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NSWC INDIAN HEAD
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MEMORANDUM METHODS FOR PREPARING THE HUMAN HEALTH RISK ASSESSMENT
SITE 28 NSWC INDIAN HEAD MD
10/14/2003
CH2MHILL

Methods for Preparing the Human Health Risk Assessment for Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland, Site 28

TO: Jeff Morris—EFA Chesapeake RPM
Dennis Orenshaw—EPA RPM
Curtis DeTore—MDE RPM
Heidi Morgan—IHDIV-NSWC RPM
Shawn Jorgensen—IHDIV-NSWC RPM
Joseph Rail—EFA Chesapeake

COPIES: Gene Peters/CH2M HILL
Margaret Kasim/CH2M HILL
Roni Warren/CH2M HILL
Adrian Hanley/CH2M HILL

FROM: Debbie Stannard/CH2M HILL
Anita Dodson/CH2M HILL

DATE: October 14, 2003

This memorandum summarizes the proposed approach for preparing the human health risk assessment (HHRA) for Indian Head Division, Naval Surface Warfare Center (NSWC), Indian Head, Maryland, Site 28.

1 General Information Site 28

Site 28 is also known as the Original Burning Ground, Slavins Dock Area, and Wildlife Area. The site is bounded on the east by the Mattawoman Creek, on the northeast by a residence, and on the west by a north-south dirt road. A fence runs along the property on all sides except on the creek side and the west side of the Original Burning Ground.

The site encompasses a former zinc recovery furnace, Artesian Well 14, and the Shoreline Burning Cage (see Figure 1). The zinc recovery furnace, designated Building 415, existed from 1928 until the early 1950s. Artesian Well 14 was installed in 1918 and at one time was used as a potable well. It became an observation well in 1988 and remains an observation well today. A small burning cage used to burn debris such as wooden crates existed to the south of Artesian Well 14.

From May to September 2003, Phases I and II of the remedial investigation were conducted to obtain data to accomplish the objective of the investigation mentioned above. The following sample matrices were collected.

JMM 12-9-03

Response to Comments on *Methods for Preparing the Human Health Risk Assessment for Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland, Site 28*

TO: Jeff Morris/EFA Chesapeake RPM
Heidi Morgan/IHDIV-NSWC RPM

COPIES: Gene Peters/CH2M HILL
Margaret Kasim/CH2M HILL
Adrian Hanley/CH2M HILL

FROM: Debbie Stannard/CH2M HILL
Roni Warren/CH2M HILL

DATE: December 2, 2003

Below are the responses to the comments received on the *Methods for Preparing the Human Health Risk Assessment for Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland, Site 28*.

Comments are presented as received, followed by CH2M HILL responses, shown in italics. Please review the responses to ensure they address your concerns. The memorandum will not be updated and re-submitted, but the comments and responses will be incorporated in the human health risk assessment section of the draft RI.

1. Comments from Jeff Morris/EFACHES

Page 1

1.1 In the first paragraph under "General Information Site 28", it is stated that the site is bounded on the northeast by a residence. The area to the northeast is actually a park.

Response: Yes, there is a park on the northeast boundary, but there is also a residence on the north by northeast boundary. Adrian Hanley has observed the residence next to the site, and this has been confirmed by Heidi Morgan.

Page 2

1.2 The abbreviation NG stands for nitroglycerin – NQ is nitroquanidine.

Response: The text will be revised as noted.

nitroguanidine

Page 5

1.7 Under “Current Scenarios and Pathways”, refer to the Mattawoman Creek Study with respect to fish ingestion.

Response: The Mattowoman Creek Study is a general study for Mattowoman Creek, so these conditions are not solely associated with Site 28. This study found that the HIs for fish ingestion were 10 under the RME scenario and 6 for the CTE scenario, which are greater than the acceptable level of 1.0. Arsenic and 4-methylphenol were the major contributors (Mattowoman Creek Study Section 6.4.3.3).

1.8 Under “Future Scenarios and Pathways”, mention that groundwater must be considered a potential source of drinking water under regulatory policies. If it doesn’t meet the necessary standards, institutional controls will be required, at a minimum.

Response: The text will be revised as noted.

Page 6

1.9 How would Region III RBCs be used?

Response: The toxicity values used in the Region III RBC table to calculate the RBCs will be used if toxicity information is not available from other sources.

Page 6

1.10 The “Deliverables” table indicated that the first time the regulators see the HHRA is when it becomes final – shouldn’t the two versions shown in the table be draft (Navy review) and draft final (regulator review)?

Response: The HHRA will be included in both the draft and final versions of the RI.

1.11 The correct review period for regulators is 60 days.

Response: We never planned for a 60 day review of the human health risk assessment interim deliverables in the original schedule. If this was the case, the delivery of the RI report would be delayed a few months. The EPA does not always review and provide comments on the human health interim deliverables in time for incorporation into the next interim deliverable or draft report. CH2M HILL usually continues forward with the human health risk assessment in order to avoid delays to the schedule.

2. Comments from Heidi Morgan/IHDIV-NSWC

Page 1

2.1 Section 1 – The Activity’s fence encompasses Site 28.

Response: The text will be revised as noted.

Page 4

2.8 Should the word “uses” be “user” in the last sentence of the 3 paragraph?

Response: That is correct. The text will be revised as noted.

Page 5

2.9 I suggest that tentative dates for conference calls aren't listed, but dates that comments are due by are fine.

Response: Agreed, the conference calls were only tentative if there needed to be any follow up based on questions and comments.

Morris, Jeffrey W CIV (EFACHES)

From: Orenshaw.Dennis@epamail.epa.gov [Orenshaw.Dennis@epamail.epa.gov] **Sent:** Thu 1/15/2004 3:01 PM
To: Morris, Jeffrey W CIV (EFACHES)
Cc: Adrian Hanley; Estabrook, Anne; DeTore, Curtis; Jorgensen Shawn; Rail, Joseph P CIV (EFACHES); Heidi Morgan
Subject: Site 28 HHRA
Attachments:

Jeff:

Dawn has completed her review of the Interim deliverable for Site 28. She offers the following comments.

Table 1

Under a recreational exposure scenario, potential risks from surface water (Mattawoman Creek) are quantitatively evaluated. However, sediment from the creek is not assessed quantitatively. For sediment, the following explanation is provided in the table: "Not considered a complete pathway because recreational users are considered to be offshore in deep water and would not have contact with sediment." This doesn't seem logical to me. If exposure to Mattawoman Creek is possible under a current or future land-use scenario, then risks from both surface water and sediment should be quantitatively evaluated. If, however, exposure to the creek is not likely, then both pathways (surface water and sediment) should be eliminated.

Under a current land-use scenario, exposure by a trespasser to surface soil is assessed. For future land-use, exposure by a trespasser to total soil (surface and subsurface) is considered. In my opinion, this latter scenario is probably unnecessary and could be eliminated from the Baseline Risk Assessment, if other members of the team agree.

Tables 2.1, 2.3, and 2.6

Lead was observed in soil at a maximum concentration of 17,000 mg/kg, with an average of 59 mg/kg. Because this average concentration is less than the soil screening level (400 mg/kg), lead was not retained as a Contaminant of Potential Concern (CoPC) at Site 28. However, with a hit of 17,000 mg/kg, it appears that a hot spot for lead exists at the site. This hot spot should be evaluated separately from other locations and will likely require remediation.

Table 2.8

Tap water RBCs are used to screen chemicals detected in water in the on-site Excavation Pit. Does this water represent a potentially potable source? If not, maybe it would be more appropriate to handle this pathway in the same manner as surface water -- screening using the tap water RBCs x 10.

Lead is identified as a CoPC in this table, but not in Table 2.6.
M.....

Table 5.2

apply to inhalation risks, not oral and dermal.

**Navy RPM Comments on
Human Health Risk Assessment Memo and Interim Deliverable
Site ~~27~~ 28
October 22, 2003**

General

The Mattawoman Creek Study should be referenced and its data should be included.

Page

Comment

1 In the first paragraph under *General Information Site 28*, it is stated that the site is bounded on the northeast by a residence. The area to the northeast is actually a park.

2 The abbreviation NG stands for nitroglycerin – NQ is nitroguanidine.

The listings of analytes include the term “explosives”, which is followed by a list of chemicals that are not necessarily explosives. What is the proper term? Also, the list is preceded by “including”, which suggests that there may be others – are there? If not, drop the word.

Under *1.3 Surface Water*, what does the second sentence mean, the surface water was collected before sediment? If the sediment was sampled at the same location following the collection of the surface water sample, suggest re-wording to clarify this.

Under *2 Data Collection and Evaluation*, the second paragraph should note that the discovery of high zinc concentrations in creek sediment during the TIE and Mattawoman Creek Study led to further review of historical information, re-evaluation of the potential risk, and identification of this as an IR site.

3 Is it really necessary to ignore unvalidated data in the risk assessment? Unless there are obvious problems with such data, they can provide a better basis for statistical analysis and fill data gaps. The Rapid Sediment Screening project included confirmatory sampling that could help determine the validity of screening results and make them useable. Also, there is motion in the regulatory community to recognize the potential benefits for using unvalidated data. (*In Search of Representativeness: Evolving the Environmental Data Quality Model*, Deanna M. Crumbling, U. S. EPA Technology Innovation Office, 2002)

5 Under *Current Scenarios and Pathways*, refer to the Mattawoman

CH2M HILL

13921 Park Center Road

Suite 600

Herndon, VA 20171

Tel 703.471.1441

Fax 703.471.1508



CH2MHILL

October 14, 2003

152962.AR.HH

Commander
EFA Chesapeake
Mr. Jeff Morris, Code 1810
Washington Navy Yard, Bldg. 212
1314 Harwood St., SE
Washington Navy Yard, DC 20374-5018

Send to Dean

Subject: Navy CLEAN II Program
Contract N62470-95-D-6007
Contract Task Order 0111
Human Health Risk Assessment Memorandum and Interim Deliverable (ID) Tables 1 and 4 at Site 28
NSWC Indian Head Division, Indian Head, MD

Dear Jeff:

CH2M HILL is pleased to submit a hard copy of the above-referenced document. If you have any comments, please bring them up in discussion for the tentative conference call on October 27, 2003, or submit them in writing to CH2M HILL. Copies of the document have also been distributed as shown below.

If you have any questions regarding this deliverable, please call me or Adrian Hanley at (703) 471-1441.

Sincerely,

CH2M HILL

Margaret Kasim

Margaret Kasim, Ph.D.
Interim Activity Manager

WDC\cover letter for revised draft final WP.doc

Cc: Heidi Morgan/IHDIV NSWC (two hard copies)
CH2M HILL (three hard copies)

Comments of the Methods for Preparing the HH Risk Assessment for Site 28 by Heidi Morgan NDW-West

Page 1

Section 1

- The Activity's fence encompasses Site 28.
- Section 1 - What source stated that burned debris included wooden crates?
- Please include information from the IAS report (i.e. the site is approximately 1.8 acres used as the original NOS burning ground).

Page 2

Section 1.1

- Should the first word on this page be surface not soil?
- Nitroguanidine is NQ and Nitroglycerine is NG.

Section 1.5

- I would suggest stating fifteen locations instead of fifteen sites?

Page 3

- Why would it be necessary to use B-qualified data in the risk assessment? Aren't B-qualifiers similar to samples with no positive results (they are not be used)?

Page 4

- Should the word "uses" be "user" in the last sentence of the 3 paragraph?

Page 5

- I suggest that tentative dates for conference calls aren't listed, but dates that comments are due by are fine.

1.1 Surface and Subsurface Soil

Soil samples were collected from 0 to 6 in. below ground surface (bgs), and subsurface soil samples were collected from 1 to 3 ft bgs at 27 locations in zone A and 8 locations in zone B. Depending on location accessibility, either a track-mounted Geoprobe or a hand-held Geoprobe was used.

The samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), TCL semivolatile organic compounds (SVOCs), Target Analyte List (TAL) metals, explosives (including nitroguanidine (NG), nitroglycerine (NQ), pentaerythritol tetranitrate (PETN), and perchlorate). Surface soil samples were also analyzed for pH, total organic carbon (TOC), and grain-size distribution.

*inconsistent w/ MRP?
= NG slums?*

1.2 Groundwater

Five monitoring wells were installed in August 2003 and sampled in September 2003. Groundwater was collected from these wells and analyzed for TCL VOCs, TCL SVOCs, TAL metals, and explosives (including NG, NQ, PETN, and perchlorate).

1.3 Surface Water

*term?
others?*

Three surface water samples were collected in the swales. Surface water was collected before sediment. Surface water samples were analyzed for TCL VOCs, TCL SVOCs, explosives (including NG, NQ, PETN, and perchlorate), and TAL metals (total and dissolved), dissolved organic carbon, and hardness.

- what does this mean?

