Final

Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant Ravenna, Ohio

Ravenna Army Ammunition Plant
Ravenna, Ohio

March 23, 2010

Contract No. W912QR-04-D-0019
Delivery Order No. 008

Prepared for:

US Army Corps of Engineers®
Louisville District

Prepared by:

SAIC®
From Science to Solutions

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08-016(NE)/031810

REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (From - To)
23-03-2010	Technical	May 2008 - March 2010

4. TITLE AND SUBTITLE

Final
Facility-Wide Human Health Cleanup Goals
at the Ravenna Army Ammunition Plant,
Ravenna, Ohio

5a. CONTRACT NUMBER
W912QR-04-D-0019

5b. GRANT NUMBER
NA

5c. PROGRAM ELEMENT NUMBER
NA

6. AUTHOR(S)
Samantha Pack

5d. PROJECT NUMBER
Delivery Order 008

5e. TASK NUMBER
NA

5f. WORK UNIT NUMBER
NA

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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8. PERFORMING ORGANIZATION REPORT NUMBER
08-016NE

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
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Louisville, Kentucky 40202-0059

10. SPONSOR/MONITOR'S ACRONYM(S)
CELRL-ED-EE

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
NA

12. DISTRIBUTION/AVAILABILITY STATEMENT
Reference Distribution Page

13. SUPPLEMENTARY NOTES
None.

14. ABSTRACT

This report presents the technical basis, calculations, and results for developing facility-wide risk-based cleanup goals for environmental media and human receptors at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio.

15. SUBJECT TERMS
remediation, human health risk, cleanup goals

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			NA
NA	NA	NA	NA	136	19b. TELEPHONE NUMBER (Include area code) NA

CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Science Applications International Corporation (SAIC) has completed the Final Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions; methods, procedures, and materials to be used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing Corps policy.

Samantha Pack — 3-22-10

Samantha Pack
Study/Design Team Leader — Date

Jill Kovalchik — 3-22-10

Jill Kovalchik
Independent Technical Review Team Leader — Date

Significant concerns and the explanation of the resolution are as follows:

Internal SAIC Independent Technical Review comments are recorded on a Document Review Record per SAIC quality assurance procedure QAAP 3.1. This Document Review Record is maintained in the project file. Changes to the report addressing the comments have been verified by the Study/Design Team Leader. As noted above, all concerns resulting from independent technical review of the project have been considered.

W. [illegible] — 3-22-10

Principal w/ A-E firm — Date

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for the
Final Facility-Wide Human Health Cleanup Goals for the
Ravenna Army Ammunition Plant
Ravenna, Ohio

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NGB = National Guard Bureau
Ohio EPA-NEDO = Ohio Environmental Protection Agency-Northeast District Office
OHARNG = Ohio Army National Guard
RVAAP = Ravenna Army Ammunition Plant
USACE = United States Army Corps of Engineers
USAEC = United States Army Environmental Command
REIMS = Ravenna Environmental Information Management System
SAIC = Science Applications International Corporation

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ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
BGS	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chemical of Concern
COPC	Chemical of Potential Concern
CSF	Cancer Slope Factor
CUG	Cleanup Goal
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
EU	Exposure Unit
FS	Feasibility Study
FWCUG	Facility-Wide Cleanup Goal
GAF	Gastrointestinal Absorption Factor
HHBRA	Human Health Baseline Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IAP	Installation Action Plan
ILCR	Incremental Lifetime Cancer Risk
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
NGB	National Guard Bureau
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
REIMS	Ravenna Environmental Information Management System
RfC	Reference Concentration
RfD	Reference Dose
ROD	Record of Decision
RI	Remedial Investigation
RVAAP	Ravenna Army Ammunition Plant
TOC	Total Organic Carbon
USACE	U.S. Army Corps of Engineers

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1.0 INTRODUCTION

Production at the Ravenna Army Ammunition Plant (RVAAP) began in 1941 with the primary missions of depot storage and ammunition loading for World War II. The facility was placed in standby status in 1950 but was reactivated for the Korean Conflict (mid 1950s) and Southeast Asia Conflict (1968-1972). Demilitarization of various munitions was also conducted from 1982 through 1992. In 1993, the facility ceased operations and entered modified caretaker status. The property and associated assets were determined to be excess by the Army. To date, a total of 20,403 acres of the former 21,683 acre facility have been transferred to the National Guard Bureau(NGB) and subsequently licensed to the Ohio Army National Guard (OHARNG) for use as a military training site. Approximately 1,280 acres remain to be transferred. The remaining land encompasses areas that must proceed through the environmental remediation process under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). These areas are referred to as areas of concern (AOCs). Once the cleanup process is complete, the property will eventually be transferred to NGB for subsequent license to and use by the OHARNG.

This document has been developed to support the environmental remediation of the remaining AOCs to complete final transfer of the land to OHARNG. The document contains calculated facility-wide cleanup goals (FWCUGs) that can accelerate the decision-making process for the remaining AOCs, taking advantage of the fact that many of the risk assessment inputs and decisions for the facility have already been agreed to by stakeholders through the application of the CERCLA and RCRA processes over the past 10 years. Most of the agreed-to risk assessment methodology has been documented in the *Ravenna Army Ammunition Plant Facility-Wide Human Health Risk Assessor Manual, Amendment 1* (USACE 2005), herein referred to as the Risk Manual. The Risk Manual, along with a supplemental White Paper (Appendix A), provides the framework for the FWCUGs presented herein.

Because risk assessment databases and methodologies change as new technical information becomes available, and because conditions and contaminant issues at the site continue to evolve, the development of FWCUGs is a continuous process. In addition, over time, stakeholders may agree that a significant change in risk methods or land use should result in a revision to the FWCUGs. When the situation arises that requires changes/updates to this document, the Army Corp of Engineers may issue Addenda to the document to communicate the changes or may develop an entire revision to the document.

1.1 BACKGROUND

RVAAP utilizes an Installation Action Plan (IAP) to outline the total multi-year restoration program for the facility. The IAP defines Installation Restoration Program (IRP) requirements and proposes a comprehensive approach to investigation and cleanup of each AOC at the Installation. In June 2004, the Ohio Environmental Protection Agency (Ohio EPA) Director's Final Findings and Orders for RVAAP laid out the formal regulatory authority for Ohio EPA to oversee and regulate the environmental remediation at RVAAP. This effort to develop FWCUGs is part of the path forward for identifying cleanup requirements for the remaining AOCs. These goals will not be used to re-evaluate past decisions.

In 1996, the U. S. Army Corps of Engineers (USACE) performed a facility-wide preliminary assessment and a relative risk site evaluation to identify and prioritize Areas of Concern at the facility. From that study, stakeholders identified priority AOCs and began Phase I RIs at high priority sites. In 1998, the first full-scale RI was performed at the Winklepeck Burning Ground, one of the high priority AOCs, including the first full-scale human health baseline risk assessment (HHBRA). This risk assessment established many of the risk assessment processes and parameters developed specifically for RVAAP. Over years of performing additional risk assessments at the RVAAP AOCs, USACE has developed a facility-wide risk

assessment model through many interactions and negotiations with stakeholders, primarily OHARNG and Ohio EPA. In 2003, many of these risk assessment processes and parameters were documented and expanded upon in the Risk Manual (USACE 2005). The Risk Manual was updated in 2005.

Recently, USACE proposed an expedited approach for performing future risk-based decision making, taking advantage of the experience gained through the completed work and the well-documented approaches in the Risk Manual. For future decisions, USACE is proposing to compare AOC contaminant levels to pre-approved FWCUGs to determine the need for remediation. Figure 1-1; Appendix A, *White Paper, Ravenna Army Ammunition Plant (RVAAP) Facility-Wide Human Health Cleanup Goal Development*; and Section 1.2 discuss this proposed process.

1.2 USE OF FACILITY-WIDE HUMAN HEALTH CLEANUP GOALS

To date, 26 AOCs at RVAAP have preceded through an HHBRA, conducted as part of RIs or Feasibility Studies (FSs) under CERCLA. Figure 1-1 shows the risk assessment input that was used to support the remediation decisions at RVAAP to date. Most AOCs have proceeded through a Phase I and Phase II RI. As part of Phase II, data representing all relevant environmental media at an AOC were screened to identify chemicals of potential concern (COPCs). All COPCs were evaluated in the HHBRA. COPCs that were estimated to pose a potential risk in the HHBRA were identified as chemicals of concern (COCs). In preparation of the AOC FS, remedial action objectives (RAOs) and cleanup goals (CUGs) were developed to address the COCs.

A RAO is a statement that specifies (EPA 1991)

1. Contaminants and media of concern.
2. Pathways through which the HHBRA has identified humans may be exposed to unacceptable concentrations of a COC.
3. CUGs, which are acceptable exposure levels of COCs that are protective of human health.

CUGs are either calculated risk-based numbers, or based on applicable or relevant and appropriate requirements. This document addresses only the method for identifying risk-based CUGs.

As indicated in Figure 1-1, the expedited approach to risk decision-making is as follows:

1. Using the risk assessment process presented in the Risk Manual (and appended by information in the Final White Paper), develop FWCUGs for all chemicals likely to be found at RVAAP.
2. Perform RI characterization sampling and analysis to establish the baseline chemical concentrations within an AOC.
3. Perform mapping and data analysis to determine exposure units (EUs) and to identify COPCs (Figure 1-2) and their related exposure point concentrations (EPCs), following the requirements for performing these tasks as spelled out in the Risk Manual and further clarified in the position paper developed by the Army Corps of Engineers provided in Appendix B.
4. Compare AOC-specific EPCs to the FWCUGs to determine AOC-specific COCs.
5. Perform the FS, Proposed Plan, and Record of Decision (ROD) to address any identified COCs.

