N60200.AR.000964
NAS CECIL FIELD, FL
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TECHNICAL MEMORANDUM REGARDING REMEDIAL INVESTIGATION AT OPERABLE UNIT 3 (OU 3) SITE 7 AND SITE 8 WITH ATTACHMENTS NAS CECIL FIELD FL
9/27/1996
ABB ENVIRONMENTAL SERVICES INC

NAS Cecil Field Administrative Record
Document Index Number

32215-003
03.07.03.0002

Technical Memorandum

Remedial Investigation
Operable Unit 3, Sites 7 and 8
NAS Cecil Field
Jacksonville, Florida

Introduction

The Base Realignment and Closure (BRAC) Cleanup Team (BCT) has requested modification of the Operable Unit (OU) 3 Remedial Investigation (RI) report (ABB-ES, 1996a) to include an estimation of risks associated with exposure to surface soil by a future residential population. The information contained within this technical memorandum will be incorporated into the final version of RI report.

The risk estimating procedures are presented in the General Information Report (ABB-ES, 1996b). Chemicals selected as chemicals of potential concern and each chemical's exposure concentration are identified in Chapter 6 of the draft RI. The residential exposure to carcinogens is an aggregate exposure composed of a child exposure (six-year duration) and an adult exposure (24-year duration) resulting in a combined 30-year exposure. The non-carcinogen exposures are not accumulative over time, therefore, adult and child hazard index (HI) are reported separately.

Risks associated with Sites 7 and 8 are calculated separately to accurately evaluate each site's potential risk. The RI identified a "hot spot" at Site 7. The hot spot was resampled and the results from the original sampling and the resampling will be presented in a separate addendum. Because the hot spot data will be presented separately, the RI and this technical memorandum did not include the hot spot results as part of the data set analysis.

Sites 7 and 8 are located next to the NAS Cecil Field 9 and 27 flightline, in an industrial area. The RI estimated human health risks associated with exposure to surface soil by a population performing activities associated with an industrial area (occupational workers, site maintenance workers, and excavation workers). This memorandum estimates the human health risks associated with activities typical of a residential population.

Site 7

Attachments 1 through 4 present the risk calculations and assumptions used. The attachments represent the risks associated with different exposure pathways and age groups. Table 1. summarizes the risks associated with future residential land use exposed to the exposure point concentration. The aggregate (combined adult and child) residential excess lifetime cancer risks (ELCR) associated with exposure to surface soil through ingestion, dermal contact and fugitive dust inhalation is 5×10^{-6}. The estimated ELCR is within the U.S. Environmental Protection Agency's (EPA) allowable cancer range (1 in 10,000 [10^{-4}] to 1 in 1,000,000 [10^{-6}]) but exceeds Florida guidance concentration of 1 in 1,000,000 [10^{-6}].

A future child resident exposed to surface soil through ingestion, dermal contact, and inhalation of fugitive dust is 0.2 and the adult resident HI is 0.05. These HIs are below both EPA's and Florida guidance concentration of 1.

Site 8

Attachments 5 through 9 presents the risk calculations and assumptions used. The attachments represent the risks associated with different exposure pathways and age groups. Table 2. summarizes the risks associated with future residential land use exposed to the exposure point concentration. The aggregate (combined adult and child) residential excess lifetime cancer risks (ELCR) associated with exposure to surface soil through ingestion, dermal contact and fugitive dust inhalation is 6×10^{-6}. The estimated ELCR is within EPA's allowable cancer range (1 in 10,000 [10^{-4}] to 1 in 1,000,000 [10^{-6}]) but exceeds Florida guidance concentration of 1 in 1,000,000 [10^{-6}].

A future child resident exposed to surface soil through ingestion, dermal contact, and inhalation of fugitive dust is 0.6 and the adult resident HI is 0.2. These HIs are below both EPA's and Florida guidance concentration of 1.

