/year	OSWER Directive 9285.6-03
FI _b	Fraction of Diet (Ingested)	0.75 (Unitless)	OSWER Directive 9285.6-03
IR _b	Ingestion Rate (Beef)	0.100 kg/day	OSWER Directive 9285.6-03
CF	Conversion Factor	10 ³ g/kg	OSWER Directive 9285.7-01B
F _b	Feed-to-beef transfer coefficient	Radionuclide-specific (days/kg)	NCRP, MEPAS, IAEA
B _{vs(dry)}	Soil-to-plant concentration factor	Radionuclide-specific (Unitless)	NCRP, MEPAS, IAEA
Q _f	Quantity of feed/silage ingested daily by cattle (dry matter)	8.2 kg DM/day	Stockdale & King 1983

Table 3.4.3 Subsistence Farmer (Radionuclides) Exposure variable explanations for the ingestion of beef.			
Variable	Definition	Value Used	Explanation/Source
Q_s	Quantity of soil ingested daily by cattle	0.8 kg/day	Mayland <i>et al.</i> 1975

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.5.1

Subsistence Farmer - Soil/Milk Exposure Pathway (Chemical - Carcinogens)

$$CS = \frac{C_m}{F_m[(B_{sd})(Q_f) + (Q_s)]}$$

$$C_m = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(SF_o) (IR_m) (FI_m) (EF) (ED)}$$

Table 3.5.1 Subsistence Farmer (Chemical - Carcinogens)
Exposure variable explanations for the ingestion of milk.

Variable	Definition	Value Used	Explanation/Source
CS	Contaminant Concentration in Soil	mg/kg	Calculated Guideline Values (GVs) ¹
C _m	Concentration of the Chemical in Milk	Chemical-specific mg/kg	Calculated Values
TR	Target Excess Individual Lifetime Cancer Risk	1 x 10 ⁻⁶ 1 x 10 ⁻⁵ 1 x 10 ⁻⁴ (Unitless)	OSWER Directive 9285.7-01B
SF _o	Oral Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 Days/year	OSWER Directive 9285.6-03
FI _m	Fraction of Diet Milk Ingested from Site	0.75 (Unitless)	OSWER Directive 9285.6-03
IR _m	Ingestion Rate (Milk)	0.400 kg/day	OSWER Directive 9285.6-03
F _m	Feed-to-milk transfer coefficient	Chemical-specific (days/kg)	NCRP, MEPAS, IAEA
B _{vs(dry)}	Soil-to-plant concentration factor	Chemical-specific (Unitless)	NCRP, MEPAS, IAEA

Table 3.5.1 Subsistence Farmer (Chemical - Carcinogens) Exposure variable explanations for the ingestion of milk.			
Variable	Definition	Value Used	Explanation/Source
Q_f	Quantity of feed/silage ingested daily by cattle (dry matter)	8.2 kg DM/day	Stockdale & King 1983
Q_s	Quantity of soil ingested daily by cattle	0.8 kg/day	Mayland <i>et al.</i> 1975

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.5.2

Subsistence Farmer - Soil/Milk Exposure Pathway (Chemical - Noncarcinogens)

$$CS = \frac{C_m}{F_m[(B_{vs(dry)})(Q_f) + (Q_s)]}$$

$$C_m = \frac{(THI) (BW) (AT) (365 \text{ days/yr})}{(IR_m) (FI_m) (EF) (\frac{1}{RfD_o}) (ED)}$$

Table 3.5.2 Subsistence Farmer (Chemical - Noncarcinogens)
Exposure variable explanations for the ingestion of milk.

Variable	Definition	Value Used	Explanation/Source
CS	Contaminant Concentration in Soil	mg/kg	Calculated Guideline Values (GVs) ¹
C _m	Concentration of the Chemical in Milk	Chemical-specific mg/kg	Calculated Values
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
RfD _o	Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
AT	Averaging Time	30 yrs	OSWER Directive 9285.6-03
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 Days/year	OSWER Directive 9285.6-03
FI _m	Fraction of Diet Milk Ingested from Site	0.75 (Unitless)	OSWER Directive 9285.6-03
IR _m	Ingestion Rate (Milk)	0.400 kg/day	OSWER Directive 9285.6-03
F _m	Feed-to-milk transfer coefficient	Chemical-specific (days/kg)	MEPAS, NCRP, IAEA
B _{vs(dry)}	Soil-to-plant concentration factor	Chemical-specific (Unitless)	MEPAS, NCRP, IAEA
Q _f	Quantity of feed/silage ingested daily by cattle (dry matter)	8.2 kg DM/day	Stockdale & King 1983

Table 3.5.2 Subsistence Farmer (Chemical - Noncarcinogens) Exposure variable explanations for the ingestion of milk.			
Variable	Definition	Value Used	Explanation/Source
Q _i	Quantity of soil ingested daily by cattle	0.8 kg/day	Mayland <i>et al.</i> 1975

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 3.5.3

Subsistence Farmer - Soil/Milk Exposure Pathway (Radionuclides)

$$CS = \frac{C_m}{F_m[(B_{vs(dry)})(Q_p) + (Q_s)]}$$

$$C_m = \frac{(TR)}{(SF_o) (CF) (IR_m) (FI_m) (EF) (ED)}$$

Table 3.5.3 Subsistence Farmer (Radionuclides)
Exposure variable explanations for the ingestion of milk.

Variable	Definition	Value Used	Explanation/Source
CS	Contaminant Concentration in Soil	Radionuclide-specific pCi/g	Calculated Guideline Values (GVs) ¹
C _m	Concentration of the Radionuclide in Milk	Radionuclide-specific (pCi/g)	Calculated Values
TR	Target Excess Individual Lifetime Cancer Risk	1 x 10 ⁻⁶ 1 x 10 ⁻⁵ 1 x 10 ⁻⁴ (Unitless)	OSWER Directive 9285.7-01B
SF _o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
ED	Exposure Duration	30 yrs	OSWER Directive 9285.6-03
EF	Exposure Frequency	350 Days/year	OSWER Directive 9285.6-03
FI _m	Fraction of Diet (Ingested)	0.75 (Unitless)	OSWER Directive 9285.6-03
IR _m	Ingestion Rate (Milk)	0.400 kg/day	OSWER Directive 9285.6-03
CF	Conversion Factor	10 ³ g/kg	OSWER Directive 9285.7-01B
F _m	Feed-to-milk transfer coefficient	Radionuclide-specific (days/kg)	Calculated value
B _{vs(dry)}	Soil-to-plant concentration factor	Radionuclide-specific (Unitless)	NCRP, MEPAS, IAEA

Table 3.5.3 Subsistence Farmer (Radionuclides) Exposure variable explanations for the ingestion of milk.			
Variable	Definition	Value Used	Explanation/Source
Q_f	Quantity of feed/silage ingested daily by cattle (dry matter)	8.2 kg DM/day	Stockdale & King 1983
Q_s	Quantity of soil ingested daily by cattle	0.8 kg/day	Mayland <i>et al.</i> 1975

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 4.1.1

Construction/Mound Employee - Soil/Sediment Exposure Pathway (Chemical - Carcinogens)

$$CS_{ING} = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(EF) (ED) (SF_o) (CF) (IR_{soil})}$$

$$CS_{INH} = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(EF) (ED) (SF_i) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)}$$

$$CS_{TOTAL} = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(EF) (ED) [(SF_o) (CF) (IR_{soil}) + (SF_i) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)]}$$

Table 4.1.1 Construction/Mound Employee (Chemical - Carcinogens) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CS _{ING}	Contaminant Concentration in Soil (Ingestion)	mg/kg	Calculated Guideline Values (GVs) ¹
CS _{INH}	Contaminant Concentration in Soil (Inhalation)	mg/kg	Calculated Guideline Values (GVs) ¹
CS _{TOTAL}	Total Contaminant Concentration in Soil for all Exposure Pathways	mg/kg	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1 x 10 ⁻⁶ 1 x 10 ⁻⁵ 1 x 10 ⁻⁴ (Unitless)	OSWER Directive 9285.7-01B
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03
SF _o	Oral Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
SF _i	Inhalation Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
CF	Conversion Factor	10 ⁻⁶ kg/mg	EPA/540/1-89/002
IR _{soil}	Ingestion Rate - Soil	480 mg/day	OSWER Directive 9285.6-03
IR _{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Chemical-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revisions

Table 4.1.1 Construction/Mound Employee (Chemical - Carcinogens) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
PEF	Particulate Emission Factor	$4.28 \times 10^9 \text{ m}^3/\text{kg}$	OSWER Directive 9285.7-01B, revisions
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	5 yrs	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

The calculated guideline values for soil inhalation are compared to the soil saturation concentration, and the lesser of the values is the guideline value.

Table 4.1.2

Construction/Mound Employee - Soil/Sediment Exposure Pathway (Chemical - Noncarcinogens)

$$CS_{ING} = \frac{(THI) (BW) (365 \text{ days/yr})}{(EF) \left(\frac{1}{RfD_o}\right) (CF) (IR_{soil})}$$

$$CS_{INH} = \frac{(THI) (BW) (365 \text{ days/yr})}{(EF) \left(\frac{1}{RfD_i}\right) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF}\right)}$$

$$CS_{TOTAL} = \frac{(THI) (BW) (365 \text{ days/yr})}{(EF) \left[\left(\frac{1}{RfD_o}\right) (CF) (IR_{soil}) + \left(\frac{1}{RfD_i}\right) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF}\right)\right]}$$

Table 4.1.2 Construction/Mound Employee (Chemical - Non-Carcinogens)
Exposure variable explanations for the soil/sediment exposure pathway

Variable	Definition	Value Used	Explanation/Source
CS_{ING}	Contaminant Concentration in Soil (Ingestion)	mg/kg	Calculated Guideline Values (GVs) ¹
CS_{INH}	Contaminant Concentration in Soil (Inhalation)	mg/kg	Calculated Guideline Values (GVs) ¹
CS_{TOTAL}	Total Contaminant Concentration in Soil for all Exposure Pathways	mg/kg	Calculated Guideline Values (GVs) ¹
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
RfD_o	Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
RfD_i	Inhalation Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
CF	Conversion Factor	10^{-6} kg/mg	EPA/540/1-89/002
IR_{soil}	Ingestion Rate - Soil	480 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Chemical-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revisions
PEF	Particulate Emission Factor	4.28×10^9 m ³ /kg	OSWER Directive 9285.7-01B, revisions
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

The calculated guideline values for soil inhalation are compared to the soil saturation concentration, and the lesser of the values is the guideline value.

Table 4.1.3

Construction/Mound Employee - Soil/Sediment Exposure Pathway (Radionuclides)

$$CS_{INO} = \frac{(TR)}{(ED_1) (EF) (SF_o) (CF_1) (IR_{soil})}$$

$$CS_{INH} = \frac{(TR)}{(ED_1) (EF) (SF_1) (CF_2) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)}$$

$$CS_{EX} = \frac{(TR)}{(ED_2) (SF_e) (1-S_e) (T_e)}$$

$$CS_{TOTAL} = \frac{(TR)}{(ED_1) (EF) [(SF_o) (CF_1) (IR_{soil}) + (SF_1) (CF_2) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)] + (ED_2) (SF_e) (1-S_e) (T_e)}$$

Table 4.1.3 Construction/Mound Employee (Radionuclides) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CS_{ING}	Radionuclide Concentration in Soil (Ingestion)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{INH}	Radionuclide Concentration in Soil (Inhalation)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{EX}	Radionuclide Concentration in Soil (External Exposure)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{TOTAL}	Total Radionuclide Concentration in Soil for all Exposure Pathways	pCi/g	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
ED_1	Exposure Duration 1	5 yrs	OSWER Directive 9285.6-03
ED_2	Exposure Duration 2	5 yrs x 0.685	OSWER Directive 9285.6-03 (250 days/yr ÷ 365 days/yr)
SF_o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF_i	Inhalation Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST

Table 4.1.3 Construction/Mound Employee (Radionuclides) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CF₂	Conversion Factor 2	10 ³ g/kg	OSWER Directive 9285.7-01B
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03
IR_{soil}	Ingestion Rate - Soil	480 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Radionuclide-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revisions
PEF	Particulate Emission Factor	4.28 x 10 ⁹ m ³ /kg	OSWER Directive 9285.7-01B, revisions
S_γ	Gamma Shielding Factor	0.1 (Unitless)	OSWER Directive 9285.7-01B (open area), revisions
T_γ	Gamma Exposure Time Factor	1/3 (Unitless)	OSWER Directive 9285.7-01B (8/24 hr exposure), revisions

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 4.2.1

Construction/Mound Employee - Groundwater Exposure Pathway (Chemical - Carcinogens)

$$CW_{ING} = \frac{(TR)(BW)(AT)(365 \text{ days/yr})}{(SF_o)(IR_{water})(EF)(ED)}$$

$$\text{ORGANICS: } CW_{DERM} = \frac{BW \times AT \times TR \times 365 \text{ day/yr}}{2 \times K_p \times 10^{-3} \frac{L}{cm^3} \times \left[\sqrt{\frac{6 \times \tau \times t_{event}}{\pi}} \right] \times EV \times EF \times SA \times ED \times SF_o}$$

$$\text{INORGANICS: } CW_{DERM} = \frac{BW \times AT \times TR \times 365 \text{ day/yr}}{K_p \times 10^{-3} \frac{L}{cm^3} \times t_{event} \times EV \times EF \times SA \times ED \times SF_o}$$

$$CW_{INH} = \frac{(TR)(BW)(AT)(365 \text{ days/yr})}{(SF_i)(K)(IR_{air})(EF)(ED)(ET)(CF_T)}$$

$$CW_{TOTAL} = \frac{1}{\frac{1}{CW_{DERM}} + \frac{1}{CW_{INH}} + \frac{1}{CW_{ING}}}$$

Table 4.2.1 Construction/Mound Employee (Chemical - Carcinogens) Exposure variable explanations for the groundwater exposure pathway.			
Variable	Definition	Value Used	Explanation/Source
CW_{ING}	Contaminant Concentration in Water (Ingestion)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{DER}	Contaminant Concentration in Water (Dermal)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{INH}	Contaminant Concentration in Water (Inhalation)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{TOTAL}	Total Contaminant Concentration in Water for all Exposure Pathways	mg/l	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
SF_o	Oral Cancer Slope Factor	Chemical specific (mg/kg-day) ⁻¹	IRIS, HEAST
IR_{water}	Daily Water Ingestion Rate	1.0 l/day	OSWER Directive 9285.6-03
SF_i	Inhalation Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
K	Volatilization Factor	$0.0005 \times 1000 \text{ l/m}^3$	OSWER Directive 9285.7-01B
IR_{air}	Daily Inhalation Rate	$20 \text{ m}^3/\text{day}$	OSWER Directive 9285.6-03
SA	Skin Surface Area Available for Contact	$19,400 \text{ cm}^2$	Whole body, EPA/600/8-89/043
K_p	Permeability Constant	Chemical-specific (cm/hr)	EPA 600/8-91/011B

Table 4.2.1 Construction/Mound Employee (Chemical - Carcinogens) Exposure variable explanations for the groundwater exposure pathway.			
Variable	Definition	Value Used	Explanation/Source
τ	chemical-specific lag time	chemical-specific (hr)	EPA 600/8-91/011B
EV	Number of showers per day	events per day (d^{-1})	EPA Dermal Risk Assessment Supplemental Guidance August 1992
CF	Conversion Factor	$1\text{ l}/1000\text{ cm}^3$	EPA/540/1-89/002
ET or (t_{event})	Exposure Time	0.167 hr/day	EPA Dermal Risk Assessment Supplemental Guidance August 1992
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	5 yrs	OSWER Directive 9285.6-03
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
CF_T	Conversion Factor for Time	1 day/24 hr	OSWER Directive 9285.7-01B
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 4.2.2

Construction/Mound Employee - Groundwater Exposure Pathway (Chemical - Noncarcinogens)

$$CW_{ING} = \frac{(THI)(BW)(365 \text{ days/yr})}{(IR_{water})\left(\frac{1}{RfD_o}\right)(EF)}$$

$$\text{ORGANICS: } CW_{DERM} = \frac{BW \times 365 \text{ day/year} \times RfD_o \times THI}{2 \times K_p \times 10^{-3} \frac{L}{cm^3} \times \left[\sqrt{\frac{6 \times \tau \times t_{event}}{\pi}} \right] \times EV \times EF \times SA}$$

$$\text{INORGANICS: } CW_{DERM} = \frac{BW \times 365 \text{ day/year} \times RfD_o \times THI}{K_p \times 10^{-3} \frac{L}{cm^3} \times t_{event} \times EV \times EF \times SA}$$

$$CW_{INH} = \frac{(THI)(BW)(365 \text{ days/yr})}{(K)\left(\frac{1}{RfD_i}\right)(IR_{air})(EF)(ET)(CF_T)}$$

$$CW_{TOTAL} = \frac{1}{\frac{1}{CW_{DERM}} + \frac{1}{CW_{INH}} + \frac{1}{CW_{ING}}}$$

Table 4.2.2 Construction/Mound Employee (Chemical - Noncarcinogens) Exposure variable explanations for the groundwater exposure pathway.			
Variable	Definition	Value Used	Explanation/Source
CW_{ING}	Contaminant Concentration in Water (Ingestion)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{DER}	Contaminant Concentration in Water (Dermal)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{INH}	Contaminant Concentration in Water (Inhalation)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{TOTAL}	Total Contaminant Concentration in Water for all Exposure Pathways	mg/l	Calculated Guideline Values (GVs) ¹
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
IR_{water}	Daily Water Ingestion Rate	1.0 l/day	OSWER Directive 9285.6-03
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03
K	Volatilization Factor	0.0005 X 1000 l/m ³	OSWER Directive 9285.7-01B
IR_{air}	Daily Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
RfD_i	Inhalation Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
PC	Permeability Constant	Chemical-specific (cm/hr)	Literature
CF	Conversion Factor	1 l/1000 cm ³	EPA/540/1-89/002
ET or (t_{event})	Exposure Time	Hours/day 0.167	EPA Dermal Risk Assessment Supplemental Guidance August 1992

Table 4.2.2 Construction/Mound Employee (Chemical - Noncarcinogens) Exposure variable explanations for the groundwater exposure pathway.			
Variable	Definition	Value Used	Explanation/Source
RfD_o	Oral Chronic Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
SA	Skin Surface Area Available for Contact	19,400 cm ²	Whole body EPA/600/8-89/043
EV	Number of showers per day	Events per day (d ⁻¹)	EPA Dermal Risk Assessment Supplemental Guidance August 1992
τ	chemical-specific lag time	chemical-specific (hr)	EPA 600/8-91/011B
CF_T	Conversion Factor for Time	1 day/24 hr	OSWER Directive 9285.7-01B
BW	Body Weight	70 kg	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 4.2.3

Construction/Mound Employee - Groundwater Exposure Pathway (Radionuclides)

$$CW_{ING} = \frac{TR}{(SF_o) (IR_{water}) (EF) (ED)}$$

For Tritium also add:

$$CW_{INHTRIT} = \frac{TR}{(SF_i) (IR_{air}) (EF) (ED) (M_{TOTAL}) (CF_1) (ET_s) (CF_T)}$$

$$CW_{DERMTRIT} = \frac{TR}{(SF_o) (SA) (K_{PTRIT}) (ET_s) (EF) (CF_2) (ED)}$$

$$CIV_{TOTALTRIT} = \frac{TR}{(EF) (ED) [(SF_o) (IR_{water}) + (SF_i) (IR_{air}) (M_{TOTAL}) (CF_1) (ET_s) (CF_T) + (SF_o) (SA) (K_{PTRIT}) (ET_s) (CF_2)]}$$

Table 4.2.3 Construction/Mound Employee (Radionuclides)
Exposure variable explanations for the groundwater exposure pathway

Variable	Definition	Value Used	Explanation/Source
CW_{ING}	Concentration of Radionuclide in Water (Ingestion)	pCi/l	Calculated Guideline Values (GVs) ¹
$CW_{INITRIT}$	Concentration of Tritium in Water (Inhalation)	pCi/l	Calculated Guideline Values (GVs) ¹
$CW_{DERMTRIT}$	Concentration of Tritium in Water (Dermal)	pCi/l	Calculated Guideline Values (GVs) ¹
CW_{TOTAL}	Total Concentration of Radionuclide in Water (all pathways)	pCi/l	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
SF_o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF_i	Inhalation Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
IR_{water}	Daily Water Ingestion Rate	1.0 l/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ hr/day	OSWER Directive 9285.6-03
M_{Total}	Airborne Mass Concentration of Water in Shower	66.96 g/m ³	ORNL Tritium Methodology
CF_i	Conversion Factor for Mass of Water	1 l/1000 g	ORNL Tritium Methodology

Table 4.2.3 Construction/Mound Employee (Radionuclides) Exposure variable explanations for the groundwater exposure pathway			
Variable	Definition	Value Used	Explanation/Source
ET _s	Exposure Time for Shower	0.167 hr/day	EPA Dermal Risk Assessment Supplemental Guidance August 1992
SA	Skin Surface Area Available for absorption	1.9 m ²	EPA/600/8-89/043, whole body
K _{p_{trit}}	Dermal Permeability Constant for Tritium	1.5 x 10 ⁻⁵ m/hr	Bronaugh et al 1980
CF _v	Conversion Factor for Volume	10 ³ l/m ³	OSWER Directive 9285.7-01B
CF _t	Conversion Factor for Time	1 day/24 hr	OSWER Directive 9285.7-01B
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	5 yrs	OSWER Directive 9285.7-01B

The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 5.1.1

Commercial/Office Worker - Soil Exposure Pathway (Chemical - Carcinogens)

$$CS_{ING} = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(EF) (ED) (SF_o) (CF) (IR_{soil})}$$

$$CS_{INH} = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(EF) (ED) (SF_i) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)}$$

$$CS_{TOTAL} = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(EF) (ED) [(SF_o) (CF) (IR_{soil}) + (SF_i) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)]}$$

Table 5.1.1 Commercial/Office Worker (Chemical - Carcinogens) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CS _{ING}	Contaminant Concentration in Soil (Ingestion)	mg/kg	Calculated Guideline Values (GVs) ¹
CS _{INH}	Contaminant Concentration in Soil (Inhalation)	mg/kg	Calculated Guideline Values (GVs) ¹
CS _{TOTAL}	Total Contaminant Concentration in Soil for all Exposure Pathways	mg/kg	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1 x 10 ⁻⁶ 1 x 10 ⁻⁵ 1 x 10 ⁻⁴ (Unitless)	OSWER Directive 9285.7-01B
BW	Body Weight •	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03
SF _o	Oral Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
SF _i	Inhalation Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
CF	Conversion Factor	10 ⁻⁶ kg/mg	EPA/540/1-89/002
IR _{soil}	Ingestion Rate - Soil	50 mg/day	OSWER Directive 9285.6-03
IR _{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Chemical-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision

Table 5.1.1 Commercial/Office Worker (Chemical - Carcinogens) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
PEF	Particulate Emission Factor	$4.28 \times 10^9 \text{ m}^3/\text{kg}$	OSWER Directive 9285.7-01B, revision
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	25 yrs	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

The calculated guideline values for soil inhalation are compared to the soil saturation concentration, and the lower of the values is the guideline value.

Table 5.1.2

Commercial/Office Worker - Soil Exposure Pathway (Chemical - Noncarcinogens)

$$CS_{ING} = \frac{(THI) (BW) (365 \text{ days/yr})}{(EF) \left(\frac{1}{RfD_o}\right) (CF) (IR_{soil})}$$

$$CS_{INH} = \frac{(THI) (BW) (365 \text{ days/yr})}{(EF) \left(\frac{1}{RfD_i}\right) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF}\right)}$$

$$CS_{TOTAL} = \frac{(THI) (BW) (365 \text{ days/yr})}{(EF) \left[\left(\frac{1}{RfD_o}\right) (CF) (IR_{soil}) + \left(\frac{1}{RfD_i}\right) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF}\right)\right]}$$

Table 5.1.2 Commercial/Office Worker (Chemical - Noncarcinogens) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CS_{ING}	Contaminant Concentration in Soil (Ingestion)	mg/kg	Calculated Guideline Values (GVs) ¹
CS_{INH}	Contaminant Concentration in Soil (Inhalation)	mg/kg	Calculated Guideline Values (GVs) ¹
CS_{TOTAL}	Total Contaminant Concentration in Soil for all Exposure Pathways	mg/kg	Calculated Guideline Values (GVs) ¹
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
RfD_o	Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
RfD_i	Inhalation Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
CF	Conversion Factor	10^{-6} kg/mg	EPA/540/1-89/002
IR_{soil}	Ingestion Rate - Soil	50 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Chemical-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28×10^9 m ³ /kg	OSWER Directive 9285.7-01B, revision
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

The calculated guideline values for soil inhalation are compared to the soil saturation concentration, and the lesser of the values is the guideline value.

Table 5.1.3

Commercial/Office Worker - Soil Exposure Pathway (Radionuclides)

$$CS_{ING} = \frac{(TR)}{(ED_1) (EF) (SF_o) (CF_1) (IR_{soil})}$$

$$CS_{INH} = \frac{(TR)}{(ED_1) (EF) (SF_1) (CF_2) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)}$$

$$CS_{EX} = \frac{(TR)}{(ED_2) (SF_e) (1-S_e) (T_e)}$$

$$CS_{TOTAL} = \frac{(TR)}{(ED_1) (EF) [(SF_o) (CF_1) (IR_{soil}) + (SF_1) (CF_2) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)] + (ED_2) (SF_e) (1-S_e) (T_e)}$$

Table 5.1.3 Commercial/Office Worker (Radionuclides)
Exposure variable explanations for the soil exposure pathway

Variable	Definition	Value Used	Explanation/Source
CS _{ING}	Radionuclide Concentration in Soil (Ingestion)	pCi/g	Calculated Guideline Values (GVs) ¹
CS _{INH}	Radionuclide Concentration in Soil (Inhalation)	pCi/g	Calculated Guideline Values (GVs) ¹
CS _{EX}	Radionuclide Concentration in Soil (External Exposure)	pCi/g	Calculated Guideline Values (GVs) ¹
CS _{TOTAL}	Total Radionuclide Concentration in Soil for all Exposure Pathways	pCi/g	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1 x 10 ⁻⁶ 1 x 10 ⁻⁵ 1 x 10 ⁻⁴ (Unitless)	OSWER Directive 9285.7-01B
ED ₁	Exposure Duration 1	25 yrs	OSWER Directive 9285.6-03
ED ₂	Exposure Duration 2	25 yrs x 0.685	OSWER Directive 9285.6-03 (250 days/yr + 365 days/yr)
SF _o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF _i	Inhalation Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF _e	External Exposure Slope Factor	Radionuclide-specific (risk/yr per pCi/g)	HEAST
CF ₁	Conversion Factor 1	10 ⁻³ g/mg	OSWER Directive 9285.7-01B

Table 5.1.3 Commercial/Office Worker (Radionuclides) Exposure variable explanations for the soil exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CF_2	Conversion Factor 2	10^3 g/kg	OSWER Directive 9285.7-01B
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03
IR_{soil}	Ingestion Rate - Soil	50 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Radionuclide-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28×10^9 m ³ /kg	OSWER Directive 9285.7-01B, revision
S_e	Gamma Shielding Factor	0.2 (Unitless)	OSWER Directive 9285.7-01B, revision
T_e	Gamma Exposure Time Factor	1/12 (Unitless)	OSWER Directive 9285.7-01B (2/24 hr exposure), revision

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

The calculated guideline values for soil inhalation are compared to the soil saturation concentrations, and the lesser of the values is the guideline value.