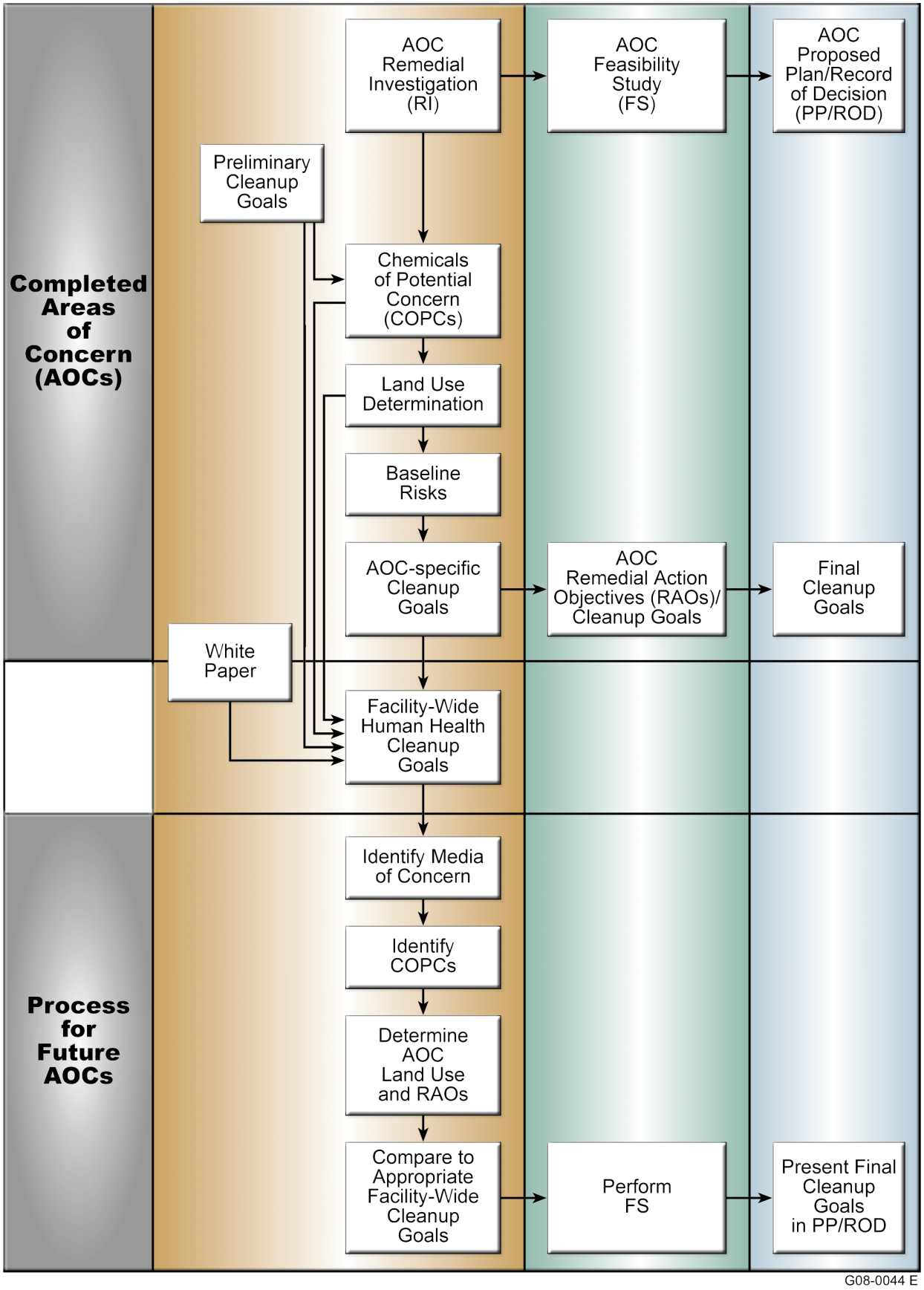

Figure 1-1. Risk Assessment Input to Support Remediation Decisions

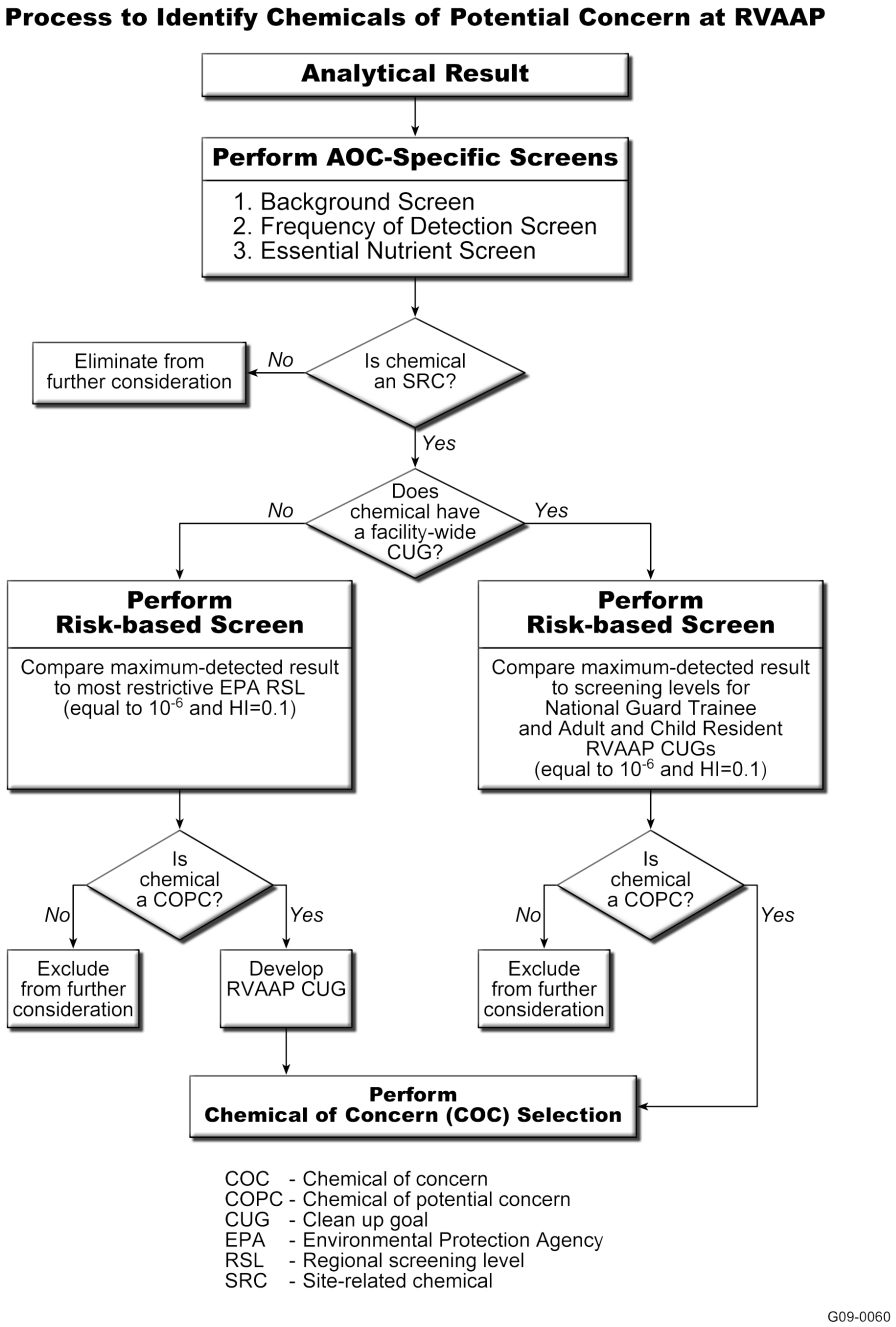

Figure 1-2. Process for Identifying Chemicals of Potential Concern

This proposed process makes use of the fact that most of the steps of the HHBRA process (i.e., identifying future land use, exposure pathways, and toxicity information) are manifested in the FWCUGs, as long as cumulative effects of multiple chemicals are considered when selecting a target risk range/hazard index (HI) level. Comparing these goals to site-related EPCs alleviates the need to perform additional HHBRAs.

Projects should consult Appendix B of this report for detailed guidance on implementing Steps 3 and 4 of the process.

Cumulative effects are accounted for in various ways when applying the FWCUGs. For non-carcinogenic toxicants, the typical target HI for a chemical = 1. In cases where there are two or more chemicals at a single site that effect the same target, a target HI <1 should be used to account for the cumulative effect of multiple chemicals affecting the same organ; hence, this document also provides FWCUGs based on an HI = 0.1. For carcinogens, a target risk = 10^{-5} has been selected by Ohio EPA that allows for multiple environmental exposures less than a 10^{-4} risk, which is the highest end of the U. S. Environmental Protection Agency (EPA) allowable risk range. The default approach to identifying the target risk and target HI for new sites at the RVAAP is to follow the precedent set at the facility that was guided by Ohio EPA's "Technical Decision Compendium: Human Health Cumulative Carcinogenic Risk and Non-carcinogenic Hazard Goals for DERR Remedial Response (Ohio EPA 2004)". This precedent identifies a target risk of 1E-05 and a target HI of 1, with the caveat that exposure to multiple COCs might require the target to be decreased.

This Target Risk and Target HI applies to the selection of final FWCUGs. When projects plan to use the FWCUGs for planning and chemical screening purposes, the FWCUGs based on the most conservative Target Risk and Target HI (e.g., 1E06 and HI = 0.1) should be used.

To address the issue of accounting for multiple chemicals and multiple exposures to noncarcinogens projects should use a "Sum of Ratios" process described in Section 5. The FWCUGs presented in this document should be applied in conjunction with the *Facility-Wide Sampling and Analysis Plan for the Ravenna Army Ammunition Plant* (USACE 2001) to ensure data are collected and analyzed to meet the requirements of the risk assessment process.

1.3 REPORT ORGANIZATION

This document is organized in the following manner:

Chapter 1 – Introduction – provides the basis for developing FWCUGs.

Chapter 2 – Facility-Wide Chemicals of Potential Concern – identifies all chemicals for which FWCUGs will need to be developed.

Chapter 3 – Exposure Assessment Considerations in Cleanup Goal Development – summarizes the full set of exposure considerations that are used to develop the FWCUGs, including future land use, future receptors, exposure pathways, and detailed exposure parameters.

Chapter 4 – Chemical-Specific Information for Chemicals of Potential Concern – provides the most up-to-date toxicity information for all facility-wide COPCs. These toxicity data are used to develop the FWCUGs.

Chapter 5 – Facility-Wide Cleanup Goals Calculation Methods and Results – provides the calculation methods and resulting FWCUGs.

Chapter 6 – References – lists the references used in this report.

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2.0 FACILITY-WIDE CHEMICALS OF POTENTIAL CONCERN

The first step in developing FWCUGs is to define the comprehensive list of chemicals at RVAAP that may be encountered at the remaining AOC and may require a numeric CUG. Two possible methods for identifying the complete contaminant list at RVAAP were evaluated:

1. Consolidate the lists of COPCs from completed RI reports.

2. Perform a new COPC screen for all chemicals in the Ravenna Environmental Information Management System (REIMS).

Option 2 was selected as the best option for identifying a facility-wide list of COPCs because risk assessment requirements for RVAAP and risk model information (e.g., toxicity factors, chemical-specific factors, etc.) may have changed since the earliest RIs, and a new COPC screen accommodates any guidance updates and information changes.

The facility-wide COPC screen followed the general guidance of the Risk Manual (Sections 3.4 and 3.5) with the following clarifications:

1. **Frequency of Detection Screen** – Because the facility-wide data set is large, chemicals meeting the <5% detection rule were not screened out per Section 3.4.1 of the Risk Manual (5% of the large data set could represent a valid contamination issue). Chemicals that were never detected are eliminated as COPCs.

2. **Background Screen** – A background screen will be used to eliminate a chemical from the facility-wide COPC list as described in the Risk Manual.

3. **Risk-based Screen –** Chemicals were screened against EPA Region 9 preliminary CUGs [preliminary remediation goals (PRGs)] (EPA 2004b). These PRGs correspond to a cancer risk level of 10^{-6} or a non-cancer hazard quotient (HQ) of 1.0. Because Ohio EPA calls for using PRGs at a cancer risk level of 10^{-6} and an HQ level of 0.1, the Region 9 PRGs at an HQ level of 1.0 are adjusted downward to a level of 0.1. The smaller PRG between a cancer risk level of 10^{-6} and an HQ level of 0.1 is used as the ultimate screening level. Any chemical for which the maximum detected value exceeds the PRG will be retained as a facility-wide COPC unless there is evidence that a single detection is a true anomaly. Chemicals detected below the screening levels were screened from further consideration (i.e., eliminated from the COPC list). Detected chemicals that do not have existing PRGs were not eliminated from the COPC list in this phase of the screening.

4. **Essential Nutrients** – Consistent with the Risk Manual, chemicals identified as essential nutrients were screened out. Chemicals that are considered essential nutrients (e.g., calcium, chloride, iodine, iron, magnesium, potassium, phosphorous, and sodium) are an integral part of the human food supply and are often added to foods as supplements. EPA recommends that these chemicals not be evaluated as COPCs as long as they are: (1) present at low concentrations (i.e., only slightly elevated above naturally occurring levels), and (2) toxic at very high doses (i.e., much higher than those that could be associated with contact at an AOC).

Results of the facility-wide COPC screen for soil/dry sediment, groundwater, surface water, and wet sediment are presented in this section.

In developing the facility-wide COPC lists, the goal was to be inclusive in identifying any chemicals that could possibly require a CUG as additional AOCs are addressed. For this reason, conservative assumptions were made in selecting data sets to review (e.g., storm sewer sample results were included in the surface water COPC screen because this water may discharge into surface water or become comingled with groundwater). The only sample types that were not included in any of the summaries were: floor sweepings, other liquid, other solid, waste material, and waste water. The rationale for excluding these media is that they are specific waste samples or other matrices that do not represent the general environmental media. In addition, these media are transient and past data do not represent the current conditions of the AOCs.

If additional COPCs are detected in future AOC RIs, a FWCUG will need to be developed using the methods provided in this document prior to proceeding through an FS.

2.1 SOIL

Table 2-1 presents all chemicals detected at least once in the soil at RVAAP. The table includes summary statistics, background values, and the COPC screening criteria (EPA Region 9 PRGs). Background soil values in Table 2-1 were developed as part of the facility-wide background sampling effort and are available in REIMS and in the Risk Manual.

Different RVAAP receptor/exposure scenarios define surface and subsurface soil EUs in different ways:

Receptor	Surface Soil	Subsurface Soil
Resident	0 to 1 ft below ground surface (BGS)	1 to 13 ft BGS
National Guard Trainee	0 to 4 ft BGS	4 to 7 ft BGS (with digging)
Engineering School Instructor	0 to 4 ft BGS (surface and subsurface combined)	
Range Maintenance Worker	0 to 4 ft BGS	Not evaluated

Because of these differences, it was determined that all soil data would be aggregated to identify the full list of chemicals for which both surface and subsurface FWCUGs would be developed. For each AOC, the appropriate RAOs will be developed during the RI/FS process, including media and receptor/exposure scenarios and the AOC-specific data that may be evaluated against the proper set of FWCUGs.

In addition, for this effort, we identified dry sediment that should be treated as soil for the purpose of risk assessment and remediation (a discussion on wet sediment is presented in Section 3.4.). There are samples in REIMS labeled as either dry sediment, drainage sediment, pond/stream sediment, or just plain "sediment." All samples labeled as dry sediment and drainage sediment were aggregated with the soil results, and all samples labeled as pond/stream sediment were summarized and handled as wet sediment (Section 3.4).

For the samples that were just labeled as sediment, the report that described the sampling event was reviewed and, based on the descriptions and maps in the report, the samples were assigned to one of three groups: wet, dry, or sewer. The samples assigned to the wet category are summarized with the wet sediment (Section 3.4). The samples assigned to the dry or sewer categories were summarized with the soil. The sewer group included sumps, basins, and storm and sanitary sewers. Sewer samples are included in the soil group because when sumps and sewers are remediated or demolished, the underlying soil will be tested for residual contamination. Besides the soil and dry sediment, the media included in the soil

Table 2-1. Facility-Wide Chemicals of Potential Concern in Soil

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria - Surface	Background Criteria - Subsurface	EPA Region 9 Res. Soil PRG (HQ=.1,10E-6)	PRG Type	COPC?	Justification
Inorganics											
Aluminum	7429905	mg/kg	4196/4196	214	252,000	17,700	19,500	7,600	nc	Yes	Max Detect >PRG
Antimony	7440360	mg/kg	1084/3650	0.0037	8,910	0.96	0.96	3.1	nc	Yes	Max Detect >PRG
Arsenic	7440382	mg/kg	4190/4207	0.28	418	15.4	19.8	0.39	ca	Yes	Max Detect >PRG
Barium	7440393	mg/kg	4206/4207	6.4	17,500	88.4	124	540	nc	Yes	Max Detect >PRG
Beryllium	7440417	mg/kg	2816/3763	0.064	10.9	0.88	0.88	15	nc	No	Max Detect < Risk Criteria
Cadmium	7440439	mg/kg	2422/4207	0.018	4,910	0	0	3.7	nc	Yes	Max Detect >PRG
Calcium	7440702	mg/kg	3722/3770	88.6	273,000	15,800	35,500	1,000,000		No	Max Detect < Risk Criteria
Chromium	7440473	mg/kg	4208/4209	1.5	4,000	17.4	27.2	22	nc	Yes	Max Detect >PRG
Chromium, hexavalent	18540299	mg/kg	97/425	1	81.9			22	nc	Yes	Max Detect >PRG
Cobalt	7440484	mg/kg	3756/3771	0.47	507	10.4	23.2	140	nc	Yes	Max Detect >PRG
Copper	7440508	mg/kg	3768/3771	0.85	74,200	17.7	32.3	310	nc	Yes	Max Detect >PRG
Cyanide	57125	mg/kg	218/1620	0.0097	112	0	0	120	nc	No	Max Detect < Risk Criteria
Iron	7439896	mg/kg	3770/3771	964	401,000	23,100	35,200	2,300	nc	Yes	Max Detect >PRG
Lead	7439921	mg/kg	4196/4208	0.32	39,000	26.1	19.1	400	nc	Yes	Max Detect >PRG
Magnesium	7439954	mg/kg	3770/3771	95.6	58,000	3,030	8,790	1,000,000		No	Max Detect < Risk Criteria
Manganese	7439965	mg/kg	4206/4207	13.4	34,000	1,450	3,030	180	nc	Yes	Max Detect >PRG
Mercury	7439976	mg/kg	2961/4192	0.0057	882	0.036	0.044	2.3	nc	Yes	Max Detect >PRG
Nickel	7440020	mg/kg	3762/3771	0.61	463	21.1	60.7	160	nc	Yes	Max Detect >PRG
Selenium	7782492	mg/kg	2046/4208	0.15	14	1.4	1.5	39	nc	No	Max Detect < Risk Criteria
Silver	7440224	mg/kg	437/4199	0.045	630	0	0	39	nc	Yes	Max Detect >PRG
Thallium	7440280	mg/kg	1798/3607	0.054	13.3	0	0.91	0.52	nc	Yes	Max Detect >PRG
Vanadium	7440622	mg/kg	3761/3763	1.2	245	31.1	37.6	7.8	nc	Yes	Max Detect >PRG
Zinc	7440666	mg/kg	4183/4207	5.3	32,100	61.8	93.3	2,300	nc	Yes	Max Detect >PRG
Nitrate	14797558	mg/kg	122/316	0.14	71.5					Yes	No Screening Criteria
Organics											
Explosives/Propellants											
1,3,5-Trinitrobenzene	99354	mg/kg	177/2887	0.017	490	0	0	180	nc	Yes	Max Detect >PRG
1,3-Dinitrobenzene	99650	mg/kg	48/2900	0.017	110	0	0	0.61	nc	Yes	Max Detect >PRG
2,4,6-Trinitrotoluene	118967	mg/kg	680/2900	0.021	390,000	0	0	3.1	nc	Yes	Max Detect >PRG
2,4-Dinitrotoluene	121142	mg/kg	169/2900	0.032	13	0	0	0.72	ca	Yes	Max Detect >PRG
2,6-Dinitrotoluene	606202	mg/kg	67/2900	0.047	11	0	0	0.72	ca	Yes	Max Detect >PRG
2-Amino-4,6-Dinitrotoluene	35572782	mg/kg	26/607	0.04	30.5	0	0			Yes	No Screening Criteria
2-Amino-4,6-dinitrotoluene	35572782	mg/kg	212/858	0.027	180	0	0			Yes	No Screening Criteria
2-Nitrotoluene	88722	mg/kg	24/2900	0.033	4.8	0	0	0.88	ca	Yes	Max Detect >PRG
3-Nitrotoluene	99081	mg/kg	39/2900	0.049	21	0	0	73	nc	No	Max Detect < Risk Criteria
4-Amino-2,6-Dinitrotoluene	19406510	mg/kg	17/607	0.03	24.7	0	0			Yes	No Screening Criteria
4-Amino-2,6-dinitrotoluene	19406510	mg/kg	149/ 859	0.054	260	0	0			Yes	No Screening Criteria
4-Nitrotoluene	99990	mg/kg	44/2900	0.046	20	0	0	12	ca	Yes	Max Detect >PRG
HMX	2691410	mg/kg	165/2900	0.1	1,700	0	0	310	nc	Yes	Max Detect >PRG
Nitrobenzene	98953	mg/kg	111/2900	0.02	0.65	0	0	2	nc	No	Max Detect < Risk Criteria