1.4 Sediment

Three sediment samples were collected in the swales. Sediment samples collected from the swales were analyzed for TCL VOCs, TCL SVOCs, TAL metals, explosives, (including, NG, NQ, PETN, and perchlorate), pH, TOC, and grain- size distribution.

1.5 Mattawoman Creek Sediment

Fifteen sites were sampled at intervals of 0-6 in. and 6-12 in. All locations were sampled for TAL metals; three sites were also sampled for TCL SVOCs and explosives (including NG, NQ, PETN, and perchlorate).

Should also use data from MWC study

2 Data Selection and Evaluation

An Initial Assessment Study (IAS), conducted in 1982, found that smokeless powder and other contaminated wastes had been burned at Site 28. The finding was based on materials manufactured when the site was in operation, from c. 1890 to 1942. The IAS concluded that there was not enough information to characterize the potential hazard at the site; therefore, the site was not recommended for a Navy Assessment and Control of Installation Pollutants confirmation study.

with what?

On the basis of a review and evaluation of site historical information, it was determined that further investigation was warranted to characterize the nature and extent of metals and

*also the TIE (?)
found high zinc in creek sed which led to further review*

other potential contaminants in soil (surface and subsurface soil), sediment, groundwater, and surface water.

Data collected during the RI will be evaluated in the risk assessment. Only data that have been fully validated will be used in the human health risk assessment; validated, qualified data will be evaluated in the risk assessment as follows:

- J-qualified data (estimated) will be treated as detected concentrations
- R-qualified data (rejected) will be excluded from the risk assessment
- B-qualified data (blank contamination) will be used in the risk assessment as if they are nondetect, and one-half the sample quantitation limit (SQL) will be used as the sample concentration
- For duplicate samples, the higher of the two concentrations will be used
- One-half the SQL will be used in place of nondetect results in calculating summary statistics for analytes having one or more positive results in a particular medium
- Analytes for which no positive results are reported for a particular medium will not be considered contaminants of potential concern (COPCs) for that medium

is this still necessary?

3 Selection of Contaminants of Potential Concern

USEPA (*Selection of Exposure Routes and Contaminants of Concern by Risk-Based Screening*, 1993) methodology will be followed to select the constituents that will be evaluated quantitatively in the HHRA. The following is methodology as it pertains to Site 28 at Indian Head:

Maximum concentrations of constituents detected in soil will be compared to the current USEPA Region III Risk-Based Concentrations (RBCs) for residential soil. RBCs that are based on noncarcinogenic effects will be divided by 10 to account for cumulative exposure. RBCs based on carcinogenic effects will be used as presented in the most current RBC table (USEPA, 2003). Constituents having a maximum detected concentration below the RBC will not be retained as soil COPCs for the HHRA.

Lead concentrations in soil will be compared to the USEPA residential child soil-screening value of 400 ppm (OSWER Directive 9355.4-12, issued July 14).

Air concentrations will be estimated on the basis of the maximum detected soil concentrations using USEPA (*Soil Screening Guidance*, May 1996) methodology. These calculated air concentrations will be compared the current EPA Region III RBCs for ambient air. RBCs that are based on noncarcinogenic effects will be divided by 10 to account for cumulative exposure. RBCs based on carcinogenic effects will be used as presented in the most current RBC table (USEPA, 2003 Region III RBC Tables). Constituents whose calculated air concentration is below the RBC will not be retained as COPCs for the soil-to-air pathway.

didn't sample air

RBC values are not available for surface water. In addition, tap water RBCs are based on exposure assumptions that are not applicable for contact with surface water. As such, screening of COPCs in surface water will be based on a comparison of maximum detected

surface water concentrations to 10 times the tap water RBCs. The use of 10 times the tap water RBC is a conservative estimate assuming that a receptor is in contact with surface water at exposure parameters (ingestion rate, skin surface area, exposure frequency, and exposure duration) much lower than those for groundwater. RBCs that are based on noncarcinogenic effects will be used as presented for tap water in the most current RBC table (USEPA, 2003). RBCs based on carcinogenic effects will be 10 times the current EPA Region III RBCs for tap water. Constituents having a maximum detected concentration less than the lowest adjusted tap water RBC will not be retained as surface water COPCs for the HHRA.

Lead concentrations in surface water will be compared to the Safe Drinking Water Act action level for lead of 15 µg/L.

Groundwater data will be compared to the current USEPA Region III RBCs for tap water (USEPA, 2003). RBCs that are based on noncarcinogenic effects will be divided by 10 to account for exposure to multiple constituents. RBCs based on carcinogenic effects will be used as presented in the most current RBC table. Any constituent whose maximum detected concentration is below the RBC will not be retained as a COPC.

Constituents that are essential human nutrients (e.g., calcium, magnesium, potassium, and sodium) will not be considered further in the quantitative risk assessment because they are typically present at low concentrations (i.e., at or near naturally occurring levels) and are toxic only at very high doses.

4 Exposure Assessment

4.1 Exposure Point Concentrations

The exposure point concentration (EPC) for the reasonable maximum exposure (RME) scenario will be based on the UCL for data sets having five or more samples. The ProUCL software program, described in *Calculating Exposure Point Concentrations at Hazardous Waste Sites, Draft* (USEPA, 2002), will be used to calculate UCLs. The lower of the selected UCL or the maximum detected concentration will be used as the RME EPC. For data sets with fewer than five samples, the maximum detected concentration will be used as the exposure point concentration. For the central tendency exposure (CTE) evaluation, the arithmetic mean value of either the log-transformed or untransformed dataset will be used (based on the data distribution determined by the Shapiro-Wilk test). The maximum detected concentration will be used in place of the arithmetic mean when the mean is greater than the maximum detected value.

The EPCs will be based on the entire data sets that are (1) deemed to be of adequate quality to support quantitative health risk analysis and (2) representative of the assumed exposure points.

4.2 Exposure Scenarios and Pathways

The scenarios and pathways that are applicable to current and future conditions at Site 28 at Indian Head are discussed below.

Current Scenarios and Pathways

Pathways associated with direct and indirect contact with surface and subsurface soil may be complete for adult utility workers engaged in repair and maintenance of the fence at the site. Exposure routes may include incidental ingestion, dermal contact, and inhalation of soil vapors or entrained particulate matter.

Adult and adolescent trespassers may potentially be exposed to surface soil. Exposure routes to be considered under this scenario include incidental ingestion, dermal contact with the surface soil, and inhalation of soil vapors or entrained particulate matter.

Mattawoman Creek adjacent to Site 28 is used for boating and fishing. Recreational users may contact the surface water in the creek while fishing and boating. Additionally, they may ingest the fish caught from the creek. Ingestion of fish from the creek will not be evaluated quantitatively since no fish tissue samples will be collected. This pathway will be evaluated qualitatively on the basis of surface water and sediment data. Exposure to surface water will be evaluated for adult and adolescent recreational uses through incidental ingestion and dermal contact.

*refer to
MW
study.*

Because of the steepness of the banks of the creek and the depth of the water where the boaters and fisherman would be, exposure to sediment will not be evaluated in the risk assessment. It is assumed that all sediment that contacts the skin would be washed off in the water.

Future Scenarios and Pathways

Possible future exposure scenarios related to surface and subsurface soil include residential, construction worker, and trespasser/visitor. For the purposes of the HHRA, these potential future exposure scenarios conservatively assume that the subsurface soil will be excavated during development and spread over the surface of the site. The potential future exposure to the soil (subsurface becoming surface) will be evaluated for adult and child residents, adult construction workers during site development activities, and adult and adolescent trespassers/visitors via ingestion, dermal contact, and inhalation.

The groundwater is not currently used and is not expected to be used in the future as a potable supply. However, the groundwater will be conservatively included in this evaluation. As a worst case estimate of exposure to groundwater, future adult and child residential exposure will be included. Additionally, the construction worker will be evaluated for potential exposure to the groundwater during excavation activities.

*also policy
is that gwd
must be ok for
drinking or
ICS*

Future recreational users will be exposed via the same pathways as the current recreational user.

4.3 Parameter Values for Dose Algorithms

Tables 4.1.RME through 4.7.CTE (Attachment B) detail the exposure parameters that will be used for quantitative estimation of route-specific intake of each exposure scenario, pathway, and receptor group outlined above and in Attachment A, Table 1. The references and rationale for the selection of each value are provided in the tables. In general, standard assumptions have been used as outlined in approved USEPA technical guidance. Particularly, for the RME case, the use of such default assumptions in the dose calculations

will result in conservative estimates of exposure for all receptor groups. Deterministic (i.e., point) estimates of chronic daily intake (dose) will be derived for both RME and CTE cases for each receptor group. However, CTE intakes will be calculated only for those scenarios that have an RME noncarcinogenic hazard greater than 1.0 and/or an RME carcinogenic risk greater than 1×10^{-4} .

5 Toxicity Assessment

Toxicity values for use in the risk assessment will be obtained from the Integrated Risk Information System (IRIS) and Health Effects Assessment Summary Tables (HEAST) databases. If information is not available from these two sources, NCEA provisional toxicity values or toxicity values from the USEPA Region III Risk-Based Concentration Table will be used. If information is not available from the preceding sources, USEPA Region III risk assessors will be consulted.

are these supposed to take precedence?

Oral toxicity values will be adjusted from administered to absorbed doses for evaluating dermal exposure. Oral absorption factors obtained from *Risk Assessment Guidance for Superfund (Volume 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment, Interim, USEPA, September 2001)* will be used. If values are not available, the values from *Oral Absorption Values for Oral-to-Dermal Extrapolation per RAGs Appendix A (USEPA, April 1999)* will be used to adjust the oral toxicity factors to dermal toxicity factors.

why are HHS calculated for COCs before taking the HHS on target?

6 Risk Characterization and Uncertainty Discussion

As noted, the characterization of health hazard and carcinogenic risk will be provided as point estimates for each receptor group. To account for cumulative effects, noncarcinogenic hazards will be considered additive based on toxicological endpoint or mechanism of action. This characterization will assume that hazards associated with constituents with common target organs will be summed and compared to USEPA's recommended threshold of one.

Carcinogenic risk will be assumed to be additive across all routes of exposure for each receptor group. Special note will be made of chemicals and exposure pathways that account for the majority of potential effects in cases where lifetime incremental cancer risk exceed 1×10^{-4} and/or the noncarcinogenic hazard index exceeds 1.

Central tendency hazards will be calculated if the cumulative RME hazard for a given media exceeds the USEPA's threshold value of 1. Central tendency carcinogenic risks will be calculated if the cumulative RME risk for a given media exceeds USEPA's upper target risk level of 1×10^{-4} .

Constituents considered to be risk drivers based on quantitative evaluation will be compared to background concentrations. The comparison of site concentrations to background concentrations will be included for risk management decision purposes.

7 Risk Assessment Deliverables

The risk assessment will be conducted according to USEPA methodology (*Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual, Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessment, December 2001*). Tables 1 and 4

are submitted with this memorandum. Tables 2, 3, 5, and 6 will be provided together as the next interim deliverable. Tables 7 through 10 will be provided in the RI report, along with all the previous tables. The tentative schedule of the deliverables is summarized below:

Deliverable	Submittal Date	Review Period (Calendar Days)	Tentative Conference Call to Discuss Comments
Memorandum and Interim Deliverable (ID) Tables 1 and 4	10/13/03	30	10/27/03
<i>draft</i> Revised ID Tables 1 and 4; New ID Tables 2, 3, 5, and 6	11/10/03	30	12/10/03
<i>?</i> Draft Final HHRA as part of RI to Navy (includes Tables 1–10)	12/16/03	30	01/15/04
<i>draft formal</i> Final HHRA as part of RI to Regulators (includes Tables 1–10)	01/29/04	<u>45</u>	03/15/04