Table 5.2.1

Commercial/Office Worker - Groundwater Exposure Pathway (Chemical - Carcinogens)

$$CW_{TOTAL} = CW_{ING} = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(SF_o) (IR_{water}) (EF) (ED)}$$

Table 5.2.1 Commercial/Office Worker) (Chemical - Carcinogens) Exposure variable explanations for the groundwater exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CW_{ING}	Contaminant Concentration in Water (Ingestion)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{TOTAL}	Total Contaminant Concentration in Water for all Exposure Pathways	mg/l	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
SF_o	Oral Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
IR_{water}	Daily Water Ingestion Rate	1.0 l/day	OSWER Directive 9285.6-03
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	25 yrs	OSWER Directive 9285.6-03
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 5.2.2

Commercial/Office Worker - Groundwater Exposure Pathway (Chemical - Noncarcinogens)

$$CW = \frac{(THI) (BW) (365 \text{ days/yr})}{(IR_{\text{water}}) \left(\frac{1}{RfD_o}\right) (EF)}$$

Table 5.2.2 Commercial/Office Worker (Chemical - Noncarcinogens) Exposure variable explanations for the groundwater exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CW_{ING}	Contaminant Concentration in Water (Ingestion)	mg/l	Calculated Guideline Values (GVs) ¹
CW_{TOTAL}	Total Contaminant Concentration in Water for all Exposure Pathways	mg/l	Calculated Guideline Values (GVs) ¹
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
RfD_o	Oral Chronic Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
IR_{water}	Daily Water Ingestion Rate	1.0 l/day	OSWER Directive 9285.6-03
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03
BW	Body weight	70 kg	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 5.2.3

Commercial/Office Worker - Groundwater Exposure Pathway (Radionuclides)

$$CW = \frac{(TR)}{(SF_o) (IR_{water}) (EF) (ED)}$$

Table 5.2.3 Commercial/Office Worker (Radionuclides) Exposure variable explanations for groundwater exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CW_{ING}	Concentration of Radionuclide in Water (Ingestion)	pCi/ℓ	Calculated Guideline Values (GVs) ¹
CW_{TOTAL}	Total Radionuclide Concentration in Water for all Exposure Pathways	pCi/ℓ	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
SF_o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
IR_{water}	Daily Water Ingestion Rate	1.0 ℓ/day	OSWER Directive 9285.6-03
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	25 yrs total	OSWER Directive 9285.7-01B

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

Table 6.1.1

Private Contractor/Off-Site Construction - Soil/Sediment Exposure Pathway (Chemical - Carcinogens)

$$CS_{ING} = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(EF) (ED) (SF_o) (CF) (IR_{soil})}$$

$$CS_{INH} = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(EF) (ED) (SF_i) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)}$$

$$CS_{TOTAL} = \frac{(TR) (BW) (AT) (365 \text{ days/yr})}{(EF) (ED) [(SF_o) (CF) (IR_{soil}) + (SF_i) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)]}$$

Table 6.1.1 Private Contractor/Off-Site Construction (Chemical - Carcinogens) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CS _{ING}	Contaminant Concentration in Soil (Ingestion)	mg/kg	Calculated Guideline Values (GVs) ¹
CS _{INH}	Contaminant Concentration in Soil (Inhalation)	mg/kg	Calculated Guideline Values (GVs) ¹
CS _{TOTAL}	Total Contaminant Concentration in Soil for all Exposure Pathways	mg/kg	Calculated Guideline Values (GVs) ¹
TR	Target Excess Individual Lifetime Cancer Risk	1 x 10 ⁻⁶ 1 x 10 ⁻⁵ 1 x 10 ⁻⁴ (Unitless)	OSWER Directive 9285.7-01B
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
AT	Averaging Time	70 yrs	OSWER Directive 9285.6-03
SF _o	Oral Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
SF _i	Inhalation Cancer Slope Factor	Chemical-specific (mg/kg-day) ⁻¹	IRIS, HEAST
CF	Conversion Factor	10 ⁻⁶ kg/mg	EPA/540/1-89/002
IR _{soil}	Ingestion Rate - Soil	480 mg/day	OSWER Directive 9285.6-03
IR _{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Chemical-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision

Table 6.1.1 Private Contractor/Off-Site Construction (Chemical - Carcinogens) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
PEF	Particulate Emission Factor	$4.28 \times 10^9 \text{ m}^3/\text{kg}$	OSWER Directive 9285.7-01B, revision
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03
ED	Exposure Duration	1 yr	OSWER Directive 9285.6-03

' The calculated guideline values (GVs) are presented in Appendix B of this report.

The calculated guideline values for soil inhalation are compared to the soil saturation concentration, and the lesser of the values is the guideline value.

Table 6.1.2

Private Contractor/Off-Site Construction - Soil/Sediment Exposure Pathway (Chemical - Noncarcinogens)

$$CS_{ING} = \frac{(THI) (BW) (365 \text{ days/yr})}{(EF) \left(\frac{1}{RfD_o}\right) (CF) (IR_{soil})}$$

$$CS_{INH} = \frac{(THI) (BW) (365 \text{ days/yr})}{(EF) \left(\frac{1}{RfD_i}\right) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF}\right)}$$

$$CS_{TOTAL} = \frac{(THI) (BW) (365 \text{ days/yr})}{(EF) \left[\left(\frac{1}{RfD_o}\right) (CF) (IR_{soil}) + \left(\frac{1}{RfD_i}\right) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF}\right) \right]}$$

Table 6.1.2 Private Contractor/Off-Site Construction (Chemical Noncarcinogens) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CS_{ING}	Contaminant Concentration in Soil (Ingestion)	mg/kg	Calculated Guideline Values (GVs) ¹
CS_{INH}	Contaminant Concentration in Soil (Inhalation)	mg/kg	Calculated Guideline Values (GVs) ¹
CS_{TOTAL}	Total Contaminant Concentration in Soil for all Exposure Pathways	mg/kg	Calculated Guideline Values (GVs) ¹
THI	Target Hazard Index	1 (Unitless)	OSWER Directive 9285.7-01B
BW	Body Weight	70 kg	OSWER Directive 9285.6-03
RfD_o	Oral Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
RfD_i	Inhalation Reference Dose	Chemical-specific (mg/kg-day)	IRIS, HEAST
CF	Conversion Factor	10 ⁻⁶ kg/mg	EPA/540/1-89/002
IR_{soil}	Ingestion Rate - Soil	480 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Chemical-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28 x 10 ⁹ m ³ /kg	OSWER Directive 9285.7-01B, revision
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

The calculated guideline values for soil inhalation are compared to the soil saturation concentration, and the lesser of the values is the guideline value.

Table 6.1.3

Private Contractor/Off-Site Construction - Soil/Sediment Exposure Pathway (Radionuclides)

$$CS_{ING} = \frac{(TR)}{(ED_1) (EF) (SF_o) (CF_1) (IR_{soil})}$$

$$CS_{INH} = \frac{(TR)}{(ED_1) (EF) (SF_i) (CF_2) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)}$$

$$CS_{EX} = \frac{(TR)}{(ED_2) (SF_e) (1-S_e) (T_e)}$$

$$CS_{TOTAL} = \frac{(TR)}{(ED_1) (EF) [(SF_o) (CF_1) (IR_{soil}) + (SF_i) (CF_2) (IR_{air}) \left(\frac{1}{VF} + \frac{1}{PEF} \right)] + (ED_2) (SF_e) (1-S_e) (T_e)}$$

Table 6.1.3 Private Contractor/Off-Site Construction (Radionuclides) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CS_{ING}	Radionuclide Concentration in Soil (Ingestion)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{INH}	Radionuclide Concentration in Soil (Inhalation)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{EX}	Radionuclide Concentration in Soil (External Exposure)	pCi/g	Calculated Guideline Values (GVs) ¹
CS_{TOTAL}	Total Radionuclide Concentration in Soil for all Exposure Pathways	pCi/g	Calculated Guideline Values (GVs)
TR	Target Excess Individual Lifetime Cancer Risk	1×10^{-6} 1×10^{-5} 1×10^{-4} (Unitless)	OSWER Directive 9285.7-01B
ED_1	Exposure Duration 1	1 yr	OSWER Directive 9285.6-03
ED_2	Exposure Duration 2	1 yr x 0.685	OSWER Directive 9285.6-03 (250 days/yr + 365 days/yr)
SF_o	Oral Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF_i	Inhalation Cancer Slope Factor	Radionuclide-specific (risk/pCi)	HEAST
SF_e	External Exposure Slope Factor	Radionuclide-specific (risk/yr per pCi/g)	HEAST
CF_1	Conversion Factor 1	10^{-3} g/mg	OSWER Directive 9285.7-01B

Table 6.1.3 Private Contractor/Off-Site Construction (Radionuclides) Exposure variable explanations for the soil/sediment exposure pathway			
Variable	Definition	Value Used	Explanation/Source
CF_2	Conversion Factor 2	10^3 g/kg	OSWER Directive 9285.7-01B
EF	Exposure Frequency	250 days/yr	OSWER Directive 9285.6-03
IR_{soil}	Ingestion Rate - Soil	480 mg/day	OSWER Directive 9285.6-03
IR_{air}	Inhalation Rate	20 m ³ /day	OSWER Directive 9285.6-03
VF	Soil-to-Air Volatilization Factor	Radionuclide-specific (m ³ /kg)	OSWER Directive 9285.7-01B, revision
PEF	Particulate Emission Factor	4.28×10^9 m ³ /kg	OSWER Directive 9285.7-01B, revision
S_e	Gamma Shielding Factor	0.1 (Unitless)	OSWER Directive 9285.7-01B (open area), revision
T_e	Gamma Exposure Time Factor	1/3 (Unitless)	OSWER Directive 9285.7-01B (8/24 hr exposure), revision

¹ The calculated guideline values (GVs) are presented in Appendix B of this report.

P1 Parameters for Radionuclides of Concern

RADIONUCLIDE	CASRN	Oral SF (risk/pCi)	Inhalation SF (risk/pCi)	External SF (risk/yr per pCi/g soil)	Soil to Plant Uptake (B _v Dry) (unitless)	Soil to Plant Uptake (B _v Wet) (unitless)	Transfer Coeff. for Milk (F _M) (day/kg)	Transfer Coeff. for Beef (F _B) (day/kg)
Actinium-227+D	014952-40-0	6.3E-10	7.9E-08	6.0E-07	2.6E-01*	5.1E-02*	3.4E-03*	4.6E-02*
Americium-241	014596-10-2	3.3E-10	3.9E-08	4.6E-09	4.0E-03*	1.0E-03*	1.5E-06 [†]	4.0E-05 [†]
Bismuth-207	013982-38-2	5.1E-12	9.4E-12	5.5E-06	1.4E-01 ^m	3.5E-02 ^m	5.0E-04 ^m	4.0E-04 ^m
Cesium-137+D	010045-97-3	3.2E-11	1.9E-11	2.1E-06	2.0E-01*	4.0E-02*	8.4E-03*	5.1E-02*
Cobalt-60	010198-40-0	1.9E-11	6.9E-11	9.8E-06	4.0E-01*	3.0E-02*	7.0E-05 [†]	1.0E-04 [†]
Plutonium-238	013981-16-3	3.0E-10	2.7E-08	1.9E-11	1.0E-03*	5.0E-04*	1.1E-06 [†]	1.8E-05 [†]
Plutonium-239	015117-48-3	3.2E-10	2.8E-08	1.3E-11	1.0E-03*	5.0E-04*	1.1E-06 [†]	1.8E-05 [†]
Plutonium-240	014119-33-6	3.2E-10	2.8E-08	1.9E-11	1.0E-03*	5.0E-04*	1.1E-06 [†]	1.8E-05 [†]
Radium-226+D	013982-63-3	3.0E-10	2.8E-09	6.7E-06	4.5E-01*	8.8E-02*	3.0E-03*	1.2E-02*
Strontium-90+D	010098-97-2	5.6E-11	6.9E-11	0.0E+00	4.0E+00*	3.0E-01*	2.8E-03*	9.0E-03*
Technetium-99	014133-76-7	1.4E-12	2.9E-12	6.2E-13	4.0E-01*	5.0E+00*	1.4E-04 [†]	1.0E-04 [†]
Thorium-228+D	014274-82-9	2.3E-10	9.7E-08	9.9E-07	4.7E-01*	9.2E-02*	5.0E-03*	5.2E-02*
Thorium-230	014269-63-7	3.8E-11	1.7E-08	4.4E-11	1.0E-03*	5.0E-04*	5.0E-06*	1.0E-04*
Thorium-232	007440-29-1	3.3E-11	1.9E-08	2.0E-11	1.0E-03*	5.0E-04*	5.0E-06*	1.0E-04*
Tritium	010028-17-8	7.2E-14	9.6E-14	0.0E+00	0.0E+00 ^m	0.0E+00 ^m	1.5E-02*	0.0E+00 ^m
Uranium-233	013968-55-3	4.5E-11	1.4E-08	3.5E-11	1.0E-02*	2.0E-03*	4.0E-04 [†]	3.4E-04 [†]
Uranium-234	013966-29-5	4.4E-11	1.4E-08	2.1E-11	1.0E-02*	2.0E-03*	4.0E-04 [†]	3.4E-04 [†]
Uranium-235+D	015117-96-1	4.7E-11	1.3E-08	2.7E-07	1.1E-02*	2.5E-03*	4.1E-04*	4.4E-04*
Uranium-238+D	007440-61-1	6.2E-11	1.2E-08	5.3E-08	1.1E-02*	2.6E-03*	4.1E-04*	4.5E-04*

*Value can be referenced in International Atomic Energy Agency (IAEA). 1982. *Generic Models Parameters for Assessing the Environmental Transfer of Radionuclides from Routine Releases: Exposures of Critical Groups*.

^mValue can be referenced in Streng, D.L. and Peterson, S.R. 1989 (updated through 1993). *Chemical Data Bases for the Multimedia Environmental Pollutant Assessment System (MEPAS)*. Prepared for the U.S. Department of Energy, Pacific Northwest Laboratory.

[†]Value can be referenced in National Council on Radiation Protection Measurement (NCRP). January 1989. *Screening Techniques for Determining Compliance with Environmental Standards. Releases of Radionuclides to the Atmosphere*. Bethesda, Maryland.

• Additive value from individual chain members

Risk-Based Guideline Values Report - Appendix A
March, 1997

P2 Parameters for Chemicals of Concern

CHEMICAL	CASRN	Oral SF (mg/kg-day)	Inhalation SF (mg/kg-day)	Oral RfD Chronic (mg/kg-day)	Oral RfD Subchronic (mg/kg-day)	Inhalation RfC Chronic (mg/kg-day)	Inhalation RfD Subchronic (mg/kg-day)	Volatilization Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)	Permeability Constant (cm/hr)	Soil to Plant Uptake (B ₁ DRY) ¹ (unitless)	Soil to Plant Uptake (B ₁ WET) ¹ (unitless)	Transfer Coefficient for Milk (F _m) ¹ (day/kg)	Transfer Coefficient for Beef (F _b) ¹ (day/kg)
High Explosives														
IMX	002691-41-0			1.0E-02							1.8E+01	4.4E+00	3.1E-08	9.8E-08
PETN														
RDX	000121-82-4	1.1E-01		1.0E-03	1.0E-03						4.9E-01	1.2E-01	1.5E-05	4.8E-05
Inorganics														
Aluminum														
Antimony	007440-36-0			4.0E-04	4.0E-04					1.0E-03	3.0E-02 *	1.0E-02 *	2.3E-05 *	4.0E-05 *
Arsenic	007440-38-2		5.0E+01	1.0E-04	1.0E-04					1.0E-03	6.0E-03	1.5E-03	6.0E-05	2.0E-03
Barium	007440-39-3			7.0E-02	7.0E-02	5.0E-04	1.4E-04			1.0E-03	1.0E-01 *	1.0E-02 *	4.8E-04 *	2.3E-04 *
Beryllium	007440-41-7	4.3E+00	8.4E+00	5.0E-03	5.0E-03					1.0E-03	1.9E-03	4.7E-04	2.0E-06	8.0E-04
Cadmium (Diet)	007440-43-9		6.1E+00	1.0E-03						1.0E-03	1.5E-01	3.8E-02	1.0E-03	4.0E-04 *
Cadmium (Water)	007440-43-9		6.1E+00	5.0E-04						1.0E-03	1.5E-01	3.8E-02	1.0E-03	4.0E-04 *
Chromium III	016063-83-1			1.0E+00	1.0E+00					1.0E-03	4.0E-02 *	1.0E-02 *	1.0E-05 *	9.0E-03 *
Chromium VI	018540-29-9		4.1E+01	5.0E-03	2.0E-02					1.0E-03	4.0E-02 *	1.0E-02 *	1.0E-05 *	9.0E-03 *
Cobalt														
Copper	007440-50-8									1.0E-03	2.5E-01	6.3E-02	1.5E-03	9.0E-03 *
Cyanide	000057-12-5			2.0E-02	2.0E-02					7.5E-03	3.4E+01	1.4E+01	4.4E-09	1.4E-08
Iron														
Lead	007439-92-1									1.0E-03	3.2E-03	8.0E-04	2.5E-04	4.0E-04 *
Lithium														
Manganese (Diet)	007439-96-3			1.4E-01	1.4E-01	5.0E-05	1.4E-03			1.0E-03 *	3.0E+00 *	4.0E-01 *	3.0E-03 *	5.0E-04 *
Manganese (Water)	007439-96-3			5.0E-03	5.0E-03	5.0E-05	1.4E-05			1.0E-03	3.0E+00 *	4.0E-01 *	3.0E-03 *	5.0E-04 *
Mercury	007439-97-6			3.0E-04	3.0E-04	3.0E-04	8.6E-05			1.0E-03	1.0E+00 *	3.0E-01 *	4.7E-04 *	1.0E-02 *
Nickel	007440-02-0			2.0E-02	2.0E-02					1.0E-03	2.0E-01 *	5.0E-02 *	1.6E-02 *	5.2E-03 *
Silver	007440-22-4			5.0E-03	5.0E-03					1.0E-03	1.0E+00 *	2.0E-01 *	5.0E-05 *	1.0E-01 *
Thallium														

P2 (Continued)

CHEMICAL	CASRN	Oral SF (mg/kg-day)	Inhalation SF (mg/kg-day)	Oral RfD Chronic (mg/kg-day)	Oral RfD Subchronic (mg/kg-day)	Inhalation RfC Chronic (mg/kg-day)	Inhalation RfD Subchronic (mg/kg-day)	Volatilization Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)	Permeability Constant (cm/hr)	Soil to Plant Uptake (B, DRY) ¹ (unitless)	Soil to Plant Uptake (B, WET) ¹ (unitless)	Transfer Coefficient for Milk (F _m) ¹ (day/kg)	Transfer Coefficient for Beef (F _b) ¹ (day/kg)
Vanadium	007440-62-2			7.0E-03	7.0E-03					1.0E-03	3.2E-03	1.3E-03	1.0E-03	2.3E-03
Zinc	007440-66-6			3.0E-01	3.0E-01					1.0E-03	1.0E+00 *	4.0E-01 *	1.0E-02 *	1.0E-01 *
Organics														
1,1,1-Trichloroethane	000071-55-6							1.7E+04		1.7E-02	1.4E+00	3.5E-01	2.5E-06	7.9E-06
1,1-Dichloroethane	000075-34-3			1.0E-01	1.0E+00	3.0E-01	1.4E-01	1.1E+01	1.4E+05	8.9E-03	3.6E+00	8.9E-01	4.9E-07	1.5E-06
1,2-Dichloroethane	000107-06-2	9.1E-02	9.1E-02					2.1E+04	6.7E+02	3.3E-03	3.4E+00	1.4E+00	2.4E-07	7.6E-07
1,2-trans-Dichloroethylene	000136-60-5			2.0E-02	2.0E-01						2.0E+01	3.1E+00	2.4E-08	7.6E-08
2-Butanone	000078-93-3			6.0E-01	2.0E+00	1.0E+00	2.9E-01	2.5E+04	9.3E+03	1.1E-03	2.7E+01	6.7E+00	1.5E-08	4.7E-08
2-Hexanone														
2-Methylnaphthalene														
4-Methyl-2-Pentanone	000108-10-1			8.0E-02	8.0E-01	8.0E-02	2.3E-02	6.5E+04	7.0E+02	3.3E-03	1.5E+01	3.7E+00	4.2E-08	1.3E-07
4-Methylphenol	000106-44-5			3.0E-03	3.0E-03					1.8E-02	3.0E+00	7.4E-01	6.8E-07	2.1E-06
Acetone	000067-64-1			1.0E-01	1.0E+00					3.7E-04	3.3E+01	1.3E+01	4.6E-09	1.5E-08
Benzene	000071-43-2	2.9E-02	2.9E-02					1.9E+04	4.9E+02	2.1E-02	2.3E+00	5.8E-01	1.0E-06	3.3E-06
Benzoic Acid	000065-85-0			4.0E+00	4.0E+00					7.3E-03	3.2E+00	8.0E-01	5.9E-07	1.9E-06
Bromodichloromethane	000075-27-4	6.2E-02		2.0E-02	2.0E-02					5.8E-03	2.0E+00	4.9E-01	1.4E-06	4.4E-06
Butyl benzyl phthalate	000083-68-7			2.0E-01	2.0E+00									
Carbon Disulfide	000075-15-0			1.0E-01	1.0E-01	1.0E-02	2.9E-03	2.0E+04	1.7E+03	2.4E-02	2.7E+00	6.8E-01	7.9E-07	2.5E-06
Carbon Tetrachloride	000056-23-5	1.3E-01	3.3E-02	7.0E-04	7.0E-03			1.9E+04	1.0E+03	2.2E-02	1.2E+00	2.9E-01	3.5E-06	1.1E-05
Chloroethane	000075-00-3					1.0E+01	2.9E+00	1.9E+03	1.6E+02	8.0E-03	3.8E+00	1.4E+00	2.1E-07	6.8E-07
Chrysene	000218-01-9	7.3E-03								8.1E-01	2.2E-02	3.3E-03	3.2E-03	1.0E-02
Cresols														
Di-n-butylphthalate	000084-74-2			1.0E-01	1.0E+00					1.2E-01	2.2E-02	3.6E-03	3.2E-03	1.0E-02
Di-n-octylphthalate	000117-84-0			2.0E-02	2.0E-02						7.6E-05	1.9E-05	5.9E-01	1.9E-02
Dibromochloromethane	000124-48-1	8.4E-02		2.0E-02	2.0E-01					3.9E-03	2.4E+00	6.0E-01	9.8E-07	3.1E-06
Dichloromethane	000075-09-2	7.5E-03		6.0E-02	6.0E-02	3.0E+00	8.6E-01	9.3E+03	1.0E+03	4.5E-03	6.9E+00	1.7E+00	1.6E-07	5.0E-07

P2 (Continued)

