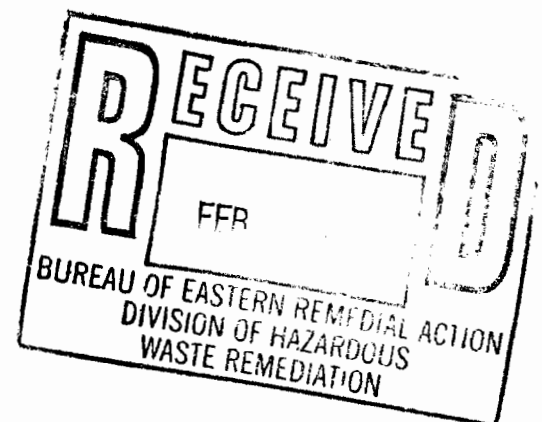


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**PATHWAY ANALYSIS REPORT
MALTA ROCKET FUEL AREA SITE
TOWNS OF MALTA AND STILLWATER, NEW YORK
RISK ASSESSMENT**



Prepared by

**ENVIRON Corporation
Princeton, New Jersey**

February 1995

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1.0 INTRODUCTION

At the request of the Malta Rocket Fuel Area (MRFA) Superfund Site Participating Parties*, ENVIRON is conducting a baseline public health and ecological risk assessment to support USEPA enforcement activities related to the Remedial Investigation (RI) at the MRFA Site in the towns of Malta and Stillwater, New York. Data collected by the Participating Parties' consultant, ERM-Northeast, Inc. (ERM), during the Remedial Investigation (ERM 1994a) will be used by ENVIRON to perform the risk assessment. Data from the Early Warning Monitoring System (EWMS) and on-site production well sampling will also be considered.

The purpose of this Pathway Analysis is to allow USEPA to review and agree upon ENVIRON's proposed inputs and assumptions prior to the development of the Draft Risk Assessment Report. The methodologies used in the development and selection of input data are described below. This Pathway Analysis report identifies the following information:

- Media to be evaluated (including indication of quantitative or qualitative assessment);
- Routes of exposure;
- Exposure scenarios for present and future surrounding land use based on the identified routes of exposure;

* The Participating Parties undertaking the Remedial Investigation/Feasibility Study are General Electric Company, NYSERDA, and the U.S. Department of Defense.

- Dose/response parameters used as one criterion for selecting contaminants of concern (COCs) and also used to characterize risk for the calculated dose estimates.

This above information is presented in Tables 1 through 21 attached to this report. It is expected that similar tables will appear in the Draft Risk Assessment Report.

The attached tables identify parameters to be used in the human health risk assessment only. The baseline ecological risk assessment will follow the approach outlined in the Final Work Plan (ENVIRON 1995) and will proceed as a Phase I ecological investigation. A major task of the baseline ecological assessment is the development of a conceptual Site model as described in the USEPA guidance document "Framework for Ecological Risk Assessment."

2.0 PUBLIC HEALTH RISK ASSESSMENT

2.1 Toxicity Values and Criteria/Guidelines

Table 1 presents the toxicity values for all contaminants detected at the MRFA Site. These values will be used in assessing relative toxicity of contaminants in the Contaminants of Concern (COC) selection process and will be used in the risk calculation in the quantitative risk assessment. Only chronic and subchronic toxicity values are included. The slope factors are provided for those chemicals classified as potential carcinogens, where available. Reference doses, where available, are provided for the assessment of noncarcinogenic health effects.

2.2 Selection of Contaminants of Concern

ENVIRON will select COCs based on the data presented in the Revised RI Report (ERM 1994a) and EWMS reports provided by ERM. General guidelines that will govern the selection process are presented below.

The COCs will be selected based on the following criteria: contaminant concentration; toxicity (see Table 1); frequency of detection; comparison of inorganic contaminant concentrations to background concentrations (contaminants which do not exceed the maximum background concentration (ERM 1994b) will be eliminated), if available; and consideration of the chemical and physical properties of organic contaminants that determine their mobility, persistence, and likelihood for bioaccumulation in the environment.

In general, a chemical will be retained as a COC if it is detected in greater than five percent of the sampling locations in a given media, unless its toxicity level is several orders of magnitude lower than that of other COCs. COCs will represent the most toxic, mobile and persistent contaminants, and those found frequently and at high concentrations at the Site. The COC selection process will be conservative, favoring the

inclusion of many contaminants in the analysis rather than the selection of only a few "indicator" chemicals.

2.3 Selection of Exposure Pathways

The physical characteristics of the Site were examined in order to adequately assess the pathways by which human receptors may become exposed to Site contaminants.

Exposure scenarios were then developed with consideration of demographics, land use and human behavior patterns. A summary of the exposure pathways considered for quantitative and qualitative analysis and the Site data to be used in the analyses are presented in Table 2. The routes considered include:

- Ingestion of ground water;
- Inhalation of contaminants volatilized from ground water during showering;
- Dermal contact with ground water during showering/bathing;
- Ingestion of surface soils;
- Inhalation of surface soils;
- Dermal contact with surface soils;
- Ingestion of subsurface soils;
- Inhalation of subsurface soils;
- Dermal contact with subsurface soils;
- Ingestion of sediments;
- Dermal contact with sediments;
- Incidental ingestion of surface water; and
- Dermal contact with surface water.

Ground Water: Presently, two on-site production wells provide potable water to the Site. However, ground water from the production wells is rendered potable by removing suspended solids via a settling tank and volatile organics via an air stripper prior to distribution to the facility. Therefore, post-treatment data will be used to evaluate current exposures to on-site employees. Exposure via ingestion will be

evaluated quantitatively. Exposure via inhalation will not be evaluated since employees do not shower at the facility.

Wright Malta Corporation, which owns part of the Site, also owns an easement which prohibits human habitation and hunting within a circle with a one mile radius extending for the center of the Test Station. The easement does not apply to the Site itself, however. While future residential use of the Site is not likely given the Site's history and the existence of the easement, it remains theoretically possible. Therefore, the scenario for future exposure to ground water assumes a private drinking water well will be installed and developed by a future resident at the Site. It is plausible to assume well installation because numerous private wells currently exist in the vicinity of the Site. However, due to turbidity, this ground water may require treatment prior to use to meet New York State requirements. Land use immediately beyond the easement which surrounds the Site includes residential developments and farmlands. The quantitative risk assessment will evaluate exposures resulting from ingestion of, dermal contact with, and inhalation of ground water contaminants that volatilize during showers. Both filtered and unfiltered RI sampling results will be used in the assessment since ground water may not be potable without filtration.

Surface Soils: Trespassers are not expected to be exposed to on-site surface soil contaminants under current conditions due to strict Site security and a fence along the entire Site perimeter. Current employees may be exposed to surface soil contaminants during outdoor activities (e.g., outdoor maintenance, lunch). Because future land use of the Site may include residential development, future on-site residents may also become exposed to surface contaminants. Both current and future employees, current and future excavation workers and future Site residents may contact surface soils via incidental ingestion and dermal contact. No inhalation exposures to volatilized or particulate emissions are likely because concentrations of VOCs are low and vegetation, pavement and prevailing wind patterns in the area will limit releases to air. Exposures to inhalation of surface soils by excavation workers will be evaluated qualitatively.

Subsurface Soils: Excavation workers may be exposed to subsurface soils (2-16 feet) through ingestion and dermal contact during future Site development. Therefore, these exposure pathways will be quantitatively evaluated. Exposures to inhalation of subsurface soils by excavation workers will be evaluated qualitatively.

Sediments: Sediment samples were collected from several quench pits, multiple dry wells, Muggett's Pond and Ravine 1b. Under current and future land use scenarios, exposures to sediments in the quench pits are unlikely. It is, in fact, questionable as to whether these samples are true sediments or merely a collection of organic detritus with a very high liquid content (ERM 1994a). These pits are not used by the current Site operations, so current exposures do not occur. Under future residential development, exposures to sediments are doubtful because the pits are approximately 30 to 35 feet deep and would likely be filled if the area were to be developed for residential use. As such, the exposure pathway for the quench pits is incomplete and exposures will not be evaluated.