60

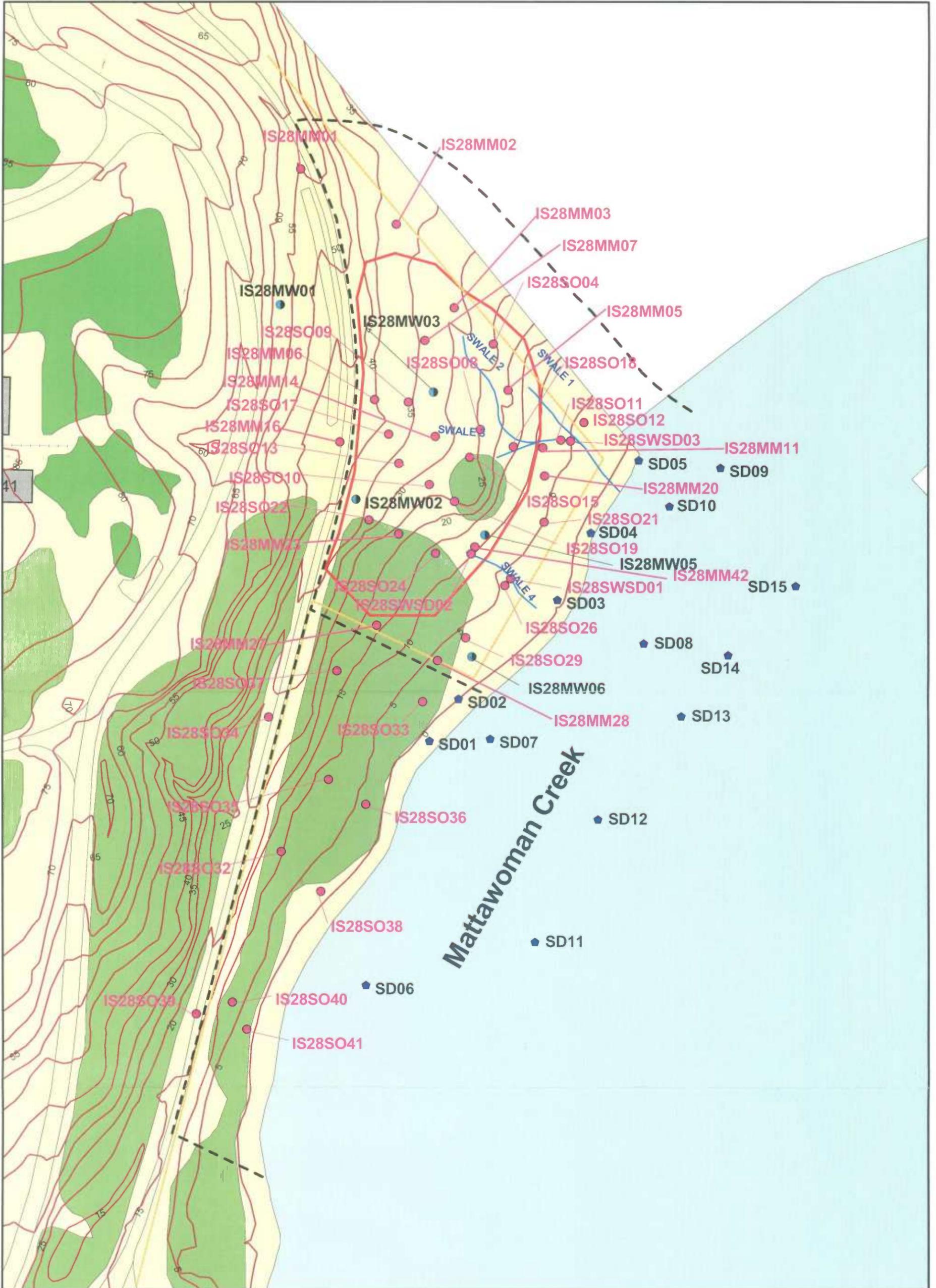


Figure 1
 Site 28 Sampling Locations
 IHDIV-NSWC
 Indian Head, Maryland

Attachment A—RAGS Part D Table 1

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
Site 28, IH/IV-NSWC
Indian Head, Maryland

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway			
Current	Soil*	Soil*	Site 28 Soil*	Utility Worker	Adult	Dermal	On-site	Quant	Utility workers could contact surface and subsurface soil while performing activities at the site.			
						Ingestion	On-site	Quant	Utility workers could contact surface and subsurface soil while performing activities at the site.			
		Air	Emissions from Site 28 Soil*	Utility Worker	Adult	Inhalation	On-site	Quant	Utility workers may inhale vapors and dust from surface and subsurface soil while working at site.			
	Surface Soil	Surface Soil	Site 28 Surface Soil	Trespasser	Adult	Dermal Absorption	On-site	Quant	Nearby residents may trespass on site and contact surface soil.			
						Ingestion	On-site	Quant	Nearby residents may trespass on site and contact surface soil.			
						Adolescents	Dermal Absorption	On-site	Quant	Nearby residents may trespass on site and contact surface soil.		
							Ingestion	On-site	Quant	Nearby residents may trespass on site and contact surface soil.		
					Air	Emissions from Site 28 Surface Soil	Trespasser	Adult	Inhalation	On-site	Quant	Nearby residents may trespass on site and inhale vapors and dust from surface soil.
Adolescent								Inhalation	On-site	Quant	Nearby residents may trespass on site and inhale vapors and dust from surface soil.	
Current/Future	Sediment	Sediment	Mattawoman Creek	Recreation	Adult	Dermal	On-site	None	Not considered a complete pathway because recreational users are considered to be offshore in deep water and would not have contact with sediment.			
						Ingestion	On-site	None	Not considered a complete pathway because recreational users are considered to be offshore in deep water and would not have contact with sediment.			
					Adolescent	Dermal	On-site	None	Not considered a complete pathway because recreational users are considered to be offshore in deep water and would not have contact with sediment.			
						Ingestion	On-site	None	Not considered a complete pathway because recreational users are considered to be offshore in deep water and would not have contact with sediment.			
					Fish	Mattawoman Creek	Recreational	Adult	Ingestion	On-site	Qual	Recreational user may ingest fish caught from Mattawoman Creek.
								Adolescent	Ingestion	On-site	Qual	Recreational user may ingest fish caught from Mattawoman Creek.
	Surface Water	Surface Water	Mattawoman Creek	Recreation	Adult	Dermal	On-site	Quant	Recreational user may come into contact with surface water while boating in Mattawoman Creek.			
						Ingestion	On-site	Quant	Recreational user may come into contact with surface water while boating in Mattawoman Creek.			
					Adolescent	Dermal	On-site	Quant	Recreational user may come into contact with surface water while boating in Mattawoman Creek.			
						Ingestion	On-site	Quant	Recreational user may come into contact with surface water while boating in Mattawoman Creek.			

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway	
Future	Soil*	Soil*	Site 28 Soil*	Resident	Adult	Dermal Absorption	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.	
						Ingestion	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.	
					Child	Dermal Absorption	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.	
						Ingestion	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.	
					Child/Adult	Dermal Absorption	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.	
						Ingestion	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.	
				Construction Worker	Adult	Dermal Absorption	On-site	Quant	Construction worker may be exposed to soil during excavation activities.	
						Ingestion	On-site	Quant	Construction worker may be exposed to soil during excavation activities.	
				Trespasser	Adolescent	Dermal Absorption	On-site	Quant	Trespasser/visitor may come into contact with soil at the site.	
						Ingestion	On-site	Quant	Trespasser/visitor may come into contact with soil at the site.	
					Adult	Dermal Absorption	On-site	Quant	Trespasser/visitor may come into contact with soil at the site.	
						Ingestion	On-site	Quant	Trespasser/visitor may come into contact with soil at the site.	
		Air	Emissions from Site 28 Soil*	Resident	Adult	Inhalation	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.	
						Child	Inhalation	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
							Child/Adult	Inhalation	On-site	Quant
				Construction Worker	Adult	Inhalation	On-site	Quant	Construction workers may inhale vapors or fugitive dust from soil during excavation activities.	
					Trespasser	Adolescent	Inhalation	On-site	Quant	Trespassers/visitors may be exposed to vapors or fugitive dust from site 28 soils.
				Adult		Inhalation	On-site	Quant	Trespassers/visitors may be exposed to vapors or fugitive dust from site 28 soils.	

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Tap Water	Resident	Adult	Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
						Dermal Absorption	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply. The adult is assumed to shower, and the child is assumed to bathe.
					Child	Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
						Dermal Absorption	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
				Child/Adult	Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply. This is for cancer risk only.	
					Dermal Absorption	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.	
				Construction Worker	Adult	Ingestion	On-site	None	Construction worker not expected to ingest significant amount of groundwater during excavation activities.
							Dermal Absorption	On-site	Quant
		Air	Water Vapors at Showerhead	Resident	Adult	Inhalation	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
		Air	Volatilization from Water in Excavation Pit	Construction Worker	Adult	Inhalation	On-site	Quant	Construction worker may be exposed during construction activities.

* Surface soil and subsurface soil combined.

Attachment B—RAGS Part D Table 4

TABLE 4-1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Dermal	Utility Worker	Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	See Table	mg/kg	See Table EPA, 2001 (3) EPA, 2001 (4) EPA, 2001 -- (1) EPA, 1991 EPA, 1991 EPA, 1989 EPA, 1989	Chronic Daily Intake (CDI) (mg/kg-day) = CS x SA x SSAF x DABS x CF1 x EF x ED x 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	3,300	cm ²		
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm ² -day		
				DABS	Dermal Absorption Factor Solids	chem specific	--		
				CF1	Conversion Factor 1	0.000001	kg/mg		
				EF	Exposure Frequency	10	days/year		
				ED	Exposure Duration	25	years		
				BW	Body Weight	70	kg		
				AT-N	Averaging Time (Non-Cancer)	9,125	days		
AT-C	Averaging Time (Cancer)	25,550	days						
Ingestion	Utility Worker	Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	See Table	mg/kg	See Table EPA, 1991 (1) EPA, 1991 (2) -- EPA, 1991 EPA, 1989 EPA, 1989	Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				IR-S	Ingestion Rate of Soil	480	mg/day		
				EF	Exposure Frequency	10	days/year		
				ED	Exposure Duration	25	years		
				CF1	Conversion Factor 1	0.000001	kg/mg		
				BW	Body Weight	70	kg		
				AT-N	Averaging Time (Non-Cancer)	9,125	days		
				AT-C	Averaging Time (Cancer)	25,550	days		

* Surface soil and subsurface soil combined.

Notes:

- (1): Professional Judgement assuming 10 days per year.
- (2) RME ED assumed to be same as USEPA's recommended ED for industrial workers.
- (3) Surface area based on adult worker wearing long pants, short-sleeved shirt, and shoes.
- (4) USEPA value for construction worker, 95th percentile.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4-2.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, HDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current
Medium: Soil*
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Utility Worker	Adult	Emissions from Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT
				CA	Chemical Concentration in Air	see Table	mg/m ³	--	
				PEF	Particulate Emissions Factor	1.32E+09	kg/m ³	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m ³ /kg	EPA, 1996	
				IN	Inhalation Rate	2.5	m ³ /hour	EPA, 1997 [3]	
				ET	Exposure Time	8	hr/day	(2)	
				EF	Exposure Frequency	10	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989					

* Surface soil and subsurface soil combined.

Notes:

- (1): Professional Judgement assuming 10 days per year.
- (2) Professional Judgement based on maintenance activities that would occur 8 hrs per day for the RME.
- (3) Inhalation rate for outdoor worker based on heavy activities.

Sources:

- EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
- EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
- EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.
- EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

TABLE 4-3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Trespasser	Adult	Site 28 Surface Soil	CS	Chemical Concentration in Soil	see Table	mg/kg	see Table	$CDI \text{ (mg/kg-day)} = CS \times SA \times SSAF \times DABS \times CF3 \times EF \times ED \times 1/BW \times 1/AT$
				SA	Skin Surface Area Available for Contact	5,700	cm ²	EPA, 2001, (2)	
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm ² -day	EPA, 2001, (3)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
		AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989			
		AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989			
		Adolescent	Site 28 Surface Soil	CS	Chemical Concentration in Soil	see Table	mg/kg	see Table	$CDI \text{ (mg/kg-day)} = CS \times SA \times SSAF \times DABS \times CF3 \times EF \times ED \times 1/BW \times 1/AT$
				SA	Skin Surface Area Available for Contact	4,400	cm ²	EPA, 2001, (4)	
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm ² -day	EPA, 2001, (5)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
CF3	Conversion Factor 3			0.000001	kg/mg	--			
EF	Exposure Frequency			52	days/year	(1)			
ED	Exposure Duration			9	years	(6)			
BW	Body Weight			51	kg	EPA, 1997,(7)			
AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989					
AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989					
Ingestion	Trespasser	Adult	Site 28 Surface Soil	CS	Chemical Concentration in Soil	See Table	mg/kg	See Table	$Chronic \text{ Daily Intake (CDI)} \text{ (mg/kg-day)} = CS \times IR-S \times EF \times ED \times CF1 \times 1/BW \times 1/AT$
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4-3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
		Adolescent	Site 28 Surface Soil	CS	Chemical Concentration in Soil	See Table	mg/kg	See Table	Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	9	years	(6)	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				BW	Body Weight	51	kg	EPA, 1997,(7)	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

- (1): Professional Judgement assuming 1 day per week for 52 weeks per year.
- (2) SA is based on adult wearing short-sleeved shirt, shorts, and shoes.
- (3) SSAF is the 95th percentile for soil adherence for Gardeners.
- (4) SA is the total of the head, hands, forearms and lower legs for the 8 through 18 year old, EPA, 2001, Exhibit C-1.
- (5) SSAF is the 95th percentile for soil adherence for Soccer Players # 1 (teens).
- (6) Assumed adolescent trespasser exposed from age 9 through 18.
- (7) Body weight is average of the mean values for boys and girls for the ages 9 through 18.