CHEMICAL	CASRN	Oral SF (mg/kg-day)	Inhalation SF (mg/kg-day)	Oral RfD Chronic (mg/kg- day)	Oral RfD Subchronic (mg/kg-day)	Inhalation RfC Chronic (mg/kg-day)	Inhalation RfD Subchronic (mg/kg-day)	Volatilization Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)	Permeability Constant (cm/hr)	Soil to Plant Uptake (B, DRY) ¹ (unitless)	Soil to Plant Uptake (B, WET) ¹ (unitless)	Transfer Coefficient for Milk (F _M) ¹ (day/kg)	Transfer Coefficient for Beef (F _B) ¹ (day/kg)
Diethyl benzene, 1,4-														
Ethyl benzene	000100-41-4			1.0E-01		1.0E+00	2.9E-01	2.1E+04	4.8E-01	7.4E-02	5.9E-01	1.5E-01	1.1E-05	3.5E-05
Hexane	000110-54-3			6.0E-02	6.0E-01	2.0E-01	5.7E-02	6.1E+03	9.1E+01		2.4E-01	5.9E-02	5.4E-05	1.7E-04
Isophorone	000078-59-1	9.5E-04		2.0E-01	2.0E+00					4.4E-03	1.9E+00	4.8E-01	1.4E-06	4.6E-06
Methyl iodide														
N-nitroso-diphenylamine	000086-30-6	4.9E-03								2.0E-02	6.0E-01	1.5E-01	1.1E-05	3.4E-05
Pentachlorophenol	000087-86-5	1.2E-01		3.0E-02	3.0E-02					6.5E-01	5.0E-02	1.2E-02	7.9E-04	2.5E-03
Phenol	000108-95-2			6.0E-01	6.0E-01					5.5E-03	5.6E+00	1.4E+00	2.3E-07	7.2E-07
Tetrachloroethene	000127-18-4			1.0E-02	1.0E-01					3.7E-01	1.2E+00	3.0E-01	3.2E-06	1.0E-05
Toluene	000108-88-3			2.0E-01	2.0E+00	4.0E-01	1.1E-01	2.5E+04	2.5E+02	4.5E-02	1.0E+00	2.6E-01	4.3E-06	1.3E-05
Tribromomethane	000075-25-2	7.9E-03	3.9E-03	2.0E-02	2.0E-01					2.6E-03	1.6E+00	4.0E-01	2.0E-06	6.3E-06
Trichloroethylene	000079-01-6	1.1E-02	6.0E-03					1.9E+04	4.4E+02	1.6E-02	1.6E+00	4.1E-01	1.9E-06	6.0E-06
Trichlorofluoromethane	000075-69-4			3.0E-01	7.0E-01	7.0E-01	2.0E-01	5.8E+03	7.3E+02	1.7E-02	1.3E+00	3.3E-01	2.7E-06	8.5E-06
Trichloromethane	000067-66-3	6.1E-03	8.1E-02	1.0E-02	1.0E-02			1.8E+04	1.5E+03	8.9E-03	2.8E+00	7.0E-01	7.4E-07	2.3E-06
Xylene	001330-20-7			2.0E+00							5.1E-01	1.3E-01	1.4E-05	4.6E-05
Diis(2-Ethylhexyl)phthalate	000117-81-7	1.4E-02		2.0E-02	2.0E-02					2.3E-02	1.7E+01	4.3E+00	3.3E-08	1.0E-07
PAHs														
Acenaphthylene														
Anthracene	000120-12-7			3.0E-01	3.0E+00					2.2E-01	1.0E-01	2.6E-02	2.2E-04	7.1E-04
Benzo(a)anthracene	000056-55-3	7.3E-01								8.1E-01	2.2E-02	5.6E-03	3.2E-03	1.0E-02
Benzo(a)pyrene	000050-32-8	7.3E+00								1.2E+00	1.2E-02	3.0E-03	9.1E-03	2.9E-02
Benzo(b)fluoranthene	000203-99-2	7.3E-01								1.2E+00	1.2E-02	3.0E-03	9.1E-03	2.9E-02
Benzo(g,h,i)perylene	000191-24-2									1.8E+00				
Benzo(k)fluoranthene	000207-08-9	7.3E-02								6.0E-01	1.2E-02	3.0E-03	9.1E-03	2.9E-02
Dibenz(a,h)anthracene	000053-70-3	7.3E+00								2.7E+00	2.2E-02	5.5E-03	3.2E-03	1.0E-02
Fluoranthene	000206-44-0			4.0E-02	4.0E-01					3.6E-01	5.7E-02	1.4E-02	6.3E-04	2.0E-03

P2 (Continued)

CHEMICAL	CASRN	Oral SF ¹ (mg/kg-day)	Inhalation SF ¹ (mg/kg-day)	Oral RfD Chronic (mg/kg-day)	Oral RfD Subchronic (mg/kg-day)	Inhalation RfC Chronic (mg/kg-day)	Inhalation RfD Subchronic (mg/kg-day)	Volatilization Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)	Permeability Constant (cm/hr)	Soil to Plant Uptake (B, DRY) ¹ (unitless)	Soil to Plant Uptake (B, WET) ¹ (unitless)	Transfer Coefficient for Milk (F _m) ¹ (day/kg)	Transfer Coefficient for Beef (F _b) ¹ (day/kg)
Indeno(1,2,3-cd)pyrene	000193-39-3	7.3E-01								1.9E+00	6.8E-03	1.7E-03	2.5E-02	7.9E-02
Phenanthrene	000085-01-8									2.7E-01	1.0E-01	2.6E-02	2.3E-04	7.2E-04
Pyrene	000129-00-0			3.0E-02	3.0E-01					3.2E-01	3.3E-02	8.1E-03	1.7E-03	5.2E-03
Pesticides/PCBs														
1,4'-DDE	000072-33-9	3.4E-01								2.4E-01	3.5E-03	8.7E-04	9.6E-03	4.9E-02
1,4'-DNT	000050-29-3	3.4E-01	3.4E-01	5.0E-04	5.0E-04					4.3E-01	1.0E-02	2.6E-03	1.1E-02	2.8E-02
Aroclor 1248	012672-29-6	7.7E+00									1.8E-02	4.5E-03	4.6E-03	1.4E-02
Aroclor 1254	011097-69-1			2.0E-03	3.0E-03						1.2E-02	3.1E-03	1.1E-02	5.1E-02
Aroclor 1260	011096-82-5	7.7E+00									2.9E-03	7.1E-04	1.1E-01	3.5E-01
Beta-BHC	000319-85-7	1.8E+00	1.8E+00								2.2E-01	5.4E-02	6.3E-03	2.0E-04
Dieldrin	000060-57-1	1.6E+01	1.6E+01	3.0E-03	5.0E-03					1.6E-02	3.7E-01	9.2E-02	1.1E-02	7.9E-03
Endrin Ketone														

¹ All values in this column, except those that are footnoted, can be referenced in Sireng, D.L. and Peterson, S.R. 1989 (updated through 1993). *Chemical Data Bases for the Multimedia Environmental Pollutant Assessment System (MEPAS)*. Prepared for the U.S. Department of Energy, Pacific Northwest Laboratory.

* Value can be referenced in National Council on Radiation Protection Measurement (NCRP). January 1989. *Screening Techniques for Determining Compliance with Environmental Standards. Releases of Radionuclides to the Atmosphere*. Bethesda, Maryland.

* Value can be referenced in International Atomic Energy Agency (IAEA). 1982. *Generic Models Parameters for Assessing the Environmental Transfer of Radionuclides from Routine Releases: Exposures of Critical Groups*.

RISK-BASED GUIDELINE VALUES

**MOUND PLANT
MIAMISBURG, OHIO**

**APPENDIX B
GUIDELINE VALUE TABLES**

March 1997

**Submitted to the
Miamisburg Environmental Management Project
U.S. DEPARTMENT OF ENERGY**

**Prepared by
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Revised by EG&G Mound Applied Technologies, Inc.

**FINAL
(REVISION 4)**

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TABLE 1A													
Residential - Soil Guideline Values: Chemicals (Units = mg/kg)													
CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
High Explosives													
IIMX				1.4E+04	1.4E+04								
PETN													
RDX	5.8E+02	5.8E+01	5.8E+00	8.2E+02	2.3E+02								
Inorganics													
Aluminum													
Antimony				1.1E+02	3.1E+01								
Arsenic				8.2E+01	2.3E+01	7.3E+04	7.3E+03	7.3E+02					
Barium				1.9E+04	5.5E+03				2.2E+06				1.9E+04
Beryllium	1.5E+01	1.5E+00	1.5E-01	1.4E+03	3.9E+02	4.3E+05	4.3E+04	4.3E+03		1.5E+01	1.5E+00	1.5E-01	
Cadmium (Diet)				2.7E+02	2.7E+02	6.0E+05	6.0E+04	6.0E+03					
Chromium III				2.7E+05	7.8E+04								
Chromium VI				1.4E+03	1.6E+03	8.9E+04	8.9E+03	8.9E+02					
Cobalt													

TABLE 1A

Residential - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Copper													
Cyanide				5.5E+03	1.6E+03								
Iron													
Lead													
Lithium													
Manganese (Diet)				3.8E+04	1.1E+04				2.2E+05				3.3E+04
Mercury				8.2E+01	2.3E+01				1.3E+06				8.2E+01
Nickel				5.5E+03	1.6E+03								
Silver				1.4E+03	3.9E+02								
Thallium													
Vanadium				1.9E+03	5.5E+02								
Zinc				8.2E+04	2.3E+04								
Organics													
1,1,1-Trichloroethane													

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁴	GV for HI=1
1,1-Dichloroethane				2.7E+04	7.8E+04				5.6E+00				5.6E+00
1,2-Dichloroethane	7.0E+02	7.0E+01	7.0E+00			2.0E+02	2.0E+01	2.0E+00		1.6E+02	1.6E+01	1.6E+00	
1,2-trans-Dichloroethylene				5.5E+03	1.6E+04								
2-Butanone				1.6E+05	1.6E+05				9.3E+03				9.3E+03
2-Hexanone													
2-Methylnaphthalene													
4-Methyl-2-Pentanone				2.2E+04	6.3E+04				7.0E+02				7.0E+02
4-Methylphenol				1.4E+03	3.9E+02								
Acetone				2.7E+04	7.8E+04								
Benzene	2.2E+03	2.2E+02	2.2E+01			4.9E+02	5.5E+01	5.5E+00		4.4E+02	4.4E+01	4.4E+00	
Benzoic Acid				1.1E+06	3.1E+05								
Bromodichloromethane	1.0E+03	1.0E+02	1.0E+01	5.5E+03	1.6E+03								
Butyl benzyl phthalate				5.5E+04	1.6E+05								
Carbon Disulfide				2.7E+04	7.8E+03				2.0E+02				2.0E+02

Mound Plant
Final (Rev. 4)

Risk-Based Cleanup Guideline Values Report - Appendix B
March, 1997

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Carbon Tetrachloride	4.9E+02	4.9E+01	4.9E+00	1.9E+02	5.5E+02	3.1E+02	3.1E+01	3.1E+00		1.9E+02	1.9E+01	1.9E+00	
Chloroethane									1.6E+02				
Chrysene	8.8E+03	8.8E+02	8.8E+01										
Cresols													
Di-n-butylphthalate				2.7E+04	7.8E+04								
Di-n-octylphthalate				5.5E+03	1.6E+03								
Dibromochloromethane	7.6E+02	7.6E+01	7.6E+00	5.5E+03	1.6E+04								
Dichloromethane	8.5E+03	8.5E+02	8.5E+01	1.6E+04	4.7E+03				1.0E+03				1.0E+03
Diethyl benzene, 1,4-													
Ethyl benzene				2.7E+04	2.7E+04				4.8E-01				4.8E-01
Hexane				1.6E+04	4.7E+04				9.1E+01				9.1E+01
Isophorone	6.7E+04	6.7E+03	6.7E+02	5.5E+04	1.6E+05								
Methyl iodide													
N-nitroso-diphenylamine	1.3E+04	1.3E+03	1.3E+02										

TABLE 1A													
Residential - Soil Guideline Values: Chemicals (Units = mg/kg)													
CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Pentachlorophenol	5.3E+02	5.3E+01	5.3E+00	8.2E+03	2.3E+03								
Phenol				1.6E+05	4.7E+04								
Tetrachloroethene				2.7E+03	7.8E+03								
Toluene				5.5E+04	1.6E+05				2.5E+02				2.5E+02
Tribromomethane	8.1E+03	8.1E+02	8.1E+01	5.5E+03	1.6E+04	9.4E+08	9.4E+07	9.4E+06		8.1E+03	8.1E+02	8.1E+01	
Trichloroethylene	5.8E+03	5.8E+02	5.8E+01			4.4E+02	2.7E+02	2.7E+01		4.4E+02	1.8E+02	1.8E+01	
Trichlorofluoromethane				8.2E+04	5.5E+04				7.3E+02				7.3E+02
Trichloromethane	1.0E+04	1.0E+03	1.0E+02	2.7E+03	7.8E+02	1.9E+02	1.9E+01	1.9E+00		1.8E+02	1.8E+01	1.8E+00	
Xylene				5.5E+05	5.5E+05								
bis(2-Ethylhexyl)phthalate	4.6E+03	4.6E+02	4.6E+01	5.5E+03	1.6E+03								
PAHs													
Acenaphthylene													
Anthracene				8.2E+04	2.3E+05								
Benzo(a)anthracene	8.8E+01	8.8E+00	8.8E-01										

TABLE 1A

Residential - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Benzo(a)pyrene	8.8E+00	8.8E-01	8.8E-02										
Benzo(b)fluoranthene	8.8E+01	8.8E+00	8.8E-01										
Benzo(g,h,i)perylene													
Benzo(k)fluoranthene	8.8E+02	8.8E+01	8.8E+00										
Dibenz(a,h)anthracene	8.8E+00	8.8E-01	8.8E-02										
Fluoranthene				1.1E+04	3.1E+04								
Indeno(1,2,3-cd)pyrene	8.8E+01	8.8E+00	8.8E-01										
Phenanthrene													
Pyrene				8.2E+03	2.3E+04								
Pesticides/PCBs													
4,4'-DDE	1.9E+02	1.9E+01	1.9E+00										
4,4'-DDT	1.9E+02	1.9E+01	1.9E+00	1.4E+02	3.9E+01	1.1E+07	1.1E+06	1.1E+05		1.9E+02	1.9E+01	1.9E+00	
Aroclor 1248	8.3E+00	8.3E-01	8.3E-02										
Aroclor 1254				5.5E+00	3.9E+00								

TABLE 1A Residential - Soil Guideline Values: Chemicals (Units = mg/kg)													
CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Aroclor 1260	8.3E+00	8.3E-01	8.3E-02										
Beta-BHC	3.5E+01	3.5E+00	3.5E-01			2.0E+06	2.0E+05	2.0E+04		3.5E+01	3.5E+00	3.5E-01	
Dieldrin	4.0E+00	4.0E-01	4.0E-02	1.4E+01	3.9E+00	2.3E+05	2.3E+04	2.3E+03		4.0E+00	4.0E-01	4.0E-02	
Endrin Ketone													

TABLE 1B

Residential - Soil Guideline Values: Radionuclides (Units = pCi/g)

RADIONUCLIDE	Ingestion			External			Inhalation			Ingestion + External + Inhalation		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴
Actinium-227+D	1.3E+02	1.3E+01	1.3E+00	1.9E+01	1.9E+00	1.9E-01	2.6E+04	2.6E+03	2.6E+02	1.6E+01	1.6E+00	1.6E-01
Americium-241	2.4E+02	2.4E+01	2.4E+00	2.4E+03	2.4E+02	2.4E+01	5.3E+04	5.3E+03	5.3E+02	2.2E+02	2.2E+01	2.2E+00
Bismuth-207	1.6E+04	1.6E+03	1.6E+02	2.0E+00	2.0E-01	2.0E-02	2.2E+08	2.2E+07	2.2E+06	2.0E+00	2.0E-01	2.0E-02
Cesium-137+D	2.5E+03	2.5E+02	2.5E+01	5.3E+00	5.3E-01	5.3E-02	1.1E+08	1.1E+07	1.1E+06	5.3E+00	5.3E-01	5.3E-02
Cobalt-60	4.2E+03	4.2E+02	4.2E+01	1.1E+00	1.1E-01	1.1E-02	3.0E+07	3.0E+06	3.0E+05	1.1E+00	1.1E-01	1.1E-02
Plutonium-238	2.7E+02	2.7E+01	2.7E+00	5.7E+05	5.7E+04	5.7E+03	7.4E+04	7.4E+03	7.4E+02	2.7E+02	2.7E+01	2.7E+00
Plutonium-239	2.5E+02	2.5E+01	2.5E+00	8.8E+05	8.8E+04	8.8E+03	7.3E+04	7.3E+03	7.3E+02	2.5E+02	2.5E+01	2.5E+00
Plutonium-240	2.5E+02	2.5E+01	2.5E+00	5.9E+05	5.9E+04	5.9E+03	7.3E+04	7.3E+03	7.3E+02	2.5E+02	2.5E+01	2.5E+00
Radium-226+D	2.7E+02	2.7E+01	2.7E+00	1.6E+00	1.6E-01	1.6E-02	7.4E+05	7.4E+04	7.4E+03	1.6E+00	1.6E-01	1.6E-02
Strontium-90+D	1.4E+03	1.4E+02	1.4E+01				2.9E+07	2.9E+06	2.9E+05	1.4E+03	1.4E+02	1.4E+01
Thorium-228+D	3.4E+02	3.4E+01	3.4E+00	1.1E+01	1.1E+00	1.1E-01	2.1E+04	2.1E+03	2.1E+02	1.1E+01	1.1E+00	1.1E-01
Thorium-230	2.1E+03	2.1E+02	2.1E+01	2.5E+05	2.5E+04	2.5E+03	1.2E+05	1.2E+04	1.2E+03	2.1E+03	2.1E+02	2.1E+01
Thorium-232	2.4E+03	2.4E+02	2.4E+01	5.6E+05	5.6E+04	5.6E+03	1.1E+05	1.1E+04	1.1E+03	2.4E+03	2.4E+02	2.4E+01

TABLE 1B**Residential - Soil Guideline Values: Radionuclides (Units = pCi/g)**

RADIONUCLIDE	Ingestion			External			Inhalation			Ingestion + External + Inhalation		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶
Tritium	1.1E+06	1.1E+05	1.1E+04				2.1E+10	2.1E+09	2.1E+08	1.1E+06	1.1E+05	1.1E+04
Uranium-233	1.8E+03	1.8E+02	1.8E+01	3.2E+05	3.2E+04	3.2E+03	1.4E+05	1.4E+04	1.4E+03	1.7E+03	1.7E+02	1.7E+01
Uranium-234	1.8E+03	1.8E+02	1.8E+01	5.2E+05	5.2E+04	5.2E+03	1.5E+05	1.5E+04	1.5E+03	1.8E+03	1.8E+02	1.8E+01
Uranium-235+D	1.7E+03	1.7E+02	1.7E+01	4.2E+01	4.2E+00	4.2E-01	1.6E+05	1.6E+04	1.6E+03	4.1E+01	4.1E+00	4.1E-01
Uranium-238+D	1.3E+03	1.3E+02	1.3E+01	2.1E+02	2.1E+01	2.1E+00	1.6E+05	1.6E+04	1.6E+03	1.8E+02	1.8E+01	1.8E+00

TABLE 1C

Residential - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal					Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for III=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for III=1 chronic	GV for III=1 sub- chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for III=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for III=1
High Explosives																	
HMX				1.8E+00													
PETN																	
RDX	7.7E-02	7.7E-03	7.7E-04	1.1E-01													
Inorganics																	
Aluminum																	
Antimony				1.5E-02				7.8E+00	5.1E+00								1.5E-02
Arsenic				1.1E-02				5.9E+00	3.9E+00								1.1E-02
Barium				2.6E+00				1.4E+03	9.0E+02								2.6E+00
Beryllium	2.0E-03	2.0E-04	2.0E-05	1.8E-01	1.1E+00	1.1E-01	1.1E-02	9.8E+01	6.4E+01					2.0E-03	2.0E-04	2.0E-05	1.8E-01
Cadmium (Water)				1.8E-02				9.8E+00	9.8E+00								1.8E-02
Chromium III				3.7E+01				2.0E+04	1.3E+04								3.6E+01
Chromium VI				1.8E-01				9.8E+01	2.6E+02								1.8E-01

TABLE 1C

Residential - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal					Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HII=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HII=1 chronic	GV for HII=1 sub- chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HII=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HII=1
Cobalt																	
Copper																	
Cyanide				7.3E-01				5.2E+01	3.4E+01								7.2E-01
Iron																	
Lead																	
Lithium																	
Manganese (Water)				1.8E-01				9.8E+01	6.4E+01								1.8E-01
Mercury				1.1E-02				5.9E+00	3.9E+00								1.1E-02
Nickel				7.3E-01				3.9E+02	2.6E+02								7.3E-01
Silver				1.8E-01				9.8E+01	6.4E+01								1.8E-01
Thallium																	
Vanadium				2.6E-01				1.4E+02	9.0E+01								2.6E-01
Zinc				1.1E+01				5.9E+03	3.9E+03								1.1E+01
Organics																	

TABLE 1C**Residential - Groundwater Guideline Values: Chemicals (Units = mg/L)**

CHEMICAL	Ingestion				Dermal					Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1 chronic	GV for HI=1 sub-chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1
1,1,1-Trichloroethane																	
1,1-Dichloroethane				3.7E+00				2.2E+02	1.4E+03				1.7E+00				1.1E+00
1,2-Dichloroethane	9.4E-02	9.4E-03	9.4E-04		9.5E+00	9.5E-01	9.5E-02			3.0E-02	3.0E-03	3.0E-04		2.3E-02	2.3E-03	2.3E-04	
1,2-trans-Dichloroethylene				7.3E-01													
2-Butanone				2.2E+01				1.1E+04	2.4E+04				3.3E+00				2.9E+00
2-Hexanone																	
2-Methylnaphthalene																	
4-Methyl-2-Pentanone				2.9E+00				4.7E+02	3.1E+03				2.7E-01				2.4E-01
4-Methylphenol				1.8E-01				5.4E+00	3.6E+00								1.8E-01
Acetone				3.7E+00				3.4E+03	2.3E+04								3.6E+00
Benzene	2.9E-01	2.9E-02	2.9E-03		7.5E+00	7.5E-01	7.5E-02			9.4E-02	9.4E-03	9.4E-04		7.1E-02	7.1E-03	7.1E-04	
Benzoic Acid				1.5E+02				1.1E+04	7.0E+03								1.4E+02
Bromodichloromethane	1.4E-01	1.4E-02	1.4E-03	7.3E-01	1.3E+01	1.3E+00	1.3E-01	6.8E+01	4.4E+01					1.4E-01	1.4E-02	1.4E-03	7.2E-01
Butyl benzyl phthalate				7.3E+00													

TABLE 1C

Residential - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal					Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 sub- chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
Carbon Disulfide				3.7E+00				8.2E+01	5.4E+01				3.3E-02				3.3E-02
Carbon Tetrachloride	6.6E-02	6.6E-03	6.6E-04	2.6E-02	1.6E+00	1.6E-01	1.6E-02	6.2E-01	4.1E+00	5.1E-02	5.1E-03	5.1E-04		2.8E-02	2.8E-03	2.8E-04	2.5E-02
Chloroethane													3.3E+01				
Chrysene	1.2E+00	1.2E-01	1.2E-02		7.7E-01	7.7E-02	7.7E-03							4.6E-01	4.6E-02	4.6E-03	
Cresols																	
Di-n-butylphthalate				3.7E+00				1.7E+01	1.1E+02								3.0E+00
Di-n-octylphthalate				7.3E-01													
Dibromochloromethane	1.0E-01	1.0E-02	1.0E-03	7.3E-01	1.4E+01	1.4E+00	1.4E-01	1.0E+02	6.6E+02					1.0E-01	1.0E-02	1.0E-03	7.2E-01
Dichloromethane	1.1E+00	1.1E-01	1.1E-02	2.2E+00	1.4E+02	1.4E+01	1.4E+00	2.6E+02	1.7E+02				1.0E+01	1.1E+00	1.1E-01	1.1E-02	1.8E+00
Diethyl benzene, 1,4-																	
Ethyl benzene				3.7E+00				2.6E+01	2.6E+01				3.3E+00				1.6E+00
Hexane				2.2E+00									6.7E-01				5.1E-01
Isophorone	9.0E+00	9.0E-01	9.0E-02	7.3E+00	1.1E+03	1.1E+02	1.1E+01	8.9E+02	5.8E+03					8.9E+00	8.9E-01	8.9E-02	7.2E+00
Methyl iodide																	

TABLE 1C

Residential - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal					Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 sub- chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
N-nitroso-diphenylamine	1.7E+00	1.7E-01	1.7E-02		4.8E+01	4.8E+00	4.8E-01							1.7E+00	1.7E-01	1.7E-02	
Pentachlorophenol	7.1E-02	7.1E-03	7.1E-04	1.1E+00	5.9E-02	5.9E-03	5.9E-04	9.0E-01	5.9E-01					3.2E-02	3.2E-03	3.2E-04	5.0E-01
Phenol				2.2E+01				2.1E+03	1.4E+03								2.2E+01
Tetrachloroethene				3.7E-01				5.3E-01	3.5E+00								2.2E-01
Toluene				7.3E+00				8.7E+01	5.7E+02				1.3E+00				1.1E+00
Tribromomethane	1.1E+00	1.1E-01	1.1E-02	7.3E-01	2.2E+02	2.2E+01	2.2E+00	1.5E+02	9.9E+02					1.1E+00	1.1E-01	1.1E-02	7.3E-01
Trichloroethylene	7.7E-01	7.7E-02	7.7E-03		2.6E+01	2.6E+00	2.6E-01			4.5E-01	4.5E-02	4.5E-03		2.8E-01	2.8E-02	2.8E-03	
Trichlorofluoromethane				1.1E+01				3.5E+02	5.3E+02				2.3E+00				1.9E+00
Trichloromethane	1.4E+00	1.4E-01	1.4E-02	3.7E-01	8.4E+01	8.4E+00	8.4E-01	2.2E+01	1.4E+01	3.4E-02	3.4E-03	3.4E-04		3.3E-02	3.3E-03	3.3E-04	3.6E-01
Xylene				7.3E+01													
bis(2-Ethylhexyl)phthalate	6.1E-01	6.1E-02	6.1E-03	7.3E-01	1.4E+01	1.4E+00	1.4E-01	1.7E+01	1.1E+01					5.8E-01	5.8E-02	5.8E-03	
PAHs																	
Acenaphthylene																	
Anthracene				1.1E+01				2.6E+01	1.7E+02								7.7E+00

TABLE 1C

Residential - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal					Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for III=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for III=1 chronic	GV for III=1 sub-chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for III=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for III=1
Benzo(a)anthracene	1.2E-02	1.2E-03	1.2E-04		7.7E-03	7.7E-04	7.7E-05							4.6E-03	4.6E-04	4.6E-05	
Benzo(a)pyrene	1.2E-03	1.2E-04	1.2E-05		5.2E-04	5.2E-05	5.2E-06							3.6E-04	3.6E-05	3.6E-06	
Benzo(b)fluoranthene	1.2E-02	1.2E-03	1.2E-04		5.1E-03	5.1E-04	5.1E-05							3.5E-03	3.5E-04	3.5E-05	
Benzo(g,h,i)perylene																	
Benzo(k)fluoranthene	1.2E-01	1.2E-02	1.2E-03		1.0E-01	1.0E-02	1.0E-03							5.5E-02	5.5E-03	5.5E-04	
Dibenz(a,h)anthracene	1.2E-03	1.2E-04	1.2E-05		2.3E-04	2.3E-05	2.3E-06							1.9E-04	1.9E-05	1.9E-06	
Fluoranthene				1.5E+00				2.2E+00	1.4E+01								8.7E-01
Indeno(1,2,3-cd)pyrene	1.2E-02	1.2E-03	1.2E-04		3.3E-03	3.3E-04	3.3E-05							2.6E-03	2.6E-04	2.6E-05	
Phenanthrene																	
Pyrene				1.1E+00				1.8E+00	1.2E+01								6.8E-01
Pesticides/PCBs																	
4,4'-DDE	2.5E-02	2.5E-03	2.5E-04		5.6E-02	5.6E-03	5.6E-04							1.7E-02	1.7E-03	1.7E-04	
4,4'-DDT	2.5E-02	2.5E-03	2.5E-04	1.8E-02	3.1E-02	3.1E-03	3.1E-04	2.3E-02	1.5E-02					1.4E-02	1.4E-03	1.4E-04	1.0E-02
Aroclor 1248	1.1E-03	1.1E-04	1.1E-05														