Dry wells typically require periodic maintenance to maintain adequate drainage. Under the current scenarios, a utility worker is assumed to be exposed to dry well sediments via incidental ingestion and dermal contact. Under a future residential development scenario, exposures to dry well sediments are unlikely so they will not be quantitatively evaluated.

Current Site employees are unlikely to contact Muggett's Pond sediments since the Site operations do not involve activities at the pond. Strict Site security and a perimeter fence currently restricts trespassers from contacting the pond sediments. Under a future residential development scenario, on-site residents may become exposed to pond sediments via incidental ingestion and dermal contact during wading. Due to the steep access to Muggett's Pond, exposure would be limited to older children and adults.

Ravine 1b is located beyond the fenced perimeter of the Test Station, within the boundaries of the circular one mile restrictive easement. Trespassers currently could have unrestricted access to this ravine so they may contact ravine sediments during wading activities. Exposures are likely to include incidental ingestion of and dermal

contact with ravine sediments. Under a future residential development scenario, the same exposure pathways are possible.

Surface Water: Surface water samples were collected from several quench pits, Muggett's Pond, and Ravine 1b. Water samples were not collected from the dry wells as water is not typically present in these structures. As described above with quench pit sediments, the exposure pathway is both unlikely and incomplete under both present and future scenarios, so exposure to quench pit water will not be evaluated.

As described for sediments in Muggett's Pond, only future exposures to surface water are likely. The shallow depth of the pond (e.g., less than two feet deep) will not support swimming so incidental ingestion will not be quantitatively evaluated. However, wading is possible, so dermal contact with surface contaminants will be quantitatively evaluated. Due to the steep access to Muggett's Pond, exposure would be limited to older children and adults.

Current trespasser and future Site residents may encounter surface water at Ravine 1b. The quantitative risk assessment will evaluate only exposures via dermal contact since the water depth in the ravine is less than one foot deep.

Air: No ambient air data were collected at the Site. Surface soils contain inorganics and PCBs at concentrations that may be elevated. However, due to Site conditions including vegetation, pavement and prevailing wind patterns in the area, risks to Site employees and future Site residents resulting from inhaling fugitive dust emissions will not be evaluated. VOC concentrations in the surface soil did not exceed 6 ppb, so inhalation exposures to VOC vapors will be minimal and will not be quantitatively evaluated. Risks posed to excavation workers will be evaluated qualitatively for exposure to surface and subsurface soils.

2.4 Exposure Parameters

The parameters to be used to calculate exposure doses are summarized in Tables 3 through 21. The tables correspond to the scenarios presented in Table 2. The

parameters are summarized only for those scenarios that are to be evaluated quantitatively.

Values used for exposure parameters generally reflect reasonable maximum assumptions. If specific inputs were not prescriptive, the following sources were used:

- *Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual, Part A* (USEPA 1989).
- *Exposure Factors Handbook* (USEPA 1990).
- *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors* (USEPA 1991).
- *Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual, Part B* (USEPA 1991).
- *Dermal Exposure Assessment: Principles and Applications*, Interim Report (USEPA 1992).
- *Guidance for Data Useability in Risk Assessment* (USEPA 1992).
- *Guidance on Risk Characterization for Risk Managers and Risk Assessors*, USEPA Memorandum (USEPA 1992).
- *Guidelines for Exposure Assessment* (USEPA 1992).
- *Supplemental Guidance to RAGS: Calculating the Concentration Term*. Office of Solid Waste and Emergency Response (USEPA 1992).

3.0 OUTSTANDING ISSUES

The following issues need to be resolved, acknowledged, and/or approved by USEPA prior to preparation of the Draft Risk Assessment Report:

A. ENVIRON proposes to initially evaluate surface soil exposures by combining all surface soil samples into one group. Based on these results, separate analyses may then be performed for specific areas, such as:

- Surface soils at Area S-1, Building 21, and Building 23P due to elevated PCB concentrations;
- Surface soils at Area SS-20/1 and SS-21 due to elevated mercury concentrations;
- Subsurface soils at Building 6 due to elevated VOC concentrations; and
- Subsurface soils at Area D-2 due to elevated inorganic concentrations.

B. ENVIRON proposes to group the ground water data into two groups since a ground water divide separates the former GE/Exxon Building from the majority of the Test Station.

Available ground water data include RI and EWMS sampling results.
ENVIRON will evaluate the appropriateness of combining these data sets.

C. ENVIRON proposes to evaluate exposure to volatile ground water contaminants during showers using Foster & Chrostowski model (as specified in RAGS Part B guidance) or other appropriate models approved by USEPA.

- D. In addition to calculating reasonable maximal exposure risks, ENVIRON proposes to estimate central tendency risk (USEPA 1992c). Estimated risks calculated using reasonable maximum exposure assumptions will be compared to those using central tendency exposure assumptions. These results will be discussed in the uncertainty section of the Draft Risk Assessment Report.

4.0 REFERENCES

- ENVIRON. 1995. *Final Work Plan, Risk Assessment, Malta Rocket Fuel Area Site, Towns of Malta and Stillwater, New York*. January.
- ERM. 1994a. *Revised Remedial Investigation Report, Malta Rocket Fuel Area Site, Towns of Malta and Saratoga, Stillwater County, New York*. September.
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- USEPA. 1988. *Superfund Exposure Assessment Manual*, USEPA 540/1-88/001, OSWER Directive 9285.5-1. April.
- USEPA. 1989a. *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)*, Interim Final. USEPA 540/1-89/003. December.
- USEPA. 1989b. *Exposure Factors Handbook*. USEPA 600/8-89/043.
- USEPA. 1991. *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors*.
- USEPA. 1992a. *Dermal Exposure Assessment: Principles and Applications*, Interim Report. USEPA 600/8-91/011B. January.
- USEPA. 1992b. *Air/Superfund National Technical Guidance Study Series, Guideline for Predictive Baseline Emission Estimation Procedures for Superfund Sites*, Interim Final. USEPA 450/1-92-002. January.
- USEPA. 1992c. *Guidelines for Exposure Assessment, Notice*. *Federal Register* 57:22888. May 29.

TABLE 1
Toxicity Values for All Organic Compounds and
Inorganic Analytes Detected at the Malta Rocket Fuel Site