Sources:

- EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4-4.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name					
Inhalation	Trespasser	Adult	Emissions from Site 28 Surface Soil	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = $CA \times IN \times ET \times EF \times ED \times 1/BW \times 1/AT$ $CA \text{ (mg/m}^3\text{)} = CS \text{ (1/PEF + 1/VF)}$					
				CA	Chemical Concentration in Air	see Table	mg/m ³	--						
				PEF	Particulate Emissions Factor	1.32E+09	kg/m ³	EPA, 1996						
				VF	Volatilization Factor for volatile constituents	calc	m ³ /kg	EPA, 1996						
				IN	Inhalation Rate	0.83	m ³ /hour	EPA, 1991						
				ET	Exposure Time	2	hr/day	(1)						
				EF	Exposure Frequency	52	days/year	(2)						
				ED	Exposure Duration	24	years	EPA, 1991						
				BW	Body Weight	70	kg	EPA, 1991						
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989						
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989						
				Inhalation	Trespasser	Adolescent	Emissions from Site 28 Soil	CS		Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = $CA \times IN \times ET \times EF \times ED \times 1/BW \times 1/AT$ $CA \text{ (mg/m}^3\text{)} = CS \text{ (1/PEF + 1/VF)}$
								CA		Chemical Concentration in Air	see Table	mg/m ³	--	
								PEF		Particulate Emissions Factor	1.32E+09	kg/m ³	EPA, 1996	
VF	Volatilization Factor for volatile constituents	calc	m ³ /kg					EPA, 1996						
IN	Inhalation Rate	0.83	m ³ /hour					EPA, 1991						
ET	Exposure Time	2	hr/day					(1)						
EF	Exposure Frequency	52	days/year					(2)						
ED	Exposure Duration	9	years					(3)						
BW	Body Weight	51	kg					EPA, 1997,(4)						
AT-C	Averaging Time (Cancer)	25,550	days					EPA, 1989						
AT-N	Averaging Time (Non-Cancer)	3,285	days					EPA, 1989						

Notes:

- (1) Professional Judgement assuming trespasser would spend a maximum of 2 hours at the site.
- (2) Professional Judgement assuming 1 day per week for 52 weeks per year.
- (3) Assumed adolescent trespasser exposed from age 9 through 18.
- (4) Body weight is average of the mean values for boys and girls for the ages 9 through 18.

Sources:

- EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
- EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
- EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.
- EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

TABLE 4-5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Ingestion	Recreation	Adult	Mattawoman Creek	CSW	Chemical Concentration in Surface Water	see Table	µg/l	--	Chronic Daily Intake (CDI) (mg/kg-day) = CSW x IR-SW x ET x EF x ED x CF1 x 1/BW x 1/AT
				IR-SW	Ingestion Rate of Surface Water	0.025	l/hour	EPA, 1989, (3)	
				ET	Exposure Time	2.6	hr/day	EPA, 1989	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	--	
				BW	Body Weight	70	kg	EPA, 1991	
		AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989			
		AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989			
		Adolescent	Mattawoman Creek	CSW	Chemical Concentration in Surface Water	see Table	µg/l	--	
				IR-SW	Ingestion Rate of Surface Water	0.025	l/hour	EPA, 1989, (3)	
				ET	Exposure Time	2.6	hr/day	EPA, 1989	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
CF1	Conversion Factor 1			0.001	mg/µg	--			
BW	Body Weight			51	kg	EPA, 1997,(2)			
AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989					
AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989					
Dermal	Recreation	Adult	Mattawoman Creek	CSW	Chemical Concentration in Surface Water	see Table	µg/l	--	CDI (mg/kg-day) = DAevent x SA x EV x EF x ED x 1/BW x 1/AT Inorganics: DAevent (mg/cm ² -event) = Kp x CW x t _{event} x CF1 x CF2 Organics : t _{event} <t*: DAevent (mg/cm ² -event) = 2 x FA x Kp x CW x (sqrt((6 x τ x t _{event})/π)) x CF1 x CF2 t _{event} >t*: DAevent (mg/cm ² -event) = FA x Kp x CW x (t _{event} /(1+B) + 2 x τ x ((1 + 3B + 3B ²)/(1+B) ²)) x CF1 x CF2
				DAevent	Dermally Absorbed Dose per Event	mg/cm ² -event	calculated	EPA, 2001	
				SA	Skin Surface Area Available for Contact	3,120	cm ²	EPA, 1997 (4)	
				Kp	Permeability Coefficient	chem specific	cm/hr	EPA, 2001	
				τ	Lag Time	chem specific	hours	EPA, 2001	
				t*	Time to Reach Steady-state	chem specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chem specific	dimensionless	EPA, 2001	
				t _{event}	Event Time	2.6	hr/day	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	--	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	l/cm ³	--	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989					

TABLE 4-5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreation	Adolescent	Mattawoman Creek	CSW	Chemical Concentration in Surface Water	see Table	µg/l	--	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	mg/cm ² -event	calculated	EPA, 2001	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	2,630	cm ²	EPA, 1997 (5)	Inorganics: DAevent (mg/cm ² -event) = Kp x CW x t _{event} x CF1 x CF2 Organics : t _{event} <t*: DAevent (mg/cm ² -event) = 2 x FA x Kp x CW x (sqrt((6 x τ x t _{event})/π)) x CF1 x CF2 t _{event} >t*: DAevent (mg/cm ² -event) = FA x Kp x CW x (t _{event} /(1+B) + 2 x τ x ((1 + 3B + 3B ²)/(1+B) ²)) x CF1 x CF2
				Kp	Permeability Coefficient	chem specific	cm/hr	EPA, 2001	
				τ	Lag Time	chem specific	hours	EPA, 2001	
				t*	Time to Reach Steady-state	chem specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chem specific	dimensionless	EPA, 2001	
				t _{event}	Event Time	2.6	hr/day	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	--	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF2	Conversion Factor 2	0.001	l/cm ³	--	
				BW	Body Weight	51	kg	EPA, 1997,(2)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989					

- Notes:
(1) Professional Judgement assuming 1 day per week for 52 weeks per year.
(2) Body weight is average of the mean values for boys and girls for the ages 9 through 18.
(3) Professional Judgment assuming one half of the ingestion rate specified for swimming.
(4) SA is the sum of the mean surface areas (for a male) of the hands and arms (includes upper arms and forearms).
(5) Based on average total body surface area (for male) children ages 9 - 18 for hands and arms (includes upper arms and forearms).

Sources:
EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
EPA, 2000: Supplemental Guidance to RAGS: Region 4 Bulletins
EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4-6.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name				
Dermal	Resident	Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	$CDI \text{ (mg/kg-day)} = CS \times SA \times SSAF \times DABS \times CF3 \times EF \times ED \times 1/BW \times 1/AT$				
				SA	Skin Surface Area Available for Contact	5,700	cm ²	EPA, 2001 (2)					
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm ² -day	EPA, 2001 (2)					
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 1995, 2001					
				CF3	Conversion Factor 3	0.000001	kg/mg	--					
				EF	Exposure Frequency	350	days/year	EPA, 1991					
				ED	Exposure Duration	24	years	EPA, 1991					
				BW	Body Weight	70	kg	EPA, 1991					
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989					
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989					
				Child/Adult	Child	Site 28 Soil*	CS	Chemical Concentration in Soil		see Table	mg/kg	--	$CDI \text{ (mg/kg-day)} = CS \times SA \times SSAF \times DABS \times CF3 \times EF \times ED \times 1/BW \times 1/AT$
							SA	Skin Surface Area Available for Contact		2,800	cm ²	EPA, 2001 (2)	
							SSAF	Soil to Skin Adherence Factor		0.2	mg/cm ² -day	EPA, 2001 (2)	
							DABS	Dermal Absorption Factor Solids		chem specific	--	EPA, 1995, 2001	
	CF3	Conversion Factor 3	0.000001				kg/mg	--					
	EF	Exposure Frequency	350				days/year	EPA, 1991					
	ED	Exposure Duration	6				years	EPA, 1991					
	BW	Body Weight	15		kg		EPA, 1991						
	AT-C	Averaging Time (Cancer)	25,550		days		EPA, 1989						
	AT-N	Averaging Time (Non-Cancer)	2,190		days		EPA, 1989						
	Child/Adult	Site 28 Soil*	CS		Chemical Concentration in Soil		see Table	mg/kg	--	$CDI \text{ (mg/kg-day)} = CS \times DA-Adj \times DABS \times CF3 \times EF \times 1/AT$			
			SA-A		Skin Surface Area Available for Contact, Adult		5,700	cm ²	EPA, 2001 (2)				
			SA-C		Skin Surface Area Available for Contact, Child		2,800	cm ²	EPA, 2001 (2)				
			SSAF-A		Soil to Skin Adherence Factor, Adult		0.07	mg/cm ² -day	EPA, 2001 (2)				
			SSAF-C	Soil to Skin Adherence Factor, Child	0.2	mg/cm ² -day	EPA, 2001 (2)						
			DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 1995, 2001						
			DA-Adj	Dermal Absorption, Age-adjusted	361	mg-year/kg-day	calculated						
	CF3	Conversion Factor 3	0.000001	kg/mg	--								
EF	Exposure Frequency	350	days/year	EPA, 1991									
ED-A	Exposure Duration, Adult	24	years	EPA, 1991									
ED-C	Exposure Duration, Child	6	years	EPA, 1991									
BW-A	Body Weight, Adult	70	kg	EPA, 1991									
BW-C	Body Weight, Child	15	kg	EPA, 1991									
AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989									

TABLE 4-6.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Worker	Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	$CDI \text{ (mg/kg-day)} =$ $CS \times SA \times SSAF \times DABS \times CF3 \times EF \times$ $ED \times 1/BW \times 1/AT$
				SA	Skin Surface Area Available for Contact	3,300	cm ²	EPA, 2001 (3)	
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm ² -day	EPA, 2001 (4)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 1995, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
Dermal	Trespasser	Adolescent	Site 28 Surface Soil	CS	Chemical Concentration in Soil	see Table	mg/kg	see Table	$CDI \text{ (mg/kg-day)} =$ $CS \times SA \times SSAF \times DABS \times CF3 \times EF \times$ $ED \times 1/BW \times 1/AT$
				SA	Skin Surface Area Available for Contact	4,400	cm ²	EPA, 2001, (5)	
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm ² -day	EPA, 2001, (6)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	9	years	(8)	
				BW	Body Weight	51	kg	EPA, 1997,(7)	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
Dermal	Trespasser	Adult	Site 28 Surface Soil	CS	Chemical Concentration in Soil	see Table	mg/kg	see Table	$CDI \text{ (mg/kg-day)} =$ $CS \times SA \times SSAF \times DABS \times CF3 \times EF \times$ $ED \times 1/BW \times 1/AT$
				SA	Skin Surface Area Available for Contact	5,700	cm ²	EPA, 2001, (9)	
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm ² -day	EPA, 2001, (10)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4-6.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Ingestion	Resident	Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				Child	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	
	IR-S	Ingestion Rate of Soil	200			mg/day	EPA, 1991		
	EF	Exposure Frequency	350			days/year	EPA, 1991		
	ED	Exposure Duration	6			years	EPA, 1991		
	CF3	Conversion Factor 3	0.000001			kg/mg	--		
	BW	Body Weight	15			kg	EPA, 1991		
	AT-C	Averaging Time (Cancer)	25,550			days	EPA, 1989		
	AT-N	Averaging Time (Non-Cancer)	2,190			days	EPA, 1989		
	Child/Adult	Site 28 Soil*	CS			Chemical Concentration in Soil	see Table	mg/kg	--
			IR-S-A	Ingestion Rate of Soil, Adult	100	mg/day	EPA, 1991		
			IR-S-C	Ingestion Rate of Soil, Child	200	mg/day	EPA, 1991		
			IR-S-Adj	Ingestion Rate of Soil, Age-adjusted	114	mg-year/kg-day	calculated		
			EF	Exposure Frequency	350	days/year	EPA, 1991		
ED-A			Exposure Duration, Adult	24	years	EPA, 1991			
ED-C			Exposure Duration, Child	6	years	EPA, 1991			
CF3			Conversion Factor 3	0.000001	kg/mg	--			
BW-A			Body Weight, Adult	70	kg	EPA, 1991			
BW-C			Body Weight, Child	15	kg	EPA, 1991			
AT-C			Averaging Time (Cancer)	25,550	days	EPA, 1989			
Construction Worker	Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT	
			IR-S	Ingestion Rate of Soil	480	mg/day	EPA, 1991		
			EF	Exposure Frequency	250	days/year	EPA, 1991		
			ED	Exposure Duration	1	years	EPA, 1991		
			CF3	Conversion Factor 3	0.000001	kg/mg	--		
			BW	Body Weight	70	kg	EPA, 1991		
			AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989		
			AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989		

TABLE 4-6.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name	
Ingestion	Trespasser	Adolescent	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	see Table	Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT	
				IR-S	Ingestion Rate of Soil	100	mg/day	(1)		
				EF	Exposure Frequency	52	days/year			
				ED	Exposure Duration	9	years			
				CF3	Conversion Factor 3	0.000001	kg/mg			--
				BW	Body Weight	51	kg			EPA, 1997,(7)
				AT-C	Averaging Time (Cancer)	25,550	days			EPA, 1989
				AT-N	Averaging Time (Non-Cancer)	3,285	days			EPA, 1989
		Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg			see Table
				IR-S	Ingestion Rate of Soil	100	mg/day	(1)		
				EF	Exposure Frequency	52	days/year			
				ED	Exposure Duration	24	years			
				CF3	Conversion Factor 3	0.000001	kg/mg			--
				BW	Body Weight	70	kg			EPA, 1991
AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989						
AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989						

* Surface soil and subsurface soil combined.