TABLE 1C

Residential - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal					Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 sub- chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Aroclor 1254				7.3E-04													
Aroclor 1260	1.1E-03	1.1E-04	1.1E-05														
Beta-BHC	4.7E-03	4.7E-04	4.7E-05														
Dieldrin	5.3E-04	5.3E-05	5.3E-06	1.8E-03	1.8E-02	1.8E-03	1.8E-04	6.1E-02	4.0E-02					5.2E-04	5.2E-05	5.2E-06	1.8E-03
Endrin Ketone																	

TABLE 1D

Residential - Groundwater Guideline Values: Radionuclides (Units = pCi/L)

RADIONUCLIDE	Ingestion			Inhalation			Dermal			Ingestion + Inhalation + Dermal		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶
Actinium-227+D	7.6E+00	7.6E-01	7.6E-02									
Americium-241	1.5E+01	1.5E+00	1.5E-01									
Bismuth-207	9.4E+02	9.4E+01	9.4E+00									
Cesium-137+D	1.5E+02	1.5E+01	1.5E+00									
Cobalt-60	2.5E+02	2.5E+01	2.5E+00									
Plutonium-238	1.6E+01	1.6E+00	1.6E-01									
Plutonium-239	1.5E+01	1.5E+00	1.5E-01									
Plutonium-240	1.5E+01	1.5E+00	1.5E-01									
Radium-226+D	1.6E+01	1.6E+00	1.6E-01									
Strontium-90+D	8.5E+01	8.5E+00	8.5E-01									
Thorium-228+D	2.1E+01	2.1E+00	2.1E-01									
Thorium-230	1.3E+02	1.3E+01	1.3E+00									
Thorium-232	1.5E+02	1.5E+01	1.5E+00									

TABLE 1D**Residential - Groundwater Guideline Values: Radionuclides (Units = pCi/L)**

RADIONUCLIDE	Ingestion			Inhalation			Dermal			Ingestion + Inhalation + Dermal		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴
Tritium	6.7E+04	6.7E+03	6.7E+02	6.7E+06	6.7E+05	6.7E+04	2.7E+07	2.7E+06	2.7E+05	6.6E+04	6.6E+03	6.6E+02
Uranium-233	1.1E+02	1.1E+01	1.1E+00									
Uranium-234	1.1E+02	1.1E+01	1.1E+00									
Uranium-235+D	1.0E+02	1.0E+01	1.0E+00									
Uranium-238+D	7.7E+01	7.7E+00	7.7E-01									

TABLE 2A

Recreational - Soil/Sediment Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
High Explosives													
DMX				5.5E+03									
PETN													
RDX	2.3E+04	2.3E+03	2.3E+02	3.3E+04	9.5E+03								
Inorganics													
Aluminum													
Antimony				4.4E+03	1.3E+03								
Arsenic				3.3E+03	9.5E+02	2.9E+06	2.9E+05	2.9E+04					
Barium				7.7E+05	2.2E+05				9.0E+07				7.7E+05
Beryllium	6.0E+02	6.0E+01	6.0E+00	5.5E+04	1.6E+04	1.8E+07	1.8E+06	1.8E+05		6.0E+02	6.0E+01	6.0E+00	
Cadmium (Diet)				1.1E+04		2.4E+07	2.4E+06	2.4E+05					
Chromium III				1.1E+07	3.2E+06								
Chromium VI				5.5E+04	6.3E+04	3.6E+06	3.6E+05	3.6E+04					
Cobalt													

TABLE 2A

Recreational - Soil/Sediment Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Copper													
Cyanide				2.2E+03	6.3E+04								
Iron													
Lead													
Lithium													
Manganese (Diet)				1.5E+06	4.4E+05				9.0E+06				1.3E+06
Mercury				3.3E+03	9.5E+02				5.4E+07				3.3E+03
Nickel				2.2E+03	6.3E+04								
Silver				5.5E+04	1.6E+04								
Thallium													
Vanadium				7.7E+04	2.2E+04								
Zinc				3.3E+06	9.5E+05								
Organic													
1,1,1-Trichloroethane													

TABLE 2A

Recreational - Soil/Sediment Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
1,1-Dichloroethane				1.1E+06	3.2E+06				2.3E+02				2.3E+02
1,2-Dichloroethane	2.8E+04	2.8E+03	2.8E+02			6.7E+02	6.7E+02	8.1E+01		6.7E+02	6.3E+02	6.3E+01	
1,2-trans-Dichloroethylene				2.2E+05	6.3E+05								
2-Butanone				6.6E+06	6.3E+06				9.3E+03				9.3E+03
2-Hexanone													
2-Methylnaphthalene													
4-Methyl-2-Pentanone				8.8E+05	2.5E+06				7.0E+02				7.0E+02
4-Methylphenol				5.5E+04	1.6E+04								
Acetone				1.1E+06	3.2E+06								
Benzene	8.9E+04	8.9E+03	8.9E+02			4.9E+02	4.9E+02	2.2E+02		4.9E+02	4.9E+02	1.8E+02	
Benzoic Acid				4.4E+07	1.3E+07								
Bromodichloromethane	4.2E+04	4.2E+03	4.2E+02	2.2E+05	6.3E+04								
Butyl benzyl phthalate				2.2E+06	6.3E+06								
Carbon Disulfide				1.1E+06	3.2E+05				1.7E+03				1.7E+03

TABLE 2A

Recreational - Soil/Sediment Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Carbon Tetrachloride	2.0E+04	2.0E+03	2.0E+02	7.7E+03	2.2E+04	1.0E+03	1.0E+03	1.2E+02		1.0E+03	7.6E+02	7.6E+01	
Chloroethane									1.6E+02				
Chrysene	3.5E+05	3.5E+04	3.5E+03										
Creosols													
Di-n-butylphthalate				1.1E+06	3.2E+06								
Di-n-octylphthalate				2.2E+05	6.3E+04								
Dibromochloromethane	3.1E+04	3.1E+03	3.1E+02	2.2E+05	6.3E+05								
Dichloromethane	3.4E+05	3.4E+04	3.4E+03	6.6E+05	1.9E+05				1.0E+03				1.0E+03
Diethyl benzene, 1,4-													
Diethyl benzene				1.1E+06					4.8E-01				4.8E-01
Hexane				6.6E+05	1.9E+06				9.1E+01				9.1E+01
Isophorone	2.7E+06	2.7E+05	2.7E+04	2.2E+06	6.3E+06								
Methyl iodide													
N-nitroso-diphenylamine	5.3E+05	5.3E+04	5.3E+03										

TABLE 2A

Recreational - Soil/Sediment Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
pentachlorophenol	2.1E+04	2.1E+03	2.1E+02	3.3E+05	9.5E+04								
phenol				6.6E+06	1.9E+06								
tetrachloroethene				1.1E+05	3.2E+05								
toluene				2.2E+06	6.3E+06				2.5E+02				2.5E+02
tribromomethane	3.3E+05	3.3E+04	3.3E+03	2.2E+05	6.3E+05	3.8E+10	3.8E+09	3.8E+08		3.3E+05	3.3E+04	3.3E+03	
trichloroethylene	2.3E+05	2.3E+04	2.3E+03			4.4E+02	4.4E+02	4.4E+02		4.4E+02	4.4E+02	4.4E+02	
trichlorofluoromethane				3.3E+06	2.2E+06				7.3E+02				7.3E+02
trichloromethane	4.2E+05	4.2E+04	4.2E+03	1.1E+05	3.2E+04	1.5E+03	7.6E+02	7.6E+01		1.5E+03	7.4E+02	7.4E+01	
ethylene				2.2E+07									
di(2-Ethylhexyl)phthalate	1.8E+05	1.8E+04	1.8E+03	2.2E+05	6.3E+04								
Alls													
acenaphthylene													
anthracene				3.3E+06	9.5E+06								
benzo(a)anthracene	3.5E+03	3.5E+02	3.5E+01										

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁴	GV for HI=1
Benzo(a)pyrene	3.5E+02	3.5E+01	3.5E+00										
Benzo(b)fluoranthene	3.5E+03	3.5E+02	3.5E+01										
Benzo(g,h,i)perylene													
Benzo(k)fluoranthene	3.5E+04	3.5E+03	3.5E+02										
Dibenz(a,h)anthracene	3.5E+02	3.5E+01	3.5E+00										
Fluoranthene				4.4E+05	1.3E+06								
Indeno(1,2,3-cd)pyrene	3.5E+03	3.5E+02	3.5E+01										
Phenanthrene													
Pyrene				3.3E+05	9.5E+05								
1,4'-DDE	7.6E+03	7.6E+02	7.6E+01										
1,4'-DDT	7.6E+03	7.6E+02	7.6E+01	5.5E+03	1.6E+03	4.3E+08	4.3E+07	4.3E+06		7.6E+03	7.6E+02	7.6E+01	
Aroclor 1248	3.4E+02	3.4E+01	3.4E+00										
Aroclor 1254				2.2E+02	1.6E+02								
Aroclor 1260	3.4E+02	3.4E+01	3.4E+00										

TABLE 2A Recreational - Soil/Sediment Guideline Values: Chemicals (Units = mg/kg)													
CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Beta-BHC	1.4E+03	1.4E+02	1.4E+01			8.2E+07	8.2E+06	8.2E+05		1.4E+03	1.4E+02	1.4E+01	
Dieldrin	1.6E+02	1.6E+01	1.6E+00	5.5E+02	1.6E+02	9.2E+06	9.2E+05	9.2E+04		1.6E+02	1.6E+01	1.6E+00	
Endrin Ketone													

TABLE 2B**Recreational - Soil/Sediment Guideline Values: Radionuclides (Units = pCi/g)**

RADIONUCLIDE	Ingestion			External			Inhalation			Ingestion + External + Inhalation		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶
Actinium-227+D	5.1E+03	5.1E+02	5.1E+01	2.9E+02	2.9E+01	2.9E+00	1.0E+06	1.0E+05	1.0E+04	2.8E+02	2.8E+01	2.8E+00
Americium-241	9.8E+03	9.8E+02	9.8E+01	3.8E+04	3.8E+03	3.8E+02	2.1E+06	2.1E+05	2.1E+04	7.8E+03	7.8E+02	7.8E+01
Bismuth-207	6.3E+05	6.3E+04	6.3E+03	3.2E+01	3.2E+00	3.2E-01	8.7E+09	8.7E+08	8.7E+07	3.2E+01	3.2E+00	3.2E-01
Cesium-137+D	1.0E+05	1.0E+04	1.0E+03	8.4E+01	8.4E+00	8.4E-01	4.3E+09	4.3E+08	4.3E+07	8.4E+01	8.4E+00	8.4E-01
Cobalt-60	1.7E+05	1.7E+04	1.7E+03	1.8E+01	1.8E+00	1.8E-01	1.2E+09	1.2E+08	1.2E+07	1.8E+01	1.8E+00	1.8E-01
Plutonium-238	1.1E+04	1.1E+03	1.1E+02	9.1E+06	9.1E+05	9.1E+04	3.0E+06	3.0E+05	3.0E+04	1.1E+04	1.1E+03	1.1E+02
Plutonium-239	1.0E+04	1.0E+03	1.0E+02	1.4E+07	1.4E+06	1.4E+05	3.0E+06	3.0E+05	3.0E+04	1.0E+04	1.0E+03	1.0E+02
Plutonium-240	1.0E+04	1.0E+03	1.0E+02	9.4E+06	9.4E+05	9.4E+04	3.0E+06	3.0E+05	3.0E+04	1.0E+04	1.0E+03	1.0E+02
Radium-226+D	1.1E+04	1.1E+03	1.1E+02	2.6E+01	2.6E+00	2.6E-01	3.0E+07	3.0E+06	3.0E+05	2.6E+01	2.6E+00	2.6E-01
Strontium-90+D	5.7E+04	5.7E+03	5.7E+02				1.2E+09	1.2E+08	1.2E+07	5.7E+04	5.7E+03	5.7E+02
Thorium-228+D	1.4E+04	1.4E+03	1.4E+02	1.8E+02	1.8E+01	1.8E+00	8.5E+05	8.5E+04	8.5E+03	1.7E+02	1.7E+01	1.7E+00
Thorium-230	8.5E+04	8.5E+03	8.5E+02	4.0E+06	4.0E+05	4.0E+04	4.8E+06	4.8E+05	4.8E+04	8.2E+04	8.2E+03	8.2E+02
Thorium-232	9.8E+04	9.8E+03	9.8E+02	8.9E+06	8.9E+05	8.9E+04	4.3E+06	4.3E+05	4.3E+04	9.5E+04	9.5E+03	9.5E+02
Tritium	4.5E+07	4.5E+06	4.5E+05				8.6E+11	8.6E+10	8.6E+09	4.5E+07	4.5E+06	4.5E+05

TABLE 2B

Recreational - Soil/Sediment Guideline Values: Radionuclides (Units = pCi/g)

RADIONUCLIDE	Ingestion			External			Inhalation			Ingestion + External + Inhalation		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶
Uranium-233	7.2E+04	7.2E+03	7.2E+02	5.0E+06	5.0E+05	5.0E+04	5.8E+06	5.8E+05	5.8E+04	7.0E+04	7.0E+03	7.9E+02
Uranium-234	7.2E+04	7.2E+03	7.2E+02	8.2E+06	8.2E+05	8.2E+04	5.9E+06	5.9E+05	5.9E+04	7.1E+04	7.1E+03	7.1E+02
Uranium-235 (D)	6.8E+04	6.8E+03	6.8E+02	6.6E+02	6.6E+01	6.6E+00	6.3E+06	6.3E+05	6.3E+04	6.6E+02	6.6E+01	6.6E+00
Uranium-238 (D)	5.2E+04	5.2E+03	5.2E+02	3.4E+03	3.4E+02	3.4E+01	6.6E+06	6.6E+05	6.6E+04	3.1E+03	3.1E+02	3.1E+01

TABLE 2C

Recreational - Surface Water Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal					Ingestion + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
High Explosives													
HMX				2.9E+03									
PETN													
RDX	1.3E+02	1.3E+01	1.3E+00	1.8E+02									
Inorganics													
Aluminum													
Antimony				2.4E+01				3.7E+00	1.4E+00				3.2E+00
Arsenic				1.8E+01				2.8E+00	1.1E+00				2.4E+00
Barium				4.1E+03				6.6E+02	2.5E+02				5.7E+02
Beryllium	3.2E+00	3.2E-01	3.2E-02	2.9E+02	5.1E-01	5.1E-02	5.1E-03	4.7E+01	1.8E+01	4.4E-01	4.4E-02	4.4E-03	4.0E+01
Cadmium (Water)				2.9E+01				4.7E+00					4.0E+00
Chromium III				5.9E+04				9.4E+03	3.6E+03				8.1E+03
Chromium VI				2.9E+02				4.7E+01	7.2E+01				4.0E+01
Cobalt													

CHEMICAL	Ingestion				Dermal					Ingestion + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
Copper													
Cyanide				1.2E+03				2.5E+01	9.7E+00				2.4E+01
Iron													
Lead													
Lithium													
Manganese (Water)				2.9E+02				4.7E+01	1.8E+01				4.0E+01
Mercury				1.8E+01				2.8E+00	1.1E+00				2.4E+00
Nickel				1.2E+03				1.9E+02	7.2E+01				1.6E+02
Silver				2.9E+02				4.7E+01	1.8E+01				4.0E+01
Thallium													
Vanadium				4.1E+02				6.6E+01	2.5E+01				5.7E+01
Zinc				1.8E+04				2.8E+03	1.1E+03				2.4E+03
Organics													
1,1,1-Trichloroethane													

TABLE 2C

Recreational - Surface Water Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal					Ingestion + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
1,1-Dichloroethane				5.9E+03				1.1E+02	4.1E+02				1.0E+02
1,2-Dichloroethane	1.5E+02	1.5E+01	1.5E+00		4.5E+00	4.5E-01	4.5E-02			4.4E+00	4.4E-01	4.4E-02	
1,2-trans-Dichloroethylene				1.2E+03									
2-Butanone				3.5E+04				5.2E+03	6.6E+03				4.5E+03
2-Hexanone													
2-Methylnaphthalene													
4-Methyl-2-Pentanone				4.7E+03				2.3E+02	8.8E+02				2.2E+02
4-Methylphenol				2.9E+02				2.6E+00	1.0E+00				2.6E+00
Acetone				5.9E+03				1.6E+03	6.4E+03				1.3E+03
Benzene	4.7E+02	4.7E+01	4.7E+00		3.6E+00	3.6E-01	3.6E-02			3.6E+00	3.6E-01	3.6E-02	
Benzoic Acid				2.4E+05				5.1E+03	2.0E+03				5.0E+03
Bromodichloromethane	2.2E+02	2.2E+01	2.2E+00	1.2E+03	6.1E+00	6.1E-01	6.1E-02	3.2E+01	1.2E+01	5.9E+00	5.9E-01	5.9E-02	3.1E+01
Butyl benzyl phthalate				1.2E+04									
Carbon Disulfide				5.9E+03				3.9E+01	1.5E+01				3.9E+01

TABLE 2C

Recreational - Surface Water Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal					Ingestion + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Carbon Tetrachloride	1.1E+02	1.1E+01	1.1E+00	4.1E+01	7.6E-01	7.6E-02	7.6E-03	3.0E-01	1.2E+00	7.6E-01	7.6E-02	7.6E-03	3.0E-01
Chloroethane													
Chrysene	1.9E+03	1.9E+02	1.9E+01		3.7E-01	3.7E-02	3.7E-03			3.7E-01	3.7E-02	3.7E-03	
Cresols													
Di-n-butylphthalate				5.9E+03				8.1E+00	3.1E+01				8.1E+00
Di-n-octylphthalate				1.2E+03									
Dibromochloromethane	1.6E+02	1.6E+01	1.6E+00	1.2E+03	6.7E+00	6.7E-01	6.7E-02	4.8E+01	1.9E+02	6.4E+00	6.4E-01	6.4E-02	4.6E+01
Dichloromethane	1.8E+03	1.8E+02	1.8E+01	3.5E+03	6.5E+01	6.5E+00	6.5E-01	1.2E+02	4.8E+01	6.2E+01	6.2E+00	6.2E-01	1.2E+02
Diethyl benzene, 1,4-													
Ethyl benzene				5.9E+03				1.3E+01					1.3E+01
Hexane				3.5E+03									
Isophorone	1.4E+04	1.4E+03	1.4E+02	1.2E+04	5.2E+02	5.2E+01	5.2E+00	4.3E+02	1.6E+03	5.0E+02	5.0E+01	5.0E+00	4.1E+02
Methyl iodide													
N-nitroso-diphenylamine	2.8E+03	2.8E+02	2.8E+01		2.3E+01	2.3E+00	2.3E-01			2.3E+01	2.3E+00	2.3E-01	

Risk-Based Cleanup Guideline Values Report - Appendix B
March, 1997

TABLE 2C

Recreational - Surface Water Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal					Ingestion + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Pentachlorophenol	1.1E+02	1.1E+01	1.1E+00	1.8E+03	2.8E-02	2.8E-03	2.8E-04	4.3E-01	1.7E-01	2.8E-02	2.8E-03	2.8E-04	4.3E-01
Phenol				3.5E+04				1.0E+03	3.9E+02				9.9E+02
Tetrachloroethene				5.9E+02				2.5E-01	9.8E-01				2.5E-01
Toluene				1.2E+04				4.2E+01	1.6E+02				4.1E+01
Tri bromomethane	1.7E+03	1.7E+02	1.7E+01	1.2E+03	1.1E+02	1.1E+01	1.1E+00	7.2E+01	2.8E+02	1.0E+02	1.0E+01	1.0E+00	6.8E+01
Trichloroethylene	1.3E+03	1.3E+02	1.3E+01		1.2E+01	1.2E+00	1.2E-01			1.2E+01	1.2E+00	1.2E-01	
Trichlorofluoromethane				1.8E+04				1.7E+02	1.5E+02				1.6E+02
Trichloromethane	2.3E+03	2.3E+02	2.3E+01	5.9E+02	4.0E+01	4.0E+00	4.0E-01	1.1E+01	4.1E+00	4.0E+01	4.0E+00	4.0E-01	1.0E+01
Xylene				1.2E+05									
bis(2-Ethylhexyl)phthalate	9.8E+02	9.8E+01	9.8E+00	1.2E+03	6.7E+00	6.7E-01	6.7E-02	8.0E+00	3.1E+00	6.6E+00	6.6E-01	6.6E-02	7.9E+00
PAHs													
Acenaphthylene													
Anthracene				1.8E+04				1.3E+01	4.8E+01				1.3E+01
Benzo(a)anthracene	1.9E+01	1.9E+00	1.9E-01		3.7E-03	3.7E-04	3.7E-05			3.7E-03	3.7E-04	3.7E-05	

TABLE 2C

Recreational - Surface Water Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal					Ingestion + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
Benzo(a)pyrene	1.9E+00	1.9E-01	1.9E-02		2.5E-04	2.5E-05	2.5E-06			2.5E-04	2.5E-05	2.5E-06	
Benzo(b)fluoranthene	1.9E+01	1.9E+00	1.9E-01		2.4E-03	2.4E-04	2.4E-05			2.4E-03	2.4E-04	2.4E-05	
Benzo(g,h,i)perylene													
Benzo(k)fluoranthene	1.9E+02	1.9E+01	1.9E+00		5.0E-02	5.0E-03	5.0E-04			5.0E-02	5.0E-03	5.0E-04	
Dibenz(a,h)anthracene	1.9E+00	1.9E-01	1.9E-02		1.1E-04	1.1E-05	1.1E-06			1.1E-04	1.1E-05	1.1E-06	
Fluoranthene				2.4E+03				1.0E+00	4.0E+00				1.0E+00
Indeno(1,2,3-cd)pyrene	1.9E+01	1.9E+00	1.9E-01		1.6E-03	1.6E-04	1.6E-05			1.6E-03	1.6E-04	1.6E-05	
Phenanthrene													
Pyrene				1.8E+03				8.7E-01	3.3E+00				8.7E-01
Pesticides/PCBs													
4,4'-DDE	4.0E+01	4.0E+00	4.0E-01		2.7E-02	2.7E-03	2.7E-04			2.7E-02	2.7E-03	2.7E-04	
4,4'-DDT	4.0E+01	4.0E+00	4.0E-01	2.9E+01	1.5E-02	1.5E-03	1.5E-04	1.1E-02	4.2E-03	1.5E-02	1.5E-03	1.5E-04	1.1E-02
Aroclor 1248	1.8E+00	1.8E-01	1.8E-02										
Aroclor 1254				1.2E+00									

TABLE 2C**Recreational - Surface Water Guideline Values: Chemicals (Units = mg/L)**

CHEMICAL	Ingestion				Dermal					Ingestion + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1
Aroclor 1260	1.8E+00	1.8E-01	1.8E-02										
Beta-BHC	7.6E+00	7.6E-01	7.6E-02										
Dieldrin	8.6E-01	8.6E-02	8.6E-03	2.9E+00	8.5E-03	8.5E-04	8.5E-05	2.9E-02	1.1E-02	8.4E-03	8.4E-04	8.4E-05	2.9E-02
Endrin Ketone													

TABLE 2D**Recreational - Surface Water Guideline Values: Radionuclides (Units = pCi/L)**

RADIONUCLIDE	Ingestion			Dermal			Ingestion + Dermal		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶
Actinium-227+D	1.2E+04	1.2E+03	1.2E+02						
Americium-241	2.3E+04	2.3E+03	2.3E+02						
Bismuth-207	1.5E+06	1.5E+05	1.5E+04						
Cesium-137+D	2.4E+05	2.4E+04	2.4E+03						
Cobalt-60	4.1E+05	4.1E+04	4.1E+03						
Plutonium-238	2.6E+04	2.6E+03	2.6E+02						
Plutonium-239	2.4E+04	2.4E+03	2.4E+02						
Plutonium-240	2.4E+04	2.4E+03	2.4E+02						
Radium-226+D	2.6E+04	2.6E+03	2.6E+02						
Strontium-90+D	1.4E+05	1.4E+04	1.4E+03						
Thorium-228+D	3.3E+04	3.3E+03	3.3E+02						
Thorium-230	2.1E+05	2.1E+04	2.1E+03						
Thorium-232	2.3E+05	2.3E+04	2.3E+03						

TABLE 2D**Recreational - Surface Water Guideline Values: Radionuclides (Units = pCi/L)**

RADIONUCLIDE	Ingestion			Dermal			Ingestion + Dermal		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴
Tritium	1.1E+08	1.1E+07	1.1E+06	1.3E+07	1.3E+06	1.3E+05	1.2E+07	1.2E+06	1.2E+05
Uranium-233	1.7E+05	1.7E+04	1.7E+03						
Uranium-234	1.7E+05	1.7E+04	1.7E+03						
Uranium-235+D	1.6E+05	1.6E+04	1.6E+03						
Uranium-238+D	1.2E+05	1.2E+04	1.2E+03						

TABLE 3A**Subsistence Farmer - Soil Guideline Values: Chemicals (Units = mg/kg)**

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
High Explosives													
11MX				6.4E+03									
PETN													
RDX	2.7E+02	2.7E+01	2.7E+00	3.8E+02	2.3E+02								
Inorganics													
Aluminum													
Antimony				5.1E+01	3.1E+01								
Arsenic				3.8E+01	2.3E+01	7.3E+04	7.3E+03	7.3E+02					
Barium				9.0E+03	5.5E+03				2.2E+06				8.9E+03
Beryllium	6.9E+00	6.9E-01	6.9E-02	6.4E+02	3.9E+02	4.3E+05	4.3E+04	4.3E+03		6.9E+00	6.9E-01	6.9E-02	
Cadmium (Diet)				1.3E+02		6.0E+05	6.0E+04	6.0E+03					
Chromium III				1.3E+05	7.8E+04								
Chromium VI				6.4E+02	1.6E+03	8.9E+04	8.9E+03	8.9E+02					
Cobalt													