Table 2-1. Facility-Wide Chemicals of Potential Concern in Soil (continued)

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria - Surface	Background Criteria - Subsurface	EPA Region 9 Res. Soil PRG (HQ=.1,10E-6)	PRG Type	COPC?	Justification
Nitrocellulose	9004700	mg/kg	324/787	0.3	4,190	0	0			Yes	No Screening Criteria
Nitroglycerin	55630	mg/kg	14/1472	1.5	140	0	0	35	ca	Yes	Max Detect >PRG
Nitroguanidine	556887	mg/kg	37/792	0.034	5.1	0	0	610	nc	No	Max Detect < Risk Criteria
RDX	121824	mg/kg	170/2900	0.057	9,800	0	0	4.4	ca	Yes	Max Detect >PRG
Tetryl	479458	mg/kg	62/2837	0.01	22	0	0	61	nc	No	Max Detect < Risk Criteria
Semivolatile Organic Compounds											
1,2,4-Trichlorobenzene	120821	mg/kg	5/1224	0.063	2.9	0	0	6.2	nc	No	Max Detect < Risk Criteria
1,2-Dichlorobenzene	95501	mg/kg	8/1207	0.043	2.9	0	0	110	nc	No	Max Detect < Risk Criteria
1,3-Dichlorobenzene	541731	mg/kg	3/1224	0.12	0.76	0	0	53	nc	No	Max Detect < Risk Criteria
1,4-Dichlorobenzene	106467	mg/kg	8/1224	0.061	1.4	0	0	3.4	ca	No	Max Detect < Risk Criteria
2,4,5-Trichlorophenol	95954	mg/kg	2/1286	0.087	0.088	0	0	610	nc	No	Max Detect < Risk Criteria
2,4,6-Trichlorophenol	88062	mg/kg	2/1276	0.088	0.089	0	0	0.61	nc	No	Max Detect < Risk Criteria
2,4-Dichlorophenol	120832	mg/kg	2/1286	0.074	0.075	0	0	18	nc	No	Max Detect < Risk Criteria
2,4-Dimethylphenol	105679	mg/kg	4/1286	0.29	2	0	0	120	nc	No	Max Detect < Risk Criteria
2,4-Dinitrophenol	51285	mg/kg	2/1214	0.25	0.26	0	0	12	nc	No	Max Detect < Risk Criteria
2-Chloronaphthalene	91587	mg/kg	2/1290	0.07	0.071	0	0	490	nc	No	Max Detect < Risk Criteria
2-Chlorophenol	95578	mg/kg	2/1286	0.089	0.09	0	0	6.3	nc	No	Max Detect < Risk Criteria
2-Methyl-4,6-dinitrophenol	534521	mg/kg	2/1262	0.18	0.18	0	0	0.61	nc	No	Max Detect < Risk Criteria
2-Methylnaphthalene	91576	mg/kg	154/1290	0.004	61	0	0	5.6	nc	Yes	Max Detect >PRG
2-Methylphenol	95487	mg/kg	3/1286	0.056	0.16	0	0	310	nc	No	Max Detect < Risk Criteria
2-Nitrobenzenamine	88744	mg/kg	2/1290	0.14	0.14	0	0	18	nc	No	Max Detect < Risk Criteria
2-Nitrophenol	88755	mg/kg	2/1285	0.1	0.1	0	0			Yes	No Screening Criteria
3,3'-Dichlorobenzidine	91941	mg/kg	2/1244	0.15	0.15	0	0	1.1	ca	No	Max Detect < Risk Criteria
3-Nitrobenzenamine	99092	mg/kg	2/1280	0.18	0.18	0	0	1.8	nc	No	Max Detect < Risk Criteria
4-Bromophenyl phenyl ether	101553	mg/kg	2/1290	0.12	0.12	0	0			Yes	No Screening Criteria
4-Chloro-3-methylphenol	59507	mg/kg	2/1286	0.11	0.11	0	0			Yes	No Screening Criteria
4-Chlorobenzenamine	106478	mg/kg	2/1272	0.16	0.17	0	0	24	nc	No	Max Detect < Risk Criteria
4-Chlorophenyl phenyl ether	7005723	mg/kg	2/1290	0.11	0.11	0	0			Yes	No Screening Criteria
4-Methylphenol	106445	mg/kg	19/1287	0.014	0.51	0	0	31	nc	No	Max Detect < Risk Criteria
4-Nitrobenzenamine	100016	mg/kg	2/1282	0.17	0.18	0	0	18	nc	No	Max Detect < Risk Criteria
4-Nitrophenol	100027	mg/kg	2/1270	0.47	0.48	0	0			Yes	No Screening Criteria
Acenaphthene	83329	mg/kg	81/1290	0.0046	360	0	0	370	nc	No	Max Detect < Risk Criteria
Acenaphthylene	208968	mg/kg	41/1283	0.0018	7.9	0	0	370	nc	No	Max Detect < Risk Criteria
Anthracene	120127	mg/kg	160/1290	0.0017	1,000	0	0	2,200	nc	No	Max Detect < Risk Criteria
Benz(*a*)anthracene	56553	mg/kg	378/1290	0.0031	1,400	0	0	0.62	ca	Yes	Max Detect >PRG
Benzenemethanol	100516	mg/kg	11/326	0.25	2.1	0	0	1,800	nc	No	Max Detect < Risk Criteria
Benzo(*a*)pyrene	50328	mg/kg	386/1289	0.0037	960	0	0	0.062	ca	Yes	Max Detect >PRG
Benzo(*b*)fluoranthene	205992	mg/kg	436/1289	0.004	1,200	0	0	0.62	ca	Yes	Max Detect >PRG
Benzo(*g,h,i*)perylene	191242	mg/kg	292/1289	0.0033	650	0	0	6.2	ca	Yes	Max Detect >PRG
Benzo(*k*)fluoranthene	207089	mg/kg	295/1289	0.0042	580	0	0	6.2	ca	Yes	Max Detect >PRG
Benzoic Acid	65850	mg/kg	20/252	0.15	2.4	0	0	24,000	nc	No	Max Detect < Risk Criteria
Bis(2-chloroethoxy)methane	111911	mg/kg	2/1001	0.076	0.077	0	0			Yes	No Screening Criteria

Table 2-1. Facility-Wide Chemicals of Potential Concern in Soil (continued)

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria - Surface	Background Criteria - Subsurface	EPA Region 9 Res. Soil PRG (HQ=.1,10E-6)	PRG Type	COPC?	Justification
Bis(2-chloroethyl) ether	111444	mg/kg	2/ 994	0.12	0.12	0	0	0.22	ca	No	Max Detect < Risk Criteria
Bis(2-chloroisopropyl) ether	108601	mg/kg	2/1290	0.22	0.23	0	0	2.9	ca	No	Max Detect < Risk Criteria
Bis(2-ethylhexyl)phthalate	117817	mg/kg	250/1290	0.014	12	0	0	35	ca	No	Max Detect < Risk Criteria
Butyl benzyl phthalate	85687	mg/kg	15/1290	0.0088	6.1	0	0	1,200	nc	No	Max Detect < Risk Criteria
Carbazole	86748	mg/kg	109/1290	0.017	460	0	0	24	ca	Yes	Max Detect >PRG
Chrysene	218019	mg/kg	426/1290	0.0031	1,000	0	0	62	ca	Yes	Max Detect >PRG
Di-n-butyl phthalate	84742	mg/kg	77/1285	0.032	26	0	0	610	nc	No	Max Detect < Risk Criteria
Di-n-octylphthalate	117840	mg/kg	4/1278	0.017	0.35	0	0	240	nc	No	Max Detect < Risk Criteria
Dibenz(*a,h*)anthracene	53703	mg/kg	134/1289	0.0064	180	0	0	0.062	ca	Yes	Max Detect >PRG
Dibenzofuran	132649	mg/kg	102/1290	0.0064	270	0	0	15	nc	Yes	Max Detect >PRG
Diethyl phthalate	84662	mg/kg	4/1290	0.0093	5.6	0	0	4,900	nc	No	Max Detect < Risk Criteria
Dimethyl phthalate	131113	mg/kg	4/1290	0.097	1.9	0	0	61,000	nc	No	Max Detect < Risk Criteria
Fluoranthene	206440	mg/kg	494/1290	0.0064	3,100	0	0	230	nc	Yes	Max Detect >PRG
Fluorene	86737	mg/kg	99/1290	0.0085	450	0	0	270	nc	Yes	Max Detect >PRG
Hexachlorobenzene	118741	mg/kg	2/1290	0.092	0.093	0	0	0.3	ca	No	Max Detect < Risk Criteria
Hexachlorobutadiene	87683	mg/kg	2/1283	0.089	0.09	0	0	1.8	nc	No	Max Detect < Risk Criteria
Hexachlorocyclopentadiene	77474	mg/kg	2/1250	0.16	0.16	0	0	37	nc	No	Max Detect < Risk Criteria
Hexachloroethane	67721	mg/kg	2/1290	0.1	0.1	0	0	6.1	nc	No	Max Detect < Risk Criteria
Indeno(1,2,3-*cd*)pyrene	193395	mg/kg	285/1290	0.0039	630	0	0	0.62	ca	Yes	Max Detect >PRG
Isophorone	78591	mg/kg	2/1290	0.065	0.065	0	0	510	ca	No	Max Detect < Risk Criteria
N-Nitroso-di-n-propylamine	621647	mg/kg	2/1290	0.13	0.13	0	0	0.069	ca	Yes	Max Detect >PRG
N-Nitrosodiphenylamine	86306	mg/kg	15/1285	0.026	2	0	0	99	ca	No	Max Detect < Risk Criteria
Naphthalene	91203	mg/kg	130/1290	0.0092	100	0	0	5.6	nc	Yes	Max Detect >PRG
Pentachlorophenol	87865	mg/kg	9/1271	0.083	3.9	0	0	3	ca	Yes	Max Detect >PRG
Phenanthrene	85018	mg/kg	350/1290	0.0049	3,200	0	0	230	nc	Yes	Max Detect >PRG
Phenol	108952	mg/kg	18/1286	0.0083	0.27	0	0	1,800	nc	No	Max Detect < Risk Criteria
Pyrene	129000	mg/kg	439/1290	0.004	3,000	0	0	230	nc	Yes	Max Detect >PRG
Pesticides/Herbicides											
4,4'-DDD	72548	mg/kg	24/665	0.0005	0.25	0	0	2.4	ca	No	Max Detect < Risk Criteria
4,4'-DDE	72559	mg/kg	120/668	0.0002	230	0	0	1.7	ca	Yes	Max Detect >PRG
4,4'-DDT	50293	mg/kg	51/654	0.0005	0.45	0	0	1.7	ca	No	Max Detect < Risk Criteria
Aldrin	309002	mg/kg	9/667	0.0002	0.091	0	0	0.029	ca	Yes	Max Detect >PRG
Dieldrin	60571	mg/kg	46/666	0.0004	9.5	0	0	0.03	ca	Yes	Max Detect >PRG
Endosulfan I	959988	mg/kg	7/666	0.0004	0.04	0	0	37	nc	No	Max Detect < Risk Criteria
Endosulfan II	33213659	mg/kg	9/666	0.0004	0.037	0	0	37	nc	No	Max Detect < Risk Criteria
Endosulfan Sulfate	1031078	mg/kg	6/665	0.0004	12	0	0	37	nc	No	Max Detect < Risk Criteria
Endrin	72208	mg/kg	28/649	0.0006	3.2	0	0	1.8	nc	Yes	Max Detect >PRG
Endrin Aldehyde	7421934	mg/kg	78/667	0.0004	200	0	0	1.8	nc	Yes	Max Detect >PRG
Endrin Ketone	53494705	mg/kg	20/667	0.0003	0.081	0	0	1.8	nc	No	Max Detect < Risk Criteria
Heptachlor	76448	mg/kg	23/666	0.0002	0.67	0	0	0.11	ca	Yes	Max Detect >PRG
Heptachlor Epoxide	1024573	mg/kg	20/666	0.0002	1.1	0	0	0.053	ca	Yes	Max Detect >PRG
Lindane	58899	mg/kg	8/666	0.0003	0.029	0	0	0.44	ca	No	Max Detect < Risk Criteria
Methoxychlor	72435	mg/kg	24/664	0.0009	0.49	0	0	31	nc	No	Max Detect < Risk Criteria

Table 2-1. Facility-Wide Chemicals of Potential Concern in Soil (continued)