- (1) Professional Judgement assuming 1 day per week for 52 weeks per year.
- (2) USEPA recommended value for adult and child resident (USEPA, 2001).
- (3) USEPA recommended value for adult worker (USEPA, 2001).
- (4) USEPA value for construction worker, 95th percentile (USEPA, 2001).
- (5) SA is the total of the head, hands, forearms and lower legs for the 8 through 18 year old, EPA, 2001, Exhibit C-1.
- (6) SSAF is the 95th percentile for soil adherence for Soccer Players # 1 (teens).
- (7) Body weight is average of the mean values for boys and girls for the ages 9 through 18.
- (8) Assumed adolescent trespasser exposed from age 9 through 18.
- (9) SA is based on adult wearing short-sleeved shirt, shorts, and shoes.
- (10) SSAF is the 95th percentile for soil adherence for Gardeners.

Sources:

- EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
- EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
- EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.
- EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.
- EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
- EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4-7.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Inhalation	Resident	Adult	Emissions from Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT CA (mg/m3) = CS (1/PEF + 1/VF)
				CA	Chemical Concentration in Air	see Table	mg/m3	--	
				PEF	Particulate Emissions Factor	1.32E+09	m3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m3/kg	EPA, 1996	
				IN	Inhalation Rate	0.83	m ³ /hour	EPA, 1991	
				ET	Exposure Time	24	hr/day	(1)	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				Resident	Child	Emissions from Site 28 Soil*	CS	Chemical Concentration in Soil	
	CA	Chemical Concentration in Air	see Table				mg/m3	--	
	PEF	Particulate Emissions Factor	1.32E+09				kg/m3	EPA, 1996	
	VF	Volatilization Factor for volatile constituents	calc				m3/kg	EPA, 1996	
	IN	Inhalation Rate	0.5				m ³ /hour	EPA, 1997	
	ET	Exposure Time	24				hr/day	(1)	
	EF	Exposure Frequency	350				days/year	EPA, 2001	
	ED	Exposure Duration	6				years	EPA, 1989	
	BW	Body Weight	15				kg	EPA, 1991	
	AT-C	Averaging Time (Cancer)	25,550				days	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	2,190				days	EPA, 1989	
	Resident	Child/Adult	Emissions from Site 28 Soil*				CS	Chemical Concentration in Soil	see Table
				CA	Chemical Concentration in Air	see Table	mg/m3	--	
				PEF	Particulate Emissions Factor	1.32E+09	kg/m3	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m3/kg	EPA, 1996	
				IN-S-A	Inhalation Rate, Adult	0.83	m3/hour	EPA, 1991	
IN-S-C				Inhalation Rate, Child	0.5	m3/hour	EPA, 1997		
IN-S-Adj				Inhalation Rate, Age-adjusted	11.6	m ³ -year/kg-day	calculated		
ET				Exposure Time	24	hours/day	(1)		
EF				Exposure Frequency	350	days/year	EPA, 2001		
ED-A				Exposure Duration, Adult	24	years	EPA, 1993		
ED-C				Exposure Duration, Child	6	years	EPA, 1991		

TABLE 4-7.FME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
	Construction Worker	Adult	Emissions from Site 28 Soil*	BW-A	Body Weight, Adult	70	kg	EPA, 1991	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CS	Chemical Concentration in Soil	see Table	mg/kg	--	
				CA	Chemical Concentration in Air	see Table	mg/m3	--	
				PEF	Particulate Emissions Factor	1.32E+09	kg/m3	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m3/kg	EPA, 1996	
				IN	Inhalation Rate	2.5	m3/hour	EPA, 1997 (6)	
				ET	Exposure Time	8	hr/day	(1)	
				EF	Exposure Frequency	250	days/year	EPA, 1993	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989				
	Trespasser	Adolescent	Emissions from Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT
				CA	Chemical Concentration in Air	see Table	mg/m3	--	
				PEF	Particulate Emissions Factor	1.32E+09	kg/m3	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m3/kg	EPA, 1996	
				IN	Inhalation Rate	1.4	m3/hour	EPA, 1997 (7)	
				ET	Exposure Time	2	hr/day	(2)	
EF				Exposure Frequency	52	days/year	(3)		
ED				Exposure Duration	9	years	(4)		
BW				Body Weight	51	kg	EPA, 1997,(5)		
AT-C				Averaging Time (Cancer)	25550	days	EPA, 1989		
AT-N	Averaging Time (Non-Cancer)	3285	days	EPA, 1989					
	Adult	Emissions from Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT	
			CA	Chemical Concentration in Air	see Table	mg/m3	--		
			PEF	Particulate Emissions Factor	1.32E+09	kg/m3	EPA, 1996		
			VF	Volatilization Factor for volatile constituents	calc	m3/kg	EPA, 1996		
			IN	Inhalation Rate	1.6	m3/hour	EPA, 1997 (8)		
			ET	Exposure Time	2	hr/day	(2)		
			EF	Exposure Frequency	52	days/year	(3)		
			ED	Exposure Duration	24	years	EPA, 1991		

TABLE 4-7.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8760	days	EPA, 1989	

* Surface soil and subsurface soil combined.

- (1) Professional Judgement, conservatively assumed all day.
- (2) Professional Judgement assuming trespasser would spend a maximum of 2 hours at the site.
- (3) Professional Judgement assuming 1 day per week for 52 weeks per year for the RME.
- (4) Professional Judgement assuming adolescents from 9 to 18 years of age.
- (5) Body weight is average of the mean values for boys and girls for the ages 9 through 18.
- (6) Inhalation rate is based on values for the outdoor worker assuming heavy activity (EPA, 1997, page 5-24).
- (7) Assumed moderate activity level, short-term exposure for males/females ages 10 to 18, Table 5-14, EPA, 1997.
- (8) Assumed moderate activity level, short-term exposure for adults, Table 5-23, EPA, 1997.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.
EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4-8.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table ---	µg/l	See Table ---	Chronic Daily Intake (CDI) (mg/kg-day) = $CW \times IR-W \times EF \times ED \times CF1 \times 1/BW \times 1/AT$
				IR-W	Ingestion Rate of Water	2	liters/day	EPA, 1997	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	--	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table ---	µg/l	See Table ---	CDI (mg/kg-day) = $CW \times IR-W \times EF \times ED \times CF1 \times 1/BW \times 1/AT$
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
	CF1			Conversion Factor 1	0.001	mg/µg	--		
	BW			Body Weight	15	kg	EPA, 1991		
	AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989				
	AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989				
	Child/Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table ---	µg/l	See Table ---	CDI (mg/kg-day) = $CW \times IR-W-Adj \times EF \times CF1 \times 1/AT$ $IR-W-Adj$ (liter-year/kd-day) = $(ED-C \times IR-W-C / BW-C) +$ $(ED-A \times IR-W-A / BW-A)$	
			IR-W-A	Ingestion Rate of Water, Adult	2	liters/day	EPA, 1997		
			IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997		
			IR-W-Adj	Ingestion Rate of Water, Age-adjusted	1.09	liter-year/kg-day	calculated		
			EF	Exposure Frequency	350	days/year	EPA, 1991		
			ED-A	Exposure Duration, Adult	24	years	EPA, 1991		
			ED-C	Exposure Duration, Child	6	years	EPA, 1991		
			CF1	Conversion Factor 1	0.001	mg/µg	--		
BW-A			Body Weight, Adult	70	kg	EPA, 1991			
BW-C			Body Weight, Child	15	kg	EPA, 1991			
AT-C			Averaging Time (Cancer)	25,550	days	EPA, 1989			

TABLE 4-8.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Dermal	Resident	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table ---	$\mu\text{g/l}$	See Table ---	$\text{CDI (mg/kg-day)} = \text{DAevent} \times \text{SA} \times \text{EV} \times \text{EF} \times \text{ED} \times 1/\text{BW} \times 1/\text{AT}$ Inorganics: $\text{DAevent (mg/cm}^2\text{-event)} = \text{Kp} \times \text{CW} \times t_{\text{event}} \times \text{CF1} \times \text{CF2}$ Organics : $t_{\text{event}} < t^*$: $\text{DAevent (mg/cm}^2\text{-event)} = 2 \times \text{FA} \times \text{Kp} \times \text{CW} \times (\text{sqrt}((6 \times t \times t_{\text{event}})/\pi)) \times \text{CF1} \times \text{CF2}$ $t_{\text{event}} > t^*$: $\text{DAevent (mg/cm}^2\text{-event)} = \text{FA} \times \text{Kp} \times \text{CW} \times (t_{\text{event}}/(1+B)) + 2 \times t \times ((1 + 3B + 3B^2)/(1+B)^2)) \times \text{CF1} \times \text{CF2}$
		DAevent		Dermally Absorbed Dose per Event	calculated	$\text{mg/cm}^2\text{-event}$	calculated		
FA	Fraction absorbed water	chemical specific		dimensionless	EPA, 2001				
Kp	Permeability Coefficient	chemical specific		cm/hr	EPA, 2001				
τ	Lag Time	chemical specific		hr/event	EPA, 2001				
t^*	Time to Reach Steady-state	chemical specific		hours	EPA, 2001				
B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific		dimensionless	EPA, 2001				
t_{event}	Event Time	0.58		hr/event	EPA, 2001				
SA	Skin Surface Area Available for Contact	18,000		cm^2	EPA, 2001				
EV	Event Frequency	1		events/day	EPA, 2001				
EF	Exposure Frequency	350		days/year	EPA, 2001				
ED	Exposure Duration	24		years	EPA, 2001				
BW	Body Weight	70		kg	EPA, 1991				
AT-C	Averaging Time (Cancer)	25,550		days	EPA, 1989				
AT-N	Averaging Time (Non-Cancer)	8,760		days	EPA, 1989				
CF1	Conversion Factor 1	0.001		$\text{mg}/\mu\text{g}$	--				
CF2	Conversion Factor 2	0.001		l/cm^3	--				
		Child		Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table ---	$\mu\text{g/l}$	
DAevent	Dermally Absorbed Dose per Event	calculated	$\text{mg/cm}^2\text{-event}$		calculated				
FA	Fraction absorbed water	chemical specific	dimensionless		EPA, 2001				
Kp	Permeability Coefficient	chemical specific	cm/hr		EPA, 2001				
τ	Lag Time	chemical specific	hr/event		EPA, 2001				
t^*	Time to Reach Steady-state	chemical specific	hours		EPA, 2001				
B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless		EPA, 2001				
t_{event}	Event Time	1.0	hr/event		EPA, 2001				
SA	Skin Surface Area Available for Contact	6,600	cm^2		EPA, 2001				
EV	Event Frequency	1	events/day		EPA, 2001				
EF	Exposure Frequency	350	days/year		EPA, 2001				
ED	Exposure Duration	6	years		EPA, 2001				
BW	Body Weight	15	kg		EPA, 1991				
AT-C	Averaging Time (Cancer)	25,550	days		EPA, 1989				
AT-N	Averaging Time (Non-Cancer)	2190	days		EPA, 1989				
CF1	Conversion Factor 1	0.001	$\text{mg}/\mu\text{g}$		--				
CF2	Conversion Factor 2	0.001	l/cm^3		--				