TABLE 3A

Subsistence Farmer - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Copper													
Cyanide				2.6E+03	1.6E+03								
Iron													
Lead													
Lithium													
Manganese (Diet)				1.8E+04	1.1E+04				2.2E+05				1.7E+04
Mercury				3.8E+01	2.3E+01				1.3E+06				3.8E+01
Nickel				2.6E+03	1.6E+03								
Silver				6.4E+02	3.9E+02								
Thallium													
Vanadium				9.0E+02	5.5E+02								
Zinc				3.8E+04	2.3E+04								
Organics													
1,1,1-Trichloroethane													

TABLE 3A

Subsistence Farmer - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
1,1-Dichloroethane				1.3E+04	7.8E+04				5.6E+00				5.6E+00
1,2-Dichloroethane	3.3E+02	3.3E+01	3.3E+00			2.0E+02	2.0E+01	2.0E+00		1.2E+02	1.2E+01	1.2E+00	
1,2-trans-Dichloroethylene				2.6E+03	1.6E+04								
2-Butanone				7.7E+04	1.6E+05				9.3E+03				9.3E+03
2-Hexanone													
2-Methylnaphthalene													
4-Methyl-2-Pentanone				1.0E+04	6.3E+04				7.0E+02				7.0E+02
4-Methylphenol				6.4E+02	3.9E+02								
Acetone				1.3E+04	7.8E+04								
Benzene	1.0E+03	1.0E+02	1.0E+01			4.9E+02	5.5E+01	5.5E+00		3.6E+02	3.6E+01	3.6E+00	
Benzoic Acid				5.1E+05	3.1E+05								
Bromodichloromethane	4.8E+02	4.8E+01	4.8E+00	2.6E+03	1.6E+03								
Butyl benzyl phthalate				2.6E+04	1.6E+05								
Carbon Disulfide				1.3E+04	7.8E+03				2.0E+02				2.0E+02

TABLE 3A

Subsistence Farmer - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Carbon Tetrachloride	2.3E+02	2.3E+01	2.3E+00	9.0E+01	5.5E+02	3.1E+02	3.1E+01	3.1E+00		1.3E+02	1.3E+01	1.3E+00	
Chloroethane									1.6E+02				
Chrysene	4.1E+03	4.1E+02	4.1E+01										
Cresols													
Di-n-butylphthalate				1.3E+04	7.8E+04								
Di-n-octylphthalate				2.6E+03	1.6E+03								
Dibromochloromethane	3.6E+02	3.6E+01	3.6E+00	2.6E+03	1.6E+04								
Dichloromethane	4.0E+03	4.0E+02	4.0E+01	7.7E+03	4.7E+03				1.0E+03				1.0E+03
Diethyl benzene, 1,4-													
Diethyl benzene				1.3E+04					4.8E-01				4.8E-01
Hexane				7.7E+03	4.7E+04				9.1E+01				9.1E+01
Isophorone	3.1E+04	3.1E+03	3.1E+02	2.6E+04	1.6E+05								
Methyl iodide													
N-nitroso-diphenylamine	6.1E+03	6.1E+02	6.1E+01										

TABLE 3A

Subsistence Farmer - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
Pentachlorophenol	2.5E+02	2.5E+01	2.5E+00	3.8E+03	2.3E+03								
Phenol				7.7E+04	4.7E+04								
Tetrachloroethene				1.3E+03	7.8E+03								
Toluene				2.6E+04	1.6E+05				2.5E+02				2.5E+02
Tribromomethane	3.8E+03	3.8E+02	3.8E+01	2.6E+03	1.6E+04	9.4E+08	9.4E+07	9.4E+06		3.8E+03	3.8E+02	3.8E+01	
Trichloroethylene	2.7E+03	2.7E+02	2.7E+01			4.4E+02	2.7E+02	2.7E+01		4.4E+02	1.3E+02	1.3E+01	
Trichlorofluoromethane				3.8E+04	5.5E+04				7.3E+02				7.3E+02
Trichloromethane	4.9E+03	4.9E+02	4.9E+01	1.3E+03	7.8E+02	1.9E+02	1.9E+01	1.9E+00		1.8E+02	1.8E+01	1.8E+00	
Xylene				2.6E+05									
bis(2-Ethylhexyl)phthalate	2.1E+03	2.1E+02	2.1E+01	2.6E+03	1.6E+03								
PAHs													
Acenaphthylene													
Anthracene				3.8E+04	2.3E+05								
Benzo(a)anthracene	4.1E+01	4.1E+00	4.1E-01										

TABLE 3A

Subsistence Farmer - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Benzo(a)pyrene	4.1E+00	4.1E-01	4.1E-02										
Benzo(b)fluoranthene	4.1E+01	4.1E+00	4.1E-01										
Benzo(g,h,i)perylene													
Benzo(k)fluoranthene	4.1E+02	4.1E+01	4.1E+00										
Dibenz(a,h)anthracene	4.1E+00	4.1E-01	4.1E-02										
Fluoranthene				5.1E+03	3.1E+04								
Indeno(1,2,3-cd)pyrene	4.1E+01	4.1E+00	4.1E-01										
Phenanthrene													
Pyrene				3.8E+03	2.3E+04								
Pesticides/PCBs													
4,4'-DDE	8.8E+01	8.8E+00	8.8E-01										
4,4'-DDT	8.8E+01	8.8E+00	8.8E-01	6.4E+01	3.9E+01	1.1E+07	1.1E+06	1.1E+05		8.8E+01	8.8E+00	8.8E-01	
Aroclor 1248	3.9E+00	3.9E-01	3.9E-02										
Aroclor 1254				2.6E+00	3.9E+00								

TABLE 3A Subsistence Farmer - Soil Guideline Values: Chemicals (Units = mg/kg)													
CHEMICAL	Ingestion					Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1 chronic	GV for HI=1 subchronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
Aroclor 1260	3.9E+00	3.9E-01	3.9E-02										
Beta-BHC	1.7E+01	1.7E+00	1.7E-01			2.0E+06	2.0E+05	2.0E+04		1.7E+01	1.7E+00	1.7E-01	
Dieldrin	1.9E+00	1.9E-01	1.9E-02	6.4E+00	3.9E+00	2.3E+05	2.3E+04	2.3E+03		1.9E+00	1.9E-01	1.9E-02	
Endrin Ketone													

TABLE 3B

Subsistence Farmer - Soil Guideline Values: Radionuclides (Units = pCi/g)

RADIONUCLIDE	Ingestion			External			Inhalation			Ingestion + External + Inhalation		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶
Actinium-227+D	3.6E+01	3.6E+00	3.6E-01	1.9E+01	1.9E+00	1.9E-01	2.6E+04	2.6E+03	2.6E+02	1.2E+01	1.2E+00	1.2E-01
Americium-241	6.8E+01	6.8E+00	6.8E-01	2.4E+03	2.4E+02	2.4E+01	5.3E+04	5.3E+03	5.3E+02	6.7E+01	6.7E+00	6.7E-01
Bismuth-207	4.4E+03	4.4E+02	4.4E+01	2.0E+00	2.0E-01	2.0E-02	2.2E+08	2.2E+07	2.2E+06	2.0E+00	2.0E-01	2.0E-02
Cesium-137+D	7.1E+02	7.1E+01	7.1E+00	5.3E+00	5.3E-01	5.3E-02	1.1E+08	1.1E+07	1.1E+06	5.3E+00	5.3E-01	5.3E-02
Cobalt-60	1.2E+03	1.2E+02	1.2E+01	1.1E+00	1.1E-01	1.1E-02	3.0E+07	3.0E+06	3.0E+05	1.1E+00	1.1E-01	1.1E-02
Plutonium-238	7.6E+01	7.6E+00	7.6E-01	5.7E+05	5.7E+04	5.7E+03	7.4E+04	7.4E+03	7.4E+02	7.6E+01	7.6E+00	7.6E-01
Plutonium-239	7.1E+01	7.1E+00	7.1E-01	8.8E+05	8.8E+04	8.8E+03	7.3E+04	7.3E+03	7.3E+02	7.1E+01	7.1E+00	7.1E-01
Plutonium-240	7.1E+01	7.1E+00	7.1E-01	5.9E+05	5.9E+04	5.9E+03	7.3E+04	7.3E+03	7.3E+02	7.1E+01	7.1E+00	7.1E-01
Radium-226+D	7.6E+01	7.6E+00	7.6E-01	1.6E+00	1.6E-01	1.6E-02	7.4E+05	7.4E+04	7.4E+03	1.6E+00	1.6E-01	1.6E-02
Strontium-90+D	4.0E+02	4.0E+01	4.0E+00				2.9E+07	2.9E+06	2.9E+05	4.0E+02	4.0E+01	4.0E+00
Thorium-228+D	9.7E+01	9.7E+00	9.7E-01	1.1E+01	1.1E+00	1.1E-01	2.1E+04	2.1E+03	2.1E+02	1.0E+01	1.0E+00	1.0E-01
Thorium-230	6.0E+02	6.0E+01	6.0E+00	2.5E+05	2.5E+04	2.5E+03	1.2E+05	1.2E+04	1.2E+03	5.9E+02	5.9E+01	5.9E+00
Thorium-232	6.8E+02	6.8E+01	6.8E+00	5.6E+05	5.6E+04	5.6E+03	1.1E+05	1.1E+04	1.1E+03	6.8E+02	6.8E+01	6.8E+00

TABLE 3B

Subsistence Farmer - Soil Guideline Values: Radionuclides (Units = pCi/g)

RADIONUCLIDE	Ingestion			External			Inhalation			Ingestion + External + Inhalation		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶
Tritium	3.1E+05	3.1E+04	3.1E+03				2.1E+10	2.1E+09	2.1E+08	3.1E+05	3.1E+04	3.1E+03
Uranium-233	5.0E+02	5.0E+01	5.0E+00	3.2E+05	3.2E+04	3.2E+03	1.4E+05	1.4E+04	1.4E+03	5.0E+02	5.0E+01	5.0E+00
Uranium-234	5.1E+02	5.1E+01	5.1E+00	5.2E+05	5.2E+04	5.2E+03	1.5E+05	1.5E+04	1.5E+03	5.0E+02	5.0E+01	5.0E+00
Uranium-235+D	4.8E+02	4.8E+01	4.8E+00	4.2E+01	4.2E+00	4.2E-01	1.6E+05	1.6E+04	1.6E+03	3.9E+01	3.9E+00	3.9E-01
Uranium-238+D	3.6E+02	3.6E+01	3.6E+00	2.1E+02	2.1E+01	2.1E+00	1.6E+05	1.6E+04	1.6E+03	1.3E+02	1.3E+01	1.3E+00

TABLE 3C

Subsistence Farmer - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICALS	Ingestion				Inhalation				Dermal					Ingestion + Inhalation + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 sub- chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
High Explosives																	
HMX				1.8E+00													
PETN																	
RDX	7.7E-02	7.7E-03	7.7E-04	1.1E-01													
Inorganics																	
Aluminum																	
Antimony				1.5E-02								7.8E+00	5.1E+00				1.5E-02
Arsenic				1.1E-02								5.9E+00	3.9E+00				1.1E-02
Barium				2.6E+00								1.4E+03	9.0E+02				2.6E+00
Beryllium	2.0E-03	2.0E-04	2.0E-05	1.8E-01					1.1E+00	1.1E-01	1.1E-02	9.8E+01	6.4E+01	2.0E-03	2.0E-04	2.0E-05	1.8E-01
Cadmium (Water)				1.8E-02								9.8E+00					1.8E-02
Chromium III				3.7E+01								2.0E+04	1.3E+04				3.6E+01
Chromium VI				1.8E-01								9.8E+01	2.6E+02				1.8E-01
Cobalt																	

TABLE 3C

Subsistence Farmer - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICALS	Ingestion				Inhalation				Dermal					Ingestion + Inhalation + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 sub- chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Copper																	
Cyanide				7.3E-01								5.2E+01	3.4E+01				7.2E-01
Iron																	
Lead																	
Lithium																	
Manganese (Water)				1.8E-01								9.8E+01	6.4E+01				1.8E-01
Mercury				1.1E-02								5.9E+00	3.9E+00				1.1E-02
Nickel				7.3E-01								3.9E+02	2.6E+02				7.3E-01
Silver				1.8E-01								9.8E+01	6.4E+01				1.8E-01
Thallium																	
Vanadium				2.6E-01								1.4E+02	9.0E+01				2.6E-01
Zinc				1.1E+01								5.9E+03	3.9E+03				1.1E+01
Organics																	
1,1,1-Trichloroethane																	

TABLE 3C

Subsistence Farmer - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICALS	Ingestion				Inhalation				Dermal					Ingestion + Inhalation + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for III=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for III=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for III=1 chronic	GV for III=1 sub- chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for III=1
1,1-Dichloroethane				3.7E+00				1.7E+00				2.2E+02	1.4E+03				1.1E+00
1,2-Dichloroethane	9.4E-02	9.4E-03	9.4E-04		3.0E-02	3.0E-03	3.0E-04		9.5E+00	9.5E-01	9.5E-02			2.3E-02	2.3E-03	2.3E-04	
1,2-trans-Dichloroethylene				7.3E-01													
2-Butanone				2.2E+01				3.3E+00				1.1E+04	2.4E+04				2.9E+00
2-Hexanone																	
2-Methylnaphthalene																	
4-Methyl-2-Pentanone				2.9E+00				2.7E-01				4.7E+02	3.1E+03				2.4E-01
4-Methylphenol				1.8E-01								5.4E+00	3.6E+00				1.8E-01
Acetone				3.7E+00								3.4E+03	2.3E+04				3.6E+00
Benzene	2.9E-01	2.9E-02	2.9E-03		9.4E-02	9.4E-03	9.4E-04		7.5E+00	7.5E-01	7.5E-02			7.1E-02	7.1E-03	7.1E-04	
Benzoic Acid				1.5E+02								1.1E+04	7.0E+03				1.4E+02
Bromodichloromethane	1.4E-01	1.4E-02	1.4E-03	7.3E-01					1.3E+01	1.3E+00	1.3E-01	6.8E+01	4.4E+01	1.4E-01	1.4E-02	1.4E-03	7.2E-01
Butyl benzyl phthalate				7.3E+00													
Carbon Disulfide				3.7E+00				3.3E-02				8.2E+01	5.4E+01				3.3E-02

TABLE 3C

Subsistence Farmer - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICALS	Ingestion				Inhalation				Dermal					Ingestion + Inhalation + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for III=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for III=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for III=1 chronic	GV for III=1 sub- chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for III=1
Carbon Tetrachloride	6.6E-02	6.6E-03	6.6E-04	2.6E-02	5.1E-02	5.1E-03	5.1E-04		1.6E+00	1.6E-01	1.6E-02	6.2E-01	4.1E+00	2.8E-02	2.8E-03	2.8E-04	2.5E-02
Chloroethane								3.3E+01									
Chrysene	1.2E+00	1.2E-01	1.2E-02						7.7E-01	7.7E-02	7.7E-03			4.6E-01	4.6E-02	4.6E-03	
Cresols																	
Di-n-butylphthalate				3.7E+00								1.7E+01	1.1E+02				3.0E+00
Di-n-octylphthalate				7.3E-01													
Dibromochloromethane	1.0E-01	1.0E-02	1.0E-03	7.3E-01					1.4E+01	1.4E+00	1.4E-01	1.0E+02	6.6E+02	1.0E-01	1.0E-02	1.0E-03	7.2E-01
Dichloromethane	1.1E+00	1.1E-01	1.1E-02	2.2E+00				1.0E+01	1.4E+02	1.4E+01	1.4E+00	2.6E+02	1.7E+02	1.1E+00	1.1E-01	1.1E-02	1.8E+00
Diethyl benzene, 1,4-																	
Ethyl benzene				3.7E+00				3.3E+00				2.6E+01					1.6E+00
Hexane				2.2E+00				6.7E-01									5.1E-01
Isophorone	9.0E+00	9.0E-01	9.0E-02	7.3E+00					1.1E+03	1.1E+02	1.1E+01	8.9E+02	5.8E+03	8.9E+00	8.9E-01	8.9E-02	7.2E+00
Methyl iodide																	
N-nitroso-diphenylamine	1.7E+00	1.7E-01	1.7E-02						4.8E+01	4.8E+00	4.8E-01			1.7E+00	1.7E-01	1.7E-02	

TABLE 3C

Subsistence Farmer - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICALS	Ingestion				Inhalation				Dermal					Ingestion + Inhalation + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1 chronic	GV for HI=1 sub- chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Pentachlorophenol	7.1E-02	7.1E-03	7.1E-04	1.1E+00					5.9E-02	5.9E-03	5.9E-04	9.0E-01	5.9E-01	3.2E-02	3.2E-03	3.2E-04	5.0E-01
Phenol				2.2E+01								2.1E+03	1.4E+03				2.2E+01
Tetrachloroethene				3.7E-01								5.3E-01	3.5E+00				2.2E-01
Toluene				7.3E+00				1.3E+00				8.7E+01	5.7E+02				1.1E+00
Tri bromomethane	1.1E+00	1.1E-01	1.1E-02	7.3E-01					2.2E+02	2.2E+01	2.2E+00	1.5E+02	9.9E+02	1.1E+00	1.1E-01	1.1E-02	7.3E-01
Trichloroethylene	7.7E-01	7.7E-02	7.7E-03		4.5E-01	4.5E-02	4.5E-03		2.6E+01	2.6E+00	2.6E-01			2.8E-01	2.8E-02	2.8E-03	
Trichlorofluoromethane				1.1E+01				2.3E+00				3.5E+02	5.3E+02				1.9E+00
Trichloromethane	1.4E+00	1.4E-01	1.4E-02	3.7E-01	3.4E-02	3.4E-03	3.4E-04		8.4E+01	8.4E+00	8.4E-01	2.2E+01	1.4E+01	3.3E-02	3.3E-03	3.3E-04	3.6E-01
Xylene				7.3E+01													
bis(2-Ethylhexyl)phthalate	6.1E-01	6.1E-02	6.1E-03	7.3E-01					1.4E+01	1.4E+00	1.4E-01	1.7E+01	1.1E+01	5.8E-01	5.8E-02	5.8E-03	7.0E-01
PAHs																	
Acenaphthylene																	
Anthracene				1.1E+01								2.6E+01	1.7E+02				7.7E+00
Benzo(a)anthracene	1.2E-02	1.2E-03	1.2E-04						7.7E-03	7.7E-04	7.7E-05			4.6E-03	4.6E-04	4.6E-05	

TABLE 3C

Subsistence Farmer - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICALS	Ingestion				Inhalation				Dermal					Ingestion + Inhalation + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for III=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for III=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for III=1 chronic	GV for III=1 sub- chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for III=1
Benzo(a)pyrene	1.2E-03	1.2E-04	1.2E-05						5.2E-04	5.2E-05	5.2E-06			3.6E-04	3.6E-05	3.6E-06	
Benzo(b)fluoranthene	1.2E-02	1.2E-03	1.2E-04						5.1E-03	5.1E-04	5.1E-05			3.5E-03	3.5E-04	3.5E-05	
Benzo(g,h,i)perylene																	
Benzo(k)fluoranthene	1.2E-01	1.2E-02	1.2E-03						1.0E-01	1.0E-02	1.0E-03			5.5E-02	5.5E-03	5.5E-04	
Dibenzo(a,h)anthracene	1.2E-03	1.2E-04	1.2E-05						2.3E-04	2.3E-05	2.3E-06			1.9E-04	1.9E-05	1.9E-06	
Fluoranthene				1.5E+00								2.2E+00	1.4E+01				8.7E-01
Indeno(1,2,3-cd)pyrene	1.2E-02	1.2E-03	1.2E-04						3.3E-03	3.3E-04	3.3E-05			2.6E-03	2.6E-04	2.6E-05	
Phenanthrene																	
Pyrene				1.1E+00								1.8E+00	1.2E+01				6.8E-01
Pesticides/PCBs																	
4,4'-DDE	2.5E-02	2.5E-03	2.5E-04						5.6E-02	5.6E-03	5.6E-04			1.7E-02	1.7E-03	1.7E-04	
4,4'-DDT	2.5E-02	2.5E-03	2.5E-04	1.8E-02					3.1E-02	3.1E-03	3.1E-04	2.3E-02	1.5E-02	1.4E-02	1.4E-03	1.4E-04	1.0E-02
Aroclor 1248	1.1E-03	1.1E-04	1.1E-05														
Aroclor 1254				7.3E-04													

TABLE 3C

Subsistence Farmer - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICALS	Ingestion				Inhalation				Dermal					Ingestion + Inhalation + Dermal			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for III=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for III=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for III=1 chronic	GV for III=1 sub- chronic	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for III=1
Aroclor 1260	1.1E-03	1.1E-04	1.1E-05														
Beta-BHC	4.7E-03	4.7E-04	4.7E-05														
Dieldrin	5.3E-04	5.3E-05	5.3E-06	1.8E-03					1.8E-02	1.8E-03	1.8E-04	6.1E-02	4.0E-02	5.2E-04	5.2E-05	5.2E-06	1.8E-03
Endrin Ketone																	

TABLE 3D

Subsistence Farmer - Groundwater Guideline Values: Radionuclides (Units = pCi/L)

RADIONUCLIDE	Ingestion			Inhalation			Dermal			Ingestion + Inhalation + Dermal		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶
Actinium-227+D	7.6E+00	7.6E-01	7.6E-02									
Americium-241	1.5E+01	1.5E+00	1.5E-01									
Bismuth-210	6.5E+02	6.5E+01	6.5E+00									
Cesium-137+D	1.5E+02	1.5E+01	1.5E+00									
Cobalt-60	2.5E+02	2.5E+01	2.5E+00									
Plutonium-238	1.6E+01	1.6E+00	1.6E-01									
Plutonium-239	1.5E+01	1.5E+00	1.5E-01									
Plutonium-240	1.5E+01	1.5E+00	1.5E-01									
Radium-226+D	1.6E+01	1.6E+00	1.6E-01									
Strontium-90+D	8.5E+01	8.5E+00	8.5E-01									
Thorium-228+D	2.1E+01	2.1E+00	2.1E-01									
Thorium-230	1.3E+02	1.3E+01	1.3E+00									
Thorium-232	1.5E+02	1.5E+01	1.5E+00									

TABLE 3D**Subsistence Farmer - Groundwater Guideline Values: Radionuclides (Units = pCi/L)**

RADIONUCLIDE	Ingestion			Inhalation			Dermal			Ingestion + Inhalation + Dermal		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶
Tritium	6.7E+04	6.7E+03	6.7E+02	6.7E+06	6.7E+05	6.7E+04	2.7E+07	2.7E+06	2.7E+05	6.6E+04	6.6E+03	6.6E+02
Uranium-233	1.1E+02	1.1E+01	1.1E+00									
Uranium-234	1.1E+02	1.1E+01	1.1E+00									
Uranium-235+D	1.0E+02	1.0E+01	1.0E+00									
Uranium-238+D	7.7E+01	7.7E+00	7.7E-01									

TABLE 3E

Subsistence Farmer - Vegetable, Beef, and Milk Guideline Values for Soil: Chemicals (Units = mg/kg)

CHEMICAL	Vegetables				Beef				Milk			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
High Explosives												
HMX				6.80e+00				3.40e+06				2.70e+06
PETN												
RDX	1.00e+01	1.00e+00	1.00e-01	1.50e+01	8.90e+03	8.90e+02	8.90e+01	1.30e+04	7.00e+03	7.00e+02	7.00e+01	1.00e+04
Inorganics												
Aluminum												
Antimony				2.40e+01				8.00e+03				3.20e+03
Arsenic				1.20e+02				1.70e+02				1.40e+03
Barium				4.20e+03				1.80e+05				2.20e+04
Beryllium	6.90e+01	6.90e+00	6.90e-01	6.30e+03	8.10e+01	8.10e+00	8.10e-01	7.50e+03	8.10e+03	8.10e+02	8.10e+01	7.50e+05
Cadmium (Diect)				1.60e+01				1.20e+03				1.20e+02
Chromium III				6.00e+04				9.60e+04				2.20e+07
Chromium VI				3.00e+02				4.80e+02				1.10e+05
Cobalt												

TABLE 3E

Subsistence Farmer - Vegetable, Beef, and Milk Guideline Values for Soil: Chemicals (Units = mg/kg)

CHEMICAL	Vegetables				Beef				Milk			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
Copper												
Cyanide				8.80e-01				3.10e+06				2.50e+06
Iron												
Lead												
Lithium												
Manganese (Diet)				2.10e+02				1.10e+04				4.50e+04
Mercury				6.00e-01				3.20e+00				1.70e+01
Nickel				2.40e+02				1.50e+03				1.20e+02
Silver				1.50e+01				1.80e+02				2.70e+03
Thallium												
Vanadium				3.20e+03				3.50e+03				2.00e+03
Zinc				4.50e+02				3.20e+02				8.10e+02
Organics												
1,1,1-Trichloroethane												

TABLE 3E**Subsistence Farmer - Vegetable, Beef, and Milk Guideline Values for Soil: Chemicals (Units = mg/kg)**

CHEMICAL	Vegetables				Beef				Milk			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1
1,1-Dichloroethane				6.70e+01				2.10e+06				1.60e+06
1,2-Dichloroethane	1.10e+00	1.10e-01	1.10e-02		7.30e+04	7.30e+03	7.30e+02		5.80e+04	5.80e+03	5.80e+02	
1,2-trans-Dichloroethylene				2.30e+00				1.50e+06				1.20e+06
2-Butanone				5.30e+01				5.60e+07				4.40e+07
2-Hexanone												
2-Methylnaphthalene												
4-Methyl-2-Pentanone				1.30e+01				4.80e+06				3.80e+06
4-Methylphenol				4.00e+00				9.10e+04				7.20e+04
Acetone				4.50e+00				1.50e+07				1.20e+07
Benzene	8.30e+00	8.30e-01	8.30e-02		1.20e+05	1.20e+04	1.20e+03		9.50e+04	9.50e+03	9.50e+02	
Benzoic Acid				3.00e+03				7.70e+07				6.10e+07
Bromodichloromethane	4.60e+00	4.60e-01	4.60e-02	2.40e+01	5.00e+04	5.00e+03	5.00e+02	2.60e+05	3.90e+04	3.90e+03	3.90e+02	2.10e+05
Butyl benzyl phthalate												
Carbon Disulfide				8.80e+01				1.70e+06				1.30e+06