Chemical	Carcinogenic			Chronic		Subchronic	
	Weight of Evidence Classification	Oral Slope Factor (mg/kg-day) ⁻¹	Inhalation Slope Factor (mg/kg-day) ⁻¹	Chronic Oral RfD (mg/kg-day)	Chronic Inhalation RfD (mg/kg-day)	Subchronic Oral RfD (mg/kg-day)	Subchronic Inhalation RfD (mg/kg-day)
Volatiles							
Acetone	D			1.00e-01 ^(A)		1.00e+00 ^(B)	
Benzene	A	2.90e-02 ^(A)	2.90e-02 ^(A,D)		171e-03 ^(D)		1.70e-02 ^(F)
Bromodichloromethane	B2	6.20e-02 ^(A)		2.00e-02 ^(A)		2.00e-02 ^(B)	
Carbon Disulfide				1.00e-01 ^(A)	1.00e-02 ^(B)	1.00e-01 ^(A,L)	1.00e-02 ^(B)
Carbon Tetrachloride	B2	1.30e-01 ^(A)	5.20e-02 ^(A,D)	7.00e-04 ^(A)	5.71e-04 ^(D)	7.00e-03 ^(A,L)	1.70e-02 ^(D)
Chlorobenzene	D			2.00e-02 ^(A)	2.00e-02 ^(B)	2.00e-01 ^(A,L)	
Chloroform	B2	6.10e-03 ^(A)	8.10e-02 ^(A,D)	1.00e-02 ^(A)		1.00e-02 ^(A,L)	1.10e-02 ^(B)
Chloromethane*	C						
1,1-Dichloroethene	C	6.00e-01 ^(A)	1.75e-01 ^(A)	9.00e-03 ^(A)		9.00e-03 ^(A)	
Ethyl Benzene	D			1.00e-01 ^(A)	2.86e-01 ^(A)	1.00e-01 ^(B)	2.86e-01 ^(D)
2-Hexanone	D			1.50e-01 ^(D)	1.50e-01 ^(D)	1.50e-01 ^(D)	1.50e-01 ^(D)
Tetrachloroethene	C-B2	5.20e-02 ^(D)	2.03e-03 ^(D)	1.00e-02 ^(A)		1.00e-01 ^(A,L)	
Toluene	D			2.00e-01 ^(A)	4.00e-01 ^(A)	2.00e+00 ^(A,L)	4.00e-01 ^(A,L)
1,1,1-Trichloroethane *	D						
Trichloroethene	C-B2	1.10e-02 ^(D)	6.00e-03 ^(D)	6.00e-03 ^(D)			
Trichlorofluoromethane				3.00e-01 ^(A)	7.00e-01 ^(B)	3.00e-01 ^(A,L)	7.00e+00 ^(B)
Trichlorotrifluoroethane				3.00e+01 ^(A)		3.00e+01 ^(A,L)	
Xylenes (total)	D			2.00e+00 ^(A)		2.00e+00 ^(A,L)	
BNAs							
Acenaphthene	D			6.00e-02 ^(A)			
Acenaphthylene	D			4.00e-02		4.00e-02	
Anthracene	D			3.00e-01 ^(A)		3.00e+00 ^(B)	
Benzo(a)anthracene	B2	7.30e-01 ^(F)	6.10e+00 ^(F)				
Benzo(a)pyrene	B2	7.30e+00 ^(A)	6.10e+00 ^(B)				
Benzo(b)fluoranthene	B2	7.30e-01 ^(F)	6.10e+00 ^(F)				
Benzo(g,h,i)perylene*	D						
Benzo(k)fluoranthene	B2	7.30e-02 ^(F)	6.10e+00 ^(F)				
bis(2-Ethylhexyl)phthalate	B2	1.40e-02 ^(A)		2.00e-02 ^(A)		1.00e-01 ^(A,L)	5.70e-02 ^(M)
Butylbenzylphthalate	C			2.00e-01 ^(A)		2.00e+00 ^(A,L)	
Carbazole	B2	2.00e-02 ^(A)					

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Chemical	Carcinogenic			Chronic		Subchronic	
	Weight of Evidence Classification	Oral Slope Factor (mg/kg-day) ⁻¹	Inhalation Slope Factor (mg/kg-day) ⁻¹	Chronic Oral RfD (mg/kg-day)	Chronic Inhalation RfD (mg/kg-day)	Subchronic Oral RfD (mg/kg-day)	Subchronic Inhalation RfD (mg/kg-day)
Chrysene	B2	7.30e-03 ^(F)	6.10e+00 ^(F)				
Dibenzo(a,h)anthracene	B2	7.30e+00 ^(F)	6.10e+00 ^(F)				
Di-n-butylphthalate	D			1.00e-01 ^(A)		5.00e-01 ^(A,L)	
Diethylphthalate	D			8.00e-01 ^(A)		8.00e+00 ^(A,L)	
2,4-Dimethylphenol	D			2.00e-02 ^(A)		2.00e-01 ^(B)	
Dimethylphthalate	D			1.00e+01 ^(B)		1.00e+01 ^(B)	
2,4-Dinitrotoluene				2.00e-03 ^(A)		2.00e-03 ^(A,L)	
Fluoranthene	D			4.00e-02 ^(A)		4.00e-01 ^(B)	
Fluorene	D			4.00e-02 ^(A)		4.00e-01 ^(B)	
Hexachlorobutadiene	C	7.80e-02 ^(A)	7.70e-02 ^(A)	2.00e-04 ^(B)		7.00e-04 ^(B)	
Indeno(1,2,3-cd)pyrene	B2	7.30e-01 ^(F)	6.10e+00 ^(F)				
2-Methylnaphthalene*	D						
2-Methylphenol	C			5.00e-02 ^(A)			
4-Methylphenol*	C						
N-Nitrosodiphenylamine	B2	4.90e-03 ^(A)					
Naphthalene*	D						
3-Nitroaniline	D			2.50e-03 ^(B)	2.50e-03 ^(C)	2.50e-03 ^(C)	2.50e-03 ^(C)
Phenanthrene	D			4.00e-02		4.00e-02	
Phenol	D			6.00e-01 ^(A)		6.00e-01 ^(B)	
Pyrene	D			3.00e-02 ^(A)		3.00e-01 ^(B)	
Pesticides/PCBs							
Aldrin	B2	1.70e+01 ^(A)	1.70e+01 ^(A)	3.00e-05 ^(A)		3.00e-05 ^(B)	
Aroclor 1254	B2	7.70e+00 ^(A)		2.00e-05 ^(A)		6.00e-05 ^(A)	
Aroclor 1260	B2	7.70e+00 ^(A)		2.00e-05 ^(L)		6.00e-05 ^(L)	
beta-BHC	C	1.80e+00 ^(A)					
delta-BHC*	D						
alpha-Chlordane	B2	1.30e+00 ^(A)	1.29e+00 ^(A)	6.00e-05 ^(A)		6.00e-05 ^(A,L)	
gamma-Chlordane	B2	1.30e+00 ^(A)	1.29e+00 ^(A)	6.00e-05 ^(A)		6.00e-05 ^(A,L)	
4,4'-DDD	B2	2.40e-01 ^(A)					
4,4'-DDE	B2	3.40e-01 ^(A)					

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4,4'-DDT	B2	3.40e-01 ^(A)	3.40e-01 ^(A)	5.00e-04 ^(A)		5.00e-04 ^(A,L)	
Dieldrin	B2	1.60e+01 ^(A)	1.61e+01 ^(A)	5.00e-05 ^(A)		5.00e-05 ^(B)	
Endosulfan				6.00e-03 ^(A)		6.00e-03 ^(A,L)	
Endosulfan II	D			6.00e-03		6.00e-03	
Endosulfan sulfate	D			6.00e-03		6.00e-03	
Endrin	D			3.00e-04 ^(A)		3.00e-04 ^(B)	
Endrin aldehyde*	D						
Endrin ketone*	D						
Heptachlor epoxide	B2	9.10e+00 ^(A)	9.10e+00 ^(A)	1.30e-05 ^(A)		1.30e-05 ^(B)	
Methoxychlor	D			5.00e-03 ^(A)		5.00e-03 ^(B)	
Inorganics							
Aluminum*							
Antimony				4.00e-04 ^(A)		4.00e-04 ^(A,L)	
Arsenic	A	1.75e+00 ^(A)	1.51e+01 ^(A)	3.00e-04 ^(A)		3.00e-04 ^(A,L)	
Barium				7.00e-02 ^(A)	5.00e-04 ^(B)	7.00e-02 ^(A,L)	5.00e-03 ^(B)
Beryllium	B2	4.30e+00 ^(A)	8.40e+00 ^(A)	5.00e-03 ^(A)		5.00e-03 ^(A,L)	
Cadmium	B1		6.30e+00 ^(A,B)	1.00e-03 ^(A) (food) 5.00e-04 ^(A) (water)		1.00e-03 ^(A,L) (food) 5.00e-04 ^(A,L) (water)	
Calcium*							
Chromium III	D			1.00e+00 ^(A)		1.00e+00 ^(A,L)	
Chromium VI	A		4.20e+01 ^(A)	5.00e-03 ^(A)		5.00e-03 ^(A,L)	
Cobalt					3.10e-06 ^(T)	2.30e-03 ^(T)	3.10e-06 ^(T)
Copper	D			2.00e-02 ^(B)		2.00e-02 ^(B)	
Cyanide (total)				2.00e-02 ^(A)	3.00e-03 ^(A)	2.00e-02 ^(A,L)	9.00e-02 ^(A,L)
Iron*							
Lead*	B2						
Magnesium*	D						
Manganese	D			1.40e-01 ^(A) (food) 5.00e-03 ^(A) (water)	5.00e-05 ^(A)	1.40e-01 ^(A,L) (food) 5.00e-03 ^(A,L) (water)	1.50e-04 ^(A,L)

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Toxicity Values for All Organic Compounds and
Inorganic Analytes Detected at the Malta Rocket Fuel Site