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria - Surface	Background Criteria - Subsurface	EPA Region 9 Res. Soil PRG (HQ=.1,10E-6)	PRG Type	COPC?	Justification
Toxaphene	8001352	mg/kg	2/668	0.006	0.006	0	0	0.44	ca	No	Max Detect < Risk Criteria
alpha-BHC	319846	mg/kg	2/666	0.0002	0.00021	0	0	0.09	ca	No	Max Detect < Risk Criteria
alpha-Chlordane	5103719	mg/kg	28/667	0.0002	11	0	0	1.6	ca	Yes	Max Detect >PRG
beta-BHC	319857	mg/kg	32/666	0.0002	0.36	0	0	0.32	ca	Yes	Max Detect >PRG
delta-BHC	319868	mg/kg	4/638	0.0001	0.0049	0	0			Yes	No Screening Criteria
gamma-Chlordane	5103742	mg/kg	70/667	0.0002	320	0	0	1.6	ca	Yes	Max Detect >PRG
Polychlorinated Biphenyls											
PCB-1016	12674112	mg/kg	6/1133	0.0031	3.3	0	0	0.39	nc	Yes	Max Detect >PRG
PCB-1221	11104282	mg/kg	2/1136	0.009	0.009	0	0	0.11	nc	No	Max Detect < Risk Criteria
PCB-1232	11141165	mg/kg	2/1136	0.0051	0.0051	0	0	0.11	nc	No	Max Detect < Risk Criteria
PCB-1242	53469219	mg/kg	2/1136	0.0074	0.0074	0	0	0.11	nc	No	Max Detect < Risk Criteria
PCB-1248	12672296	mg/kg	6/1136	0.0051	2	0	0	0.11	nc	Yes	Max Detect >PRG
PCB-1254	11097691	mg/kg	307/1136	0.0026	3200	0	0	0.11	nc	Yes	Max Detect >PRG
PCB-1260	11096825	mg/kg	85/1123	0.0021	29	0	0	0.11	nc	Yes	Max Detect >PRG
Volatile Organic Compounds											
1,1,1-Trichloroethane	71556	mg/kg	3/974	0.0008	0.013	0	0	200	nc	No	Max Detect < Risk Criteria
1,1,2,2-Tetrachloroethane	79345	mg/kg	2/971	0.0008	0.0008	0	0	0.41	ca	No	Max Detect < Risk Criteria
1,1,2-Trichloroethane	79005	mg/kg	2/962	0.0009	0.0009	0	0	0.73	ca	No	Max Detect < Risk Criteria
1,1-Dichloroethane	75343	mg/kg	2/974	0.001	0.001	0	0	51	nc	No	Max Detect < Risk Criteria
1,1-Dichloroethene	75354	mg/kg	3/971	0.001	0.0074	0	0	12	nc	No	Max Detect < Risk Criteria
1,2-Dichloroethane	107062	mg/kg	2/974	0.0008	0.0008	0	0	0.28	ca	No	Max Detect < Risk Criteria
1,2-Dichloroethene	540590	mg/kg	50/781	0.0007	0.018	0	0	4.3	nc	No	Max Detect < Risk Criteria
1,2-Dichloropropane	78875	mg/kg	2/974	0.001	0.001	0	0	0.34	ca	No	Max Detect < Risk Criteria
1,2-Dimethylbenzene	95476	mg/kg	2/245	0.002	0.02	0	0	27	nc	No	Max Detect < Risk Criteria
2-Butanone	78933	mg/kg	76/969	0.0036	0.44	0	0	2,200	nc	No	Max Detect < Risk Criteria
2-Hexanone	591786	mg/kg	2/955	0.002	0.002	0	0			Yes	No Screening Criteria
4-Methyl-2-pentanone	108101	mg/kg	2/961	0.004	0.004	0	0	530	nc	No	Max Detect < Risk Criteria
Acetone	67641	mg/kg	174/940	0.0029	0.87	0	0	1,400	nc	No	Max Detect < Risk Criteria
Benzene	71432	mg/kg	13/974	0.0009	0.066	0	0	0.64	ca	No	Max Detect < Risk Criteria
Bromodichloromethane	75274	mg/kg	2/974	0.0009	0.0009	0	0	0.82	ca	No	Max Detect < Risk Criteria
Bromoform	75252	mg/kg	2/953	0.001	0.001	0	0	62	ca	No	Max Detect < Risk Criteria
Bromomethane	74839	mg/kg	2/939	0.004	0.004	0	0	0.39	nc	No	Max Detect < Risk Criteria
Carbon Disulfide	75150	mg/kg	16/954	0.0023	0.18	0	0	36	nc	No	Max Detect < Risk Criteria
Carbon Tetrachloride	56235	mg/kg	3/974	0.001	0.001	0	0	0.22	nc	No	Max Detect < Risk Criteria
Chlorobenzene	108907	mg/kg	5/974	0.001	0.26	0	0	15	nc	No	Max Detect < Risk Criteria
Chloroethane	75003	mg/kg	3/962	0.002	0.091	0	0	3	ca	No	Max Detect < Risk Criteria
Chloroform	67663	mg/kg	20/974	0.0008	0.023	0	0	0.22	ca	No	Max Detect < Risk Criteria
Chloromethane	74873	mg/kg	5/971	0.001	0.0051	0	0	4.7	nc	No	Max Detect < Risk Criteria
Dibromochloromethane	124481	mg/kg	2/957	0.0009	0.0009	0	0	1.1	ca	No	Max Detect < Risk Criteria
Dimethylbenzene	1330207	mg/kg	35/883	0.0012	0.61	0	0	27	nc	No	Max Detect < Risk Criteria
Ethylbenzene	100414	mg/kg	11/974	0.0008	0.16	0	0	190	nc	No	Max Detect < Risk Criteria
M + P Xylene	136777612	mg/kg	1/145	0.0051	0.0051	0	0	27	nc	No	Max Detect < Risk Criteria
Methylene Chloride	75092	mg/kg	134/956	0.0006	0.26	0	0	9.1	ca	No	Max Detect < Risk Criteria

Table 2-1. Facility-Wide Chemicals of Potential Concern in Soil (continued)

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria - Surface	Background Criteria - Subsurface	EPA Region 9 Res. Soil PRG (HQ=.1,10E-6)	PRG Type	COPC?	Justification
Naphthalene	91203	mg/kg	1/1	0.0046	0.00458	0	0	5.6	nc	No	Max Detect < Risk Criteria
Styrene	100425	mg/kg	18/974	0.0007	0.036	0	0	440	nc	No	Max Detect < Risk Criteria
Tetrachloroethene	127184	mg/kg	9/974	0.0009	0.0048	0	0	0.48	ca	No	Max Detect < Risk Criteria
Toluene	108883	mg/kg	175/974	0.0004	3.7	0	0	66	nc	No	Max Detect < Risk Criteria
Trichloroethene	79016	mg/kg	33/963	0.0008	0.012	0	0	0.053	ca	No	Max Detect < Risk Criteria
Vinyl Chloride	75014	mg/kg	2/974	0.001	0.001	0	0	0.079	ca	No	Max Detect < Risk Criteria
cis-1,3-Dichloropropene	10061015	mg/kg	2/949	0.001	0.001	0	0	0.78	ca	No	Max Detect < Risk Criteria
trans-1,3-Dichloropropene	10061026	mg/kg	2/939	0.001	0.001	0	0	0.78	ca	No	Max Detect < Risk Criteria

ca = Carcinogenic.
CAS = Chemical Abstracts Service.
COPC = Chemical of potential concern.
EPA = U. S. Environmental Protection Agency.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
HQ = Hazard quotient.
nc = Non-carcinogenic.
PCB = Polychlorinated biphenyl.
PRG = Preliminary remediation goal.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
Res. = Residential.

summary are ballast (fill materials under the train tracks that, from an assessment and remediation point of view, must be treated similar to soil) and trench soil.

Several anion and miscellaneous results that are found in REIMS are not included in the soil table [e.g., chloride, alkalinity, and total organic carbon (TOC)]; however, one anion, nitrate, for which there are toxicity data, is included.

2.2 GROUNDWATER

The groundwater data set in REIMS is quite extensive, containing over 800 sampling results for many chemicals. These results come from both CERCLA and RCRA characterization and permit efforts, as well as the facility-wide groundwater sampling that takes place semiannually. For this exercise, we evaluated over 800 filtered groundwater samples, which represent the actual dissolved-phase of a chemical in the groundwater, but did not include unfiltered data and well point results. Well point sampling was intended for Phase I reconnaissance. Because the well points were not installed and sampled using standard groundwater sampling requirements (e.g., filter pack, surface casings, etc.), the sample quality is questionable.

Table 2-2 provides the complete list of facility-wide COPCs for groundwater for which FWCUGs were developed. Anions and miscellaneous analytes for which no toxicity data exist are eliminated from consideration (e.g., nitrite, sulfate, sulfide, sulfite, alkalinity, ammonia, phenols, total petroleum hydrocarbons-diesel-range organics, total dissolved solids, and TOC).

2.3 SURFACE WATER

Table 2-3 provides the facility-wide COPCs for surface water. For this evaluation, only unfiltered water samples were used because they represent the natural state of surface water at the time of exposure. All samples labeled as surface water samples were included in this evaluation. Several “special” sample types that were designated in REIMS as surface water were included in this evaluation to cover not only ponds and streams, but also water that could flow into the environment (e.g., samples collected from storm sewers, sanitary sewers, or manholes). Inclusion of these samples ensures that FWCUGs are developed for chemicals that may be present under current and potential future conditions.

As with the other media, some anions and miscellaneous analytes were eliminated for the set.

2.4 SEDIMENT

As indicated in Section 3.1, the REIMS database contained many sediment entries that represent various media types (e.g., dry sediment actually represents floodplain and other types of soil). Database entries that were actually evaluated in the sediment COPC screen are those that represent soil/sediment that are covered by water (e.g., pond and stream sediment) and thus are part of an aquatic environment. Table 2-4 provides the facility-wide sediment COPCs for which FWCUGs are developed. Dry sediment samples were assigned to the soil media dataset.

Table 2-2. Facility-Wide Chemicals of Potential Concern in Groundwater

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria - Unconsolidated	Background Criteria - Bedrock	EPA Tap Water PRG=10E-6, HQ=0.1	PRG Type	COPC?	Justification
Inorganics											
Aluminum	7429905	mg/L	186/ 772	0.0028	11.4			3.6	nc	Yes	Exceeds PRG
Antimony	7440360	mg/L	88/ 805	0.000066	0.0129	0	0	0.0015	nc	Yes	Exceeds PRG
Arsenic	7440382	mg/L	300/ 805	0.00054	0.1	0.0117	0	0.000045	ca	Yes	Exceeds PRG
Barium	7440393	mg/L	789/ 805	0.0016	1.2	0.0821	0.256	0.26	nc	Yes	Exceeds PRG
Beryllium	7440417	mg/L	47/ 805	0.000029	0.0027	0	0	0.0073	nc	No	Max < PRG
Cadmium	7440439	mg/L	60/ 805	0.00009	0.0125	0	0	0.0018	nc	Yes	Exceeds PRG
Calcium	7440702	mg/L	805/ 805	3.2	940	115	53.1	500		Yes	Exceeds PRG
Chromium	7440473	mg/L	30/ 784	0.0014	0.083	0.0073	0	0.011	nc	Yes	Exceeds PRG
Chromium, hexavalent	18540299	mg/L	10/ 16	0	0.01			0.011	nc	No	Max < PRG
Cobalt	7440484	mg/L	230/ 805	0.00054	0.438	0	0	0.073	nc	Yes	Exceeds PRG
Copper	7440508	mg/L	156/ 786	0.00093	0.0272	0	0	0.15	nc	No	Max < PRG
Cyanide	57125	mg/L	2/ 33	0.015	0.019	0	0	0.073	nc	No	Max < PRG
Iron	7439896	mg/L	539/ 805	0.0082	177	0.279	1.43	1.1	nc	Yes	Exceeds PRG
Lead	7439921	mg/L	47/ 805	0.0002	0.012	0	0			Yes	No PRG
Magnesium	7439954	mg/L	804/ 805	1.5	420	43.3	15	200		Yes	Exceeds PRG
Manganese	7439965	mg/L	770/ 805	0.00026	7.72	1.02	1.34	0.088	nc	Yes	Exceeds PRG
Mercury	7439976	mg/L	36/ 806	0.00003	0.0004	0	0	0.0011	nc	No	Max < PRG
Nickel	7440020	mg/L	372/ 805	0.00035	1.47	0	0.0834	0.073	nc	Yes	Exceeds PRG
Selenium	7782492	mg/L	38/ 805	0.00047	0.01	0	0	0.018	nc	No	Max < PRG
Silver	7440224	mg/L	6/ 805	0.00078	0.0014	0	0	0.018	nc	No	Max < PRG
Thallium	7440280	mg/L	72/ 804	0.000023	0.0029	0	0	0.00024	nc	Yes	Exceeds PRG
Vanadium	7440622	mg/L	18/ 804	0.0008	0.0135	0	0	0.0036	nc	Yes	Exceeds PRG
Zinc	7440666	mg/L	358/ 802	0.0017	1.91	0.0609	0.0523	1.1	nc	Yes	Exceeds PRG
Chloride	16887006	mg/L	22/ 22	1.3	18.4			1,700		No	Max < PRG
Nitrate	14797558	mg/L	27/ 120	0.02	1,200			1	nc	Yes	Exceeds PRG
Phosphorous	7723140	mg/L	1/ 3	0.1	0.1			500		No	Max < PRG
Organics											
Explosives/Propellants											
1,3,5-Trinitrobenzene	99354	mg/L	91/ 776	0.000015	0.065			0.11	nc	No	Max < PRG
1,3-Dinitrobenzene	99650	mg/L	43/ 777	0.000019	0.0013			0.00036	nc	Yes	Exceeds PRG
2,4,6-Trinitrotoluene	118967	mg/L	73/ 782	0.000025	0.13			0.0018	nc	Yes	Exceeds PRG
2,4-Dinitrotoluene	121142	mg/L	74/ 782	0.000033	0.0079			0.000099	ca	Yes	Exceeds PRG
2,6-Dinitrotoluene	606202	mg/L	33/ 780	0.000053	0.0038			0.000099	ca	Yes	Exceeds PRG
2-Amino-4,6-Dinitrotoluene	35572782	mg/L	46/ 519	0.00017	0.022					Yes	No PRG
2-Amino-4,6-dinitrotoluene	35572782	mg/L	27/ 142	0.00012	0.032					Yes	No PRG

Table 2-2. Facility-Wide Chemicals of Potential Concern in Groundwater (continued)