TABLE 4-8.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (cont'd)	Resident	Child/Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table ---	µg/l	See Table ---	$CDI (mg/kg\text{-}day) = DA\text{-}Adj \times EF \times 1/AT$ $DA\text{-}Adj = (DAevent\text{-}A \times SA\text{-}A \times ED\text{-}A \times 1/BW\text{-}A) + (DAevent\text{-}C \times SA\text{-}C \times ED\text{-}C \times 1/BW\text{-}C)$ Inorganics: $DAevent (mg/cm^2\text{-}event) = Kp \times CW \times t_{event} \times CF1 \times CF2$ Organics : $t_{event} < t^*$: $DAevent (mg/cm^2\text{-}event) = 2 \times FA \times Kp \times CW \times (\sqrt{(6 \times \tau \times t_{event})/\pi}) \times CF1 \times CF2$ $t_{event} > t^*$: $DAevent (mg/cm^2\text{-}event) = FA \times Kp \times CW \times (t_{event}/(1+B) + 2 \times \tau \times ((1 + 3B + 3B^2)/(1+B^2))) \times CF1 \times CF2$
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm ² -event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm ² -event	calculated	
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2001	
				τ	Lag Time	chemical specific	hr/event	EPA, 2001	
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2001	
				t _{event} -A	Event Time, Adult	0.58	hr/event	EPA, 2001	
				t _{event} -C	Event Time, Child	1.0	hr/event	EPA, 2001	
				SA-A	Skin Surface Area, Adult	18,000	cm ²	EPA, 2001	
				SA-C	Skin Surface Area, Child	6,600	cm ²	EPA, 2001	
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED-A	Exposure Duration, Adult	24	years	EPA, 2001	
				ED-C	Exposure Duration, Child	6	years	EPA, 2001	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
CF1	Conversion Factor 1	0.001	mg/µg	--					
CF2	Conversion Factor 2	0.001	l/cm ³	--					

TABLE 4-8.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Dermal (cont'd)	Construction Worker	Adult	Water in Excavation Pit	CW	Chemical Concentration in Water	See Table ---	μg/l	See Table ---	$CDI \text{ (mg/kg-day)} = DA_{event} \times SA \times EV \times EF \times ED \times 1/BW \times 1/AT$ Inorganics: $DA_{event} \text{ (mg/cm}^2\text{-event)} = Kp \times CW \times t_{event} \times CF1 \times CF2$ Organics : $t_{event} < t^*$: $DA_{event} \text{ (mg/cm}^2\text{-event)} = 2 \times FA \times Kp \times CW \times (\text{sqrt}((6 \times \tau \times t_{event})/\pi)) \times CF1 \times CF2$ $t_{event} > t^*$: $DA_{event} \text{ (mg/cm}^2\text{-event)} = FA \times Kp \times CW \times (t_{event}/(1+B) + 2 \times \tau \times ((1 + 3B + 3B^2)/(1+B)^2)) \times CF1 \times CF2$
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm ² -event	calculated	
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2001	
				τ	Lag Time	chemical specific	hr/event	EPA, 2001	
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2001	
				t _{event}	Event Time	8	hr/day	(1)	
				SA	Skin Surface Area Available for Contact	3,300	cm ²	EPA, 2001 (2)	
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
CF1	Conversion Factor 1	0.001	mg/μg	--					
CF2	Conversion Factor 2	0.001	l/cm ³	--					

(1) Professional Judgement based on construction activities that would occur 8 hrs per day for the RME.
(2) USEPA recommended value for adult worker (USEPA, 2001).

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4-9 RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Inhalation	Resident	Adult	Water Vapors at showerhead	CW	Chemical Concentration in Water	See Table ---	$\mu\text{g/l}$	See Table ---	Chronic Daily Intake (CDI) (mg/kg-day) = InhExp x EF x ED x 1/AT Foster & Chrostowski Shower Inhalation Model for InhExp
				InhExp	Inhalation Exposure per Shower	calculated	mg/kg-shower		
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989				
	Construction Worker	Adult	Water Vapors at Excavation Pit	CW	Chemical Concentration in Water	See Table ---	$\mu\text{g/l}$	See Table ---	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT CA calculated using two-film model
				CA	Chemical Concentration in Air	calculated	mg/m^3		
				IN	Inhalation Rate	2.5	m^3/hour	EPA, 1991	
				ET	Exposure Time	8	hr/day	(1)	
				EF	Exposure Frequency	125	days/year	(2)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
AT-N				Averaging Time (Non-Cancer)	365	days	EPA, 1989		

Notes:

- (1) Professional Judgement based on construction activities that would occur 8 hrs per day for the RME.
- (2) Assumed duration of construction project may be 1/2 a year.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

TABLE 4-1.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Dermal	Utility Worker	Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	See Table	mg/kg	See Table	Chronic Daily Intake (CDI) (mg/kg-day) = CS x SA x SSAF x DABS x CF1 x EF x ED x 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	2,000	cm ²	EPA, 2001 (2)	
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm ² -day	EPA, 2001 (3)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF1	Conversion Factor 1	0.000001	kg/mg	--	
				EF	Exposure Frequency	5	days/year	(1)	
				ED	Exposure Duration	5	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	1,825	days	EPA, 1989	
AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989					
Ingestion	Utility Worker	Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	See Table	mg/kg	See Table	Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1993	
				EF	Exposure Frequency	5	days/year	(1)	
				ED	Exposure Duration	5	years	EPA, 1993	
				CF1	Conversion Factor 1	0.000001	kg/mg	--	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	1,825	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

* Surface soil and subsurface soil combined

Notes:

(1): Professional Judgement assuming 5 days per year.

(2) CT SA is the sum of the mean surface areas (for a male) of the head and hands.

(3) Soil to skin adherence factor is based on 50th percentile weighted adherence factor for utility workers.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4-2.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IH/DIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current
Medium: Soil*
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Utility Worker	Adult	Emissions from Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT
				CA	Chemical Concentration in Air	calculated	mg/m ³	calculated	
				PEF	Particulate Emissions Factor	1.32E+09	kg/m ³	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m ³ /kg	EPA, 1996	
				IN	Inhalation Rate	1.5	m ³ /hour	EPA, 1997 (2)	
				ET	Exposure Time	4	hr/day	(3)	
				EF	Exposure Frequency	5	days/year	(1)	
				ED	Exposure Duration	5	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989	
AT-N	Averaging Time (Non-Cancer)	1825	days	EPA, 1989					

* Surface soil and subsurface soil combined.

Notes:

- (1): Professional Judgement assuming 5 days per year.
- (2) Inhalation rate for outdoor worker based on moderate activities.
- (3) Professional Judgement based on activities that would occur 4 hrs per day.

Sources:

- EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
- EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
- EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
- EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.
- EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
- EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
- EPA, 2002: Region III Risk-Based Concentration Table. October 9, 2002.

TABLE 4-3.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Trespasser	Adult	Site 28 Surface Soil	CS	Chemical Concentration in Soil	see Table	mg/kg	see Table	$CDI \text{ (mg/kg-day)} = CS \times SA \times SSAF \times DABS \times CF3 \times EF \times ED \times 1/BW \times 1/AT$
				SA	Skin Surface Area Available for Contact	2,000	cm ²	EPA, 1992, (2)	
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm ² -day	EPA, 2001, (3)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989			
		Adolescent	Site 28 Surface Soil	CS	Chemical Concentration in Soil	see Table	mg/kg	see Table	$CDI \text{ (mg/kg-day)} = CS \times SA \times SSAF \times DABS \times CF3 \times EF \times ED \times 1/BW \times 1/AT$
				SA	Skin Surface Area Available for Contact	3,700	cm ²	EPA, 1992	
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm ² -day	EPA, 2001, (4)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
BW	Body Weight			51	kg	EPA, 1997, (5)			
AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989					
AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989					
Ingestion	Trespasser	Adult	Site 28 Surface Soil	CS	Chemical Concentration in Soil	See Table	mg/kg	See Table	$Chronic \ Daily \ Intake \ (CDI) \text{ (mg/kg-day)} = CS \times IR-S \times EF \times ED \times CF1 \times 1/BW \times 1/AT$
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1991	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	3285	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989	

TABLE 4-3.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Ingestion	Trespasser	Adolescent	Site 28 Surface Soil	CS	Chemical Concentration in Soil	See Table	mg/kg	See Table	Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1991	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				BW	Body Weight	51	kg	EPA, 1997,(5)	
				AT-N	Averaging Time (Non-Cancer)	8760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989	

Notes:

- (1): Professional Judgement assuming 1 day per week for 26 weeks per year.
- (2) SA is the sum of the mean surface areas (for a male) of the head and hands.
- (3) SSAF is the geometric mean for soil adherence for Gardeners.
- (4) SSAF is the geometric mean for soil adherence for Soccer Players # 1 (teens).
- (4) Body weight is average of the mean values for boys and girls for the ages 9 through 18.

Sources:

- EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
- EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
- EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.
- EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
- EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
- EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4-4.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name					
Inhalation	Trespasser	Adult	Emissions from Site 28 Surface Soil	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT					
				CA	Chemical Concentration in Air	see Table	mg/m3	--						
				PEF	Particulate Emissions Factor	1.32E+09	kg/m3	EPA, 1996						
				VF	Volatilization Factor for volatile constituents	calc	m3/kg	EPA, 1996						
				IN	Inhalation Rate	0.5	m3/hour	EPA, 1997 (2)						
				ET	Exposure Time	1.8	hr/day	(1)						
				EF	Exposure Frequency	26	days/year	(3)						
				ED	Exposure Duration	9	years	EPA, 1993						
				BW	Body Weight	70	kg	EPA, 1991						
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989						
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989						
				Inhalation	Trespasser	Adolescent	Emissions from Site 28 Soil	CS		Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT
								CA		Chemical Concentration in Air	see Table	mg/m3	--	
								PEF		Particulate Emissions Factor	1.32E+09	kg/m3	EPA, 1996	
VF	Volatilization Factor for volatile constituents	calc	m3/kg					EPA, 1996						
IN	Inhalation Rate	0.542	m3/hour					EPA, 1997, (6)						
ET	Exposure Time	1.8	hr/day					(1)						
EF	Exposure Frequency	26	days/year					(3)						
ED	Exposure Duration	9	years					(4)						
BW	Body Weight	51	kg					EPA, 1997,(5)						
AT-C	Averaging Time (Cancer)	25,550	days					EPA, 1989						
AT-N	Averaging Time (Non-Cancer)	3,285	days					EPA, 1989						

Notes:

- (1) Professional Judgement assuming trespasser would spend a maximum of 1.8 hours at the site.
- (2) Inhalation rate for adult, sedentary activities.
- (3) Professional Judgement assuming 1 day per week for 26 weeks per year.
- (4) Professional Judgement assuming adolescents from 9 to 18 years of age.
- (5) Body weight is average of the mean values for boys and girls for the ages 9 through 18.
- (6) Average of Long-term exposure of male and female ages 9-18, Table 5-23, EFH 1997.

Sources:

- EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.
EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
EPA, 1999: Risk-Based Concentration Table. October 27, 1999.

TABLE 4-5.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Ingestion	Recreation	Adult	Mattawoman Creek	CSW	Chemical Concentration in Surface Water	see Table	µg/l	--	Chronic Daily Intake (CDI) (mg/kg-day) = $CSW \times IR-SW \times ET \times EF \times ED \times CF1 \times 1/BW \times 1/AT$
				IR-SW	Ingestion Rate of Surface Water	0.025	l/hour	EPA, 1989, (3)	
				ET	Exposure Time	2.8	hr/day	EPA, 1989	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	--	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989			
		Adolescent	Mattawoman Creek	CSW	Chemical Concentration in Surface Water	see Table	µg/l	--	Chronic Daily Intake (CDI) (mg/kg-day) = $CSW \times IR-SW \times ET \times EF \times ED \times CF1 \times 1/BW \times 1/AT$
				IR-SW	Ingestion Rate of Surface Water	0.025	l/hour	EPA, 1989, (3)	
				ET	Exposure Time	2.6	hr/day	EPA, 1989	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
CF1	Conversion Factor 1			0.001	mg/µg	--			
BW	Body Weight	51	kg	EPA, 1997,(2)					
AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989					
AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989					
Dermal	Recreation	Adult	Mattawoman Creek	CSW	Chemical Concentration in Surface Water	see Table	µg/l	--	CDI (mg/kg-day) = $DAevent \times SA \times EV \times EF \times ED \times 1/BW \times 1/AT$ Inorganics: $DAevent \text{ (mg/cm}^2\text{-event)} = Kp \times CW \times t_{event} \times CF1 \times CF2$ Organics : $t_{event} < t^*$: $DAevent \text{ (mg/cm}^2\text{-event)} = 2 \times FA \times Kp \times CW \times (\sqrt{t_{event} \times (6 \times \tau \times t_{event}) / \pi}) \times CF1 \times CF2$ $t_{event} > t^*$: $DAevent \text{ (mg/cm}^2\text{-event)} = FA \times Kp \times CW \times (t_{event} / (1+B) + 2 \times \tau \times ((1 + 3B + 3B^2)/(1+B^2))) \times CF1 \times CF2$
				DAevent	Dermally Absorbed Dose per Event	mg/cm ² -event	calculated	EPA, 2001	
				SA	Skin Surface Area Available for Contact	3,120	cm ²	EPA, 1997 (4)	
				Kp	Permeability Coefficient	chem specific	cm/hr	EPA, 2001	
				τ	Lag Time	chem specific	hours	EPA, 2001	
				t*	Time to Reach Steady-state	chem specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chem specific	dimensionless	EPA, 2001	
				t _{event}	Event Time	2.6	hr/day	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	--	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	l/cm ³	--	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989					