References

ABB-ES, 1996a, Remedial Investigation Operable Unit 3, Sites 7 and 8, Naval Air Station Cecil Field, Jacksonville, Florida, September 1996

ABB-ES, 1996b, General Information Report, Naval Air Station Cecil Field, Jacksonville, Florida, August 1996

Table 1
Site 7, Risk Summary for Future Residential Scenarios

Technical Memorandum
Operable Unit 3
Naval Air Station Cecil Field
Jacksonville, Florida

Medium and Receptor		Exposure Route	HI	ELCR
Future Land Use				
Surface Soil:				
	Adult Resident	Incidental Ingestion	0.03	1×10^{-8}
		Dermal Contact	0.02	9×10^{-7}
		Inhalation	ND	1×10^{-10}
		Total Adult Resident	**0.05**	**2×10^{-6}**
	Child Resident	Incidental Ingestion	0.2	3×10^{-6}
		Dermal Contact	0.03	3×10^{-7}
		Inhalation	ND	8×10^{-11}
		Total Child Resident:	**0.2**	**3×10^{-6}**
		Total Resident:	**NC**	**5×10^{-6}**

Notes: NC = not calculated because child and adult hazard indices are not additive.
ND = no toxicity values available for calculation.
HI = hazard index.
ELCR = excess lifetime cancer risk.

Table 2
Site 8, Risk Summary for Future Residential Scenarios

Technical Memorandum
Operable Unit 3
Naval Air Station Cecil Field
Jacksonville, Florida

Medium and Receptor		Exposure Route	HI	ELCR
Future Land Use				
Surface Soil:				
	Adult Resident	Incidental Ingestion	0.06	5×10^{-7}
		Dermal Contact	0.09	3×10^{-6}
		Inhalation	ND	2×10^{-10}
		Total Adult Resident	**0.2**	**4×10^{-6}**
	Child Resident	Incidental Ingestion	0.5	1×10^{-6}
		Dermal Contact	0.1	1×10^{-6}
		Inhalation	ND	2×10^{-10}
		Total Child Resident:	**0.6**	**2×10^{-6}**
		Total Resident:	**NC**	**6×10^{-6}**

Notes: NC = not calculated because child and adult hazard indices are not additive.
ND = *no toxicity values available for calculation.*
HI = hazard index.
ELCR = excess lifetime cancer risk.

SITE 7
RISK CALCULATIONS

Attachment 1

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
NAS Cecil
Jacksonville, Fl.
Site 7

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm^2-event	USEPA, 1995
ABSORPTION FRACTION	ABS_d	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,750	cm^2	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm^2-event	USEPA, 1992a
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	350	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	24	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.

USEPA, 1992a. Dermal Exposure Assessment. Principles and Applications; EPA/600/8-91/011B; January 1992.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE}_{\text{INGESTION}} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$\text{INTAKE}_{\text{DERMAL}} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

Note: For noncarcinogenic effects, AT = ED.

Attachment 1

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
NAS Cecil
Jacksonville, Fl.
Site 7

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo (a) anthracene	O	260	ug/kg	1.2E-07	0.73	8.9E-08	0.01	7.0E-08	0.8	5.6E-08	1.5E-07
Benzo (a) pyrene	O	255	ug/kg	1.2E-07	7.3	8.7E-07	0.01	6.9E-08	8	5.5E-07	1.4E-06
Benzo (b) fluoranthene	O	483	ug/kg	2.3E-07	0.73	1.7E-07	0.01	1.3E-07	0.8	1.0E-07	2.7E-07
Benzo (k) fluoranthene	O	179	ug/kg	8.4E-08	0.073	6.1E-09	0.01	4.8E-08	0.08	3.9E-09	1.0E-08
Chrysene	O	270	ug/kg	1.3E-07	0.0073	9.3E-10	0.01	7.3E-08	0.008	5.8E-10	1.5E-09
Dibenz (a,h) anthracene	O	62	ug/kg	2.9E-08	7.3	2.1E-07	0.01	1.7E-08	8	1.3E-07	3.5E-07
Indeno (1,2,3-cd) pyrene	O	174	ug/kg	8.2E-08	0.73	6.0E-08	0.01	4.7E-08	0.8	3.8E-08	9.7E-08
					SUMMARY CANCER RISK	1E-06				9E-07	2E-06

[1]Relative potency factors were applied to the CSFs for carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November, 1995)
[3] Calculated from oral CSFs.
ND = no data available.