Chemical	Carcinogenic			Chronic		Subchronic	
	Weight of Evidence Classification	Oral Slope Factor (mg/kg-day) ⁻¹	Inhalation Slope Factor (mg/kg-day) ⁻¹	Chronic Oral RfD (mg/kg-day)	Chronic Inhalation RfD (mg/kg-day)	Subchronic Oral RfD (mg/kg-day)	Subchronic Inhalation RfD (mg/kg-day)
Mercury	D			3.00e-04 ^(B)	3.00e-04 ^(B)	3.00e-04 ^(B)	3.00e-04 ^(B)
Nickel			8.4e-01 ^(B,5)	2.00e-02 ^(A)		2.00e-02 ^(A,L)	
Potassium*							
Selenium	D			5.00e-03 ^(A)		5.00e-03 ^(A,L)	
Silver	D			5.00e-03 ^(A)		5.00e-03 ^(A,L)	
Sodium*							
Thallium*	D						
Vanadium				7.00e-03 ^(B)		7.00e-03 ^(B)	
Zinc	D			3.00e-01 ^(A)		3.00e-01 ^(A,L)	

Notes:

- (A) USEPA. Integrated Risk Information System (IRIS).
- (B) USEPA. 1994. Health Effects Assessment Summary Tables (HEAST). Supplement No. 1 to the March 1994 Annual Update. EPA 540/R-94/059. July.
- (C) Nair, RS, CS Auletta, RE Schroeder, and FR Johannsen. 1990. chronic toxicity, oncogenic potential, and reproductive toxicity of p-nitroaniline in rats. Fund. Appl. Toxicol. 15:607-621.
- (D) Allen, N, JR Mendell, DJ Billmaier, RE Fontaine, and J O'Neill. 1975. Toxic polyneuropathy due to methy-n-butyl ketone. Arch. Neurol. 32:209-218.
- (E) Tipton, IH, PL Stewart and PG Martin. 1966. Health Phys. 12:1683-1689.
- (F) USEPA. 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. EPA/600/2-93/089. July.
- (G) USEPA. 1993. Environmental Criteria and Assessment Office (ECAO), Superfund Technical Support Center. Interim Criteria for PCE and TCE (facsimile). November.
- (H) USEPA. ECAO. 1993. Derivation of a Provisional Subchronic Oral RfD for Ethylbenzene (CASRN 100-41-4). December 3.
- (I) USEPA. ECAO. 1994. Derivation of a Provisional Subchronic Oral RfD for Hexachlorobutadiene (CASRN 87-68-3). January 24.
- (J) USEPA. ECAO. 1994. Subchronic Toxicity Information for Benzene, Bromomethane, Ethylbenzene, Hexachlorobutadiene, Elemental Mercury Vapor and Toluene. Letter to K. Edelman. June 10.
- (K) ENVIRON derived from unit risk value.
- (L) ENVIRON derived from Chronic RfD.
- (M) Interim value from ECAO, pending confirmation by ECAO.
- (N) Withdrawn from IRIS or HEAST.
- (O) Other EPA documents as noted in USEPA Risk-Based Concentration Table, Fourth Quarter 1994.
- (P) USEPA. ECAO. 1994. Derivation of a Provisional Subchronic Inhalation RFC for Benzene (CASRN 71-43-2).
- (Q) USEPA. ECAO. 1993. Subchronic RFC for Carbon Tetrachloride (CASRN 56-23-5). August 25.
- (R) USEPA. ECAO. 1993. Subchronic RFC for Chloroform (CASRN 67-66-3). August 25.
- (S) Inhalation Slope Factor for Nickel Refinery Dust.
- (T) Tipton, IH, PL Stewart and PG Martin. 1966. Health Phys. 12:1683-1689. and Toxic Substances and Disease Registry (ATSDR). 1990. Toxicological profile for cobalt. Draft. U.S. Public Health Service.
- (U) Based on Aroclor 1254.
- * No toxicity values available pending confirmation by ECAO.

TABLE 2
MRFA Site: Summary of Exposure Pathways

Pathway	Receptor	Time-Frame Evaluated		Degree of Assessment		Rationale for Selection or Exclusion	Data Grouping
		Present	Future	Quant.	Qual.		
Ground Water							
Ingestion of Ground Water	On-site Employee	Yes	NA	X		Two on-site production wells currently supply potable water to the Malta Site. However, ground water is treated via a settling tank and air stripping prior to distribution to the facility.	All post-treatment ground water results from on-site production wells.
	On-site Resident	No	Yes	X		Future residential development of Malta Site is unlikely but may theoretically occur. Future residents may elect to install a private well on this property. Existing public water supply is not hydraulically connected to the water-bearing unconsolidated materials beneath the Malta Site.	All filtered and unfiltered ground water results from RI and results from the past two years of monitoring of Early Warning Monitoring System and untreated production well data. Samples to be divided into two groups based on a ground water divide which separates the former GE/Exxon Building from the Test Station. The use of treated water will be assessed in the uncertainty section.
Inhalation of Ground Water Contaminants During Showers	On-site Employee	No	No			Shower facilities do not exist at the Malta Site so employees cannot become exposed via this pathway.	
	On-site Resident	No	Yes	X		Some of the detected ground water contaminants exhibit Henry's Law Constants that are greater than 1×10^5 atm-m ³ /mole and molecular weights of less than 200 g/mole. These contaminants could easily volatilize from ground water, so future residents may be exposed during showers.	All filtered and unfiltered ground water results from RI and results from the past two years of monitoring of Early Warning Monitoring System. Samples to be divided into two groups based on a ground water divide which separates the former GE/Exxon Building from the Test Station. The use of treated water will be assessed in the uncertainty section.
Dermal Contact with Ground Water Contaminants During Showers	On-site Employee	No	No			Shower facilities do not exist at the Malta site so employees cannot become exposed via this pathway.	All filtered and unfiltered ground water results from RI, untreated production well data and results from the past two years of monitoring of Early Warning Monitoring System. Samples divided into two groups based on a ground water divide which separates the former GE/Exxon Building from the Test Station. The use of treated water will be assessed in the uncertainty section.
	On-site Resident	No	Yes	X		Future residential development of Malta site may occur. Future residents may elect to install a private well on this property. Future residents may be exposed during showers.	

TABLE 2
MRFA Site: Summary of Exposure Pathways

Pathway	Receptor	Time-Frame Evaluated		Degree of Assessment		Rationale for Selection or Exclusion	Data Grouping
		Present	Future	Quant.	Qual.		
Surface Soils							
Incidental Ingestion of On-site Surface Soils	Trespasser	No	No			Trespassing is not expected due to strict Site security and perimeter fence.	
	On-site Employee	Yes	NA	X		Current employees may be exposed during outdoor activities (e.g., lunch, maintenance).	All surface soil samples (0-2') from RI. Possibility for separate specific area analysis; first may include Area S-1, Building 21, and Building 23P; second includes Areas SS-20/1 and SS-21.
	On-site Resident	No	Yes	X		Future residential development of Malta Site may occur.	All surface soil samples (0-2') from RI. Possibility for separate specific area analysis; first may include Area S-1, Building 21, and Building 23P; second includes Areas SS-20/1 and SS-21.
	Excavation Worker	No	Yes	X		Future residential development of Site may occur. Workers may be exposed to surface soils during excavation.	All surface soil samples (0-2') from RI. Possibility for separate specific area analysis; first may include Area S-1, Building 21, and Building 23P; second includes Areas SS-20/1 and SS-21.
Dermal Contact with On-site Surface Soils							
	Trespasser	No	No			Trespassing is not expected due to strict Site security and perimeter fence.	
	On-site Employee	Yes	NA	X			All surface soil samples (0-2') from RI. Possibility for separate specific area analysis of Area S-1, Building 21, and Building 23P.
	On-site Resident	No	Yes	X		Future residential development of Malta Site may occur.	All surface soil samples (0-2') from RI. Possibility for separate specific area analysis of Area S-1, Building 21, and Building 23P.
	Excavation	No	Yes	X		Future residential development of Malta Site may occur.	All surface soil samples (0-2') from RI. Possibility for separate specific area analysis of Area S-1, Building 21, and Building 23P.