TABLE 3E

Subsistence Farmer - Vegetable, Beef, and Milk Guideline Values for Soil: Chemicals (Units = mg/kg)

CHEMICAL	Vegetables				Beef				Milk			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
Carbon Tetrachloride	3.70e+00	3.70e-01	3.70e-02	1.40e+00	1.60e+04	1.60e+03	1.60e+02	6.10e+03	1.20e+04	1.20e+03	1.20e+02	4.80e+03
Chloroethane												
Chrysene	3.40e+03	3.40e+02	3.40e+01		3.10e+03	3.10e+02	3.10e+01		2.50e+03	2.50e+02	2.50e+01	
Cresols												
Di-n-butylphthalate				1.10e+04				9.80e+03				7.80e+03
Di-n-octylphthalate				6.20e+05				1.30e-01				1.00e-01
Dibromochloromethane	2.80e+00	2.80e-01	2.80e-02	2.00e+01	4.30e+04	4.30e+03	4.30e+02	3.10e+05	3.40e+04	3.40e+03	3.40e+02	2.40e+05
Dichloromethane	1.10e+01	1.10e+00	1.10e-01	2.10e+01	1.10e+06	1.10e+05	1.10e+04	2.00e+06	8.40e+05	8.40e+04	8.40e+03	1.60e+06
Diethyl benzene, 1,4-												
Ethyl benzene				4.10e+02				4.90e+05				3.90e+05
Hexane				6.10e+02				1.20e+05				9.80e+04
Isophorone	3.10e+02	3.10e+01	3.10e+00	2.50e+02	3.20e+06	3.20e+05	3.20e+04	2.60e+06	2.50e+06	2.50e+05	2.50e+04	2.00e+06
Methyl iodide												
N-nitroso-diphenylamine	1.90e+02	1.90e+01	1.90e+00		2.40e+05	2.40e+04	2.40e+03		1.90e+05	1.90e+04	1.90e+03	

TABLE 3E

Subsistence Farmer - Vegetable, Beef, and Milk Guideline Values for Soil: Chemicals (Units = mg/kg)

CHEMICAL	Vegetables				Beef				Milk			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
Pentachlorophenol	9.30e+01	9.30e+00	9.30e-01	1.40e+03	6.20e+02	6.20e+01	6.20e+00	9.60e+03	4.90e+02	4.90e+01	4.90e+00	7.60e+03
Phenol				2.60e+02				1.70e+07				1.40e+07
Tetrachloroethene				2.00e+01				9.00e+04				7.10e+04
Toluene				4.70e+02				1.60e+06				1.20e+06
Tribromomethane	4.40e+01	4.40e+00	4.40e-01	3.00e+01	3.30e+05	3.30e+04	3.30e+03	2.20e+05	2.60e+05	2.60e+04	2.60e+03	1.80e+05
Trichloroethylene	3.10e+01	3.10e+00	3.10e-01		2.40e+05	2.40e+04	2.40e+03		1.90e+05	1.90e+04	1.90e+03	
Trichlorofluoromethane				5.40e+02				2.90e+06				2.30e+06
Trichloromethane	3.20e+01	3.20e+00	3.20e-01	8.50e+00	6.70e+05	6.70e+04	6.70e+03	1.70e+05	5.30e+05	5.30e+04	5.30e+03	1.40e+05
Xylene				9.40e+03				8.60e+06				6.80e+06
bis(2-Ethylhexyl)phthalate	2.30e+00	2.30e-01	2.30e-02	2.80e+00	1.10e+06	1.10e+05	1.10e+04	1.30e+06	8.80e+05	8.80e+04	8.80e+03	1.10e+06
PAHs												
Acenaphthylene												
Anthracene				6.90e+03				2.50e+05				2.00e+05
Benzo(a)anthracene	3.40e+01	3.40e+00	3.40e-01		3.20e+01	3.20e+00	3.20e-01		2.50e+01	2.50e+00	2.50e-01	

TABLE 3E

Subsistence Farmer - Vegetable, Beef, and Milk Guideline Values for Soil: Chemicals (Units = mg/kg)

CHEMICAL	Vegetables				Beef				Milk			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻²	GV for HI=1
Benzo(a)pyrene	6.30e+00	6.30e-01	6.30e-02		1.20e+00	1.20e-01	1.20e-02		9.50e-01	9.50e-02	9.50e-03	
Benzo(b)fluoranthene	6.30e+01	6.30e+00	6.30e-01		1.20e+01	1.20e+00	1.20e-01		9.50e+00	9.50e-01	9.50e-02	
Benzo(g,h,i)perylene												
Benzo(k)fluoranthene	6.30e+02	6.30e+01	6.30e+00		1.20e+02	1.20e+01	1.20e+00		9.50e+01	9.50e+00	9.50e-01	
Dibenz(a,h)anthracene	3.40e+00	3.40e-01	3.40e-02		3.10e+00	3.10e-01	3.10e-02		2.50e+00	2.50e-01	2.50e-02	
Fluoranthene				1.70e+03				1.50e+04				1.20e+04
Indeno(1,2,3-cd)pyrene	1.10e+02	1.10e+01	1.10e+00		4.60e+00	4.60e-01	4.60e-02		3.60e+00	3.60e-01	3.60e-02	
Phenanthrene												
Pyrene				2.20e+03				5.20e+03				4.10e+03
Pesticides/PCBs												
4,4'-DDE	4.70e+02	4.70e+01	4.70e+00		1.60e+01	1.60e+00	1.60e-01		2.10e+01	2.10e+00	2.10e-01	
4,4'-DIT	1.60e+02	1.60e+01	1.60e+00	1.20e+02	2.70e+01	2.70e+00	2.70e-01	2.00e+01	1.80e+01	1.80e+00	1.80e-01	1.30e+01
Aroclor 1248	4.00e+00	4.00e-01	4.00e-02		2.20e+00	2.20e-01	2.20e-02		1.70e+00	1.70e-01	1.70e-02	
Aroclor 1254				3.80e+00				4.10e-01				4.80e-01

TABLE 3E**Subsistence Farmer - Vegetable, Beef, and Milk Guideline Values for Soil: Chemicals (Units = mg/kg)**

CHEMICAL	Vegetables				Beef				Milk			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Aroclor 1260	2.50e+01	2.50e+00	2.50e-01		1.00e-01	1.00e-02	1.00e-03		8.00e-02	8.00e-03	8.00e-04	
Beta-BHC	1.40e+00	1.40e-01	1.40e-02		2.50e+02	2.50e+01	2.50e+00		1.90e+02	1.90e+01	1.90e+00	
Dieldrin	9.50e-02	9.50e-03	9.50e-04	3.20e-01	4.70e-01	4.70e-02	4.70e-03	1.60e+00	8.70e-02	8.70e-03	8.70e-04	3.00e-01
Endrin Ketone												

TABLE 3F**Subsistence Farmer - Vegetable, Beef, and Milk Guideline Values for Soil: Radionuclides (Units = pCi/g)**

RADIONUCLIDE	Ingestion of Vegetables			Ingestion of Beef			Ingestion of Milk		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶
Actinium-227+D	2.4E+00	2.4E-01	2.4E-02	1.5E+00	1.5E-01	1.5E-02	5.1E+00	5.1E-01	5.1E-02
Americium-241	2.4E+02	2.4E+01	2.4E+00	1.2E+04	1.2E+03	1.2E+02	7.7E+04	7.7E+03	7.7E+02
Bismuth-207	4.4E+02	4.4E+01	4.4E+00	3.2E+04	3.2E+03	3.2E+02	6.5E+03	6.5E+02	6.5E+01
Cesium-137+D	6.2E+01	6.2E+00	6.2E-01	3.2E+01	3.2E+00	3.2E-01	4.9E+01	4.9E+00	4.9E-01
Cobalt-60	1.4E+02	1.4E+01	1.4E+00	1.6E+04	1.6E+03	1.6E+02	5.9E+03	5.9E+02	5.9E+01
Plutonium-238	5.3E+02	5.3E+01	5.3E+00	3.0E+04	3.0E+03	3.0E+02	1.2E+05	1.2E+04	1.2E+03
Plutonium-239	4.9E+02	4.9E+01	4.9E+00	2.8E+04	2.8E+03	2.8E+02	1.1E+05	1.1E+04	1.1E+03
Plutonium-240	4.9E+02	4.9E+01	4.9E+00	2.8E+04	2.8E+03	2.8E+02	1.1E+05	1.1E+04	1.1E+03
Radium-226+D	3.0E+00	3.0E-01	3.0E-02	7.9E+00	7.9E-01	7.9E-02	7.8E+00	7.8E-01	7.8E-02
Strontium-90+D	4.6E+00	4.6E-01	4.6E-02	7.5E+00	7.5E-01	7.5E-02	6.0E+00	6.0E-01	6.0E-02
Thorium-228+D	3.6E+00	3.6E-01	3.6E-02	2.3E+00	2.3E-01	2.3E-02	5.9E+00	5.9E-01	5.9E-02
Thorium-230	4.1E+03	4.1E+02	4.1E+01	4.2E+04	4.2E+03	4.2E+02	2.1E+05	2.1E+04	2.1E+03
Thorium-232	4.7E+03	4.7E+02	4.7E+01	4.8E+04	4.8E+03	4.8E+02	2.4E+05	2.4E+04	2.4E+03

TABLE 3F**Subsistence Farmer - Vegetable, Beef, and Milk Guideline Values for Soil: Radionuclides (Units = pCi/g)**

RADIONUCLIDE	Ingestion of Vegetables			Ingestion of Beef			Ingestion of Milk		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶
Tritium							3.7E+04	3.7E+03	3.7E+02
Uranium-233	8.7E+02	8.7E+01	8.7E+00	9.5E+03	9.5E+02	9.5E+01	2.0E+03	2.0E+02	2.0E+01
Uranium-234	8.8E+02	8.8E+01	8.8E+00	9.5E+03	9.5E+02	9.5E+01	2.0E+03	2.0E+02	2.0E+01
Uranium-235+D	6.6E+02	6.6E+01	6.6E+00	6.9E+03	6.9E+02	6.9E+01	1.9E+03	1.9E+02	1.9E+01
Uranium-238+D	4.9E+02	4.9E+01	4.9E+00	5.1E+03	5.1E+02	5.1E+01	1.4E+03	1.4E+02	1.4E+01

TABLE 4A

Construction/Mound Employee - Soil/Sediment Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
High Explosives												
HMX				1.10e+04								
PETN												
RDX	2.70e+03	2.70e+02	2.70e+01	6.40e+04								
Inorganics												
Aluminum												
Antimony				8.50e+01								
Arsenic				6.40e+01	6.00e+05	6.00e+04	6.00e+03					
Barium				1.50e+04				3.10e+06				1.50e+04
Beryllium	7.00e+01	7.00e+00	7.00e-01	1.10e+03	3.65e+06	3.65e+05	3.65e+04		7.00e+01	7.00e+00	7.00e-01	
Cadmium (Diet)				2.10e+02	5.00e+06	5.00e+05	5.00e+04					
Chromium III				2.10e+05								
Chromium VI				1.10e+03	7.50e+05	7.50e+04	7.50e+03					
Cobalt												
Copper												

TABLE 4A

Construction/Mound Employee - Soil/Sediment Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
Cyanide				4.30e+03								
Iron												
Lead												
Lithium												
Manganese (Diet)				3.00e+04				3.10e+05				2.70e+04
Mercury				6.40e+01				1.90e+06				6.40e+01
Nickel				4.30e+03								
Silver				1.10e+03								
Thallium												
Vanadium				1.50e+03								
Zinc				6.40e+04								
Organics												
1,1,1-Trichloroethane												
1,1-Dichloroethane				2.10e+04				7.80e+00				7.80e+00
1,2-Dichloroethane	3.30e+03	3.30e+02	3.30e+01		1.70e+03	1.70e+02	1.70e+01		1.10e+03	1.10e+02	1.10e+01	

TABLE 4A

Construction/Mound Employee - Soil/Sediment Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
1,2-trans-Dichloroethylene				4.30e+03								
2-Butanone				1.30e+05				9.30e+03				9.30e+03
2-Hexanone												
2-Methylnaphthalene												
4-Methyl-2-Pentanone				1.70e+04				7.00e+02				7.00e+02
4-Methylphenol				1.10e+03								
Acetone				2.10e+04								
Benzene	1.05e+04	1.05e+03	1.05e+02		2.45e+03	4.65e+02	4.65e+01		2.45e+03	3.20e+02	3.20e+01	
Benzoic Acid				8.50e+05								
Bromodichloromethane	4.80e+03	4.80e+02	4.80e+01	4.30e+03								
Butyl benzyl phthalate				4.30e+04								
Carbon Disulfide				2.10e+04				2.90e+02				2.80e+02
Carbon Tetrachloride	2.30e+03	2.30e+02	2.30e+01	1.50e+02	2.55e+03	2.55e+02	2.55e+01		1.20e+03	1.20e+02	1.20e+01	
Chloroethane								1.60e+02				
Chrysene	4.10e+04	4.10e+03	4.10e+02									

TABLE 4A

Construction/Mound Employee - Soil/Sediment Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Cresols												
Di-n-butylphthalate				2.10e+04								
Di-n-octylphthalate				4.30e+03								
Dibromochloromethane	3.55e+03	3.55e+02	3.55e+01	4.30e+03								
Dichloromethane	3.95e+04	3.95e+03	3.95e+02	1.30e+04				1.00e+03				1.00e+03
Diethyl benzene, 1,4-												
Ethyl benzene				2.10e+04				4.80e-01				4.80e-01
Hexane				1.30e+04				9.10e+01				9.10e+01
Isophorone	3.15e+03	3.15e+04	3.15e+03	4.30e+04								
Methyl iodide												
N-nitroso-diphenylamine	6.00e+04	6.00e+03	6.00e+02									
Pentachlorophenol	2.50e+03	2.50e+02	2.50e+01	6.40e+03								
Phenol				1.30e+05								
Tetrachloroethene				2.10e+03								
Toluene				4.30e+04				2.50e+02				2.50e+02

TABLE 4A

Construction/Mound Employee - Soil/Sediment Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Tribromomethane	3.75e+04	3.75e+03	3.75e+02	4.30e+03	8.00e+09	8.00e+08	8.00e+07		3.75e+04	3.75e+03	3.75e+02	
Trichloroethylene	2.70e+04	2.70e+03	2.70e+02		2.20e+03	2.20e+03	2.25e+02		2.20e+03	1.25e+03	1.25e+02	
Trichlorofluoromethane				6.40e+04				7.30e+02				7.30e+02
Trichloromethane	4.90e+04	4.90e+03	4.90e+02	2.10e+03	1.55e+03	1.55e+02	1.55e+01		1.55e+03	1.55e+02	1.55e+01	
Xylene				4.30e+05								
bis(2-Ethylhexyl)phthalate	2.15e+04	2.15e+03	2.15e+02	4.30e+03								
PAHs												
Acenaphthylene												
Anthracene				6.40e+04								
Benzo(a)anthracene	4.10e+02	4.10e+01	4.10e+00									
Benzo(a)pyrene	4.10e+01	4.10e+00	4.10e-01									
Benzo(b)fluoranthene	4.10e+02	4.10e+01	4.10e+00									
Benzo(g,h,i)perylene												
Benzo(k)fluoranthene	4.10e+03	4.10e+02	4.10e+01									
Dibenz(a,h)anthracene	4.10e+01	4.10e+00	4.10e-01									

TABLE 4A

Construction/Mound Employee - Soil/Sediment Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Fluoranthene				8.50e+03								
Indeno(1,2,3-cd)pyrene	4.10e+02	4.10e+01	4.10e+00									
Phenanthrene												
Pyrene				6.40e+03								
Pesticides/PCBs												
4,4'-DDE	9.00e+02	9.00e+01	9.00e+00									
4,4'-DDT	9.00e+02	9.00e+01	9.00e+00	1.10e+02	9.00e+07	9.00e+06	9.00e+05		9.00e+02	9.00e+01	9.00e+00	
Aroclor 1248	3.85e+01	3.85e+00	3.85e-01									
Aroclor 1254				4.30e+00								
Aroclor 1260	3.85e+01	3.85e+00	3.85e-01									
Beta-BHC	1.65e+02	1.65e+01	1.65e+00		1.70e+07	1.70e+06	1.70e+05		1.65e+02	1.65e+01	1.65e+00	
Dieldrin	1.85e+01	1.85e+00	1.85e-01	1.10e+01	1.90e+06	1.90e+05	1.90e+04		1.85e+01	1.85e+00	1.85e-01	
Endrin Ketone												

TABLE 4B Construction/Mound Employee - Soil/Sediment Guideline Values: Radionuclides (Units = pCi/g)

RADIONUCLIDE	Ingestion			External			Inhalation			Ingestion + External + Inhalation		
	GV for TR=10-4	GV for TR=10-5	GV for TR=10-6	GV for TR=10-4	GV for TR=10-5	GV for TR=10-6	GV for TR=10-4	GV for TR=10-5	GV for TR=10-6	GV for TR=10-4	GV for TR=10-5	GV for TR=10-6
Actinium-227+D	2.65e+02	2.65e+01	2.65e+00	1.65e+02	1.65e+01	1.65e+00	2.20e+05	2.20e+04	2.20e+03	1.00 e+02	1.00 e+01	1.00 e+00
Americium-241	5.00e+02	5.00e+01	5.00e+00	2.10e+04	2.10e+03	2.10e+02	4.45e+05	4.45e+04	4.45e+03	4.45e+02	4.95e+01	4.95 e+00
Bismuth-207	3.30e+04	3.30e+03	3.30e+02	1.75e+01	1.75e+00	1.75e-01	1.80e+09	1.80e+08	1.80e+07	1.75e+01	1.75e+00	1.75 e-01
Cesium-137+D	5.50e+03	5.50e+02	5.50e+01	4.65e+01	4.65e+00	4.65e-01	9.00e+08	9.00e+07	9.00 e+06	4.60e+01	4.60e+00	4.6 e-01
Cobalt-60	9.00e+03	9.00 e+02	9.00 e+01	10.00e+00	1.00e+00	1.00e-01	2.50e+08	2.50e+07	2.50 e+06	1.00 e+01	1.00e+00	1.00 e-01
Plutonium-238	5.50e+02	5.50e+01	5.50 e+00	5.00e+06	5.00 e+05	5.00 e+04	6.50e+05	6.50 e+04	6.50 e+03	5.50e+02	5.50 e+01	5.50 e+00
Plutonium-239	5.50e+02	5.50 e+01	5.50 e+00	7.50e+06	7.50 e+05	7.50 e+04	6.00e+05	6.00 e+04	6.00 e+03	5.50 e+02	5.50 e+01	5.50 e+00
Plutonium-240	5.50e+02	5.50 e+01	5.50 e+00	5.00e+06	5.00 e+05	5.00 e+04	6.00e+05	6.00 e+04	6.00 e+03	5.50 e+02	5.50 e+01	5.50 e+00
Radium-226+D	5.50 e+02	5.50 e+01	5.50 e+00	1.45e+01	1.45e+00	1.45e-01	6.00e+06	6.00e+05	6.00 e+04	1.40e+01	1.40e+00	1.40 e-01
Strontium-90+D	3.00e+03	3.00 e+01	3.00 e+00				2.45e+08	2.45 e+07	2.45 e+06	3.00 e+02	3.00 e+01	3.00 e+00
Thorium-228+D	7.00e+02	7.00 e+01	7.00 e+00	10.00e+01	10.00 e+00	1.00e+00	1.75e+05	1.75e+04	1.75 e+03	8.50e+01	8.50 e+00	8.50 e-01
Thorium-230	4.45e+03	4.45e+02	4.45e+01	2.20e+06	2.20 e+05	2.20 e+04	10.00e+05	10.00 e+04	10.00 e+03	4.40e+03	4.40e+02	4.40 e+01
Thorium-232	5.00e+03	5.00 e+02	5.00 e+01	4.95e+06	4.95 e+05	4.95 e+04	9.00e+05	9.00 e+04	9.00 e+03	5.00e+03	5.00 e+02	5.00 e+01
Tritium	2.35e+06	2.35 e+05	2.35 e+04				1.80e+11	1.80 e+10	1.80 e+09	2.35e+06	2.35 e+05	2.35 e+04

TABLE 4B Construction/Mound Employee - Soil/Sediment Guideline Values: Radionuclides (Units = pCi/g)

RADIONUCLIDE	Ingestion			External			Inhalation			Ingestion + External + Inhalation		
	GV for TR=10-4	GV for TR=10-5	GV for TR=10-6	GV for TR=10-4	GV for TR=10-5	GV for TR=10-6	GV for TR=10-4	GV for TR=10-5	GV for TR=10-6	GV for TR=10-4	GV for TR=10-5	GV for TR=10-6
Uranium-233	3.70e+03	3.70e+02	3.70 e+01	2.75e+06	2.75 e+05	2.75 e+04	1.20e+06	1.20 e+05	1.20 e+04	3.70e+03	3.70 e+02	3.70 e+01
Uranium-234	3.75e+03	3.75 e+02	3.75 e+01	4.55e+06	4.55 e+05	4.55 e+04	1.20e+06	1.20 e+05	1.20 e+04	3.75 e+03	3.75 e+02	3.75 e+01
Uranium-235+D	3.55e+03	3.55 e+02	3.55 e+01	3.65e+02	3.65 e+01	3.65e+00	1.30e+06	1.30 e+05	1.30 e+04	3.35e+02	3.35 e+01	3.35 e+00
Uranium-238+D	2.70e+03	2.70 e+02	2.70 e+01	1.85e+03	1.85 e+02	1.85 e+01	1.40e+06	1.40 e+05	1.40 e+04	1.10e+03	1.10 e+02	1.10 e+01

TABLE 4C

Construction/Mound Employee - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal				Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
High Explosives																
HMX				5.1E+00												
PETN																
RDX	2.6E-01	2.6E-02	2.6E-03	3.1E-01												
Inorganics																
Aluminum																
Antimony				4.1E-02				1.3E+01								4.1E-02
Arsenic				3.1E-02				9.5E+00								3.1E-02
Barium				7.2E+00				2.2E+03								7.1E+00
Beryllium	6.7E-03	6.7E-04	6.7E-05	5.1E-01	2.1E+00	2.1E-01	2.1E-02	1.6E+02					6.6E-03	6.6E-04	6.6E-05	5.1E-01
Cadmium (Water)				5.1E-02				1.6E+01								5.1E-02
Chromium III				1.0E+02				3.2E+04								1.0E+02
Chromium VI				5.1E-01				1.6E+02								5.1E-01
Cobalt																
Copper																

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Construction/Mound Employee - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal				Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Cyanide				2.0E+00				8.4E+01								2.0E+00
Iron																
Lead																
Lithium																
Manganese (Water)				5.1E-01				1.6E+02								5.1E-01
Mercury				3.1E-02				9.5E+00								3.1E-02
Nickel				2.0E+00				6.3E+02								2.0E+00
Silver				5.1E-01				1.6E+02								5.1E-01
Thallium																
Vanadium				7.2E-01				2.2E+02								7.1E-01
Zinc				3.1E+01				9.5E+03								3.1E+01
Organics																
1,1,1-Trichloroethane																
1,1-Dichloroethane				1.0E+01				3.5E+02				2.1E+02				9.5E+00
1,2-Dichloroethane	3.1E-01	3.1E-02	3.1E-03		1.8E+01	1.8E+00	1.8E-01		4.5E+00	4.5E-01	4.5E-02		2.9E-01	2.9E-02	2.9E-03	

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Construction/Mound Employee - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal				Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
1,2-trans-Dichloroethylene				2.0E+00												
2-Butanone				6.1E+01				1.7E+04				4.2E+02				5.3E+01
2-Hexanone																
2-Methylnaphthalene																
4-Methyl-2-Pentanone				8.2E+00				7.6E+02				3.4E+01				6.5E+00
4-Methylphenol				5.1E-01				8.8E+00								4.8E-01
Acetone				1.0E+01				5.5E+03								1.0E+01
Benzene	9.9E-01	9.9E-02	9.9E-03		4.0E+00	4.0E-01	4.0E-02		1.4E+01	1.4E+00	8.0E-03		7.5-01	7.5E-02	7.5E-03	
Benzoic Acid				4.1E+02				1.7E+04								4.0E+02
Bromodichloromethane	4.6E-01	4.6E-02	4.6E-03	2.0E+00	2.5E+01	2.5E+00	2.5E-01	1.1E+02					4.5E-01	4.5E-02	4.5E-03	2.0E+00
Butyl benzyl phthalate				2.0E+01												
Carbon Disulfide				1.0E+01				1.8E+00				4.2E+00				1.1E+00
Carbon Tetrachloride	2.2E-01	2.2E-02	2.2E-03	7.2E-02	2.6E+00	2.6E-01	2.6E-02	1.7E-01	7.8E+00	7.8E-01	7.8E-02		2.0E-01	2.0E-02	2.0E-03	5.1E-02
Chloroethane												4.2E+03				
Chrysene	3.9E+00	3.9E-01	3.9E-02		7.3E-01	7.3E-02	7.4E-03						6.3E-01	6.3E-02	6.3E-03	

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Construction/Mound Employee - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal				Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Cresols																
Di-n-butylphthalate				1.0E+01				6.8E+00								4.1E+00
Di-n-octylphthalate				2.0E+00												
Dibromochloromethane	3.4E-01	3.4E-02	3.4E-03	2.0E+00	2.7E+01	2.7E+00	2.7E-01	1.6E+02					3.4E-01	3.4E-02	3.4E-03	2.0E+00
Dichloromethane	3.8E+00	3.8E-01	3.8E-02	6.1E+00	2.6E+02	2.6E+01	2.6E+00	4.2E+02				1.3E+03	3.8E+00	3.8E-01	3.8E-02	6.0E+00
Diethyl benzene, 1,4-																
Ethyl benzene				1.0E+01				7.5E-01				4.2E+02				6.9E-01
Hexane				6.1E+00								8.4E+01				5.7E+00
Isophorone	3.0E+01	3.0E+00	3.0E-01	2.0E+01	2.1E+03	2.1E+02	2.1E+01	1.4E+03					3.0E+01	3.0E+00	3.0E-01	2.0E+01
Methyl iodide																
N-nitroso-diphenylamine	5.8E+00	5.8E-01	5.8E-02		5.6E+01	5.6E+00	5.6E-01						5.3E+01	5.3E-01	5.3E-02	
Pentachlorophenol	2.4E-01	2.4E-02	2.4E-03	3.1E+00	4.4E-02	4.4E-03	4.4E-04	1.1E-01					4.4E-02	4.4E-03	4.4E-04	1.1E-01
Phenol				6.1E+01				3.4E+03								6.0E+01
Tetrachloroethene				1.0E+00				1.3E-01								1.2E-01
Toluene				2.0E+01				1.7E+00				1.7E+02				1.5E+00