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria - Unconsolidated	Background Criteria - Bedrock	EPA Tap Water PRG=10E-6, HQ=0.1	PRG Type	COPC?	Justification
2-Nitrotoluene	88722	mg/L	39/ 777	0.000089	0.0065			0.000049	ca	Yes	Exceeds PRG
3-Nitrotoluene	99081	mg/L	11/ 777	0.000076	0.00078			0.012	nc	No	Max < PRG
4-Amino-2,6-Dinitrotoluene	19406510	mg/L	45/ 519	0.00016	0.041					Yes	No PRG
4-Amino-2,6-dinitrotoluene	19406510	mg/L	25/ 142	0.000092	0.054					Yes	No PRG
4-Nitrotoluene	99990	mg/L	30/ 777	0.00005	0.0037			0.00066	ca	Yes	Exceeds PRG
HMX	2691410	mg/L	79/ 784	0.000038	0.018			0.18	nc	No	Max < PRG
Nitrobenzene	98953	mg/L	31/ 783	0.000044	0.0015			0.00034	nc	Yes	Exceeds PRG
Nitrocellulose	9004700	mg/L	93/ 704	0.085	9.4					Yes	No PRG
Nitroglycerin	55630	mg/L	6/ 369	0.00018	0.027			0.0048	ca	Yes	Exceeds PRG
Nitroguanidine	556887	mg/L	1/ 709	0.014	0.014			0.36	nc	No	Max < PRG
PETN	78115	mg/L	9/ 81	0.00032	0.00094					Yes	No PRG
RDX	121824	mg/L	106/ 781	0.000042	0.088			0.00061	ca	Yes	Exceeds PRG
Tetryl	479458	mg/L	32/ 775	0.000025	0.002			0.036	nc	No	Max < PRG
Semivolatile Organic Compounds											
2,4-Dinitrotoluene	121142	mg/L	16/ 712	0.00063	0.0035			0.000099	ca	Yes	Exceeds PRG
2,6-Dinitrotoluene	606202	mg/L	11/ 716	0.00064	0.0046			0.000099	ca	Yes	Exceeds PRG
2-Methylnaphthalene	91576	mg/L	1/ 774	0.00025	0.00025			0.00062	nc	No	Max < PRG
4-Methylphenol	106445	mg/L	1/ 761	0.0029	0.0029			0.018	nc	No	Max < PRG
4-Nitrobenzenamine	100016	mg/L	1/ 772	0.0041	0.0041			0.0032	ca	Yes	Exceeds PRG
Benz(*a*)anthracene	56553	mg/L	4/ 774	0.00014	0.00027			0.000092	ca	Yes	Exceeds PRG
Benzo(*a*)pyrene	50328	mg/L	4/ 774	0.00012	0.00029			0.0000092	ca	Yes	Exceeds PRG
Benzo(*b*)fluoranthene	205992	mg/L	3/ 774	0.0001	0.0002			0.000092	ca	Yes	Exceeds PRG
Benzo(*g,h,i*)perylene	191242	mg/L	3/ 757	0.00025	0.00081					Yes	No PRG
Benzo(*k*)fluoranthene	207089	mg/L	4/ 774	0.00011	0.00024			0.00092	ca	No	Max < PRG
Benzoic Acid	65850	mg/L	30/ 445	0.0013	0.015			15	nc	No	Max < PRG
Bis(2-ethylhexyl)phthalate	117817	mg/L	133/ 778	0.00088	0.4			0.0048	ca	Yes	Exceeds PRG
Butyl benzyl phthalate	85687	mg/L	5/ 774	0.0015	0.014			0.73	nc	No	Max < PRG
Caprolactam	105602	mg/L	11/ 14	0.014	0.39			1.8	nc	No	Max < PRG
Chrysene	218019	mg/L	5/ 774	0.0001	0.00025			0.0092	ca	No	Max < PRG
Di-n-butyl phthalate	84742	mg/L	22/ 764	0.00036	0.0078			0.36	nc	No	Max < PRG
Di-n-octylphthalate	117840	mg/L	18/ 773	0.00045	0.0021			0.15	nc	No	Max < PRG
Dibenz(*a,h*)anthracene	53703	mg/L	3/ 757	0.00024	0.00095			0.0000092	ca	Yes	Exceeds PRG
Diethyl phthalate	84662	mg/L	24/ 774	0.00033	0.0013			2.9	nc	No	Max < PRG
Fluoranthene	206440	mg/L	2/ 764	0.00023	0.00032			0.15	nc	No	Max < PRG
Fluorene	86737	mg/L	1/ 766	0.00066	0.00066			0.024	nc	No	Max < PRG
Indeno(1,2,3-*cd*)pyrene	193395	mg/L	5/ 757	0.00009	0.00081			0.000092	ca	Yes	Exceeds PRG
Pentachlorophenol	87865	mg/L	1/ 751	0.003	0.003			0.00056	ca	Yes	Exceeds PRG

Table 2-2. Facility-Wide Chemicals of Potential Concern in Groundwater (continued)

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria - Unconsolidated	Background Criteria - Bedrock	EPA Tap Water PRG=10E-6, HQ=0.1	PRG Type	COPC?	Justification
Phenanthrene	85018	mg/L	3/ 764	0.00018	0.0028					Yes	No PRG
Phenol	108952	mg/L	9/ 741	0.0011	0.028			1.1	nc	No	Max < PRG
Phenols	64743039	mg/L	1/ 3	0.067	0.067					Yes	No PRG
Pyrene	129000	mg/L	3/ 766	0.00013	0.0004			0.018	nc	No	Max < PRG
Pesticides/Herbicides											
4,4'-DDD	72548	mg/L	3/ 739	0.000019	0.00035			0.00028	ca	Yes	Exceeds PRG
4,4'-DDE	72559	mg/L	9/ 739	0.0000095	0.013			0.0002	ca	Yes	Exceeds PRG
4,4'-DDT	50293	mg/L	19/ 738	0.000012	0.00022			0.0002	ca	Yes	Exceeds PRG
Aldrin	309002	mg/L	3/ 739	0.000011	0.000054			0.000004	ca	Yes	Exceeds PRG
Dieldrin	60571	mg/L	4/ 739	0.0000093	0.000053			0.0000042	ca	Yes	Exceeds PRG
Endosulfan I	959988	mg/L	2/ 732	0.000035	0.00017			0.022	nc	No	Max < PRG
Endosulfan II	33213659	mg/L	2/ 739	0.000016	0.000018			0.022	nc	No	Max < PRG
Endosulfan Sulfate	1031078	mg/L	1/ 739	0.000023	0.000023			0.022	nc	No	Max < PRG
Endrin	72208	mg/L	2/ 723	0.000025	0.00031			0.0011	nc	No	Max < PRG
Endrin Aldehyde	7421934	mg/L	8/ 739	0.0000091	0.00018			0.0011	nc	No	Max < PRG
Endrin Ketone	53494705	mg/L	1/ 736	0.000044	0.000044			0.0011	nc	No	Max < PRG
Heptachlor	76448	mg/L	18/ 736	0.0000063	0.00019			0.000015	ca	Yes	Exceeds PRG
Heptachlor Epoxide	1024573	mg/L	29/ 740	0.000007	0.013			0.0000074	ca	Yes	Exceeds PRG
Lindane	58899	mg/L	12/ 739	0.0000083	0.0001			0.000052	ca	Yes	Exceeds PRG
Methoxychlor	72435	mg/L	20/ 739	0.000012	0.00009			0.018	nc	No	Max < PRG
Toxaphene	8001352	mg/L	4/ 732	0.00034	0.0053			0.000061	ca	Yes	Exceeds PRG
alpha-BHC	319846	mg/L	2/ 739	0.000011	0.000065			0.000011	ca	Yes	Exceeds PRG
alpha-Chlordane	5103719	mg/L	21/ 736	0.0000073	0.00016			0.00019	ca	No	Max < PRG
beta-BHC	319857	mg/L	47/ 739	0.0000071	0.00057			0.000037	ca	Yes	Exceeds PRG
delta-BHC	319868	mg/L	4/ 713	0.0000066	0.000046					Yes	No PRG
gamma-Chlordane	5103742	mg/L	3/ 736	0.000019	0.000028			0.00019	ca	No	Max < PRG
Polychlorinated Biphenyls											
PCB-1242	53469219	mg/L	3/ 740	0.00072	0.009			0.000034	ca	Yes	Exceeds PRG
PCB-1254	11097691	mg/L	2/ 740	0.000051	0.00016			0.000034	ca	Yes	Exceeds PRG
PCB-1260	11096825	mg/L	1/ 722	0.0067	0.0067			0.000034	ca	Yes	Exceeds PRG
Volatile Organic Compounds											
1,1,1-Trichloroethane	71556	mg/L	2/ 782	0.0058	0.01			0.32	nc	No	Max < PRG
1,1,2,2-Tetrachloroethane	79345	mg/L	1/ 782	0.00084	0.00084			0.000055	ca	Yes	Exceeds PRG
1,1-Dichloroethane	75343	mg/L	1/ 782	0.0022	0.0022			0.081	nc	No	Max < PRG
1,1-Dichloroethene	75354	mg/L	5/ 780	0.0003	0.0042			0.034	nc	No	Max < PRG
1,2-Dichloroethane	107062	mg/L	1/ 780	0.00046	0.00046			0.00012	ca	Yes	Exceeds PRG
1,2-Dichloroethene	540590	mg/L	2/ 740	0.00038	0.001			0.0061	nc	No	Max < PRG
2-Butanone	78933	mg/L	12/ 757	0.00055	0.064			0.7	nc	No	Max < PRG

Table 2-2. Facility-Wide Chemicals of Potential Concern in Groundwater (continued)

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria - Unconsolidated	Background Criteria - Bedrock	EPA Tap Water PRG=10E-6, HQ=0.1	PRG Type	COPC?	Justification
4-Methyl-2-pentanone	108101	mg/L	2/ 782	0.00035	0.0083			0.2	nc	No	Max < PRG
Acetone	67641	mg/L	29/ 707	0.00086	0.074			0.55	nc	No	Max < PRG
Benzene	71432	mg/L	9/ 782	0.00022	0.0011			0.00035	ca	Yes	Exceeds PRG
Bromoform	75252	mg/L	1/ 738	0.00035	0.00035			0.0085	ca	No	Max < PRG
Carbon Disulfide	75150	mg/L	44/ 782	0.0002	0.0079			0.1	nc	No	Max < PRG
Carbon Tetrachloride	56235	mg/L	4/ 756	0.00015	0.0016			0.00017	ca	Yes	Exceeds PRG
Chloroform	67663	mg/L	12/ 782	0.00019	0.0017			0.00017	ca	Yes	Exceeds PRG
Chloromethane	74873	mg/L	33/ 780	0.00013	0.0038			0.016	nc	No	Max < PRG
Methylene Chloride	75092	mg/L	34/ 759	0.00023	0.007			0.0043	ca	Yes	Exceeds PRG
Tetrachloroethene	127184	mg/L	4/ 780	0.00049	0.00066			0.0001	ca	Yes	Exceeds PRG
Toluene	108883	mg/L	16/ 780	0.0002	0.011			0.072	nc	No	Max < PRG
Trichloroethene	79016	mg/L	4/ 782	0.002	0.012			0.000028	ca	Yes	Exceeds PRG

ca = Carcinogenic.
CAS = Chemical Abstracts Service.
COPC = Chemical of potential concern.
EPA = U. S. Environmental Protection Agency.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
HQ = Hazard quotient.
nc = Non-carcinogenic.
PCB = Polychlorinated biphenyl.
PETN = Pentaerythritol tetranitrate.
PRG = Preliminary remediation goal.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

Table 2-3. Facility-Wide Chemicals of Potential Concern in Surface Water

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria run	EPA Tap Water PRG=10E-6, HQ=0.1	PRG Type	COPC?	Justification
Inorganics										
Aluminum	7429905	mg/L	241/ 325	0.0236	123	3.37	3.6	nc	Yes	Exceeds PRG
Antimony	7440360	mg/L	55/ 326	0.00042	0.88	0	0.0015	nc	Yes	Exceeds PRG
Arsenic	7440382	mg/L	133/ 327	0.00052	0.77	0.0032	0.000045	ca	Yes	Exceeds PRG
Barium	7440393	mg/L	326/ 327	0.0069	1.9	0.0475	0.26	nc	Yes	Exceeds PRG
Beryllium	7440417	mg/L	21/ 327	0.000021	0.0011	0	0.0073	nc	No	Max < PRG
Cadmium	7440439	mg/L	61/ 327	0.00013	0.051	0	0.0018	nc	Yes	Exceeds PRG
Calcium	7440702	mg/L	326/ 327	4.5	184	41.4	500		No	Max < PRG
Chromium	7440473	mg/L	112/ 323	0.00069	0.2	0	0.011	nc	Yes	Exceeds PRG
Chromium, hexavalent	18540299	mg/L	8/ 39	0.01	0.05		0.011	nc	Yes	Exceeds PRG
Cobalt	7440484	mg/L	71/ 327	0.00019	0.062	0	0.073	nc	No	Max < PRG
Copper	7440508	mg/L	141/ 319	0.00081	0.89	0.0079	0.15	nc	Yes	Exceeds PRG
Cyanide	57125	mg/L	4/ 178	0.0071	0.065	0	0.073	nc	No	Max < PRG
Iron	7439896	mg/L	299/ 327	0.046	197	2.56	1.1	nc	Yes	Exceeds PRG
Lead	7439921	mg/L	138/ 337	0.00082	14	0			Yes	No PRG
Magnesium	7439954	mg/L	322/ 327	0.38	202	10.8	200		Yes	Exceeds PRG
Manganese	7439965	mg/L	318/ 327	0.00099	15.8	0.391	0.088	nc	Yes	Exceeds PRG
Mercury	7439976	mg/L	44/ 327	0.00005	0.0219	0	0.0011	nc	Yes	Exceeds PRG
Nickel	7440020	mg/L	112/ 327	0.00079	0.24	0	0.073	nc	Yes	Exceeds PRG
Selenium	7782492	mg/L	19/ 327	0.003	0.016	0	0.018	nc	No	Max < PRG
Silver	7440224	mg/L	10/ 327	0.00074	0.092	0	0.018	nc	Yes	Exceeds PRG
Thallium	7440280	mg/L	8/ 308	0.0013	0.4	0	0.00024	nc	Yes	Exceeds PRG
Vanadium	7440622	mg/L	90/ 327	0.00076	0.21	0	0.0036	nc	Yes	Exceeds PRG
Zinc	7440666	mg/L	200/ 327	0.0027	5.4	0.042	1.1	nc	Yes	Exceeds PRG
Chloride	16887006	mg/L	2/ 4	1.7	2.2		1,700		No	Max < PRG
Nitrate	14797558	mg/L	36/ 74	0.06	2,600		1	nc	Yes	Exceeds PRG
Perchlorate	7601903	mg/L	3/ 13	0.0075	0.025		0.00036	nc	Yes	Exceeds PRG
Organics										
Explosives/Propellants										
1,3,5-Trinitrobenzene	99354	mg/L	14/ 308	0.00007	0.009		0.11	nc	No	Max < PRG
1,3-Dinitrobenzene	99650	mg/L	7/ 308	0.000047	0.000097		0.00036	nc	No	Max < PRG
2,4,6-Trinitrotoluene	118967	mg/L	34/ 308	0.000049	1		0.0018	nc	Yes	Exceeds PRG
2,4-Dinitrotoluene	121142	mg/L	17/ 308	0.000051	0.012		0.000099	ca	Yes	Exceeds PRG

Table 2-3. Facility-Wide Chemicals of Potential Concern in Surface Water (continued)