TABLE 4-5.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Dermal	Recreation	Adolescent	Mattawoman Creek	CSW	Chemical Concentration in Surface Water	see Table	µg/l	--	$CDI \text{ (mg/kg-day)} = DA_{event} \times SA \times EV \times EF \times ED \times 1/BW \times 1/AT$ Inorganics: $DA_{event} \text{ (mg/cm}^2\text{-event)} = Kp \times CW \times t_{event} \times CF1 \times CF2$ Organics : $t_{event} < t^*$: $DA_{event} \text{ (mg/cm}^2\text{-event)} = 2 \times FA \times Kp \times CW \times (\text{sqrt}((6 \times \tau \times t_{event})/\pi)) \times CF1 \times CF2$ $t_{event} > t^*$: $DA_{event} \text{ (mg/cm}^2\text{-event)} = FA \times Kp \times CW \times (t_{event}/(1+B) + 2 \times \tau \times ((1 + 3B + 3B^2)/(1+B)^2)) \times CF1 \times CF2$
				DAevent	Dermally Absorbed Dose per Event	mg/cm ² -event	calculated	EPA, 2001	
				SA	Skin Surface Area Available for Contact	2,630	cm ²	EPA, 1997 (5)	
				Kp	Permeability Coefficient	chem specific	cm/hr	EPA, 2001	
				τ	Lag Time	chem specific	hours	EPA, 2001	
				t*	Time to Reach Steady-state	chem specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chem specific	dimensionless	EPA, 2001	
				t _{event}	Event Time	2.6	hr/day	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	--	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF2	Conversion Factor 2	0.001	l/cm ³	--	
				BW	Body Weight	51	kg	EPA, 1997,(2)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989					

Notes:

- (1) Professional Judgment assuming 1 day per week for 26 weeks per year.
- (2) Body weight is average of the mean values for boys and girls for the ages 9 through 18.
- (3) Professional Judgment assuming one half of the ingestion rate specified for swimming.
- (4) SA is the sum of the mean surface areas (for a male) of the hands and arms (includes upper arms and forearms).
- (5) Based on average total body surface area (for male) children ages 9 - 18 for hands and arms (includes upper arms and forearms).

Sources:

- EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.
EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
EPA, 2000: Supplemental Guidance to RAGS: Region 4 Bulletins
EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4-6.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Dermal	Resident	Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	CDI (mg/kg-day) = CS x SA x SSAF x DABS x CF3 x EF x ED x 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	5,700	cm ²	EPA, 2001 (2)	
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm ² -day	EPA, 2001 (2)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 1995, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989				
	Resident	Child	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	CDI (mg/kg-day) = CS x SA x SSAF x DABS x CF3 x EF x ED x 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	2,800	cm ²	EPA, 2001 (2)	
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm ² -day	EPA, 2001 (2)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 1995, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989				
	Resident	Child/Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	CDI (mg/kg-day) = CS x DA-Adj x DABS x CF3 x EF x 1/AT DA-Adj (mg-year/kg-day) = [(ED-C x SA-C / BW-C)*SSAF-C + (ED-A x SA-A / BW-A)*SSAF-A]
				SA-A	Skin Surface Area Available for Contact, Adult	5,700	cm ²	EPA, 2001 (2)	
				SA-C	Skin Surface Area Available for Contact, Child	2,800	cm ²	EPA, 2001 (2)	
				SSAF-A	Soil to Skin Adherence Factor, Adult	0.07	mg/cm ² -day	EPA, 2001 (2)	
				SSAF-C	Soil to Skin Adherence Factor, Child	0.2	mg/cm ² -day	EPA, 2001 (2)	
				DA-Adj	Dermal Absorption, Age-adjusted	275.3	mg-year/kg-day	calculated	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
EF				Exposure Frequency	234	days/year	EPA, 1993		
ED-A				Exposure Duration, Adult	9	years	EPA, 1993		
ED-C				Exposure Duration, Child	6	years	EPA, 1991		
BW-A				Body Weight, Adult	70	kg	EPA, 1991		
BW-C				Body Weight, Child	15	kg	EPA, 1991		
AT-C				Averaging Time (Cancer)	25,550	days	EPA, 1989		

TABLE 4-6 CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IH DIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Dermal	Construction Worker	Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	CDI (mg/kg-day) = CS x SA x SSAF x DABS x CF3 x EF x ED x 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	3,300	cm ²	EPA, 2001 (3)	
				SSAF	Soil to Skin Adherence Factor	0.1	mg/cm ² -day	EPA, 2001 (4)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 1995, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				EF	Exposure Frequency	219	days/year	EPA, 1993	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989					
Dermal	Trespasser	Adolescent	Site 28 Surface Soil	CS	Chemical Concentration in Soil	see Table	mg/kg	see Table	CDI (mg/kg-day) = CS x SA x SSAF x DABS x CF3 x EF x ED x 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	4,400	cm ²	EPA, 2001, (5)	
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm ² -day	EPA, 2001, (6)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	(8)	
				BW	Body Weight	51	kg	EPA, 1997,(7)	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989					
Dermal	Trespasser	Adult	Site 28 Surface Soil	CS	Chemical Concentration in Soil	see Table	mg/kg	see Table	CDI (mg/kg-day) = CS x SA x SSAF x DABS x CF3 x EF x ED x 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	5,700	cm ²	EPA, 2001, (9)	
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm ² -day	EPA, 2001, (10)	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2001	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989					

TABLE 4-6.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Ingestion	Resident	Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1993	
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
				Child	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	
	IR-S	Ingestion Rate of Soil	100			mg/day	EPA, 1993		
	EF	Exposure Frequency	234			days/year	EPA, 1993		
	ED	Exposure Duration	6			years	EPA, 1991		
	CF3	Conversion Factor 3	0.000001			kg/mg	--		
	BW	Body Weight	15			kg	EPA, 1991		
	AT-C	Averaging Time (Cancer)	25,550			days	EPA, 1989		
	AT-N	Averaging Time (Non-Cancer)	2,190			days	EPA, 1989		
	Child/Adult	Site 28 Soil*	CS			Chemical Concentration in Soil	see Table	mg/kg	--
			IR-S-A	Ingestion Rate of Soil, Adult	50	mg/day	EPA, 1993		
			IR-S-C	Ingestion Rate of Soil, Child	100	mg/day	EPA, 1993		
			IR-S-Adj	Ingestion Rate of Soil, Age-adjusted	46.43	mg-year/kg-day	calculated		
			EF	Exposure Frequency	234	days/year	EPA, 1993		
			ED-A	Exposure Duration, Adult	9	years	EPA, 1993		
			ED-C	Exposure Duration, Child	6	years	EPA, 1991		
			CF3	Conversion Factor 3	0.000001	kg/mg	--		
			BW-A	Body Weight, Adult	70	kg	EPA, 1991		
	BW-C	Body Weight, Child	15	kg	EPA, 1991				
	AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989				
Construction Worker	Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT	
			IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1997		
			EF	Exposure Frequency	219	days/year	EPA, 1993		
			ED	Exposure Duration	1	years	EPA, 1991		
			CF3	Conversion Factor 3	0.000001	kg/mg	--		
			BW	Body Weight	70	kg	EPA, 1991		
			AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989		
			AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989		

TABLE 4-6.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Ingestion	Trespasser	Adolescent	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	see Table	Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1993	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				BW	Body Weight	51	kg	EPA, 1997,(7)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Adult	Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	see Table	
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1993	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				BW	Body Weight	70	kg	EPA, 1991	
AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989					
AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989					

* Surface soil and subsurface soil combined

- (1) Professional Judgement assuming 1 day per week for 26 weeks per year.
- (2) USEPA recommended value for adult and child resident (USEPA, 2001).
- (3) USEPA recommended value for adult worker (USEPA, 2001).
- (4) USEPA value for construction worker, geometric mean (USEPA, 2001).
- (5) SA is the total of the head, hands, forearms and lower legs for the 8 through 18 year old, EPA, 2001, Exhibit C-1.
- (6) SSAF is the 95th percentile for soil adherence for Soccer Players # 1 (teens).
- (7) Body weight is average of the mean values for boys and girls for the ages 9 through 18.
- (8) Assumed adolescent trespasser exposed from age 9 through 18.
- (9) SA is based on adult wearing short-sleeved shirt, shorts, and shoes.
- (10) SSAF is the 95th percentile for soil adherence for Gardeners.

Sources:

- EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.
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EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.
EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4-7.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Emissions from Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT
				CA	Chemical Concentration in Air	see Table	mg/m3	--	
				PEF	Particulate Emissions Factor	1.32E+09	m3/kg	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m3/kg	EPA, 1996	
				IN	Inhalation Rate	0.55	m ³ /hour	EPA, 1997 (9)	
				ET	Exposure Time	12	hr/day	(1)	
				EF	Exposure Frequency	234	days/year	EPA, 2001	
				ED	Exposure Duration	9	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989			
		Child	Emissions from Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT
				CA	Chemical Concentration in Air	see Table	mg/m3	--	
				PEF	Particulate Emissions Factor	1.32E+09	kg/m3	EPA, 1996	
				VF	Volatilization Factor for volatile constituents	calc	m3/kg	EPA, 1996	
	IN			Inhalation Rate	0.35	m ³ /hour	EPA, 1997 (9)		
	ET			Exposure Time	12	hr/day	(1)		
	EF			Exposure Frequency	234	days/year	EPA, 2001		
	ED			Exposure Duration	6	years	EPA, 1991		
	BW			Body Weight	15	kg	EPA, 1991		
	AT-C			Averaging Time (Cancer)	25550	days	EPA, 1989		
	AT-N	Averaging Time (Non-Cancer)	2190	days	EPA, 1989				
	Child/Adult	Emissions from Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN-S-Adj x ET x EF x 1/AT IN-S-Adj (m3-year/kg-hour) = (ED-C x IN-S-C / BW-C) + (ED-A x IN-S-A / BW-A)	
			CA	Chemical Concentration in Air	see Table	mg/m3	--		
			PEF	Particulate Emissions Factor	1.32E+09	kg/m3	EPA, 1996		
			VF	Volatilization Factor for volatile constituents	calc	m3/kg	EPA, 1996		
			IN-S-A	Inhalation Rate, Adult	0.55	m ³ /hour	EPA, 1997 (9)		
IN-S-C			Inhalation Rate, Child	0.35	m ³ /hour	EPA, 1997 (9)			
IN-S-Adj			Inhalation Rate, Age-adjusted	2.5	m3-year/kg-hour	calculated			
ET			Exposure Time	12	hr/day	(1)			
EF			Exposure Frequency	234	days/year	EPA, 2001			
ED-A			Exposure Duration, Adult	9	years	EPA, 1993			
ED-C			Exposure Duration, Child	6	years	EPA, 1991			

TABLE 4-7.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name	
	Construction Worker	Adult	Emissions from Site 28 Soil*	BW-A	Body Weight, Adult	70	kg	EPA, 1991	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT	
				BW-C	Body Weight, Child	15	kg	EPA, 1991		
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989		
				CS	Chemical Concentration in Soil	see Table	mg/kg	--		
				CA	Chemical Concentration in Air	see Table	mg/m3	--		
				PEF	Particulate Emissions Factor	1.32E+09	kg/m3	EPA, 1996		
				VF	Volatilization Factor for volatile constituents	calc	m3/kg	EPA, 1996		
				IN	Inhalation Rate	1.5	m3/hour	EPA, 1997 (6)		
				ET	Exposure Time	4	hr/day	(7)		
				EF	Exposure Frequency	219	days/year	EPA, 1993		
				ED	Exposure Duration	1	years	EPA, 1991		
				BW	Body Weight	70	kg	EPA, 1991		
	AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989					
	AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989					
		Trespasser	Adolescent	Emissions from Site 28 Soil*	CS	Chemical Concentration in Soil	see Table	mg/kg	--	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT
					CA	Chemical Concentration in Air	see Table	mg/m3	--	
					PEF	Particulate Emissions Factor	1.32E+09	kg/m3	EPA, 1996	
					VF	Volatilization Factor for volatile constituents	calc	m3/kg	EPA, 1996	
					IN	Inhalation Rate	0.72	m3/hour	EPA, 1997 (11)	
					ET	Exposure Time	2	hr/day	(3)	
					EF	Exposure Frequency	26	days/year	(4)	
					ED	Exposure Duration	9	years	(5)	
					BW	Body Weight	51	kg	EPA, 1997,(8)	
					AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989	
AT-N					Averaging Time (Non-Cancer)	3285	days	EPA, 1989		
						Adult	Emissions from Site 28 Soil*	CS	Chemical Concentration in Soil	
	CA	Chemical Concentration in Air	see Table	mg/m3				--		
	PEF	Particulate Emissions Factor	1.32E+09	kg/m3				EPA, 1996		
	VF	Volatilization Factor for volatile constituents	calc	m3/kg				EPA, 1996		
	IN	Inhalation Rate	0.83	m3/hour				EPA, 1999		
	ET	Exposure Time	1	m3/hour				EPA, 1997 (10)		
	EF	Exposure Frequency	26	days/year				(4)		
	ED	Exposure Duration	9	years				EPA, 1993		

TABLE 4-7.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8760	days	EPA, 1989	

* Surface soil and subsurface soil combined.