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Construction/Mound Employee - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal				Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Tribromomethane	3.6E+00	3.6E-01	3.6E-02	2.0E+00	4.3E+02	4.3E+01	4.3E+00	2.4E+02					3.6E+00	3.6E-01	3.6E-02	2.0E+00
Trichloroethylene	2.6E+00	2.6E-01	2.6E-02		3.5E+00	3.5E-01	3.5E-02		6.9E+01	6.9E+00	6.9E-01		1.5E+00	1.5E-01	1.5E-02	
Trichlorofluoromethane				3.1E+01				1.1E+02				2.9E+02				2.2E+01
Trichloromethane	4.7E+00	4.7E-01	4.7E-02	1.0E+00	1.6E+02	1.6E+01	1.6E+00	3.5E+01	5.1E+00	5.1E-01	5.1E-02		2.4E+00	2.4E-01	2.4E-02	9.9E-01
Xylene				2.0E+02												
bis(2-Ethylhexyl)phthalate	2.0E+00	2.0E-01	2.0E-02	2.0E+00	3.1E+00	3.1E-01	3.1E-02	6.2E-01					1.2E+00	1.2E-01	1.2E-02	4.7E-01
PAHs																
Acenaphthylene																
Anthracene				3.1E+01				4.2E+01								1.8E+01
Benzo(a)anthracene	3.9E-02	3.9E-03	3.9E-04		7.4E-03	7.4E-04	7.4E-05						6.3E-03	6.3E-04	6.3E-05	
Benzo(a)pyrene	3.9E-03	3.9E-04	3.9E-05		4.4E-04	4.4E-05	4.4E-06						3.9E-04	3.9E-05	3.9E-06	
Benzo(b)fluoranthene	3.9E-02	3.9E-03	3.9E-04		4.3E-03	4.3E-04	4.3E-05						3.9E-03	3.9E-04	3.9E-05	
Benzo(g,h,i)perylene																
Benzo(k)fluoranthene	3.9E-01	3.9E-02	3.9E-03		2.0E-01	2.0E-02	2.0E-03						1.3E-01	1.3E-02	1.3E-03	
Dibenz(a,h)anthracene	3.9E-03	3.9E-04	3.9E-05		1.6E-04	1.6E-05	1.6E-06						1.5E-04	1.5E-05	1.5E-06	

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Construction/Mound Employee - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal				Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Fluoranthene				4.1E+00				4.2E-01								3.8E-01
Indeno(1,2,3-cd)pyrene	3.9E-02	3.9E-03	3.9E-04		2.3E-03	2.3E-04	2.3E-05						2.2E-03	2.2E-04	2.2E-05	
Phenanthrene																
Pyrene				3.1E+00				2.9E+00								1.5E+00

TABLE 4C

Construction/Mound Employee - Groundwater Guideline Values: Chemicals (Units = mg/L)

CHEMICAL	Ingestion				Dermal				Inhalation				Ingestion + Dermal + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Pesticides/PCBs																
4,4'-DDE	8.4E-02	8.4E-03	8.4E-04		2.9E-02	2.9E-03	2.9E-04						2.2E-02	2.2E-03	2.2E-04	
4,4'-DDT	8.4E-02	8.4E-03	8.4E-04	5.1E-02	1.2E-02	1.2E-03	1.2E-04	1.5E-03					1.1E-02	1.1E-03	1.1E-04	1.5E-03
Aroclor 1248	3.7E-03	3.7E-04	3.7E-05													
Aroclor 1254				2.0E-03												
Aroclor 1260	3.7E-03	3.7E-04	3.7E-05													
Beta-BHC	1.6E-02	1.6E-03	1.6E-04													
Dieldrin	1.8E-03	1.8E-04	1.8E-05	5.1E-03	6.0E-03	6.0E-04	6.0E-05	3.4E-03					1.4E-03	1.4E-04	1.4E-05	2.1E-03
Endrin Ketone																

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TABLE 4D

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TABLE 4D

Construction/Mound Employee -- Groundwater Guideline Values: Radionuclides (Units = pCi/L)												
RADIONUCLIDE	Ingestion			Inhalation			Dermal			Ingestion + Inhalation + Dermal		
	GV for TR= 1.00E-04	GV for TR= 1.00E-05	GV for TR= 1.00E-06	GV for TR= 1.00E-04	GV for TR= 1.00E-05	GV for TR= 1.00E-06	GV for TR= 1.00E-04	GV for TR= 1.00E-05	GV for TR= 1.00E-06	GV for TR= 1.00E-04	GV for TR= 1.00E-05	GV for TR= 1.00E-06
Actinium-227+D	1.3E+02	1.3E+01	1.3E+00									
Americium-241	2.4E+02	2.4E+01	2.4E+00									
Bismuth-207	1.6E+04	1.6E+03	1.6E+02									
Cesium-137+D	2.5E+03	2.5E+02	2.5E+01									
Cobalt-60	4.2E+03	4.2E+02	4.2E+01									
Plutonium-238	2.7E+02	2.7E+01	2.7E+00									
Plutonium-239	2.5E+02	2.5E+01	2.5E+00									
Plutonium-240	2.5E+02	2.5E+01	2.5E+00									
Radium-226+D	2.7E+02	2.7E+01	2.7E+00									
Strontium-90+D	1.4E+03	1.4E+02	1.4E+01									
Thorium-228+D	3.5E+02	3.5E+01	3.5E+00									
Thorium-230	2.1E+03	2.1E+02	2.1E+01									
Thorium-232	2.4E+03	2.4E+02	2.4E+01									
Tritium	1.1E+06	1.1E+05	1.1E+04	1.2E+08	1.2E+07	1.2E+06	2.3E+08	2.3E+07	2.3E+06	1.1E+06	1.1E+05	1.1E+04
Uranium-233	1.8E+03	1.8E+02	1.8E+01									
Uranium-234	1.8E+03	1.8E+02	1.8E+01									
Uranium-235+D	1.7E+03	1.7E+02	1.7E+01									
Uranium-238+D	1.3E+03	1.3E+02	1.3E+01									

TABLE 5A**Commercial/Office Worker - Soil Guideline Values: Chemicals (Units = mg/kg)**

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
High Explosives												
HMX				1.0E+05								
PETN												
RDX	5.2E+03	5.2E+02	5.2E+01	6.1E+03								
Inorganics												
Aluminum												
Antimony				8.2E+02								
Arsenic				6.1E+02	1.2E+05	1.2E+04	1.2E+03					
Barium				1.4E+05				3.1E+06				1.4E+05
Beryllium	1.3E+02	1.3E+01	1.3E+00	1.0E+04	7.3E+05	7.3E+04	7.3E+03		1.3E+02	1.3E+01	1.3E+00	
Cadmium (Diet)				2.0E+03	1.0E+06	1.0E+05	1.0E+04					
Chromium III				2.0E+06								
Chromium VI				1.0E+04	1.5E+05	1.5E+04	1.5E+03					
Cobalt												
Copper												

TABLE 5A

Commercial/Office Worker - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Cyanide				4.1E+04								
Iron												
Lead												
Lithium												
Manganese (Diet)				2.9E+05				3.1E+05				1.5E+05
Mercury				6.1E+02				1.9E+06				6.1E+02
Nickel				4.1E+04								
Silver				1.0E+04								
Thallium												
Vanadium				1.4E+04								
Zinc				6.1E+05								
Organics												
1,1,1-Trichloroethane												
1,1-Dichloroethane				2.0E+05				7.8E+00				7.8E+00
1,2-Dichloroethane	6.3E+03	6.3E+02	6.3E+01		3.4E+02	3.4E+01	3.4E+00		3.2E+02	3.2E+01	3.2E+00	

TABLE 5A

Commercial/Office Worker - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
1,2-trans-Dichloroethylene				4.1E+04								
2-Butanone				1.2E+06				9.3E+03				9.3E+03
2-Hexanone												
2-Methylnaphthalene												
4-Methyl-2-Pentanone				1.6E+05				7.0E+02				7.0E+02
4-Methylphenol				1.0E+04								
Acetone				2.0E+05								
Benzene	2.0E+04	2.0E+03	2.0E+02		4.9E+02	9.3E+01	9.3E+00		4.9E+02	8.9E+01	8.9E+00	
Benzoic Acid				8.2E+06								
Bromodichloromethane	9.2E+03	9.2E+02	9.2E+01	4.1E+04								
Butyl benzyl phthalate				4.1E+05								
Carbon Disulfide				2.0E+05				2.9E+02				2.8E+02
Carbon Tetrachloride	4.4E+03	4.4E+02	4.4E+01	1.4E+03	5.1E+02	5.1E+01	5.1E+00		4.6E+02	4.6E+01	4.6E+00	
Chloroethane								1.6E+02				
Chrysene	7.8E+04	7.8E+03	7.8E+02									

TABLE 5A

Commercial/Office Worker - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Cresols												
Di-n-butylphthalate				2.0E+03								
Di-n-octylphthalate				4.1E+04								
Dibromochloromethane	6.8E+03	6.8E+02	6.8E+01	4.1E+04								
Dichloromethane	7.6E+04	7.6E+03	7.6E+02	1.2E+03				1.0E+03				1.0E+03
Diethyl benzene, 1,4-												
Ethyl benzene				2.0E+03				4.8E-01				4.8E-01
Hexane				1.2E+03				9.1E+01				9.1E+01
Isophorone	6.0E+03	6.0E+04	6.0E+03	4.1E+03								
Methyl iodide												
N-nitroso-diphenylamine	1.2E+03	1.2E+04	1.2E+03									
Pentachlorophenol	4.8E+03	4.8E+02	4.8E+01	6.1E+04								
Phenol				1.2E+06								
Tetrachloroethene				2.0E+04								
Toluene				4.1E+03				2.5E+02				2.5E+02

TABLE 5A

Commercial/Office Worker - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Tribromomethane	7.2E+04	7.2E+03	7.2E+02	4.1E+04	1.6E+09	1.6E+08	1.6E+07		7.2E+04	7.2E+03	7.2E+02	
Trichloroethylene	5.2E+04	5.2E+03	5.2E+02		4.4E+02	4.4E+02	4.5E+01		4.4E+02	4.1E+02	4.1E+01	
Trichlorofluoromethane				6.1E+05				7.3E+02				7.3E+02
Trichloromethane	9.4E+04	9.4E+03	9.4E+02	2.0E+04	3.1E+02	3.1E+01	3.1E+00		3.1E+02	3.1E+01	3.1E+00	
Xylene				4.1E+06								
bis(2-Ethylhexyl)phthalate	4.1E+04	4.1E+03	4.1E+02	4.1E+04								
PAHs												
Acenaphthylene												
Anthracene				6.1E+05								
Benzo(a)anthracene	7.8E+02	7.8E+01	7.8E+00									
Benzo(a)pyrene	7.8E+01	7.8E+00	7.8E-01									
Benzo(b)fluoranthene	7.8E+02	7.8E+01	7.8E+00									
Benzo(g,h,i)perylene												
Benzo(k)fluoranthene	7.8E+03	7.8E+02	7.8E+01									
Dibenzo(a,h)anthracene	7.8E+01	7.8E+00	7.8E-01									

TABLE 5A

Commercial/Office Worker - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Fluoranthene				8.2E+04								
Indeno(1,2,3-cd)pyrene	7.8E+02	7.8E+01	7.8E+00									
Phenanthrene												
Pyrene				6.1E+04								
Pesticides/PCBs												
4,4'-DDE	1.7E+03	1.7E+02	1.7E+01									
4,4'-DDT	1.7E+03	1.7E+02	1.7E+01	1.0E+03	1.8E+07	1.8E+06	1.8E+05		1.7E+03	1.7E+02	1.7E+01	
Aroclor 1248	7.4E+01	7.4E+00	7.4E-01									
Aroclor 1254				4.1E+01								
Aroclor 1260	7.4E+01	7.4E+00	7.4E-01									
Beta-BHC	3.2E+02	3.2E+01	3.2E+00		3.4E+06	3.4E+05	3.4E+04		3.2E+02	3.2E+01	3.2E+00	
Dieldrin	3.6E+01	3.6E+00	3.6E-01	1.0E+02	3.8E+05	3.8E+04	3.8E+03		3.6E+01	3.6E+00	3.6E-01	
Endrin Ketone												

TABLE 5B**Commercial/Office Worker - Soil/Sediment Guideline Values: Radionuclides (Units = pCi/g)**

RADIONUCLIDE	Ingestion			External			Inhalation			Ingestion + External + Inhalation		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶
Actinium-227+D	5.1E+02	5.1E+01	5.1E+00	1.5E+02	1.5E+01	1.5E+00	4.4E+04	4.4E+03	4.4E+02	1.1E+02	1.1E+01	1.1E+00
Americium-241	9.8E+02	9.8E+01	9.8E+00	1.9E+04	1.9E+03	1.9E+02	8.9E+04	8.9E+03	8.9E+02	9.2E+02	9.2E+01	9.2E+00
Bismuth-207	6.3E+04	6.3E+03	6.3E+02	1.6E+01	1.6E+00	1.6E-01	3.6E+08	3.6E+07	3.6E+06	1.6E+01	1.6E+00	1.6E-01
Cesium-137+D	1.0E+04	1.0E+03	1.0E+02	4.2E+01	4.2E+00	4.2E-01	1.8E+08	1.8E+07	1.8E+06	4.2E+01	4.2E+00	4.2E-01
Cobalt-60	1.7E+04	1.7E+03	1.7E+02	9.0E+00	9.0E-01	9.0E-02	5.0E+07	5.0E+06	5.0E+05	9.0E+00	9.0E-01	9.0E-02
Plutonium-238	1.1E+03	1.1E+02	1.1E+01	4.5E+06	4.5E+05	4.5E+04	1.3E+05	1.3E+04	1.3E+03	1.1E+03	1.1E+02	1.1E+01
Plutonium-239	1.0E+03	1.0E+02	1.0E+01	7.0E+06	7.0E+05	7.0E+04	1.2E+05	1.2E+04	1.2E+03	1.0E+03	1.0E+02	1.0E+01
Plutonium-240	1.0E+03	1.0E+02	1.0E+01	4.7E+06	4.7E+05	4.7E+04	1.2E+05	1.2E+04	1.2E+03	1.0E+03	1.0E+02	1.0E+01
Radium-226+D	1.1E+03	1.1E+02	1.1E+01	1.3E+01	1.3E+00	1.3E-01	1.2E+06	1.2E+05	1.2E+04	1.3E+01	1.3E+00	1.3E-01
Strontium-90+D	5.7E+03	5.7E+02	5.7E+01				4.9E+07	4.9E+06	4.9E+05	5.7E+03	5.7E+02	5.7E+01
Thorium-228+D	1.4E+03	1.4E+02	1.4E+01	8.8E+01	8.8E+00	8.8E-01	3.5E+04	3.5E+03	3.5E+02	8.3E+01	8.3E+00	8.3E-01
Thorium-230	8.5E+03	8.5E+02	8.5E+01	2.0E+06	2.0E+05	2.0E+04	2.0E+05	2.0E+04	2.0E+03	8.1E+03	8.1E+02	8.1E+01
Thorium-232	9.8E+03	9.8E+02	9.8E+01	4.4E+06	4.4E+05	4.4E+04	1.8E+05	1.8E+04	1.8E+03	9.2E+03	9.2E+02	9.2E+01
Tritium	4.5E+06	4.5E+05	4.5E+04				3.6E+10	3.6E+09	3.6E+08	4.5E+06	4.5E+05	4.5E+04

TABLE 5B**Commercial/Office Worker - Soil/Sediment Guideline Values: Radionuclides (Units = pCi/g)**

RADIONUCLIDE	Ingestion			External			Inhalation			Ingestion + External + Inhalation		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶
Uranium-233	7.1E+03	7.1E+02	7.1E+01	2.5E+06	2.5E+05	2.5E+04	2.4E+05	2.4E+04	2.4E+03	6.9E+03	6.9E+02	6.9E+01
Uranium-234	7.2E+03	7.2E+02	7.2E+01	4.1E+06	4.1E+05	4.1E+04	2.4E+05	2.4E+04	2.4E+03	7.0E+03	7.0E+02	7.0E+01
Uranium-235+D	6.8E+03	6.8E+02	6.8E+01	3.3E+02	3.3E+01	3.3E+00	2.6E+05	2.6E+04	2.6E+03	3.1E+02	3.1E+01	3.1E+00
Uranium-238+D	5.2E+03	5.2E+02	5.2E+01	1.7E+03	1.7E+02	1.7E+01	2.8E+05	2.8E+04	2.8E+03	1.3E+03	1.3E+02	1.3E+01

TABLE 5C
Commercial/Office Worker - Groundwater Guideline Values: Chemicals
(Units mg/L)

CHEMICAL	Ingestion			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
High Explosives				
HMX				5.1E+00
PETN				
RDX	2.6E-01	2.6E-02	2.6E-03	3.1E-01
Inorganics				
Aluminum				
Antimony				4.1E-02
Arsenic				3.1E-02
Barium				7.2E+00
Beryllium	6.7E-03	6.7E-04	6.7E-05	5.1E-01
Cadmium (Water)				5.1E-02
Chromium III				1.0E+02
Chromium VI				5.1E-01
Cobalt				
Copper				

TABLE 5C**Commercial/Office Worker - Groundwater Guideline Values: Chemicals
(Units mg/L)**

CHEMICAL	Ingestion			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Cyanide				2.0E+00
Iron				
Lead				
Lithium				
Manganese (Water)				5.1E-01
Mercury				3.1E-02
Nickel				2.0E+00
Silver				5.1E-01
Thallium				
Vanadium				7.2E-01
Zinc				3.1E+01
Organics				
1,1,1-Trichloroethane				
1,1-Dichloroethane				1.0E+01
1,2-Dichloroethane	3.1E-01	3.1E-02	3.1E-03	

TABLE 5C**Commercial/Office Worker - Groundwater Guideline Values: Chemicals
(Units mg/L)**

CHEMICAL	Ingestion			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
1,2-trans-Dichloroethylene				2.0E+00
2-Butanone				6.1E+01
2-Hexanone				
2-Methylnaphthalene				
4-Methyl-2-Pentanone				8.2E+00
4-Methylphenol				5.1E-01
Acetone				1.0E+01
Benzene	9.9E-01	9.9E-02	9.9E-03	
Benzoic Acid				4.1E+02
Bromodichloromethane	4.6E-01	4.6E-02	4.6E-03	2.0E+00
Butyl benzyl phthalate				2.0E+01
Carbon Disulfide				1.0E+01
Carbon Tetrachloride	2.2E-01	2.2E-02	2.2E-03	7.2E-02
Chloroethane				
Chrysene	3.9E+00	3.9E-01	3.9E-02	

TABLE 5C
Commercial/Office Worker - Groundwater Guideline Values: Chemicals
(Units mg/L)

CHEMICAL	Ingestion			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Cresols				
Di-n-butylphthalate				1.0E+01
Di-n-octylphthalate				2.0E+00
Dibromochloromethane	3.4E-01	3.4E-02	3.4E-03	2.0E+00
Dichloromethane	3.8E+00	3.8E-01	3.8E-02	6.1E+00
Diethyl benzene, 1,4-				
Ethyl benzene				1.0E+01
Hexane				6.1E+00
Isophorone	3.0E+01	3.0E+00	3.0E-01	2.0E+01
Methyl iodide				
N-nitroso-diphenylamine	5.8E+00	5.8E-01	5.8E-02	
Pentachlorophenol	2.4E-01	2.4E-02	2.4E-03	3.1E+00
Phenol				6.1E+01
Tetrachloroethene				1.0E+00
Toluene				2.0E+01

TABLE 5C**Commercial/Office Worker - Groundwater Guideline Values: Chemicals
(Units mg/L)**

CHEMICAL	Ingestion			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Tribromomethane	3.6E+00	3.6E-01	3.6E-02	2.0E+00
Trichloroethylene	2.6E+00	2.6E-01	2.6E-02	
Trichlorofluoromethane				3.1E+01
Trichloromethane	4.7E+00	4.7E-01	4.7E-02	1.0E+00
Xylene				2.0E+02
bis(2-Ethylhexyl)phthalate	2.0E+00	2.0E-01	2.0E-02	2.0E+00
PAHs				
Acenaphthylene				
Anthracene				3.1E+01
Benzo(a)anthracene	3.9E-02	3.9E-03	3.9E-04	
Benzo(a)pyrene	3.9E-03	3.9E-04	3.9E-05	
Benzo(b)fluoranthene	3.9E-02	3.9E-03	3.9E-04	
Benzo(g,h,i)perylene				
Benzo(k)fluoranthene	3.9E-01	3.9E-02	3.9E-03	
Dibenz(a,h)anthracene	3.9E-03	3.9E-04	3.9E-05	

TABLE 5C**Commercial/Office Worker - Groundwater Guideline Values: Chemicals
(Units mg/L)**

CHEMICAL	Ingestion			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Fluoranthene				4.1E+00
Indeno(1,2,3-cd)pyrene	3.9E-02	3.9E-03	3.9E-04	
Phenanthrene				
Pyrene				3.1E+00
Pesticides/PCBs				
4,4'-DDE	8.4E-02	8.4E-03	8.4E-04	
4,4'-DDT	8.4E-02	8.4E-03	8.4E-04	5.1E-02
Aroclor 1248	3.7E-03	3.7E-04	3.7E-05	
Aroclor 1254				2.0E-03
Aroclor 1260	3.7E-03	3.7E-04	3.7E-05	
Beta-BHC	1.6E-02	1.6E-03	1.6E-04	
Dieldrin	1.8E-03	1.8E-04	1.8E-05	5.1E-03
Endrin Ketone				

TABLE 5D**Commercial/Office Worker - Groundwater
Guideline Values: Radionuclides (Units = pCi/L)**

RADIONUCLIDE	Ingestion		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶
Actinium-227+D	2.6E+01	2.6E+00	2.6E-01
Americium-241	4.9E+01	4.9E+00	4.9E-01
Bismuth-207	3.2E+03	3.2E+02	3.2E+01
Cesium-137+D	5.1E+02	5.1E+01	5.1E+00
Cobalt-60	8.5E+02	8.5E+01	8.5E+00
Plutonium-238	5.4E+01	5.4E+00	5.4E-01
Plutonium-239	5.1E+01	5.1E+00	5.1E-01
Plutonium-240	5.1E+01	5.1E+00	5.1E-01
Radium-226+D	5.4E+01	5.4E+00	5.4E-01
Strontium-90+D	2.9E+02	2.9E+01	2.9E+00

TABLE 5D

**Commercial/Office Worker - Groundwater
Guideline Values: Radionuclides (Units = pCi/L)**

RADIONUCLIDE	Ingestion		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶
Thorium-228+D	6.9E+01	6.9E+00	6.9E-01
Thorium-230	4.3E+02	4.3E+01	4.3E+00
Thorium-232	4.9E+02	4.9E+01	4.9E+00
Tritium	2.2E+05	2.2E+04	2.2E+03
Uranium-233	3.6E+02	3.6E+01	3.6E+00
Uranium-234	3.6E+02	3.6E+01	3.6E+00
Uranium-235+D	3.4E+02	3.4E+01	3.4E+00
Uranium-238+D	2.6E+02	2.6E+01	2.6E+00

TABLE 6A												
Private Contractor/Off-Site Construction - Soil Guideline Values: Chemicals (Units = mg/kg)												
CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
High Explosives												
HMX				1.1E+04								
PETN												
RDX	1.4E+04	1.4E+03	1.4E+02	6.4E+02								
Inorganics												
Aluminum												
Antimony				8.5E+01								
Arsenic				6.4E+01	3.1E+06	3.1E+05	3.1E+04					
Barium				1.5E+04				3.1E+06				1.5E+04
Beryllium	3.5E+02	3.5E+01	3.5E+00	1.1E+03	1.8E+07	1.8E+06	1.8E+05		3.5E+02	3.5E+01	3.5E+00	
Cadmium (Diet)				2.1E+02	2.5E+07	2.5E+06	2.5E+05					
Chromium III				2.1E+05								
Chromium VI				1.1E+03	3.7E+06	3.7E+05	3.7E+04					
Cobalt												
Copper												

TABLE 6A												
Private Contractor/Off-Site Construction - Soil Guideline Values: Chemicals (Units = mg/kg)												
CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁴	GV for HI=1
Cyanide				4.3E+03								
Iron												
Lead												
Lithium												
Manganese (Diet)				3.0E+04				3.1E+05				2.7E+04
Mercury				6.4E+01				1.9E+06				6.4E+01
Nickel				4.3E+03								
Silver				1.1E+03								
Thallium												
Vanadium				1.5E+03								
Zinc				6.4E+04								
Organics												
1,1,1-Trichloroethane												
1,1-Dichloroethane				2.1E+04				7.8E+00				7.8E+00
1,2-Dichloroethane	1.6E+04	1.6E+03	1.6E+02		6.7E+02	6.7E+02	8.4E+01		6.7E+02	5.5E+02	5.5E+01	

TABLE 6A**Private Contractor/Off-Site Construction - Soil Guideline Values: Chemicals (Units = mg/kg)**

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
1,2-trans-Dichloroethylene				4.3E+03								
2-Butanone				1.3E+05					9.3E+03			9.3E+03
2-Hexanone												
2-Methylnaphthalene												
4-Methyl-2-Pentanone				1.7E+04					7.0E+02			7.0E+02
4-Methylphenol				1.1E+03								
Acetone				2.1E+04								
Benzene	5.1E+04	5.1E+03	5.1E+02		4.9E+02	4.9E+02	2.3E+02		4.9E+02	4.9E+02	1.6E+02	
Benzoic Acid				8.5E+05								
Bromodichloromethane	2.4E+04	2.4E+03	2.4E+02	4.3E+03								
Butyl benzyl phthalate				4.3E+04								
Carbon Disulfide				2.1E+04					2.9E+02			2.8E+02
Carbon Tetrachloride	1.1E+04	1.1E+03	1.1E+02	1.5E+02	1.0E+03	1.0E+03	1.3E+02		1.0E+03	6.1E+02	6.1E+01	
Chloroethane									1.6E+02			
Chrysene	2.0E+05	2.0E+04	2.0E+03									