TABLE 2 MRFA Site: Summary of Exposure Pathways						
Pathway	Receptor	Time-Frame Evaluated			Rationale for Selection or Exclusion	Data Grouping
		Present	Future	Degree of Assessment Quant.		
Surface Soils						
Inhalation of On-site Surface Soils Released as Fugitive Dusts	On-site Employee	No	NA		No inhalation exposures to particulate emissions are likely because vegetation, pavement and prevailing wind patterns in the area will limit releases to air.	
	On-site Resident	No	No			
	Excavation Worker	No	Yes	X	Workers may be exposed to volatile or particulate emissions during excavation activities.	All surface soil samples (0-2') from RI. Possibility for separate specific area analysis of Area S-1, Building 21, and Building 23P.
Subsurface Soils						
Incidental Ingestion of On-site Subsurface Soils	Excavation Worker	No	Yes	X	Future residential development of Site may occur. Workers may be exposed to subsurface soils during excavation.	All soil samples between 2 and 16 feet below ground surface.
Dermal Contact with On-site Subsurface Soils(a)	Excavation Worker	No	Yes	X	Future residential development of Site may occur. Workers may be exposed to subsurface soils during excavation.	All soil samples between 2 and 16 feet below ground surface.
Inhalation of Subsurface Soil	Excavation Worker	No	Yes	X	Workers may be exposed to volatile or particulate emissions during excavation activities.	All soil samples between 2 and 16 feet below ground surface.
Sediments						
Incidental Ingestion of Sediments from:						
Quench Pits	Utility Worker or On-site Employee	No	No		The quench pits are no longer in use, located 30 to 35 feet below ground surface.	
Dry Wells	Utility Worker	Yes	Yes	X	Periodic maintenance is required to maintain adequate flow.	All dry well sediment samples from RI.
Muggett's Pond	On-site Employee	No	No		Facility operations do not involve activities at the pond.	
	On-site Resident	No	Yes	X	Wading may occur during warmer seasons if Malta Site is developed for residential use.	All sediment samples collected from Muggett's Pond during RI.
Ravine 1b	Trespasser	Yes	Yes	X	Wading may occur during warmer seasons since access to easement is not restricted.	Ravine 1b sediment samples from RI.
	On-site Resident	No	Yes	X	Wading may occur during warmer seasons if Malta Site is developed for residential use.	Ravine 1b sediment samples from RI.

TABLE 2
MRFA Site: Summary of Exposure Pathways

Pathway	Receptor	Time-Frame Evaluated		Degree of Assessment		Rationale for Selection or Exclusion	Data Grouping
		Present	Future	Quant.	Qual.		
Sediments							
Dermal Contact with Sediments from:							
Quench Pits	Utility Worker or On-site Employee	No	No			The quench pits are no longer in use, and are located 30 to 35 feet below ground surface.	
Dry Wells	Utility Worker	Yes	Yes	X		Periodic maintenance is required to maintain adequate flow.	All dry well sediment samples from RI.
Muggett's Pond	On-site Employee	No	No			Facility operations do not involve activities at the pond.	
	On-site Resident	No	Yes	X		Wading may occur during warmer seasons if site is developed for residential use.	All sediment samples collected from Muggett's Pond during RI.
Ravine 1b	Trespasser	Yes	Yes	X		Wading may occur during warmer seasons since access to easement is not restricted.	Ravine 1b sediment samples from RI.
	On-site Resident	No	Yes	X		Wading may occur during warmer seasons if site is developed for residential use.	Ravine 1b sediment samples from RI.
Surface Water							
Incidental Ingestion of Surface Water from:							
Quench Pits	Utility Worker or On-site Employee	No	No			The quench pits are no longer in use, and are located 30 to 35 feet below ground surface.	
Dry Wells	Utility Worker	No	No			It is assumed that water is not typically present in these structures.	
Muggett's Pond	On-site Employee	No	No			Facility operations do not involve activities at the pond.	
	On-site Resident	No	No			Muggett's Pond is too shallow to support swimming (less than two feet deep). Although wading is possible, incidental ingestion is unlikely during wading.	

TABLE 2
MRFA Site: Summary of Exposure Pathways

Pathway	Receptor	Time-Frame Evaluated		Degree of Assessment		Rationale for Selection or Exclusion	Data Grouping
		Present	Future	Quant.	Qual.		
Surface Water							
Ravine 1b	Trespasser	No	No			Ravine 1b stream is too shallow to support swimming (less than one foot deep). Although wading is possible, incidental ingestion is unlikely during wading.	
	On-site Resident	No	No				
Dermal Contact with Surface Water from:							
Quench Pits	Utility Worker or On-site Employee	No	No			The quench pits are no longer in use, and are located 30 to 35 feet below ground surface.	
Dry Wells	Utility Worker	No	No			It is assumed that water is not typically present in these structures.	
Muggett's Pond	On-site Employee	No	No			Facility operations do not involve activities at the pond.	
	On-site Resident	No	Yes	X		Wading is possible if site is developed for residential use. However, Muggett's Pond is too shallow to support swimming (less than two feet deep).	All surface water samples collected from Muggett's Pond during RI.
Ravine 1b	Trespasser	Yes	Yes	X		Wading may occur since access to the ravine is not restricted.	Surface water sample collected from Ravine 1b.
	On-site Resident	No	Yes	X		Wading may occur if site is developed for residential use.	Surface water sample collected from Ravine 1b.

TABLE 2 MRFA Site: Summary of Exposure Pathways						
Pathway	Receptor	Time-Frame Evaluated		Degree of Assessment		Data Grouping
		Present	Future	Quant.	Qual.	
Air						
All inhalation pathways are addressed in ground water or surface soil discussions.						

NA = Not applicable; future site conditions are assumed to be identical to current site conditions for this specific pathway.

TABLE 3
Exposure Pathway: Ingestion of Ground Water by On-Site Workers for Present Scenario

Variable	Range	Midpoint	Value Used	Rationale	Reference
Receptor Population				On-site Worker	
Body Weight (kg)					
On-site Worker	--	--	70	Per EPA Guidance	RAGS Suppl.
Duration of Exposure (years)					
On-site Worker	1 - 30	15	25	Per EPA Guidance	RAGS Suppl.
Exposure Frequency (days/year)	1 - 365	182.5	250	Per EPA Guidance	RAGS Suppl.
Ingestion Rate (L/day)	--	--	1	Per EPA Guidance	RAGS Suppl.
Averaging Time (days)					
Noncarcinogens	--	--	9125	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens.	RAGS
Carcinogens	--	--	25550		

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Vol. I. Supplemental Guidance: Standard Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 4
Exposure Pathway: Ingestion of Ground Water by On-Site Resident for Future Scenario

Variable	Range	Midpoint	Value Used	Rationale	Reference
Receptor Population				On-site Resident	
Body Weight (kg)					
Child (1-6 yrs)	--	--	15	Per EPA Guidance	RAGS Suppl.
Adult	--	--	70		
Duration of Exposure (years)					
Child	1 - 6	3	6	90th percentile for time at a single residence	RAGS Suppl.
Adult	1 - 70	35	24		
Exposure Frequency (days/year)	1 - 350	175	350	Per EPA Guidance	RAGS Suppl.
Ingestion Rate (L/day)	--	--	2	Per EPA Guidance	RAGS Suppl.
Averaging Time (days)					
Child					
Noncarcinogens	--	--	2190	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens.	RAGS
Carcinogens	--	--	25550		
Adult			8760		
Noncarcinogens	--	--	25550		
Carcinogens	--	--			

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Vol. I. Supplemental Guidance: Standard Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 5
Exposure Pathway: Inhalation of Contaminants Volatilized from Ground Water
When On-Site Residents Shower for Future Scenario