- (1) Professional Judgement, assumed 1/2 day.
- (2) Professional Judgement based on maintenance activities that would occur 8 hrs per day.
- (3) Professional Judgement assuming trespasser would spend a maximum of 2 hours at the site.
- (4) Professional Judgement assuming 1 day per week for 26 weeks per year for the RME.
- (5) Professional Judgement assuming adolescents from 9 to 18 years of age.
- (6) Inhalation rate is based on values for the outdoor worker assuming moderate activity (EPA, 1997, page 5-24).
- (7) Professional Judgement based on maintenance activities that would occur 4 hrs per day.
- (8) Body weight is average of the mean values for boys and girls for the ages 9 through 18.
- (9) Average of the mean recommended inhalation values Table 5-23, EPA, 1997.
- (10) Assumed light activity level, short-term exposure for adult, Table 5-23, EPA, 1997.
- (11) Assumed light activity level, short-term exposure for males/females ages 10 to 18, Table 5-14, EPA, 1997.

Sources:

- EPA, 1989: Risk Assessment Guidance for Superfund Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.
EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4-8.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHQIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Ingestion	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table ---	$\mu\text{g/l}$	See Table ---	Chronic Daily Intake (CDI) (mg/kg-day) = CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				IR-W	Ingestion Rate of Water	1.4	liters/day	EPA, 1997 (2)	
				EF	Exposure Frequency	234	days/year	EPA, 2001	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF1	Conversion Factor 1	0.001	mg/ μg	--	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
				Child	Tap Water	CW	Chemical Concentration in Water	See Table ---	
		IR-W	Ingestion Rate of Water			0.74	liters/day	EPA, 1997 (3)	
		EF	Exposure Frequency			234	days/year	EPA, 1993	
		ED	Exposure Duration			6	years	EPA, 1991	
		CF1	Conversion Factor 1			0.001	mg/ μg	--	
		BW	Body Weight			15	kg	EPA, 1991	
		AT-C	Averaging Time (Cancer)			25,550	days	EPA, 1989	
		AT-N	Averaging Time (Non-Cancer)			2,190	days	EPA, 1989	
		Child/Adult	Tap Water			CW	Chemical Concentration in Water	See Table ---	$\mu\text{g/l}$
				IR-W-A	Ingestion Rate of Water, Adult	1.4	liters/day	EPA, 1993	
				IR-W-C	Ingestion Rate of Water, Child	0.74	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	0.48	liter-year/kg-day	calculated	
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED-A	Exposure Duration, Adult	9	years	EPA, 1993	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/ μg	--	
BW-A	Body Weight, Adult			70	kg	EPA, 1991			
BW-C	Body Weight, Child			15	kg	EPA, 1991			
AT-C	Averaging Time (Cancer)			25,550	days	EPA, 1989			

TABLE 4-8.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE

Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name		
Dermal	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table ---	µg/l	See Table ---	$CDI (mg/kg\text{-}day) = DA_{event} \times SA \times EV \times EF \times ED \times 1/BW \times 1/AT$ $DA_{event} (mg/cm^2\text{-}event) = \frac{Kp \times CW \times t_{event} \times CF1 \times CF2}{t_{event} < t^* : 2 \times FA \times Kp \times CW \times (\sqrt{t_{event}} / \pi)}$ $t_{event} > t^* : FA \times Kp \times CW \times (t_{event} / (1+B) + 2 \times t \times ((1 + 3B + 3B^2)/(1+B)^2)) \times CF1 \times CF2$		
				DA _{event}	Dermally Absorbed Dose per Event	calculated	mg/cm ² -event	calculated			
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001			
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2001			
				τ	Lag Time	chemical specific	hr/event	EPA, 2001			
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2001			
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2001			
				t _{event}	Event Time	0.25	hr/event	EPA, 2001			
				SA	Skin Surface Area Available for Contact	18,000	cm ²	EPA, 2001			
				EV	Event Frequency	1	events/day	EPA, 2001			
		EF	Exposure Frequency	234	days/year	EPA, 1993					
		ED	Exposure Duration	9	years	EPA, 2001					
		BW	Body Weight	70	kg	EPA, 1991					
		AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989					
		AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989					
		CF1	Conversion Factor 1	0.001	mg/µg	--					
		CF2	Conversion Factor 2	0.001	l/cm ³	--					
				Child	Tap Water	CW	Chemical Concentration in Water	See Table ---	µg/l	See Table ---	$CDI (mg/kg\text{-}day) = DA_{event} \times SA \times EV \times EF \times ED \times 1/BW \times 1/AT$ $DA_{event} (mg/cm^2\text{-}event) = \frac{Kp \times CW \times t_{event} \times CF1 \times CF2}{t_{event} < t^* : 2 \times FA \times Kp \times CW \times (\sqrt{t_{event}} / \pi)}$ $t_{event} > t^* : FA \times Kp \times CW \times (t_{event} / (1+B) + 2 \times t \times ((1 + 3B + 3B^2)/(1+B)^2)) \times CF1 \times CF2$
						DA _{event}	Dermally Absorbed Dose per Event	calculated	mg/cm ² -event	calculated	
						FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001	
Kp	Permeability Coefficient					chemical specific	cm/hr	EPA, 2001			
τ	Lag Time					chemical specific	hr/event	EPA, 2001			
t*	Time to Reach Steady-state					chemical specific	hours	EPA, 2001			
B	Ratio of Permeability of Stratum Corneum to Epidermis					chemical specific	dimensionless	EPA, 2001			
t _{event}	Event Time					0.33	hr/event	EPA, 2001			
SA	Skin Surface Area Available for Contact					6,800	cm ²	EPA, 2001			
EV	Event Frequency					1	events/day	EPA, 2001			
EF	Exposure Frequency	234	days/year	EPA, 1993							
ED	Exposure Duration	6	years	EPA, 2001							
BW	Body Weight	15	kg	EPA, 1991							
AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989							
AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989							
CF1	Conversion Factor 1	0.001	mg/µg	--							
CF2	Conversion Factor 2	0.001	l/cm ³	--							

TABLE 4-8 CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IH/DIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name					
Dermal (continued)	Resident	Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table ---	µg/l	See Table ---	$CDI \text{ (mg/kg-day)} = DA\text{-Adj} \times EF \times 1/AT$ $DA\text{-Adj} = (DA\text{-event-A} \times SA\text{-A} \times ED\text{-A} \times 1/BW\text{-A}) + (DA\text{-event-C} \times SA\text{-C} \times ED\text{-C} \times 1/BW\text{-C})$ Inorganics: $DA\text{-event} \text{ (mg/cm}^2\text{-event)} = Kp \times CW \times t_{\text{event}} \times CF1 \times CF2$ Organics: $t_{\text{event}} < 1^*$: $DA\text{-event} \text{ (mg/cm}^2\text{-event)} = 2 \times FA \times Kp \times CW \times (\text{sqrt}((8 \times \tau \times t_{\text{event}})/\pi)) \times CF1 \times CF2$ $t_{\text{event}} > 1^*$: $DA\text{-event} \text{ (mg/cm}^2\text{-event)} = FA \times Kp \times CW \times (t_{\text{event}}/(1+B) + 2 \times \tau \times ((1 + 3B + 3B^2)/(1+B)^2)) \times CF1 \times CF2$					
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm ² -event	calculated						
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm ² -event	calculated						
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated						
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2001						
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2001						
				τ	Lag Time	chemical specific	hr/event	EPA, 2001						
				1*	Time to Reach Steady-state	chemical specific	hours	EPA, 2001						
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2001						
				t _{event} -A	Event Time, Adult	0.25	hr/event	EPA, 2001						
				t _{event} -C	Event Time, Child	0.33	hr/event	EPA, 2001						
				SA-A	Skin Surface Area, Adult	18,000	cm ²	EPA, 2001						
				SA-C	Skin Surface Area, Child	6,600	cm ²	EPA, 2001						
				EV	Event Frequency	1	events/day	EPA, 2001						
				EF	Exposure Frequency	234	days/year	EPA, 1993						
				ED-A	Exposure Duration, Adult	9	years	EPA, 2001						
				ED-C	Exposure Duration, Child	6	years	EPA, 2001						
				BW-A	Body Weight, Adult	70	kg	EPA, 1991						
				BW-C	Body Weight, Child	15	kg	EPA, 1991						
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989						
				CF1	Conversion Factor 1	0.001	mg/µg	--						
				CF2	Conversion Factor 2	0.001	l/cm ³	--						
				Construction Worker	Adult	Adult	Water in Excavation Pit	CW		Chemical Concentration in Water	See Table ---	µg/l	See Table ---	$CDI \text{ (mg/kg-day)} = DA\text{-event} \times SA \times EV \times EF \times ED \times 1/BW \times 1/AT$ Inorganics: $DA\text{-event} \text{ (mg/cm}^2\text{-event)} = Kp \times CW \times t_{\text{event}} \times CF1 \times CF2$ Organics: $t_{\text{event}} < 1^*$: $DA\text{-event} \text{ (mg/cm}^2\text{-event)} = 2 \times FA \times Kp \times CW \times (\text{sqrt}((8 \times \tau \times t_{\text{event}})/\pi)) \times CF1 \times CF2$ $t_{\text{event}} > 1^*$: $DA\text{-event} \text{ (mg/cm}^2\text{-event)} = FA \times Kp \times CW \times (t_{\text{event}}/(1+B) + 2 \times \tau \times ((1 + 3B + 3B^2)/(1+B)^2)) \times CF1 \times CF2$
								DAevent		Dermally Absorbed Dose per Event	calculated	mg/cm ² -event	calculated	
								FA		Fraction absorbed water	chemical specific	dimensionless	EPA, 2001	
								Kp		Permeability Coefficient	chemical specific	cm/hr	EPA, 2001	
τ	Lag Time	chemical specific	hr/event					EPA, 2001						
1*	Time to Reach Steady-state	chemical specific	hours					EPA, 2001						
B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless					EPA, 2001						
t _{event}	Event Time	4	hr/day					(1)						
SA	Skin Surface Area Available for Contact	3,300	cm ²					EPA, 2001 (4)						
EV	Event Frequency	1	events/day					EPA, 2001						
EF	Exposure Frequency	219	days/year					EPA, 1993						
ED	Exposure Duration	1	years					EPA, 1991						
BW	Body Weight	70	kg					EPA, 1991						
AT-C	Averaging Time (Cancer)	25,550	days					EPA, 1989						
AT-N	Averaging Time (Non-Cancer)	365	days					EPA, 1989						
CF1	Conversion Factor 1	0.001	mg/µg					--						
CF2	Conversion Factor 2	0.001	l/cm ³					--						

TABLE 4-8.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
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- (1) Professional judgement assuming 1/2 RME value for CT.
- (2) Mean value of recommended drinking water intake rates.
- (3) Average mean of recommended drinking water intake rates for child 1 - 10 years old
- (4) EPA recommended value for adult worker (USEPA, 2001).

Sources:

EPA, 1989. Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.8-03.
EPA, 1993. Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4-9.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 28, IHDIV-NSWC
Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Inhalation	Resident	Adult	Water Vapors at showerhead	CW	Chemical Concentration In Water	See Table ---	µg/l	See Table ---	Chronic Daily Intake (CDI) (mg/kg-day) = InhExp x EF x ED x 1/AT Foster & Chrostowski Shower Inhalation Model for InhExp
				InhExp	Inhalation Exposure per Shower	calculated	mg/kg-shower		
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	3,265	days	EPA, 1989				
	Construction Worker	Adult	Water Vapors at Excavation Pit	CW	Chemical Concentration In Water	See Table ---	µg/l	See Table ---	Chronic Daily Intake (CDI) (mg/kg-day) = CA x IN x ET x EF x ED x 1/BW x 1/AT CA calculated using two-film model
				CA	Chemical Concentration In Air	calculated	mg/m ³		
				IN	Inhalation Rate	1.5	m ³ /hour	EPA, 1997 (2)	
				ET	Exposure Time	4	hr/day	(1)	
EF				Exposure Frequency	219	days/year	EPA, 1993		
ED	Exposure Duration	1	years	EPA, 1991					
BW	Body Weight	70	kg	EPA, 1991					
AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989					
AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989					

Notes:

- (1) Professional Judgement assuming 1/2 the RME value for the CT.
- (2) Inhalation rate is based on values for the outdoor worker assuming moderate activity (EPA, 1997, page 5-24).

Sources:

- EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
- EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
- EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
- EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.