Attachment 1

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
NAS Cecil
Jacksonville, Fl.
Site 7

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo (a) anthracene	O	260	ug/kg	3 6E-07	ND		0 01	2.0E-07	ND		
Benzo (a) pyrene	O	255	ug/kg	3.5E-07	ND		0.01	2.0E-07	ND		
Benzo (b) fluoranthene	O	483	ug/kg	6.6E-07	ND		0.01	3 8E-07	ND		
Benzo (k) fluoranthene	O	179	ug/kg	2.5E-07	ND		0.01	1.4E-07	ND		
Chrysene	O	270	ug/kg	3.7E-07	ND		0.01	2.1E-07	ND		
Dibenz (a,h) anthracene	O	62	ug/kg	8 5E-08	ND		0.01	4.9E-08	ND		
Indeno (1,2,3-cd) pyrene	O	174	ug/kg	2 4E-07	ND		0.01	1.4E-07	ND		
Manganese	I	60.3	mg/kg	8.3E-05	0.047	1.8E-03	0.001	4 7E-06	0.0019	2.5E-03	4.3E-03
TRPH	O	530000	ug/kg	7.3E-04	0.03	2.4E-02	0.01	4.2E-04	0.03	1.4E-02	3.8E-02
SUMMARY HAZARD INDEX						3E-02				2E-02	4E-02

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November, 1995)
[2] Calculated from oral RfDs.
ND = no data available

Attachment 2

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT
NAS Cecil Field
Jacksonville, Fl.
Site 7

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.833	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	24	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1995
EXPOSURE DURATION	ED	24	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note:

For noncarcinogenic effects: AT = ED

Attachment 2

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT
NAS Cecil Field
Jacksonville, Fl.
Site 7

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)-1	CANCER RISK
Benzo (a) anthracene	O	260	ug/kg	2.10E-10	2.0E-11	0.31	**6.1E-12**
Benzo (a) pyrene	O	255	ug/kg	2.06E-10	1.9E-11	3.1	**6.0E-11**
Benzo (b) fluoranthene	O	483	ug/kg	3.90E-10	3.7E-11	0.31	**1.1E-11**
Benzo (k) fluoranthene	O	179	ug/kg	1.44E-10	1.4E-11	0.031	**4.2E-13**
Chrysene	O	270	ug/kg	2.18E-10	2.0E-11	0.0031	**6.3E-14**
Dibenz (a,h) anthracene	O	62	ug/kg	5.00E-11	4.7E-12	3.1	**1.5E-11**
Indeno (1,2,3-cd) pyrene	O	174	ug/kg	1.40E-10	1.3E-11	0.31	**4.1E-12**
						SUMMARY CANCER RISK	**1E-10**

ND = no data available.

Attachment 2

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT
NAS Cecil Field
Jacksonville, Fl.
Site 7

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo (a) anthracene	O	260	ug/kg	2.10E-10	5.7E-11	ND	
Benzo (a) pyrene	O	255	ug/kg	2.06E-10	5.6E-11	ND	
Benzo (b) fluoranthene	O	483	ug/kg	3.90E-10	1.1E-10	ND	
Benzo (k) fluoranthene	O	179	ug/kg	1.44E-10	4.0E-11	ND	
Chrysene	O	270	ug/kg	2.18E-10	6.0E-11	ND	
Dibenz (a,h) anthracene	O	62	ug/kg	5.00E-11	1.4E-11	ND	
Indeno (1,2,3-cd) pyrene	O	174	ug/kg	1.40E-10	3.8E-11	ND	
Manganese	I	60.3	mg/kg	4.86E-08	1.3E-08	ND	
TRPH	O	530000	ug/kg	4.27E-07	1.2E-07	ND	
						SUMMARY HAZARD INDEX	**0E+00**

ND = no data available.