Variable	Range	Midpoint	Value Used	Rationale	Reference
Receptor Population				On-site Resident	
Contaminant Concentration (mg/m ³)					
Modeled value based on RME ground water concentrations					
Body Weight (kg)					
Child (1-6 yrs)	--	--	15	Per EPA Guidance	RAGS Suppl.
Adult	--	--	70		
Exposure Time (hour/day)	0.116 - 0.2	0.158	0.2	90th percentile value for showering	RAGS
Duration of Exposure (years)					
Child	1 - 6	3	6	90th percentile for time at a single residence	RAGS Suppl.
Adult	1 - 70	35	24		
Exposure Frequency (days/year)	1 - 350	175	350	Per EPA Guidance	RAGS Suppl.
Inhalation Rate (m ³ /day)	--	--	0.6	Value used is an hourly rate that is specific to showering activities	RAGS
Averaging Time (days)					
<u>Child</u>					
Noncarcinogens	--	--	2190	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens.	RAGS
Carcinogens	--	--	25550		
<u>Adult</u>					
Noncarcinogens	--	--	8760		
Carcinogens	--	--	25550		

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Vol. I. Supplemental Guidance: Standard Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 6
Exposure Pathway: Dermal Contact with Ground Water
When On-Site Residents Shower/Bathe for Future Scenario

Variable	Range	Midpoint	Value Used	Rationale	Reference
Receptor Population					
				On-site Resident	
Body Weights (kg)					
Child (1-6 yrs)	--	--	15	Per EPA Guidance	RAGS Suppl.
Adult	--	--	70		
Exposure Time (hour/day)					
	0.116 - 0.2	0.158	0.2	90th percentile value for showering/bathing	RAGS
Duration of Exposure (years)					
Child	1 - 6	3	6	90th percentile for time at a single residence	RAGS Suppl.
Adult	1 - 70	35	24		
Exposure Frequency (days/year)					
	1 - 350	175	350	Per EPA Guidance	RAGS Suppl.
Skin Surface Area Contacted (cm²)					
Child	--	--	7280	50th percentile value averaged over entire group	DEA
Adult	17000 - 23000	20000	20000		
Permeability Coefficient (cm/hr)					
Chemical-specific	--	--	Various	Chemical-specific values	DEA
Averaging Time (days)					
Child					RAGS
Noncarcinogens	--	--	2190	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens.	
Carcinogens	--	--	25550		
Adult					
Noncarcinogens	--	--	8760		
Carcinogens	--	--	25550		

DEA: *Dermal Exposure Assessment: Principles and Applications, Interim Report*, EPA 600/8-91/011B. Office of Research and Development. January 1992.

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Vol. I. Supplemental Guidance: Standard Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 7
Exposure Pathway: Incidental Ingestion of Surface Soils
by On-Site Employee for Present Scenario

Variable	Range	Midpoint	Value Used	Rationale	Reference
<i>Receptor Population</i>				On-site Employee	
<i>Body Weight (kg)</i> On-site Worker	--	--	70	Per EPA Guidance	RAGS Suppl.
<i>Duration of Exposure (years)</i> On-site Worker	1 - 30	15	25	Per EPA Guidance	RAGS Suppl.
<i>Exposure Frequency (days/year)</i>	1 - 365	182.5	250	Assumes 5 day work week for 50 weeks per year	RAGS Suppl.
<i>Ingestion Rate (mg/day)</i>	--	--	50	Value used is specified for adult workers	RAGS Suppl.
<i>Averaging Time (days)</i> Noncarcinogens Carcinogens	-- --	-- --	9125 25550	Value used is based on exposure duration for noncarcinogens and lifetime for carcinogens	RAGS

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Vol. I. Supplemental Guidance: Standard Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 8
Exposure Pathway: Incidental Ingestion of On-Site Surface Soils by
On-Site Resident for Future Scenario

Variable	Range	Midpoint	Value Used	Rationale	Reference
<i>Receptor Population</i>			On-site Resident		
<i>Body Weight (kg)</i>					
Child (1 - 6 yrs)	--	--	15	Per EPA Guidance	RAGS Suppl.
Adult	--	--	70		
<i>Duration of Exposure (years)</i>					
Child	1 - 6	3	6	Total years in age group.	RAGS Suppl.
Adult	1 - 70	35	24	90th percentile for time at a single residence	
<i>Exposure Frequency (days/year)</i>	1-350	175	350	Per EPA Guidance	RAGS Suppl.
<i>Ingestion Rate (mg/day)</i>					
Child	--	--	100	Per EPA Guidance.	RAGS Suppl.
Adult	--	--	50	Assumes 50% daily incidental soil ingestion rate.	
<i>Averaging Time (days)</i>					
Child					
Noncarcinogens	--	--	2190	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS
Carcinogens	--	--	25550		
Adult					
Noncarcinogens	--	--	8760		
Carcinogens	--	--	25550		

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I. Supplemental Guidance: Standards Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 9
Exposure Pathway: Dermal Contact with Surface Soils by On-Site Employee for Present Scenario

Variable	Range	Midpoint	Value Used	Rationale	Reference
<i>Receptor Population</i>				On-site Employee	
<i>Body Weight (kg)</i> On-Site Worker	--	--	70	Per EPA Guidance	RAGS Suppl.
<i>Duration of Exposure (years)</i> On-Site Worker	1 - 70	35	25	Assumes 5 day work weeks for 50 weeks per year	RAGS Suppl.
<i>Exposure Frequency (days/year)</i>	1 - 350	175	250	Per EPA Guidance	RAGS Suppl.
<i>Skin Surface Area Contacted (cm²)</i>					
Arms	1090 - 2920	2005	2280	50th percentile values averaged over entire age group	DEA
Hands	596 - 1130	863	840		
Lower Legs	930 - 2960	1945	2070		
Total Area of These Limbs	2616 - 7010	4813	5190		
<i>Soil Skin Adherence Factor (mg/cm²)</i>	0.2-1.0	0.6	0.6	Value used is midpoint of range	DEA
<i>Absorption Factor</i> Chemical-specific	--	--	Various	Chemical-specific values	DEA
<i>Averaging Time (days)</i> Noncarcinogens	--	--	9125	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS
Carcinogens	--	--	25550		

DEA: *Dermal Exposure Assessment: Principles and Applications, Interim Report*, EPA 600/8-91/011B. Office of Research and Development. January 1992.

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I. Supplemental Guidance: Standards Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 10
Exposure Pathway: Dermal Contact with Surface Soils
by On-Site Resident for Future Scenario

Variable	Range	Midpoint	Value Used	Rationale	Reference
<i>Receptor Population</i>				On-site Resident	
<i>Body Weight (kg)</i>					
Child (1 - 6 yrs)	--	--	15	Per EPA Guidance	RAGS Suppl.
Adult	--	--	70		
<i>Duration of Exposure (years)</i>					
Child	1 - 6	3	6	Total years in age group.	RAGS Suppl.
Adult	1 - 70	35	24	90th percentile for time at a single residence	
<i>Exposure Frequency (days/year)</i>	1 - 350	175	350	Per EPA Guidance	RAGS Suppl.
<i>Skin Surface Area Contacted (cm²)</i>					
<u>Child</u>					
Arms	932 - 1039	941	950	Per EPA Guidance	DEA, EFH
Hands	376 - 445	381	390		
Lower Legs	732 - 816	763	770		
Total Area of These Limbs	2040 - 2300	2085	2110		
<u>Adult</u>					
Arms	1090 - 2920	2005	2280	Per EPA Guidance	DEA
Hands	596 - 1130	863	840		
Lower Legs	930 - 2960	1945	2070		
Total Area of These Limbs	2616 - 7010	4813	5190		
<i>Soil Skin Adherence Factor (mg/cm²)</i>	0.2-1.0	0.6	0.6	Value used is midpoint of range	DEA
<i>Absorption Factor</i>					
Chemical-specific	--	--	Various	Chemical-specific values	DEA
<i>Averaging Time (days)</i>					
<u>Child</u>					
Noncarcinogens	--	--	2190	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS
Carcinogens	--	--	25550		
<u>Adult</u>					
Noncarcinogens	--	--	8760		
Carcinogens	--	--	25550		

DEA: *Dermal Exposure Assessment: Principles and Applications, Interim Report*, EPA 600/8-91/011B. Office of Research and Development. January 1992.