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria run	EPA Tap Water PRG=10E-6, HQ=0.1	PRG Type	COPC?	Justification
2,6-Dinitrotoluene	606202	mg/L	6/ 308	0.00011	0.0045		0.000099	ca	Yes	Exceeds PRG
2-Amino-4,6-Dinitrotoluene	35572782	mg/L	9/ 104	0.00023	0.0076				Yes	No PRG
2-Amino-4,6-dinitrotoluene	35572782	mg/L	32/ 110	0.00013	0.46				Yes	No PRG
2-Nitrotoluene	88722	mg/L	5/ 309	0.00021	0.0051		0.000049	ca	Yes	Exceeds PRG
3-Nitrotoluene	99081	mg/L	8/ 308	0.00014	0.00049		0.012	nc	No	Max < PRG
4-Amino-2,6-Dinitrotoluene	19406510	mg/L	12/ 104	0.00025	0.021				Yes	No PRG
4-Amino-2,6-dinitrotoluene	19406510	mg/L	33/ 110	0.0001	0.81				Yes	No PRG
4-Nitrotoluene	99990	mg/L	10/ 309	0.0001	0.0039		0.00066	ca	Yes	Exceeds PRG
HMX	2691410	mg/L	31/ 308	0.000093	1.7		0.18	nc	Yes	Exceeds PRG
Nitrobenzene	98953	mg/L	2/ 308	0.000066	0.00016		0.00034	nc	No	Max < PRG
Nitrocellulose	9004700	mg/L	22/ 132	0.094	1.1				Yes	No PRG
Nitroguanidine	556887	mg/L	2/ 133	0.009	0.012		0.36	nc	No	Max < PRG
RDX	121824	mg/L	51/ 309	0.0001	4.4		0.00061	ca	Yes	Exceeds PRG
Tetryl	479458	mg/L	4/ 309	0.00013	0.01		0.036	nc	No	Max < PRG
Semivolatile Organic Compounds										
1,3-Dichlorobenzene	541731	mg/L	2/ 223	0.00044	0.00087		0.018	nc	No	Max < PRG
1,4-Dichlorobenzene	106467	mg/L	1/ 223	0.00052	0.00052		0.0005	ca	Yes	Exceeds PRG
2,4,6-Trichlorophenol	88062	mg/L	1/ 240	0.00031	0.00031		0.00036	nc	No	Max < PRG
2,4-Dimethylphenol	105679	mg/L	1/ 240	0.088	0.088		0.073	nc	Yes	Exceeds PRG
2,4-Dinitrotoluene	121142	mg/L	1/ 222	0.011	0.011		0.000099	ca	Yes	Exceeds PRG
2,6-Dinitrotoluene	606202	mg/L	1/ 222	0.013	0.013		0.000099	ca	Yes	Exceeds PRG
2-Methylphenol	95487	mg/L	4/ 240	0.0018	0.072		0.18	nc	No	Max < PRG
4-Methylphenol	106445	mg/L	19/ 240	0.00026	0.17		0.018	nc	Yes	Exceeds PRG
Acenaphthene	83329	mg/L	2/ 240	0.00061	0.0018		0.037	nc	No	Max < PRG
Acenaphthylene	208968	mg/L	1/ 240	0.00094	0.00094				Yes	No PRG
Anthracene	120127	mg/L	6/ 240	0.00017	0.0027		0.18	nc	No	Max < PRG
Benz(*a*)anthracene	56553	mg/L	9/ 240	0.00012	0.0053		0.000092	ca	Yes	Exceeds PRG
Benzenemethanol	100516	mg/L	5/ 137	0.0064	0.012		1.1	nc	No	Max < PRG
Benzo(*a*)pyrene	50328	mg/L	12/ 240	0.0001	0.0035		9.2E-06	ca	Yes	Exceeds PRG
Benzo(*b*)fluoranthene	205992	mg/L	11/ 240	0.00011	0.016		0.000092	ca	Yes	Exceeds PRG
Benzo(*g,h,i*)perylene	191242	mg/L	9/ 237	0.00019	0.0037				Yes	No PRG
Benzo(*k*)fluoranthene	207089	mg/L	13/ 240	0.00012	0.0057		0.00092	ca	Yes	Exceeds PRG
Benzoic Acid	65850	mg/L	6/ 119	0.0038	0.41		15	nc	No	Max < PRG

Table 2-3. Facility-Wide Chemicals of Potential Concern in Surface Water (continued)

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria run	EPA Tap Water PRG=10E-6, HQ=0.1	PRG Type	COPC?	Justification
Bis(2-ethylhexyl)phthalate	117817	mg/L	42/ 240	0.0014	0.97		0.0048	ca	Yes	Exceeds PRG
Butyl benzyl phthalate	85687	mg/L	1/ 240	0.0029	0.0029		0.73	nc	No	Max < PRG
Carbazole	86748	mg/L	2/ 240	0.0012	0.0034		0.0034	ca	No	Max < PRG
Chrysene	218019	mg/L	14/ 240	0.0001	0.025		0.0092	ca	Yes	Exceeds PRG
Di-n-butyl phthalate	84742	mg/L	2/ 240	0.0012	0.003		0.36	nc	No	Max < PRG
Dibenz(*a,h*)anthracene	53703	mg/L	8/ 237	0.00013	0.00082		9.2E-06	ca	Yes	Exceeds PRG
Dibenzofuran	132649	mg/L	2/ 240	0.00049	0.0011		0.0012	nc	No	Max < PRG
Fluoranthene	206440	mg/L	12/ 240	0.00013	0.059		0.15	nc	No	Max < PRG
Fluorene	86737	mg/L	2/ 240	0.00063	0.0017		0.024	nc	No	Max < PRG
Indeno(1,2,3-*cd*)pyrene	193395	mg/L	13/ 237	0.0001	0.0038		0.000092	ca	Yes	Exceeds PRG
Isophorone	78591	mg/L	1/ 240	0.0022	0.0022		0.071	ca	No	Max < PRG
N-Nitrosodiphenylamine	86306	mg/L	1/ 240	0.00021	0.00021		0.014	ca	No	Max < PRG
Naphthalene	91203	mg/L	1/ 240	0.0006	0.0006		0.00062	nc	No	Max < PRG
Pentachlorophenol	87865	mg/L	1/ 240	0.0048	0.0048		0.00056	ca	Yes	Exceeds PRG
Phenanthrene	85018	mg/L	7/ 240	0.00015	0.012				Yes	No PRG
Phenol	108952	mg/L	14/ 240	0.00062	0.21		1.1	nc	No	Max < PRG
Pyrene	129000	mg/L	13/ 240	0.00014	0.046		0.018	nc	Yes	Exceeds PRG
Pesticides/Herbicides										
4,4'-DDT	50293	mg/L	1/ 199	0.00031	0.00031		0.0002	ca	Yes	Exceeds PRG
Aldrin	309002	mg/L	2/ 206	0.000012	0.000012		0.000004	ca	Yes	Exceeds PRG
Endosulfan Sulfate	1031078	mg/L	1/ 206	0.000071	0.000071		0.022	nc	No	Max < PRG
Endrin Ketone	53494705	mg/L	1/ 206	0.000055	0.000055		0.0011	nc	No	Max < PRG
Heptachlor Epoxide	1024573	mg/L	3/ 206	0.00026	0.00075		7.4E-06	ca	Yes	Exceeds PRG
beta-BHC	319857	mg/L	3/ 206	0.000062	0.000069		0.000037	ca	Yes	Exceeds PRG
Polychlorinated Biphenyls										
PCB-1254	11097691	mg/L	4/ 254	0.00057	0.012		0.000034	ca	Yes	Exceeds PRG
Volatile Organic Compounds										
1,1,2,2-Tetrachloroethane	79345	mg/L	2/ 244	0.0021	0.003		0.000055	ca	Yes	Exceeds PRG
1,2-Dichloroethene	540590	mg/L	1/ 214	0.0092	0.0092		0.0061	nc	Yes	Exceeds PRG
2-Butanone	78933	mg/L	6/ 242	0.00066	0.0051		0.7	nc	No	Max < PRG
Acetone	67641	mg/L	52/ 238	0.00083	0.016		0.55	nc	No	Max < PRG
Carbon Disulfide	75150	mg/L	13/ 242	0.00066	0.004		0.1	nc	No	Max < PRG
Chloroform	67663	mg/L	7/ 244	0.00054	0.0021		0.00017	ca	Yes	Exceeds PRG
Chloromethane	74873	mg/L	4/ 244	0.0003	0.001		0.016	nc	No	Max < PRG

Table 2-3. Facility-Wide Chemicals of Potential Concern in Surface Water (continued)

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria run	EPA Tap Water PRG=10E-6, HQ=0.1	PRG Type	COPC?	Justification
Dimethylbenzene	1330207	mg/L	1/ 214	0.0017	0.0017		0.021	nc	No	Max < PRG
Methylene Chloride	75092	mg/L	21/ 240	0.0018	0.012		0.0043	ca	Yes	Exceeds PRG
Styrene	100425	mg/L	1/ 244	0.0011	0.0011		0.16	nc	No	Max < PRG
Tetrachloroethene	127184	mg/L	1/ 244	0.0006	0.0006		0.0001	ca	Yes	Exceeds PRG
Toluene	108883	mg/L	28/ 244	0.00049	0.064		0.072	nc	No	Max < PRG
Trichloroethene	79016	mg/L	5/ 244	0.00046	0.011		0.000028	ca	Yes	Exceeds PRG
cis-1,2-Dichloroethene	156592	mg/L	1/ 123	0.009	0.009		0.0061	nc	Yes	Exceeds PRG

ca = Carcinogenic.
CAS = Chemical Abstracts Service.
COPC = Chemical of potential concern.
EPA = U. S. Environmental Protection Agency.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
HQ = Hazard quotient.
nc = Non-carcinogenic.
PCB = Polychlorinated biphenyl.
PRG = Preliminary remediation goal.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

Table 2-4. Facility-Wide Chemicals of Potential Concern in Sediment

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria	Max. > Bkg.?	EPA Region 9 Res. Soil PRG (HQ=.1,10E-6)	PRG Type	COPC?	Justification
Inorganics											
Aluminum	7429905	mg/kg	498/ 498	214	34,800	13,900	Yes	7,600	nc	Yes	Max Detect >PRG
Antimony	7440360	mg/kg	139/ 451	0.086	8,120	0	Yes	3.1	nc	Yes	Max Detect >PRG
Arsenic	7440382	mg/kg	508/ 509	1.3	418	19.5	Yes	0.39	ca	Yes	Max Detect >PRG
Barium	7440393	mg/kg	509/ 509	6.4	2,170	123	Yes	540	nc	Yes	Max Detect >PRG
Beryllium	7440417	mg/kg	294/ 458	0.064	2.5	0.38	Yes	15	nc	No	Max Detect < Risk Criteria
Cadmium	7440439	mg/kg	317/ 509	0.032	67.9	0	Yes	3.7	nc	Yes	Max Detect >PRG
Calcium	7440702	mg/kg	456/ 458	278	130,000	5,510	Yes	1,000,000		No	Max Detect < Risk Criteria
Chromium	7440473	mg/kg	506/ 507	1.6	4,000	18.1	Yes	22	nc	Yes	Max Detect >PRG
Chromium, hexavalent	18540299	mg/kg	37/ 109	1	33		None	22	nc	Yes	Max Detect >PRG
Cobalt	7440484	mg/kg	451/ 458	1.1	115	9.1	Yes	140	nc	No	Max Detect < Risk Criteria
Copper	7440508	mg/kg	458/ 458	1.8	1,140	27.6	Yes	310	nc	Yes	Max Detect >PRG
Cyanide	57125	mg/kg	22/ 254	0.1	8.3	0	Yes	120	nc	No	Max Detect < Risk Criteria
Iron	7439896	mg/kg	458/ 458	1,200	331,000	28,200	Yes	2,300	nc	Yes	Max Detect >PRG
Lead	7439921	mg/kg	508/ 509	1.6	24,800	27.4	Yes	400	nc	Yes	Max Detect >PRG
Magnesium	7439954	mg/kg	457/ 458	362	58,000	2,760	Yes	1,000,000		No	Max Detect < Risk Criteria
Manganese	7439965	mg/kg	508/ 509	21.8	30,500	1,950	Yes	180	nc	Yes	Max Detect >PRG
Mercury	7439976	mg/kg	346/ 507	0.0091	35	0.059	Yes	2.3	nc	Yes	Max Detect >PRG
Nickel	7440020	mg/kg	455/ 458	2.6	305	17.7	Yes	160	nc	Yes	Max Detect >PRG
Selenium	7782492	mg/kg	211/ 509	0.22	8.2	1.7	Yes	39	nc	No	Max Detect < Risk Criteria
Silver	7440224	mg/kg	113/ 509	0.045	534	0	Yes	39	nc	Yes	Max Detect >PRG
Thallium	7440280	mg/kg	152/ 378	0.18	3.6	0.89	Yes	0.52	nc	Yes	Max Detect >PRG
Vanadium	7440622	mg/kg	457/ 458	1.6	51	26.1	Yes	7.8	nc	Yes	Max Detect >PRG
Zinc	7440666	mg/kg	506/ 509	11.4	18,400	532	Yes	2,300	nc	Yes	Max Detect >PRG
Organics											
Explosives/Propellants											
1,3,5-Trinitrobenzene	99354	mg/kg	8/ 402	0.071	0.45	0	Yes	180	nc	No	Max Detect < Risk Criteria
1,3-Dinitrobenzene	99650	mg/kg	6/ 402	0.03	0.11	0	Yes	0.61	nc	No	Max Detect < Risk Criteria
2,4,6-Trinitrotoluene	118967	mg/kg	61/ 402	0.021	310	0	Yes	3.1	nc	Yes	Max Detect >PRG
2,4-Dinitrotoluene	121142	mg/kg	19/ 402	0.033	2	0	Yes	0.72	ca	Yes	Max Detect >PRG
2,6-Dinitrotoluene	606202	mg/kg	13/ 402	0.076	0.28	0	Yes	0.72	ca	No	Max Detect < Risk Criteria
2-Amino-4,6-dinitrotoluene	35572782	mg/kg	18/ 126	0.073	23	0	Yes			Yes	No Screening Criteria
2-Nitrotoluene	88722	mg/kg	2/ 402	0.07	0.23	0	Yes	0.88	ca	No	Max Detect < Risk Criteria
3-Nitrotoluene	99081	mg/kg	8/ 402	0.071	0.16	0	Yes	73	nc	No	Max Detect < Risk Criteria
4-Amino-2,6-dinitrotoluene	19406510	mg/kg	20/ 126	0.054	15	0	Yes			Yes	No Screening Criteria
4-Nitrotoluene	99990	mg/kg	7/ 402	0.07	0.22	0	Yes	12	ca	No	Max Detect < Risk Criteria

Table 2-4. Facility-Wide Chemicals of Potential Concern in Sediment (continued)