Attachment 3

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
NAS Cecil
Jacksonville, Fl.
Site 7

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	200	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
AGE-SPECIFIC SURFACE AREA	SA	age-specific	cm²	USEPA, 1989
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
BODY WEIGHT	BW	15	kg	USEPA, 1991
AGE-SPECIFIC BODY WEIGHT	BW	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	350	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	6	years	USEPA, 1995
AGE-SPECIFIC EXPOSURE DURATION	*ED*	*age-specific*	*years*	*Assumption*
AGE-WEIGHTED SURFACE AREA [2]	$SA_{wt/adj}$	766	cm²-year/kg	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992a
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1995

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose.

[2] In estimating the dermally absorbed dose for children age1 through 6, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992.

USEPA, 1989. Exposure Factors Handbook; EPA/600/8-89/043; May 1989

USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.

USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.

USEPA, 1995 Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = (DA_{event} \times EF / AT \times 365\ days/year) \times SA_{wt/adj}$$

Where:

$SA_{wt/adj}$ = SUM (SA x ED / BW)

DA_{event} = CS x AF x ABS x CF

Note: **For noncarcinogenic effects, AT = ED.**

Attachment 3

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
NAS Cecil
Jacksonville, Fl.
Site 7

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo (a) anthracene	O	260	ug/kg	2.8E-07	0.73	2.1E-07	0.01	2.7E-08	0.8	2.2E-08	2.3E-07
Benzo (a) pyrene	O	255	ug/kg	2.8E-07	7.3	2.0E-06	0.01	2.7E-08	8	2.1E-07	2.3E-06
Benzo (b) fluoranthene	O	483	ug/kg	5.3E-07	0.73	3.9E-07	0.01	5.1E-08	0.8	4.1E-08	4.3E-07
Benzo (k) fluoranthene	O	179	ug/kg	2.0E-07	0.073	1.4E-08	0.01	1.9E-08	0.08	1.5E-09	1.6E-08
Chrysene	O	270	ug/kg	3.0E-07	0.0073	2.2E-09	0.01	2.8E-08	0.008	2.3E-10	2.4E-09
Dibenz (a,h) anthracene	O	62	ug/kg	6.8E-08	7.3	5.0E-07	0.01	6.5E-09	8	5.2E-08	5.5E-07
Indeno (1,2,3-cd) pyrene	O	174	ug/kg	1.9E-07	0.73	1.4E-07	0.01	1.8E-08	0.8	1.5E-08	1.5E-07
					SUMMARY CANCER RISK	3E-06				3E-07	4E-06

[1] Relative potency factors were applied to the CSFs of carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November, 1995)
[3] Calculated from oral CSFs.
NE = not evaluated.

Attachment 3

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
NAS Cecil
Jacksonville, Fl
Site 7

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo (a) anthracene	O	260	ug/kg	3.3E-06	ND		0.01	3.2E-07	ND		
Benzo (a) pyrene	O	255	ug/kg	3.3E-06	ND		0.01	3.1E-07	ND		
Benzo (b) fluoranthene	O	483	ug/kg	6.2E-06	ND		0.01	5.9E-07	ND		
Benzo (k) fluoranthene	O	179	ug/kg	2.3E-06	ND		0.01	2.2E-07	ND		
Chrysene	O	270	ug/kg	3.5E-06	ND		0.01	3.3E-07	ND		
Dibenz (a,h) anthracene	O	62	ug/kg	7 9E-07	ND		0.01	7.6E-08	ND		
Indeno (1,2,3-cd) pyrene	O	174	ug/kg	2.2E-06	ND		0.01	2.1E-07	ND		
Manganese	I	60.3	mg/kg	7.7E-04	0.047	1.6E-02	0.001	7.4E-06	0.0019	3.9E-03	2.0E-02
TRPH	O	530000	ug/kg	6.8E-03	0.03	2.3E-01	0.01	6.5E-04	0 03	2.2E-02	2.5E-01
SUMMARY HAZARD INDEX						2E-01				3E-02	3E-01

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November, 1995)
[2] Calculated from oral RfDs.
ND = no data available.

Attachment 4

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
NAS Cecil Field
Jacksonville, Fl.

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION IN AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.625	m^3/hour	USEPA, 1995
BODY WEIGHT	BW	15	kg	USEPA, 1991
EXPOSURE TIME	ET	24	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	6	years	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note:

For noncarcinogenic effects: AT = ED

Attachment 4

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
NAS Cecil Field
Jacksonville, Fl.