ERH: *Exposure Factors Handbook*, EPA 600/8-89/043. Exposure Assessment Group, Office of Health and Environmental Assessment. 1989.

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I. Supplemental Guidance: Standards Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 11
Exposure Pathway: Incidental Ingestion of
Surface and Subsurface Soils by Excavation Worker
For Future Scenarios

Variable	Range	Midpoint	Value Used	Rationale	Reference
<i>Receptor Population</i>				Excavation Worker	
<i>Body Weight (kg)</i> Excavation Worker	--	--	70	Per EPA Guidance	RAGS Suppl.
<i>Duration of Exposure (years)</i> Excavation Worker	1 - 30	15	1	Per EPA Guidance	RAGS Suppl.
<i>Exposure Frequency (days/year)</i>	1 - 365	182.5	65	Assume excavation occurs 5 days/week for 3 months	
<i>Ingestion Rate (mg/day)</i>	--	--	480	Value used is specified for adults engaged in yard work	RAGS Suppl.
<i>Averaging Time (days)</i> Noncarcinogens Carcinogens	-- --	-- --	65 25550	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS

RAGS: *Risk Assessment Guidance for Superfund, Volume 1*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.
RAGS Suppl.: *Risk Assessment Guidance for Superfund, Vol. 1. Supplemental Guidance: Standard Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 12
Dermal Contact With Surface and Subsurface Soils
by Excavation Worker for Future Scenario

Variable	Range	Midpoint	Value Used	Rationale	Reference
<i>Receptor Population</i>				Excavation Worker	
<i>Body Weight (kg)</i> Excavation Worker	--	--	70	Per EPA Guidance	RAGS Suppl.
<i>Duration of Exposure (years)</i> Adult	1 - 70	35	1	Per EPA Guidance	RAGS Suppl.
<i>Exposure Frequency (days/year)</i>	1 - 350	175	65	Assume excavation occurs 5 days/week for 3 months Per EPA guidance	
<i>Skin Surface Area Contacted (cm²)</i>					
Arms	1090 - 2920	2005	2280	50th percentile values averaged over entire age group	DEA
Hands	596 - 1130	863	840		
Lower Legs	930 - 2960	1945	2070		
Total Area of These Limbs	2616 - 7010	4813	5190		
<i>Soil Skin Adherence Factor (mg/cm²)</i>	0.2-1.0	0.6	0.6	Value used is midpoint of range	DEA
<i>Absorption Factor</i> Chemical-specific	--	--	Various	Chemical-specific values	DEA
<i>Averaging Time (days)</i>					
Noncarcinogens	--	--	65	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS
Carcinogens	--	--	25550		

DEA: *Dermal Exposure Assessment: Principles and Applications, Interim Report*, EPA 600/8-91/011B. Office of Research and Development. January 1992.

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I. Supplemental Guidance: Standards Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 13
Exposure Pathway: Incidental Ingestion of
Dry Well Sediments by Utility Worker
for Present and Future Scenarios

Variable	Range	Midpoint	Value Used	Rationale	Reference
Receptor Population				Utility Worker	
Body Weight (kg) Utility Worker	--	--	70	Per EPA Guidance	RAGS Suppl.
Duration of Exposure (years) Utility Worker	1 - 30	15	25	Per EPA Guidance	RAGS Suppl.
Exposure Frequency (days/year)	1 - 365	182.5	2	Assume maintenance of dry wells is necessary 2 days/year	
Ingestion Rate (mg/day)	--	--	50	Value used is specified for adults	RAGS Suppl.
Averaging Time (days) Noncarcinogens Carcinogens	-- --	-- --	9125 25550	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS

RAGS: *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.
RAGS Suppl.: *Risk Assessment Guidance for Superfund, Vol. I. Supplemental Guidance: Standard Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 14
Exposure Pathway: Dermal Contact With
Dry Well Sediments by Utility Worker
For Present and Future Scenarios

Variable	Range	Midpoint	Value Used	Rationale	Reference
<i>Receptor Population</i>				Utility Worker	
<i>Body Weight (kg)</i> Utility Worker	--	--	70	Per EPA Guidance	RAGS Suppl.
<i>Duration of Exposure (years)</i>	1 - 70	35	25	Per EPA Guidance	RAGS Suppl.
<i>Exposure Frequency (days/year)</i>	1 - 350	175	2	Assume maintenance of dry wells is necessary 2 days/year	
<i>Skin Surface Area Contacted (cm²)</i>					
Arms	1090 - 2920	2005	2280	50th percentile values averaged over entire age group	DEA
Hands	596 - 1130	863	840		
Lower Legs	930 - 2960	1945	2070		
Total Area of These Limbs	2616 - 7010	4813	5190		
<i>Soil Skin Adherence Factor (mg/cm²)</i>	0.2-1.0	0.6	0.6	Value used is midpoint of range	DEA
<i>Absorption Factor</i> Chemical-specific	--	--	Various	Chemical-specific values	DEA
<i>Averaging Time (days)</i>					
Noncarcinogens	--	--	9125	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS
Carcinogens	--	--	25550		

DEA: *Dermal Exposure Assessment: Principles and Applications, Interim Report*, EPA 600/8-91/011B. Office of Research and Development. January 1992.

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I. Supplemental Guidance: Standards Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 15
Exposure Pathway: Incidental Ingestion of Sediments
in Ravine 1B by Youth Trespassers
For Present and Future Scenarios

Variable	Range	Midpoint	Value Used	Rationale	Reference
<i>Receptor Population</i>				Youth Trespasser	
<i>Body Weight (kg)</i> Trespasser (9-18 yrs)	30.7 - 66.7	48.7	50	Per EPA Guidance	EFH
<i>Duration of Exposure (years)</i> Trespasser	1 - 10	5	10	Total years in age group	RAGS Suppl.
<i>Exposure Frequency (days/year)</i>	1 - 273	136.5	117	Assumes 5 d/wk outdoors during summer and 2 d/wk during spring and fall (39 weeks total)	
<i>Ingestion Rate (mg/day)</i>	--	--	50	Per EPA Guidance. Assumes 50% of daily incidental sediment ingestion rate.	RAGS Suppl.
<i>Averaging Time (days)</i> Noncarcinogens Carcinogens	-- --	-- --	3650 25550	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS

EFH: *Exposure Factors Handbook*, EPA 600/8-89/043. Exposure Assessment Group, office of Health and Environmental Assessment. 1989.

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I. Supplemental Guidance: Standards Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 16
Exposure Pathway: Incidental Ingestion of
Sediments in Muggett's Pond Sediments and
Ravine 1B by On-Site Residents for Future Scenarios

Variable	Range	Midpoint	Value Used	Rationale	reference
Receptor Population				On-site Resident	
Body Weight (kg)					
Child					
1 - 5 yrs	--	--	15	Per EPA Guidance	RAGS Suppl.
6 - 15 yrs	--	--	39		
Adult	--	--	70		
Duration of Exposure (years)					
Child					
1 - 5 yrs	1 - 5	3	5	Total years in age group. 90th percentile for time at a single residence	RAGS Suppl.
6 - 15 yrs	1 - 10	5	10		
Adult	1 - 15	8	15		
Exposure Frequency (days/year)					
Child					
1 - 5 yrs	0	0	0	No exposure is expected for this age group. Assumes 5 d/wk outdoors during summer and 3 d/wk during spring and fall (39 weeks total) Assumes 2 d/wk outdoors during spring, summer, and fall (39 weeks total)	
6 - 15 yrs	1 - 365	1 - 365	143		
Adult	1 - 365	1 - 365	78		
Ingestion Rate (mg/day)					
Child	--	--	100	Per EPA Guidance. Assumes 50% of daily incidental sediment ingestion rate.	RAGS Suppl.
Adult	--	--	50		
Averaging Time (days)					
Child (6 - 15 yrs)					
Noncarcinogens	--	--	3650	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS
Carcinogens	--	--	25550		
Adult					
Noncarcinogens	--	--	5475		
Carcinogens	--	--	25550		

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I. Supplemental Guidance: Standards Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 17
Exposure Pathway: Dermal Contact With Sediments
in Ravine 1B by Youth Trespassers for
Present and Future Scenarios