TABLE 6A												
Private Contractor/Off-Site Construction - Soil Guideline Values: Chemicals (Units = mg/kg)												
CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
Cresols												
Di-n-butylphthalate				2.1E+04								
Di-n-octylphthalate				4.3E+03								
Dibromochloromethane	1.8E+04	1.8E+03	1.8E+02	4.3E+03								
Dichloromethane	2.0E+05	2.0E+04	2.0E+03	1.3E+04				1.0E+03				1.0E+03
Diethyl benzene, 1,4-												
Ethyl benzene				2.1E+04				4.0E-01				4.8E-01
Hexane				1.3E+04				9.1E+01				9.1E+01
Isophorone	1.6E+06	1.6E+05	1.6E+04	4.3E+04								
Methyl iodide												
N-nitroso-diphenylamine	3.0E+05	3.0E+04	3.0E+03									
Pentachlorophenol	1.2E+04	1.2E+03	1.2E+02	6.4E+03								
Phenol				1.3E+05								
Tetrachloroethene				2.1E+03								
Toluene				4.3E+04				2.5E+02				2.5E+02

TABLE 6A

Private Contractor/Off-Site Construction - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for HI=1
Tribromomethane	1.9E+05	1.9E+04	1.9E+03	4.3E+03	3.9E+10	3.9E+09	3.9E+08		1.9E+05	1.9E+04	1.9E+03	
Trichloroethylene	1.4E+05	1.4E+04	1.4E+03		4.4E+02	4.4E+02	4.4E+02		4.4E+02	4.4E+02	4.4E+02	
Trichlorofluoromethane				6.4E+04				7.3E+02				7.3E+02
Trichloromethane	2.4E+05	2.4E+04	2.4E+03	2.1E+03	1.5E+03	7.9E+02	7.9E+01		1.5E+03	7.6E+02	7.6E+01	
Xylene				4.3E+05								
bis(2-Ethylhexyl)phthalate	1.1E+05	1.1E+04	1.1E+03	4.3E+03								
PAHs												
Acenaphthylene												
Anthracene				6.4E+04								
Benzo(a)anthracene	2.0E+03	2.0E+02	2.0E+01									
Benzo(a)pyrene	2.0E+02	2.0E+01	2.0E+00									
Benzo(b)fluoranthene	2.0E+03	2.0E+02	2.0E+01									
Benzo(g,h,i)perylene												
Benzo(k)fluoranthene	2.0E+04	2.0E+03	2.0E+02									
Dibenz(a,h)anthracene	2.0E+02	2.0E+01	2.0E+00									

TABLE 6A

Private Contractor/Off-Site Construction - Soil Guideline Values: Chemicals (Units = mg/kg)

CHEMICAL	Ingestion				Inhalation				Ingestion + Inhalation			
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for HI=1
Fluoranthene				8.5E+03								
Indeno(1,2,3-cd)pyrene	2.0E+03	2.0E+02	2.0E+01									
Phenanthrene												
Pyrene				6.4E+03								
Pesticides/PCBs												
4,4'-DDE	4.4E+03	4.4E+02	4.4E+01									
4,4'-DDT	4.4E+03	4.4E+02	4.4E+01	1.1E+02	4.5E+08	4.5E+07	4.5E+06		4.4E+03	4.4E+02	4.4E+01	
Aroclor 1248	1.9E+02	1.9E+01	1.9E+00									
Aroclor 1254				4.3E+00								
Aroclor 1260	1.9E+02	1.9E+01	1.9E+00									
Beta-BHC	8.3E+02	8.3E+01	8.3E+00		8.5E+07	8.5E+06	8.5E+05		8.3E+02	8.3E+01	8.3E+00	
Dieldrin	9.3E+01	9.3E+00	9.3E-01	1.1E+01	9.6E+06	9.6E+05	9.6E+04		9.3E+01	9.3E+00	9.3E-01	
Endrin Ketone												

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TABLE 6B**Private Contractor/Off-Site Construction - Soil Guideline Values: Radionuclides (Units = pCi/g)**

RADIONUCLIDE	Ingestion			External			Inhalation			Ingestion + External + Inhalation		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻³	GV for TR=10 ⁻⁶
Actinium-227+D	1.3E+03	1.3E+02	1.3E+01	8.2E+02	8.2E+01	8.2E+00	1.1E+06	1.1E+05	1.1E+04	5.1E+02	5.1E+01	5.1E+00
Americium-241	2.5E+03	2.5E+02	2.5E+01	1.1E+05	1.1E+04	1.1E+03	2.2E+06	2.2E+05	2.2E+04	2.5E+03	2.5E+02	2.5E+01
Bismuth-207	1.7E+05	1.7E+04	1.7E+03	8.9E+01	8.9E+00	8.9E-01	9.1E+09	9.1E+08	9.1E+07	8.9E+01	8.9E+00	8.9E-01
Cesium-137+D	2.6E+04	2.6E+03	2.6E+02	2.3E+02	2.3E+01	2.3E+00	4.5E+09	4.5E+08	4.5E+07	2.3E+02	2.3E+01	2.3E+00
Cobalt-60	4.4E+04	4.4E+03	4.4E+02	5.0E+01	5.0E+00	5.0E-01	1.2E+09	1.2E+08	1.2E+07	5.0E+01	5.0E+00	5.0E-01
Plutonium-238	2.8E+03	2.8E+02	2.8E+01	2.5E+07	2.5E+06	2.5E+05	3.1E+06	3.1E+05	3.1E+04	2.8E+03	2.8E+02	2.8E+01
Plutonium-239	2.6E+03	2.6E+02	2.6E+01	3.9E+07	3.9E+06	3.9E+05	3.1E+06	3.1E+05	3.1E+04	2.6E+03	2.6E+02	2.6E+01
Plutonium-240	2.6E+03	2.6E+02	2.6E+01	2.6E+07	2.6E+06	2.6E+05	3.1E+06	3.1E+05	3.1E+04	2.6E+03	2.6E+02	2.6E+01
Radium-226+D	2.8E+03	2.8E+02	2.8E+01	7.2E+01	7.2E+00	7.2E-01	3.1E+07	3.1E+06	3.1E+05	7.0E+01	7.0E+00	7.0E-01
Strontium-90+D	1.5E+04	1.5E+03	1.5E+02				1.2E+09	1.2E+08	1.2E+07	1.5E+04	1.5E+03	1.5E+02
Thorium-228+D	3.6E+03	3.6E+02	3.6E+01	4.9E+02	4.9E+01	4.9E+00	8.9E+05	8.9E+04	8.9E+03	4.3E+02	4.3E+01	4.3E+00
Thorium-230	2.2E+04	2.2E+03	2.2E+02	1.1E+07	1.1E+06	1.1E+05	5.0E+06	5.0E+05	5.0E+04	2.2E+04	2.2E+03	2.2E+02
Thorium-232	2.5E+04	2.5E+03	2.5E+02	2.5E+07	2.5E+06	2.5E+05	4.4E+06	4.4E+05	4.4E+04	2.5E+04	2.5E+03	2.5E+02
Tritium	1.2E+07	1.2E+06	1.2E+05				8.9E+11	8.9E+10	8.9E+09	1.2E+07	1.2E+06	1.2E+05

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TABLE 6B**Private Contractor/Off-Site Construction - Soil Guideline Values: Radionuclides (Units = pCi/g)**

RADIONUCLIDE	Ingestion			External			Inhalation			Ingestion + External + Inhalation		
	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶	GV for TR=10 ⁻⁴	GV for TR=10 ⁻⁵	GV for TR=10 ⁻⁶
Uranium-233	1.9E+04	1.9E+03	1.9E+02	1.4E+07	1.4E+06	1.4E+05	6.1E+06	6.1E+05	6.1E+04	1.9E+04	1.9E+03	1.9E+02
Uranium-234	1.9E+04	1.9E+03	1.9E+02	2.3E+07	2.3E+06	2.3E+05	6.1E+06	6.1E+05	6.1E+04	1.9E+04	1.9E+03	1.9E+02
Uranium-235+D	1.8E+04	1.8E+03	1.8E+02	1.8E+03	1.8E+02	1.8E+01	6.6E+06	6.6E+05	6.6E+04	1.7E+03	1.7E+02	1.7E+01
Uranium-238+D	1.3E+04	1.3E+03	1.3E+02	9.3E+03	9.3E+02	9.3E+01	6.9E+06	6.9E+05	6.9E+04	5.5E+03	5.5E+02	5.5E+01

RISK-BASED GUIDELINE VALUES

**MOUND PLANT
MIAMISBURG, OHIO**

**APPENDIX C
OAK RIDGE NATIONAL LABORATORY TRITIUM INHALATION METHODOLOGY**

March 1997

**Submitted to the
Miamisburg Environmental Management Project
U.S. DEPARTMENT OF ENERGY**

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U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400**

Revised by EG&G Mound Applied Technologies, Inc.

**FINAL
(REVISION 4)**

A SIMPLIFIED METHOD FOR ESTIMATING RISK
FROM INHALATION OF TRITIATED HOUSEHOLD WATER

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TRITIUM INHALATION

The tritiated water vapor which enters the home during use of a shower may be viewed to result in two exposure components. One component is associated with the inhalation of water vapor during the time in the shower stall and the second results from inhalation of the water vapor introduced into the home by the use of the shower. The following develops each component separately.

The mass concentration of water vapor and fog droplets in the shower stall during showering is defined as

$$M_{Total} = M_{vapor} + M_{droplets} \quad (1)$$

where

M_{total} is the airborne mass concentration of water in the shower stall (g/m^3),
 M_{vapor} is the mass of saturated water vapor at the temperature of the shower (48.67 g/m^3 at 39°C),
 $M_{droplet}$ is the mass concentration of fog droplets (g/m^3)

The mass concentration of fog droplets is computed as the difference between the saturated water vapor at 39°C and that at the ambient temperature of the shower stall (30.38 g/m^3 at 30°C) or 18.29 g/m^3 (CRC 1989).

Assuming a tritium concentration, C_w (pCi/L), in the household water supply then the intake of tritium while showering is

$$I_{Shower} = C_w M_{Total} IR ET_s EF ED CF \quad (2)$$

where

I_{Shower} is the inhalation intake of tritium activity (pCi),
 C_w is the tritium activity concentration in household water (pCi/L),
 IR is the inhalation rate ($0.6 \text{ m}^3/\text{hr}$ to 0.83 (EPA 1990, 1991)),
 ET_s is the exposure time in the shower (0.2 hr/d (EPA 1990)),
 EF is the exposure frequency (350 d/yr (EPA 1991)),
 ED is the exposure duration (30 y (EPA 1991)),
 CF is the conversion factor (1 L/1000 g).

The tritium content of the indoor air is a function of time and the air exchange rate of house. We assume a house floor plan of 1200 ft^2 (volume of 275 m^3) with an air exchange rate of $750 \text{ m}^3/\text{h}$ (McKone and Bogen 1992). A family of four resides in the home, each person shower daily with each showering introducing the equivalent of six shower volumes of water vapor into the home (Best professional judgement).

For simplicity, the showering is considered to instantaneously inject the tritiated vapor into the house and the subsequent intake of tritium from household air is computed considering the average daily airborne

tritium concentration. Various scenarios could be postulated regarding the family's use of the shower, in particular the temporal relationship between showering and residing in the home. For example, one might maximize this component by assuming all family members showered in the evening and then resided for 15 hours in the home (15 hours is the standard assumption of the number of hours spent indoors each day (EPA 1990, 1991)). An opposite extreme would have the family leave the house for nine hours immediately after showering.

Assume showering instantaneously injects tritium concentrations into the household air from which it will be removed by the household air exchange rate (750 m³/h which is equivalent to 2.73 household volumes per hour). The time-dependent airborne concentration of tritium $C_A(t)$ expelled per shower would be given as:

$$C_A(t) = \frac{Q}{V_{House}} e^{-\lambda t} \quad (3)$$

$$= \frac{C_W M_{Total} N_{SV} V_{Shower} CF}{V_{House}} e^{-\lambda t}$$

where

Q is the activity of tritium that will be expelled from the shower volume to the house (pCi)
 N_{SV} is the number shower volumes expelled into the home per shower (assumed to be 6),
 V_{Shower} is the volume of the shower stall (5 m³),
 V_{House} is the volume of the house (275 m³),
 λ is the fractional air exchange rate of the house (2.73 hr⁻¹ (McKone and Bogen 1992)),
 all other parameters are defined above.

The average tritium intake while in the house is computed as the time integral of the air concentration and the breathing rate as

$$I_{House} = N_P F ED EF IR \int_0^{\infty} C_A(t) dt \quad (4)$$

$$= \frac{N_P F ED EF IR Q}{V_{House}} \int_0^{\infty} e^{-\lambda t} dt$$

$$= \frac{N_P F ED EF IR C_W M_{Total} N_{SV} V_{Shower} CF}{\lambda V_{House}}$$

where

N_P is the number of family members taking a daily shower (assumed to be 4/d),
 F is the fraction of the day spent in house (i.e., 15h/24h = 0.625)
 and all other terms have been defined above.

The lifetime risk from inhalation of tritiated water vapor from showering includes the sum of these two components can be expressed as:

$$\begin{aligned}
 Risk &= SF (I_{Shower} + I_{House}) \\
 &= SF C_W EF ED IR M_{Total} CF \left[ET_s + \frac{F N_P N_{SV} V_{shower}}{\lambda V_{house}} \right] \quad (5)
 \end{aligned}$$

where SF (risk/pCi) is the cancer slope factor for inhalation of tritiated water vapor from HEAST (EPA 1994).

DERMAL EXPOSURE

The dermal exposure to tritium is adapted from the method of Hamilton and coworkers ((1993). The risk equation is given below:

$$Risk_{DERMTRIT} = (C_w) (SF_o) (SA) (K_{PTRIT}) (ET) (EF) (CF) (ED) \quad (6)$$

Where:

C_w	is the tritium concentration in water (pCi/L),
SF_o	is the oral slope factor from HEAST (EPA 1994),
SA	is the skin surface area available for absorption (m^2),
K_{PTRIT}	is the dermal permeability constant for tritium (1.5×10^{-3} m/hour (Bronaugh et al 1986)),
ET	is the exposure time (hours/day),
EF	is the exposure frequency (days/year),
ED	is the exposure duration (years),
CF	is the conversion factor (10^3 L/ m^3).

The specific input parameters will depend on site-specific exposures. Default values for showering and swimming are given in EPA 1991 and EPA 1990.

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RISK-BASED GUIDELINE VALUES

**MOUND PLANT
MIAMISBURG, OHIO**

**APPENDIX D
GROUNDWATER EXPOSURE CALCULATIONS FOR THE CONSTRUCTION WORKER
INCORPORATING REVISED DERMAL CALCULATIONS**

March 1997

**Submitted to the
Miamisburg Environmental Management Project
U.S. DEPARTMENT OF ENERGY**

Prepared by EG&G Mound Applied Technologies, Inc.

At the request of the Ohio Environmental Protection Agency (OEPA), the dermal calculation for groundwater exposure for the construction worker was changed from the default *RAGS – Part B* (EPA 1991a) methodology to the equations and methodology presented in *Dermal Exposure Assessment: Principles and Application, Interim Report* (EPA 1992a) and in *Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Assessment, Interim Guidance* (EPA 1992b). The primary dermal exposure pathway has been determined to be from groundwater exposure during showering for a construction worker. For this reason incidental dermal exposure from surface water is not calculated.

Only the tables for the construction worker have been revised in this Final, Revision 0 document because the construction worker and office worker exposure scenarios are the scenarios that DOE, USEPA, OEPA, and stakeholders have agreed best represent the Mound Plant future use. The tables for the office worker do not change from the draft revision 3 document because office workers do not have a significant dermal exposure pathway to the groundwater because they are not expected to shower at the Mound Plant.

Where the same water supply is used for drinking and bathing, the importance of dermal contact with water can be evaluated by comparing the possible absorbed dose occurring during bathing relative to that occurring as a result of ingestion:

$$\frac{\text{Dermal Dose}}{\text{Ingestion Dose}} = \frac{2 \times C_w \times K_p \times SA \times EV \times \sqrt{\frac{6 \times \tau \times t_{\text{event}}}{\pi}}}{C_w \times IR \times ABS_{GI}}$$

Where:

C_w	=	Contaminant concentration in water (mg/cm ³)
K_p	=	Permeability coefficient in water (cm/hour) (values found in EPA 1992b)
τ	=	Chemical specific lag time (hr) (values found in EPA 1992b)
t_{event}	=	Exposure time (hr/event)
SA	=	Exposed skin area (cm ²)
EV	=	Event/day (default assumption = 1 event/day)
IR	=	Water ingestion rate (L/day) x (1,000 cm ³ /L)
ABS_{GI}	=	Fraction of contaminant absorbed in G.I. tract

Assuming an average adult ingestion rate (IR) of 2 L/day, GI tract absorption fraction (ABS_{GI}) of 1, shower time of 10 minutes, and skin area of 20,000 cm², this ratio becomes:

$$\frac{\text{Dermal Dose}}{\text{Ingested Dose}} = 10 \times K_p \times \sqrt{\tau}$$

So the dermal dose exceeds the ingested dose when:

$$K_p \times \sqrt{\tau} > 0.1$$

Only chemicals that have a K_p that exceed 0.1 (EPA 1992b) are carried through the following dermal calculations:

Carcinogens:

$$DA_{\text{dose}} = \frac{DA_{\text{event}} \times EV \times EF \times SA \times ED}{BW \times AT \times 365 \text{ day/yr}}$$

Non-Carcinogens:

$$DA_{\text{dose}} = \frac{DA_{\text{event}} \times EV \times EF \times SA}{BW \times 365 \text{ day/yr}}$$

where:

$$\text{(for organics)} DA_{\text{event}} = 2 \times K_p \times C_w \times 10^{-3} \frac{\text{L}}{\text{cm}^3} \times \sqrt{\frac{6 \times \tau \times t_{\text{event}}}{\pi}}$$

$$\text{(for inorganics)} DA_{\text{event}} = K_p \times C_w \times t_{\text{event}} \times 10^{-3} \frac{\text{L}}{\text{cm}^3}$$

DA_{event}	=	dermally absorbed dose mg/cm ² per event
DA_{dose}	=	dermally absorbed dose (mg/kg-day)
C_w	=	contaminant concentration in water (mg/L)
K_p	=	chemical-specific permeability coefficient (cm/hr)
SA	=	skin surface area available for contact (cm ²)
τ	=	chemical-specific lag time (hr)
t_{event}	=	duration of exposure event (hr/event)
EV	=	events per day (d ⁻¹)
EF	=	exposure frequency (d/yr.)
ED	=	exposure duration (yr.)
BW	=	body weight (kg)
AT	=	averaging time (yr. × 365 d/yr.)

Re-arranging the above equations, since $TR = DA_{\text{dose}} \times SF$, we can substitute and solve for C_w as a function of risk for the dermal pathway:

Carcinogens:

Organics:

$$C_{W_{\text{DERM}}} = \frac{BW \times AT \times TR \times 365 \text{ day/yr}}{2 \times K_p \times 10^{-3} \frac{\text{L}}{\text{cm}^3} \times \left[\sqrt{\frac{6 \times \tau \times t_{\text{event}}}{\pi}} \right] \times EV \times EF \times SA \times ED \times SF}$$

Inorganics:

$$C_{W_{\text{DERM}}} = \frac{BW \times AT \times TR \times 365 \text{ day/yr}}{K_p \times 10^{-3} \frac{\text{L}}{\text{cm}^3} \times t_{\text{event}} \times EV \times EF \times SA \times ED \times SF}$$

Where TR is the target risk (10^{-4} to 10^{-6}) and SF is the Oral Slope Factor (mg/kg-day)⁻¹.

The equation for non-carcinogenic risk (HI=1) is:

Non-carcinogens:

Organics:

$$C_{W_{\text{DERM}}} = \frac{BW \times 365 \text{ day/year} \times \text{RfD}}{2 \times K_p \times 10^{-3} \frac{\text{L}}{\text{cm}^3} \times \left[\sqrt{\frac{6 \times \tau \times t_{\text{event}}}{\pi}} \right] \times \text{EV} \times \text{EF} \times \text{SA}}$$

Inorganics:

$$C_{W_{\text{DERM}}} = \frac{BW \times 365 \text{ day/year} \times \text{RfD}}{K_p \times 10^{-3} \frac{\text{L}}{\text{cm}^3} \times t_{\text{event}} \times \text{EV} \times \text{EF} \times \text{SA}}$$

Where RfD is the reference dose (mg/kg-day)

The total contaminant concentration in water C_{total} is calculated as the reciprocal of the sum of the fractions of the individual pathways from the following formula:

$$C_{W_{\text{total}}} = \frac{1}{\left(\frac{1}{C_{W_{\text{ING}}}} + \frac{1}{C_{W_{\text{DERM}}}} + \frac{1}{C_{W_{\text{INH}}}} \right)}$$

The dermal equations for $C_{W_{\text{INH}}}$ and $C_{W_{\text{ING}}}$ are presented in Appendix A.

The following calculated data for the Construction Worker scenario has been included in table 4C in Appendix B.

CARCINOGENS

CHEMICAL	Kp	Tau	DAdose	SFo	RISK	GVderm	GVing	GVinh	GVtot
						10-6 Risk	mg/l	mg/l	mg/l
Benzene	0.11	0.26	0.000859	2.90E-02	2.49E-05	4.0E-02	9.90E-03	1.40E-01	7.51E-03
Carbon disulfide	0.5	0.27							
Carbon tetrachloride	0.022	0.76	0.000294	0.13	3.82E-05	2.6E-02	2.20E-03	7.80E-02	1.98E-03
Chrysene	0.81	2.2	0.018406	7.30E-03	0.000134	7.4E-03	3.90E-02		6.25E-03
Di-n-butylphthalate	3.30E-02	4.3							
Ethyl benzene	1	0.39							
N-nitroso diphenylamine	2.00E-02	1.4	0.000363	4.90E-03	1.78E-06	5.6E-01	5.80E-02		5.26E-02
Pentachlorophenol	0.65	3.7	0.019155	0.12	0.002299	4.4E-04	3.1		4.35E-04
Tetrachloroethene	0.37	0.9							
Toluene	1	0.32							
Trichloroethylene	0.23	0.55	0.002613	1.10E-02	2.87E-05	3.5E-02	2.60E-02	6.90E-01	1.46E-02
Trichlorofluoromethane	1.70E-02	0.6							
bis-2 ethylhexylphthalate	3.30E-02	21	0.002317	1.40E-02	3.24E-05	3.1E-02	2.00E-02		1.21E-02
Benzo(a)anthracene	0.81	2.2	0.018406	0.73	0.013437	7.4E-05	3.90E-04		6.25E-05
Benzo(a)pyrene	1.2	2.9	0.031308	7.3	0.228548	4.4E-06	3.90E-05		3.93E-06
Benzo(b)fluoranthene	1.2	3	0.031843	0.73	0.023245	4.3E-05	3.90E-04		3.87E-05
Dibenzo(ah)anthracene	2.7	4.4	0.086769	7.3	0.633413	1.6E-06	3.90E-05		1.52E-06
Fluoranthene	0.36	1.5							
Indeno(1,2,3-cd)pyrene	1.9	4.2	0.059656	0.73	0.043549	2.3E-05	3.90E-04		2.17E-05
Phenanthrene	0.23	1.1		?					
4,4'-DDE	0.24	7.6	0.010137	0.34	0.003446	2.9E-04	8.40E-04		2.16E-04
4,4'-DDT	0.43	13	0.023753	0.34	0.008076	1.2E-04	8.40E-04		1.08E-04
Dieldrin	1.60E-02	18	0.00104	16	0.01664	6.0E-05	1.80E-05		1.39E-05

NON-CARCINOGENS

CHEMICAL	Kp	Tau	Oral RfD	Dadose non-car	HI	dermal Hlda=1 mg/l	Hling mg/l	Hlinh mg/l	Hltot mg/l
Benzene	0.11	0.26							
Carbon disulfide	0.5	0.27	0.1	0.055722	0.55722	1.794624	1.00E+01	4.20E+00	1.12E+00
Carbon tetrachloride	0.022	0.76	7.00E-04	0.004113	5.876329	0.170174	7.20E-02		5.06E-02
Chrysene	0.81	2.2							
Di-n-butylphthalate	3.30E-02	4.3	0.1	0.014677	0.146765	6.813609	1.00E+01		4.05E+00
Ethyl benzene	1	0.39	0.1	0.133939	1.33939	0.746609	1.00E+01	4.20E+02	6.94E-01
N-nitroso diphenylamine	2.00E-02	1.4							
Pentachlorophenol	0.65	3.7	3.00E-02	0.268157	8.938561	0.111875	3.10E+00		1.08E-01
Tetrachloroethene	0.37	0.9	0.01	0.075283	7.528312	0.132832	1.00E+00		1.17E-01
Toluene	1	0.32	0.2	0.121325	0.606624	1.648467	2.00E+01	1.70E+02	1.51E+00
Trichloroethylene	0.23	0.55							
Trichlorofluoromethane	1.70E-02	0.6	0.3	0.002824	0.009414	106.2239	3.10E+01	2.90E+02	2.22E+01
bis-2 ethylhexylphthalate	3.30E-02	21	2.00E-02	0.032434	1.621692	0.61664	2.00E+00		4.71E-01
Benzo(a)anthracene	0.81	2.2							
Benzo(a)pyrene	1.2	2.9							
Benzo(b)fluoranthene	1.2	3							
Dibenzo(ah)anthracene	2.7	4.4							
Fluoranthene	0.36	1.5	0.04	0.094563	2.364083	0.422997	4.10E+00		3.83E-01
Indeno(1,2,3-cd)pyrene	1.9	4.2							
Phenanthrene	0.23	1.1	?	0.051737					
4,4'-DDE	0.24	7.6							
4,4'-DDT	0.43	13	5.00E-04	0.332518	665.0354	0.001504	5.10E-02		1.46E-03
Dieldrin	1.60E-02	18	5.00E-05	0.014559	291.1796	0.003434	5.10E-03		2.05E-03