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)-1	CANCER RISK
Benzo (a) anthracene	O	260	ug/kg	2.10E-10	1.7E-11	0.31	5.3E-12
Benzo (a) pyrene	O	255	ug/kg	2.06E-10	1.7E-11	3.1	5.2E-11
Benzo (b) fluoranthene	O	483	ug/kg	3.90E-10	3.2E-11	0.31	9.9E-12
Benzo (k) fluoranthene	O	179	ug/kg	1.44E-10	1.2E-11	0.031	3.7E-13
Chrysene	O	270	ug/kg	2.18E-10	1.8E-11	0.0031	5.5E-14
Dibenz (a,h) anthracene	O	62	ug/kg	5.00E-11	4.1E-12	3.1	1.3E-11
Indeno (1,2,3-cd) pyrene	O	174	ug/kg	1.40E-10	1.2E-11	0.31	3.6E-12
						SUMMARY CANCER RISK	8E-11

NE = not evaluated.

Attachment 4

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
NAS Cecil Field
Jacksonville, Fl.

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo (a) anthracene	O	260	ug/kg	2.10E-10	2.0E-10	ND	
Benzo (a) pyrene	O	255	ug/kg	2.06E-10	2.0E-10	ND	
Benzo (b) fluoranthene	O	483	ug/kg	3.90E-10	3.7E-10	ND	
Benzo (k) fluoranthene	O	179	ug/kg	1.44E-10	1.4E-10	ND	
Chrysene	O	270	ug/kg	2.18E-10	2.1E-10	ND	
Dibenz (a,h) anthracene	O	62	ug/kg	5.00E-11	4.8E-11	ND	
Indeno (1,2,3-cd) pyrene	O	174	ug/kg	1.40E-10	1.3E-10	ND	
Manganese	I	60.3	mg/kg	4.86E-08	4.7E-08	ND	
TRPH	O	530000	ug/kg	4.27E-07	4.1E-07	ND	
						SUMMARY HAZARD INDEX	0E+00

ND = no data available.

SITE 8
RISK CALCULATIONS

Attachment 5

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
NAS Cecil Field
Jacksonville, Fl.
Site 8

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
ABSORPTION FRACTION	ABS_d	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,750	cm²	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992a
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	350	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	24	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors", OSWER Directive 9285.6-03

USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{DERMAL} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

DA_{event} = CS x AF x ABS_d x CF

Note: For noncarcinogenic effects, AT = ED.

Attachment 5

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
NAS Cecil Field
Jacksonville, Fl.
Site 8

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] $(mg/kg\text{-}day)^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [3] $(mg/kg\text{-}day)^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Beryllium	I	0.27	mg/kg	1.3E-07	4.3	5.5E-07	0.001	7.3E-09	430	3.1E-06	3.7E-06
SUMMARY CANCER RISK						5E-07				3E-06	4E-06

[1]Relative potency factors were applied to the CSFs for carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November,1995)
[3] Calculated from oral CSFs.
ND = no data available.

Attachment 5

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
NAS Cecil Field
Jacksonville, FL
Site 8

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Antimony	I	3.25	mg/kg	4.5E-06	0.0004	1.1E-02	0.001	2.6E-07	0.000004	6.4E-02	7.5E-02
Beryllium	I	0.27	mg/kg	3 7E-07	0.005	7.4E-05	0.001	2.1E-08	0.00005	4.3E-04	5.0E-04
TRPH	O	973000	ug/kg	1.3E-03	0.03	4.4E-02	0.01	7.7E-04	0.03	2.6E-02	7 0E-02
SUMMARY HAZARD INDEX						6E-02				9E-02	1E-01

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November, 1995)
[2] Calculated from oral RfDs.
ND = no data available

Attachment 6

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT
NAS Cecil Field
Jacksonville, Fl.
Site 8

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.833	m^3/hour	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	24	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1995
EXPOSURE DURATION	ED	24	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note:

For noncarcinogenic effects: AT = ED

Attachment 6

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT
NAS Cecil Field
Jacksonville, Fl.
Site 8

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)-1	CANCER RISK
Beryllium	I	0.27	mg/kg	2.18E-10	2.0E-11	8.4	1.7E-10
					SUMMARY CANCER RISK		2E-10

ND = no data available.