Variable	Range	Midpoint	Value Used	Rationale	Reference
<i>Receptor Population</i>				Youth Trespasser	
<i>Body Weight (kg)</i> Youth (Age 9-18)	--	--	50	Value used is average of all age groups in range.	EFH
<i>Duration of Exposure (years)</i> Youth	1 - 10	5	10	Total years in age group.	
<i>Exposure Frequency (days/year)</i>	1 - 365	1 - 365	117	Assumes 5 d/wk outdoors during summer and 2 d/wk during spring and fall (39 weeks total)	
<i>Skin Surface Area Contacted (cm²)</i>					
Arms	--	2035	2040	50th percentile values averaged over entire age group	EFH
Hands	--	778	780		
Lower Legs	--	1876	1880		
Total Area of These Limbs	--	4689	4700		
<i>Soil Skin Adherence Factor (mg/cm²)</i>	0.2-1.0	0.6	0.6	Value used is midpoint of range	DEA
<i>Absorption Factor</i> Chemical-specific	--	--	Various	Chemical-specific values	DEA
<i>Averaging Time (days)</i>					
Noncarcinogens	--	--	3650	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS
Carcinogens	--	--	25550		

- DEA: *Dermal Exposure Assessment: Principles and Applications, Interim Report*, EPA 600/8-91/011B. Office of Research and Development. January 1992.
- EFH: *Exposure Factors Handbook*, EPA 600/8-89/043. Exposure Assessment Group, Office of Health and Environmental Assessment. 1989.
- RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

TABLE 18
Exposure Pathway: Dermal Contact With Sediments in Muggett's Pond and Ravine 1B
by On-Site Resident for Future Scenarios

Variable	Range	Midpoint	Value Used	Rationale	Reference
Receptor Population					
On-site Resident					
Body Weight (kg)					
Child				Per EPA Guidance	RAGS Suppl.
1 - 5 yrs	--	--	15		
6 - 15 yrs	--	--	39		
Adult	--	--	70		
Duration of Exposure (years)					
Child					
1 - 5 yrs	1 - 5	3	5	Total years in age group.	RAGS Suppl.
6 - 15 yrs	1 - 10	5	10	90th percentile for time at a	
Adult	1 - 15	8	18	single residence	
Exposure Frequency (days/year)					
Child					
1 - 5 yrs	0	0	0	No exposure is expected for this age group.	
6 - 15 yrs	1 - 365	1 - 365	143	Assumes 5 d/wk outdoors during summer and 3 d/wk during spring and fall (39 weeks total)	
Adult	1 - 365	1 - 365	78	Assumes 2 d/wk outdoors during spring, summer, and fall (39 weeks total)	
Skin Surface Area Contacted (cm²)					
Child (6 - 15 yrs)					
Arms	--	1523	1530	Per EPA Guidance	DEA, EFH
Hands	--	615	620		
Lower Legs	--	1463	1470		
Total Area of These Limbs	--	360	3620		
Adult					
Arms	1090 -	2005	2280	Per EPA Guidance	DEA
Hands	2920	863	840		
Lower Legs	596 -	1945	2070		
Total Area of These Limbs	1130				
	930 -	4813	5190		
	2960				
	2616 -				
	7010				
Soil Skin Adherence Factor (mg/cm²)					
	0.2-1.0	0.6	0.6	Value used is midpoint of range	DEA
Absorption Factor					
Chemical-specific	--	--	Various	Chemical-specific values	DEA
Averaging Time (days)					
Child (6 - 15 yrs)					
Noncarcinogens	--	--	3650	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS
Carcinogens	--	--	25550		
Adult					
Noncarcinogens	--	--	5475		
Carcinogens	--	--	25550		

DEA: *Dermal Exposure Assessment: Principles and Applications, Interim Report*, EPA 600/8-91/011B. Office of Research and Development. January 1992.

EFH: *Exposure Factors Handbook*, EPA 600/8-89/043. Exposure Assessment Group, Office of Health and Environmental Assessment. 1989

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I. Supplemental Guidance: Standards Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 19
Exposure Pathway: Dermal Contact With
Surface Water in Ravine 1B by Youth
Trespasser for Present and Future Scenarios

Variable	Range	Midpoint	Value Used	Rationale	Reference
Receptor Population				Youth Trespasser	
Body Weight (kg) Youth (Age 9-18)	--	--	50	Per EPA Guidance	EFH
Duration of Exposure (years) Youth	1 - 10	5	10	Total years in age group.	RAGS Suppl.
Exposure Frequency (days/year)	1 - 273	136.5	117	Assumes 5 d/wk outdoors during summer and 2 d/wk during spring and fall (39 weeks total)	
Skin Surface Area Contacted (cm ²)					
Arms	--	2035	2040	50th percentile values averaged over entire age group	EFH
Hands	--	778	780		
Lower Legs	--	1876	1880		
Total Area of These Limbs	--	4689	4700		
Dermal Permeability Constant Chemical-specific	--	--	Various	Chemical-specific values	DEA
Averaging Time (days)					
Noncarcinogens	--	--	3650	Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS
Carcinogens	--	--	25550		

DEA: *Dermal Exposure Assessment: Principles and Applications, Interim Report*, EPA 600/8-91/011B. Office of Research and Development. January 1992.

EFH: *Exposure Factors Handbook*, EPA 600/8-89/043. Exposure Assessment Group, Office of Health and Environmental Assessment. 1989

RAGS: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I*, EPA 540/1-89/002. Office of Emergency and Remedial Response. December 1989.

RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume I. Supplemental Guidance: Standards Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

TABLE 20
Dermal Contact With Surface Water in
Muggett's Pond and Ravine 1B by On-Site
Resident for Future Scenarios

Variable	Range	Midpoint	Value Used	Rationale	Reference
Receptor Population					
On-site Resident					
Body Weights (kg)					
<u>Child</u>				Per EPA Guidance	RAGS Suppl.
1-5 years	--	--	15		
6-15 years	--	--	39		
Adult	--	--	70		
Duration of Exposure (years)					
<u>Child</u>				Total years in age group. 90th percentile for time at a single residence	RAGS Suppl.
1-5 years	1-5	3	5		
6-15 years	1-10	5	10		
Adult	1-15	8	15		
Exposure Frequency (days/year)					
<u>Child</u>				No exposure is expected for this age group.	
1-5 years	0	0	0	Assumes 5 d/wk outdoors during summer and 3 d/wk during spring and fall (39 weeks total)	
6-15 years	1-365	1-365	143		
Adult	1-365	183	78	Assumes 2 d/wk outdoors during spring, summer, and fall (39 weeks total)	
Skin Surface Area Contacted (cm²)					
<u>Child (6-15 years)</u>				Per EPA Guidance	DEA, EFH
Arms	--	1523	1530		
Hands	--	615	620		
Lower Legs	--	1463	1470		
Total Area of These Limbs	--	3601	3620		
<u>Adult</u>				Per EPA Guidance	DEA
Arms	1090-2920	2005	2280		
Hands	596-1130	863	840		
Lower Legs	930-2960	1945	2070		
Total Area of These Limbs	2616-7010	4813	5190		
Dermal Permeability Constant					
Chemical-specific	--	--	Various	Chemical-specific values	DEA
Averaging Time (days)					
<u>Child (6-15 years)</u>				Values used are based on exposure duration for noncarcinogens and lifetime exposure for carcinogens	RAGS
Noncarcinogens	--	--	3650		
Carcinogens	--	--	25550		
<u>Adult</u>					
Noncarcinogens	--	--	5475		
Carcinogens	--	--	25550		

DEA: *Dermal Exposure Assessment: Principles and Applications, Interim Report*, EPA 600/8-91/011B. Office of Research and Development. January 1992.

EFH: *Exposure Factors Handbook*, EPA 600/8-89/043. Exposure Assessment Group, Office of Health and Environmental Assessment. 1989.

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RAGS Suppl.: U.S. EPA, *Risk Assessment Guidance for Superfund, Volume 1. Supplemental Guidance: Standards Default Exposure Factors*, Interim Final. Office of Emergency and Remedial Response. March 1991.

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