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria	Max. > Bkg.?	EPA Region 9 Res. Soil PRG (HQ=.1,10E-6)	PRG Type	COPC?	Justification
HMX	2691410	mg/kg	18/ 402	0.11	600	0	Yes	310	nc	Yes	Max Detect >PRG
Nitrobenzene	98953	mg/kg	25/ 402	0.038	0.38	0	Yes	2	nc	No	Max Detect < Risk Criteria
Nitrocellulose	9004700	mg/kg	62/ 161	0.43	700	0	Yes			Yes	No Screening Criteria
Nitroglycerin	55630	mg/kg	4/ 275	20	49	0	Yes	35	ca	Yes	Max Detect >PRG
Nitroguanidine	556887	mg/kg	5/ 166	0.035	0.16	0	Yes	610	nc	No	Max Detect < Risk Criteria
RDX	121824	mg/kg	5/ 402	0.18	2,100	0	Yes	4.4	ca	Yes	Max Detect >PRG
Semivolatile Organic Compounds											
1,2,4-Trichlorobenzene	120821	mg/kg	1/ 250	0.064	0.064	0	Yes	6.2	nc	No	Max Detect < Risk Criteria
1,2-Dichlorobenzene	95501	mg/kg	2/ 239	0.089	0.092	0	Yes	110	nc	No	Max Detect < Risk Criteria
2-Methylnaphthalene	91576	mg/kg	16/ 294	0.004	1.6	0	Yes	5.6	nc	No	Max Detect < Risk Criteria
4-Methylphenol	106445	mg/kg	9/ 293	0.056	0.51	0	Yes	31	nc	No	Max Detect < Risk Criteria
Acenaphthene	83329	mg/kg	7/ 294	0.088	1.4	0	Yes	370	nc	No	Max Detect < Risk Criteria
Acenaphthylene	208968	mg/kg	4/ 294	0.0018	0.31	0	Yes	370	nc	No	Max Detect < Risk Criteria
Anthracene	120127	mg/kg	20/ 294	0.0031	2.6	0	Yes	2,200	nc	No	Max Detect < Risk Criteria
Benz(*a*)anthracene	56553	mg/kg	70/ 294	0.0052	9.5	0	Yes	0.62	ca	Yes	Max Detect >PRG
Benzo(*a*)pyrene	50328	mg/kg	71/ 294	0.0062	15	0	Yes	0.062	ca	Yes	Max Detect >PRG
Benzo(*b*)fluoranthene	205992	mg/kg	85/ 294	0.0058	14	0	Yes	0.62	ca	Yes	Max Detect >PRG
Benzo(*g,h,i*)perylene	191242	mg/kg	42/ 294	0.013	11	0	Yes	6.2	ca	Yes	Max Detect >PRG
Benzo(*k*)fluoranthene	207089	mg/kg	40/ 294	0.019	19	0	Yes	6.2	ca	Yes	Max Detect >PRG
Benzoic Acid	65850	mg/kg	2/ 55	0.24	0.3	0	Yes	24,000	nc	No	Max Detect < Risk Criteria
Bis(2-ethylhexyl)phthalate	117817	mg/kg	46/ 294	0.032	1.9	0	Yes	35	ca	No	Max Detect < Risk Criteria
Butyl benzyl phthalate	85687	mg/kg	3/ 294	0.0088	0.087	0	Yes	1,200	nc	No	Max Detect < Risk Criteria
Carbazole	86748	mg/kg	11/ 294	0.066	3	0	Yes	24	ca	No	Max Detect < Risk Criteria
Chrysene	218019	mg/kg	78/ 294	0.0081	15	0	Yes	62	ca	No	Max Detect < Risk Criteria
Di-n-butyl phthalate	84742	mg/kg	23/ 294	0.038	16	0	Yes	610	nc	No	Max Detect < Risk Criteria
Dibenz(*a,h*)anthracene	53703	mg/kg	9/ 294	0.043	5.4	0	Yes	0.062	ca	Yes	Max Detect >PRG
Dibenzofuran	132649	mg/kg	6/ 294	0.11	0.5	0	Yes	15	nc	No	Max Detect < Risk Criteria
Fluoranthene	206440	mg/kg	101/ 294	0.014	30	0	Yes	230	nc	No	Max Detect < Risk Criteria
Fluorene	86737	mg/kg	9/ 294	0.073	1.1	0	Yes	270	nc	No	Max Detect < Risk Criteria
Indeno(1,2,3-*cd*)pyrene	193395	mg/kg	44/ 294	0.0043	9.9	0	Yes	0.62	ca	Yes	Max Detect >PRG
N-Nitrosodiphenylamine	86306	mg/kg	2/ 294	0.085	0.62	0	Yes	99	ca	No	Max Detect < Risk Criteria
Naphthalene	91203	mg/kg	8/ 294	0.06	0.97	0	Yes	5.6	nc	No	Max Detect < Risk Criteria
Phenanthrene	85018	mg/kg	59/ 294	0.02	13	0	Yes	230	nc	No	Max Detect < Risk Criteria
Phenol	108952	mg/kg	1/ 293	0.16	0.16	0	Yes	1,800	nc	No	Max Detect < Risk Criteria
Pyrene	129000	mg/kg	85/ 294	0.011	25	0	Yes	230	nc	No	Max Detect < Risk Criteria

Table 2-4. Facility-Wide Chemicals of Potential Concern in Sediment (continued)

Analyte	CAS Number	Units	Results >Detection Limit	Minimum Detect	Maximum Detect	Background Criteria	Max. > Bkg.?	EPA Region 9 Res. Soil PRG (HQ=.1,10E-6)	PRG Type	COPC?	Justification
Pesticides/Herbicides											
4,4'-DDD	72548	mg/kg	8/ 161	0.00053	0.026	0	Yes	2.4	ca	No	Max Detect < Risk Criteria
4,4'-DDE	72559	mg/kg	18/ 161	0.00052	0.13	0	Yes	1.7	ca	No	Max Detect < Risk Criteria
4,4'-DDT	50293	mg/kg	3/ 150	0.0016	0.0065	0	Yes	1.7	ca	No	Max Detect < Risk Criteria
Dieldrin	60571	mg/kg	6/ 161	0.00041	0.058	0	Yes	0.03	ca	Yes	Max Detect >PRG
Endosulfan I	959988	mg/kg	1/ 161	0.00052	0.00052	0	Yes	37	nc	No	Max Detect < Risk Criteria
Endosulfan Sulfate	1031078	mg/kg	1/ 161	0.0045	0.0045	0	Yes	37	nc	No	Max Detect < Risk Criteria
Endrin	72208	mg/kg	4/ 150	0.00055	0.022	0	Yes	1.8	nc	No	Max Detect < Risk Criteria
Endrin Aldehyde	7421934	mg/kg	4/ 161	0.0018	0.072	0	Yes	1.8	nc	No	Max Detect < Risk Criteria
Endrin Ketone	53494705	mg/kg	2/ 161	0.01	0.019	0	Yes	1.8	nc	No	Max Detect < Risk Criteria
Heptachlor	76448	mg/kg	2/ 161	0.0019	0.0034	0	Yes	0.11	ca	No	Max Detect < Risk Criteria
Heptachlor Epoxide	1024573	mg/kg	2/ 161	0.00057	0.037	0	Yes	0.053	ca	No	Max Detect < Risk Criteria
Lindane	58899	mg/kg	2/ 161	0.00086	0.013	0	Yes	0.44	ca	No	Max Detect < Risk Criteria
Methoxychlor	72435	mg/kg	7/ 161	0.00094	0.0073	0	Yes	31	nc	No	Max Detect < Risk Criteria
alpha-Chlordane	5103719	mg/kg	1/ 161	11	11	0	Yes	1.6	ca	Yes	Max Detect >PRG
beta-BHC	319857	mg/kg	7/ 161	0.00066	0.12	0	Yes	0.32	ca	No	Max Detect < Risk Criteria
gamma-Chlordane	5103742	mg/kg	5/ 161	0.0061	10	0	Yes	1.6	ca	Yes	Max Detect >PRG
Polychlorinated Biphenyls											
PCB-1016	12674112	mg/kg	2/ 233	0.1	3.3	0	Yes	0.39	nc	Yes	Max Detect >PRG
PCB-1248	12672296	mg/kg	1/ 233	0.09	0.09	0	Yes	0.11	nc	No	Max Detect < Risk Criteria
PCB-1254	11097691	mg/kg	33/ 233	0.031	260	0	Yes	0.11	nc	Yes	Max Detect >PRG
PCB-1260	11096825	mg/kg	6/ 227	0.032	0.22	0	Yes	0.11	nc	Yes	Max Detect >PRG
Volatile Organic Compounds											
1,2-Dichloroethene	540590	mg/kg	3/ 139	0.0022	0.01	0	Yes	4.3	nc	No	Max Detect < Risk Criteria
2-Butanone	78933	mg/kg	61/ 204	0.0042	0.11	0	Yes	2,200	nc	No	Max Detect < Risk Criteria
Acetone	67641	mg/kg	111/ 203	0.003	0.54	0	Yes	1,400	nc	No	Max Detect < Risk Criteria
Benzene	71432	mg/kg	1/ 204	0.0018	0.0018	0	Yes	0.64	ca	No	Max Detect < Risk Criteria
Carbon Disulfide	75150	mg/kg	5/ 193	0.0023	0.013	0	Yes	36	nc	No	Max Detect < Risk Criteria
Chloroform	67663	mg/kg	2/ 204	0.002	0.005	0	Yes	0.22	ca	No	Max Detect < Risk Criteria
Chloromethane	74873	mg/kg	2/ 204	0.003	0.004	0	Yes	4.7	nc	No	Max Detect < Risk Criteria
Dimethylbenzene	1330207	mg/kg	1/ 149	0.003	0.003	0	Yes	27	nc	No	Max Detect < Risk Criteria
Methylene Chloride	75092	mg/kg	52/ 204	0.00073	0.048	0	Yes	9.1	ca	No	Max Detect < Risk Criteria
Toluene	108883	mg/kg	30/ 204	0.0011	3.7	0	Yes	66	nc	No	Max Detect < Risk Criteria
Trichloroethene	79016	mg/kg	3/ 193	0.0012	0.012	0	Yes	0.053	ca	No	Max Detect < Risk Criteria

Bkg. = Background.
ca = Carcinogenic.
CAS = Chemical Abstracts Service.
COPC = Chemical of potential concern.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
HQ = Hazard quotient.
nc = Noncarcinogenic.
PCB = Polychlorinated biphenyl.
PRG = Preliminary remediation goal.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
Res. = Residential.

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3.0 EXPOSURE ASSESSMENT CONSIDERATIONS IN CLEANUP GOAL DEVELOPMENT

This chapter summarizes RVAAP land uses and receptors that were considered in the development of FWCUGs. Much of the information summarized herein is presented in detail in the Risk Manual.

When the RVAAP IRP began in 1989, RVAAP was identified as a 21,419-acre installation. The property boundary was resurveyed by OHARNG over a 2-year period (2002 and 2003) and the actual total acreage of the property was found to be 21,683.289 acres. As of February 2006, a total of 20,403 acres of the former 21,683-acre RVAAP have been transferred to NGB and subsequently licensed to OHARNG for use as a military training site [Ravenna Training and Logistics Site (RTLS)]. When RVAAP was operational, RTLS did not exist and the entire 21,683-acre parcel was a government-owned, contractor-operated industrial facility. The RVAAP IRP encompasses investigation and cleanup of contamination from past activities over the entire 21,683 acres of the former RVAAP. The current RVAAP consists of the 1,280 acres that include AOCs. At present, workers infrequently visit the RVAAP AOCs for maintenance purposes, such as mowing; to conduct environmental investigations; and to perform remediation activities. As cleanup of the AOCs is completed, they will also be transferred to OHARNG.

Under the current and future planned land use for RVAAP, the Risk Manual identified human receptors and exposure pathways that must be evaluated in RVAAP risk assessments. The identified receptors include:

- Security and Maintenance Personnel,
- National Guard – Fire/Dust Suppression Worker,
- National Guard Trainee,
- Resident Farmer,
- Trespasser Adult/Juvenile, and
- Recreators – Hunter/Trapper/Fisher.

Based on review of National Guard training activities, there will be mounted versus dismounted, and digging versus no digging activities at the site. In all cases, the National Guard Trainee is exposed to surface soil (considered to be 0 – 4 ft BGS due to the use of tracked vehicles). In cases where there will be dismounted/digging activities, the National Guard Trainee is also exposed to subsurface soil (4 to 7 ft BGS).

As planning for OHARNG training activities progressed, two additional training activities were identified that were not covered in the RVAAP Risk Manual. These activities include:

- National Guard Engineering School training, and
- National Guard Range Maintenance (for any type of ranges).

Table 3-1 summarizes the complete set of receptors and exposure pathways that are being considered in the development of the FWCUGs. The exposure models for the initial six receptors used to estimate the amount of a chemical that humans may ingest or absorb are presented in the Risk Manual. The detailed exposure parameters for the six receptors are also presented in the Risk Manual. The detailed exposure parameter values for the two additional receptors, the Engineering School Instructor and the Small Arms Range Maintenance Soldier, are presented in a White Paper (included herein as Appendix A). As indicated in Table 3-1, FWCUGs for one soil exposure pathway, “ingestion of foodstuffs/crops,” are

Table 3-1. Exposure Pathways Considered for Cleanup Goal Development

Exposure Pathways	Trespasser Adult/Juvenile	National Guard Engineering School Instructor	Recreators – Hunter/Trapper/Fisher	National Guard – Fire/Dust Suppression Worker	Range Maintenance Soldier	National Guard Trainee [a]	Resident Farmer	Security Guard/Maintenance Personnel
Surface Soil								
Incidental Ingestion	X	X	X	X	X	X	X	X
Dermal Contact	X	X	X	X	X	X	X	X
Inhalation of VOCs and Dust	X	X	X	X	X	X	X	X
Ingestion of Foodstuffs/Crops							O	
Subsurface Soil								
Incidental Ingestion		X				X	X	
Dermal Contact		X				X	X	
Inhalation		X				X	X	
Groundwater								
Drinking Water Ingestion						X	X	
Dermal Contact while Showering						X	X	
Inhalation of VOCs during Household Water Use						X	X	
Surface Water								
Ingestion (drinking water, incidental)	X		X	X		X	X	
Dermal Contact while Swimming/Wading	X		X	X		X	X	
Inhalation of VOCs	X		X	X		X	X	
Ingestion of Fish			X					
Sediment								
Incidental Ingestion	X		X	X		X	X	
Dermal Contact	X		X	X		X	X	
Inhalation of VOCs and Dust	X		X	X		X	X	
Ingestion of Fish			X					

[a] The National Guard Trainee scenario presented herein represents the "dismounted training – digging" scenario, which assumes digging activities and thus exposure to both surface and subsurface soil. Unless detailed training land use requirements are well understood, this is the default scenario for the National Guard trainee.
Mounted/Dismounted Training – Digging (7'): Direct contact is permitted with soil and water from the surface to 7 ft below ground surface (BGS) 24 hr/day, 24 days/year on inactive duty training and/or 24 hr/day, 15 days/year during annual training with no ill effect to the soldier. Digging and occupying fighting positions to 7 ft BGS is permitted (IAW STP 21-1-SMCT, Oct 94, pp 245-255). Tracked and wheeled operations are permitted only as directed in Section 16, AGO Pam 210-1.
Mounted/Dismounted Training – No Digging: Direct contact is permitted with soil and/or water 24 hr/day, 24 days/year on inactive duty training and/or 24 hr/day, 15 days/year during annual training with no ill effect to the soldier. All digging is prohibited in this area. Digging and occupying fighting positions, tank defilade positions, tank ditches, and battle positions that extend BGS is prohibited. Exposures are expected to occur down to 4 ft BGS due to track disturbances of soil. Tracked and wheeled operations are permitted only as directed in Section 16, AGO Pam 210-1.