Attachment 6

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT
NAS Cecil Field
Jacksonville, Fl.
Site 8

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Antimony	I	3.25	mg/kg	2.62E-09	7.2E-10	ND	
Beryllium	I	0.27	mg/kg	2.18E-10	6.0E-11	ND	
TRPH	O	973000	ug/kg	7.85E-07	2.1E-07	ND	
					SUMMARY HAZARD INDEX		0E+00

ND = no data available.

Attachment 7

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
NAS Cecil Field
Jacksonville, Fl.
Site 8

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	200	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100 %	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
AGE-SPECIFIC SURFACE AREA	SA	age-specific	cm²	USEPA, 1989
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
BODY WEIGHT	BW	15	kg	USEPA, 1991
AGE-SPECIFIC BODY WEIGHT	BW	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	350	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	6	years	USEPA, 1995
AGE-SPECIFIC EXPOSURE DURATION	ED	age-specific	years	Assumption
AGE-WEIGHTED SURFACE AREA [2]	$SA_{wt/wt}$	766	cm²-year/kg	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992a
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1995

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose.

[2] In estimating the dermally absorbed dose for children age1 through 6, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992.

USEPA, 1989. Exposure Factors Handbook;EPA/600/8-89/043, May 1989.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.

USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B; January 1992.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)$^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = (DA_{event} \times EF / AT \times 365\ days/year) \times SA_{wt/wt}$$

Where:

$SA_{wt/wt}$ = SUM (SA x ED / BW)

DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED.

Attachment 7

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
NAS Cecil Field
Jacksonville, Fl.
Site 8

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] $(mg/kg\text{-}day)^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] $(mg/kg\text{-}day)^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Beryllium	I	0.27	mg/kg	3.0E-07	4.3	1.3E-06	0.001	2.8E-09	430	1.2E-06	2.5E-06
					SUMMARY CANCER RISK	1E-06				1E-06	2E-06

[1] Relative potency factors were applied to the CSFs of carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November, 1995)
[3] Calculated from oral CSFs.
NE = not evaluated

Attachment 7

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
NAS Cecil Field
Jacksonville, Fl.
Site 8

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL R/D (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL R/D [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Antimony	I	3.25	mg/kg	4.2E-05	0.0004	1 0E-01	0.001	4.0E-07	0.000004	9.9E-02	2.0E-01
Beryllium	I	0.27	mg/kg	3.5E-06	0.005	6.9E-04	0.001	3.3E-08	0.00005	6.6E-04	1.4E-03
TRPH	O	973000	ug/kg	1.2E-02	0.03	4 1E-01	0.01	1.2E-03	0.03	4.0E-02	4.5E-01
					SUMMARY HAZARD INDEX	5E-01				1E-01	7E-01

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November, 1995)
[2] Calculated from oral RfDs.
ND = no data available

Attachment 8

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
NAS Cecil Field
Jacksonville, Fl.

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION IN AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.625	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	15	kg	USEPA, 1991
EXPOSURE TIME	ET	24	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	6	years	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$$CA = C \times CF \times (1/PEF)$$

Note:

For noncarcinogenic effects: AT = ED

Attachment 8

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
NAS Cecil Field
Jacksonville, Fl.

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)-1	CANCER RISK
Beryllium	I	0.27	mg/kg	2.18E-10	1.8E-11	8.4	1.5E-10
					SUMMARY CANCER RISK		2E-10

NE = not evaluated.

Attachment 8

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
NAS Cecil Field
Jacksonville, Fl.

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Antimony	I	3.25	mg/kg	2.62E-09	2.5E-09	ND	
Beryllium	I	0.27	mg/kg	2.18E-10	2.1E-10	ND	
TRPH	O	973000	ug/kg	7.85E-07	7.5E-07	ND	
					SUMMARY HAZARD INDEX		0E+00

ND = no data available.