O = Pathway evaluated separately from other pathways identified for this media, thus resulting in two sets of cleanup goals: (1) without foodstuff, and (2) foodstuff exposure.
VOC = Volatile organic compound.
X = Pathway evaluated.

being evaluated and presented separately from the other soil exposure pathways. As discussed with Ohio EPA, these food ingestion-based values could be applied on a case-by-case basis but are not considered part of the default approach.

Table 3-2 summarizes all exposure parameters used to develop the FWCUGs, many of which come directly from the Risk Manual (USACE 2005). The footnotes in Table 3-2 also come directly from the Risk Manual.

Table 3-2. Exposure Factors for Receptors at RVAAP, Facility-Wide

Parameter	Units	Security Guard/ Maintenance Worker	National Guard			Engineering School Instructor*	Resident Farmer		Hunter/ Trapper	Fisher Recreator	Trespasser	
			Dust/Fire Control Worker	Trainee	Range Maintenance Soldier		Adult	Child			Adult	Juvenile
Surface Soil												
Incidental ingestion												
Soil ingestion rate	kg/day	0.0001[a]	0.0001[a]	0.0001[a]	0.0001[a]	0.0001[a]	0.0001[a]	0.0002[a]	0.0001[a]	0.0001[a]	0.0001[a]	0.0002[a]
Exposure time	hr/day	1[b]	4[b]	24[b]	6	9.5	24[a]	24[a]	6[b]	4[b]	2[b]	2[b]
Exposure frequency	days/year	250[a]	15[b]	39[b]	85	180	350[a]	350[a]	2[b]	5[b]	75[b]	50[b]
Exposure duration	years	25[a]	25[b]	25[b]	25	25	30[a]	6[a]	30[a]	30[a]	30[a]	10
Body weight	kg	70[a]	70[a]	70[a]	70[a]	70[a]	70[a]	15[a]	70[a]	70[a]	70[a]	45[a]
Carcinogen averaging time	days	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]
Non-carcinogen averaging time	days	9125[a]	9125[a]	9125[a]	9125[a]	9125[a]	10,950[a]	2190[a]	10,950[a]	10,950[a]	10,950[a]	3650[a]
Fraction ingested	unitless	1[b]	1[b]	1[b]	1	1	1[b]	1[b]	1[b]	1[b]	1[b]	1[b]
Conversion factor	days/hr	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Dermal contact												
Skin area	m^2/event	0.33[d]	0.33[d]	0.33[d]	0.33[d]	0.33[d]	0.57[d]	0.22[t]	0.57[d]	0.57[d]	0.57[d]	0.815
Adherence factor	mg/cm^2	0.7[c]	0.3[c]	0.3[c]	0.3[c]	0.3[c]	0.4[c]	0.2[t]	0.3[c]	0.3[c]	0.4[c]	0.2[t]
Absorption fraction	unitless	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]
Exposure frequency	days/year	250[a]	15[b]	39[b]	85	180	350[a]	350[a]	2[b]	5[b]	75[a]	50[a]
Exposure duration	years	25[a]	25[b]	25[b]	25	25	30[a]	6[a]	30[a]	30[a]	30[a]	10
Body weight	kg	70[a]	70[a]	70[a]	70[a]	70[a]	70[a]	15[a]	70[a]	70[a]	70[a]	45[a]
Carcinogen averaging time	days	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]
Non-carcinogen averaging time	days	9125[a]	9125[a]	9125[a]	9125[a]	9125[a]	10,950[a]	2190[a]	10,950[a]	10,950[a]	10,950[a]	3650[a]
Conversion factor	$(kg\text{-}cm^2)/(mg\text{-}m^2)$	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Inhalation of VOCs and dust												
Inhalation rate	m^3/day	20[a]	44.4[t]	44.4[t]	20.5	19.8	20[a]	10[q]	20[a]	20[a]	20[a]	20[a]
Exposure time	hr/day	1[b]	4[b]	24[b]	6	9.5	24[a]	24[a]	6[b]	4[b]	2[b]	2[b]
Exposure frequency	days/year	250[a]	15[b]	39[b]	85	180	350[a]	350[a]	2[b]	5[b]	75[a]	50[a]
Precipitation modifying factor	unitless	NA	NA	NA	NA	0.68	NA	NA	NA	NA	NA	NA
Exposure duration	years	25[a]	25[b]	25[b]	25	25	30[a]	6[a]	30[a]	30[a]	30[a]	10
Body weight	kg	70[a]	70[a]	70[a]	70[a]	70[a]	70[a]	15[a]	70[a]	70[a]	70[a]	45[a]
Carcinogen averaging time	days	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]
Non-carcinogen averaging time	days	9125[a]	9125[a]	9125[a]	9125[a]	9125[a]	10,950[a]	2190[a]	10,950[a]	10,950[a]	10,950[a]	3650[a]
Particulate emission factor	m^3/day	9.24E+08	9.24E+08	1.67E+06	9.24E+08	1.67E+06	9.24E+08	9.24E+08	9.24E+08	9.24E+08	9.24E+08	9.24E+08
Conversion factor	days/hr	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Subsurface Soil												
Incidental ingestion												
Soil ingestion rate	kg/day	NA	NA	0.0001[a]	NA	NA	0.0001[a]	0.0002[a]	NA	NA	NA	NA
Exposure time	hr/day	NA	NA	24[b]	NA	NA	24[a]	24[a]	NA	NA	NA	NA
Exposure frequency	days/year	NA	NA	39[b]	NA	NA	350[a]	350[a]	NA	NA	NA	NA
Exposure duration	years	NA	NA	25[b]	NA	NA	30[a]	6[a]	NA	NA	NA	NA
Body weight	kg	NA	NA	70[a]	NA	NA	70[a]	15[a]	NA	NA	NA	NA
Carcinogen averaging time	days	NA	NA	25,550[a]	NA	NA	25,550[a]	25,550[a]	NA	NA	NA	NA

Table 3-2. Exposure Factors for Receptors at RVAAP, Facility Wide (continued)

Parameter	Units	Security Guard/ Maintenance Worker	National Guard			Engineering School Instructor*	Resident Farmer		Hunter/ Trapper	Fisher Recreator	Trespasser	
			Dust/Fire Control Worker	Trainee	Range Maintenance Soldier		Adult	Child			Adult	Juvenile
Non-carcinogen averaging time	days	NA	NA	9125[a]	NA	NA	10,950[a]	2190[a]	NA	NA	NA	NA
Fraction ingested	unitless	NA	NA	1[b]	NA	NA	1[b]	1[b]	NA	NA	NA	NA
Conversion factor	days/hr	NA	NA	0.042	NA	NA	0.042	0.042	NA	NA	NA	NA
Dermal contact												
Skin area	m^2/event	NA	NA	0.33[d]	NA	NA	0.57[d]	0.22[t]	NA	NA	NA	NA
Adherence factor	mg/cm^2	NA	NA	0.3[c]	NA	NA	0.4[c]	0.2[t]	NA	NA	NA	NA
Absorption fraction	unitless	NA	NA	chem. spec.[p]	NA	NA	chem. spec.[p]	chem. spec.[p]	NA	NA	NA	NA
Exposure frequency	days/year	NA	NA	39[b]	NA	NA	350[a]	350[a]	NA	NA	NA	NA
Exposure duration	years	NA	NA	25[b]	NA	NA	30[a]	6[a]	NA	NA	NA	NA
Body weight	kg	NA	NA	70[a]	NA	NA	70[a]	15[a]	NA	NA	NA	NA
Carcinogen averaging time	days	NA	NA	25,550[a]	NA	NA	25,550[a]	25,550[a]	NA	NA	NA	NA
Non-carcinogen averaging time	days	NA	NA	9125[a]	NA	NA	10,950[a]	2190[a]	NA	NA	NA	NA
Conversion factor	(kg-cm^2)/ (mg-m^2)	NA	NA	0.01	NA	NA	0.01	0.01	NA	NA	NA	NA
Inhalation of VOCs and dust												
Inhalation rate	m^3/day	NA	NA	44.4[t]	NA	NA	20[a]	10[q]	NA	NA	NA	NA
Exposure time	hr/day	NA	NA	24[b]	NA	NA	24[a]	24[a]	NA	NA	NA	NA
Exposure frequency	days/year	NA	NA	39[b]	NA	NA	350[a]	350[a]	NA	NA	NA	NA
Exposure duration	years	NA	NA	25[b]	NA	NA	30[a]	6[a]	NA	NA	NA	NA
Body weight	kg	NA	NA	70[a]	NA	NA	70[a]	15[a]	NA	NA	NA	NA
Carcinogen averaging time	days	NA	NA	25,550[a]	NA	NA	25,550[a]	25,550[a]	NA	NA	NA	NA
Non-carcinogen averaging time	days	NA	NA	9125[a]	NA	NA	10,950[a]	2190[a]	NA	NA	NA	NA
Particulate emission factor	m^3/day	NA	NA	1.67E+06	NA	NA	9.24E+08	9.24E+08	NA	NA	NA	NA
Conversion factor	days/hr	NA	NA	0.042	NA	NA	0.042	0.042	NA	NA	NA	NA
Sediment												
Incidental ingestion												
Soil ingestion rate	kg/day	NA	0.0001[a]	0.0001[a]	NA	NA	0.0001[a]	0.0002[a]	0.0001[a]	0.0001[a]	0.0001[a]	0.0002[a]
Exposure time	hr/day	NA	4[b]	24[b]	NA	NA	24[a]	24[a]	6[b]	4[b]	2[b]	2[b]
Exposure frequency	days/year	NA	15[b]	39[b]	NA	NA	350[a]	350[a]	2[b]	5[b]	75[b]	50[b]
Exposure duration	years	NA	25[b]	25[b]	NA	NA	30[a]	6[a]	30[a]	30[a]	30[a]	10
Body weight	kg	NA	70[a]	70[a]	NA	NA	70[a]	15[a]	70[a]	70[a]	70[a]	45[a]
Carcinogen averaging time	days	NA	25,550[a]	25,550[a]	NA	NA	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]
Non-carcinogen averaging time	days	NA	9125[a]	9125[a]	NA	NA	10,950[a]	2190[a]	10,950[a]	10,950[a]	10,950[a]	3650[a]
Fraction ingested	unitless	NA	1[b]	1[b]	NA	NA	1[b]	1[b]	1[b]	1[b]	1[b]	1[b]
Conversion factor	days/hr	NA	0.042	0.042	NA	NA	0.042	0.042	0.042	0.042	0.042	0.042
Dermal contact												
Skin area	m^2/event	NA	0.33[d]	0.33[d]	NA	NA	0.57[d]	0.22[t]	0.52[d]	0.52[d]	0.57[d]	0.815
Adherence factor	mg/cm^2	NA	0.3[c]	0.3[c]	NA	NA	0.4[c]	0.2[t]	0.3[c]	0.3[c]	0.4[c]	0.2[t]
Absorption fraction	unitless	NA	chem. spec.[p]	chem. spec.[p]	NA	NA	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]	chem. spec.[p]
Exposure frequency	days/year	NA	15[b]	39[b]	NA	NA	350[a]	350[a]	2[b]	5[b]	75[b]	50[b]
Exposure duration	years	NA	25[b]	25[b]	NA	NA	30[a]	6[a]	30[a]	30[a]	30[a]	10
Body weight	kg	NA	70[a]	70[a]	NA	NA	70[a]	15[a]	70[a]	70[a]	70[a]	45[a]

Table 3-2. Exposure Factors for Receptors at RVAAP, Facility Wide (continued)

Parameter	Units	Security Guard/ Maintenance Worker	National Guard			Engineering School Instructor*	Resident Farmer		Hunter/ Trapper	Fisher Recreator	Trespasser	
			Dust/Fire Control Worker	Trainee	Range Maintenance Soldier		Adult	Child			Adult	Juvenile
Carcinogen averaging time	days	NA	25,550[a]	25,550[a]	NA	NA	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]
Non-carcinogen averaging time	days	NA	9125[a]	9125[a]	NA	NA	10,950[a]	2190[a]	10,950[a]	10,950[a]	10,950[a]	3650[a]
Conversion factor	(kg-cm^2)/ (mg-m^2)	NA	0.01	0.01	NA	NA	0.01	0.01	0.01	0.01	0.01	0.01
Inhalation of VOCs and dust												
Inhalation rate	m^3/day	NA	44.4[t]	44.4[t]	NA	NA	20[a]	10[q]	20[a]	20[a]	20[a]	20[a]
Exposure time	hr/day	NA	4[b]	24[b]	NA	NA	24[a]	24[a]	6[b]	4[b]	2[b]	2[b]
Exposure frequency	days/year	NA	15[b]	39[b]	NA	NA	350[a]	350[a]	2[b]	5[b]	75[b]	50[b]
Exposure duration	years	NA	25[b]	25[b]	NA	NA	30[a]	6[a]	30[a]	30[a]	30[a]	10
Body weight	kg	NA	70[a]	70[a]	NA	NA	70[a]	15[a]	70[a]	70[a]	70[a]	45[a]
Carcinogen averaging time	days	NA	25,550[a]	25,550[a]	NA	NA	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]
Non-carcinogen averaging time	days	NA	9125[a]	9125[a]	NA	NA	10,950[a]	2190[a]	10,950[a]	10,950[a]	10,950[a]	3650[a]
Particulate emission factor	m^3/day	NA	9.24E+08	1.67E+06	NA	NA	9.24E+08	9.24E+08	9.24E+08	9.24E+08	9.24E+08	9.24E+08
Conversion factor	days/hr	NA	0.042	0.042	NA	NA	0.042	0.042	0.042	0.042	0.042	0.042
Surface Water												
Incidental ingestion while swimming/wading/showering												
Incidental water ingestion rate	L/hr	NA	0.1[b]	0.1[b]	NA	NA	0.1[b]	0.1[b]	0.1[b]	0.1[b]	0.05[b]	0.05[b]
Exposure time	hr/day	NA	1	1	NA	NA	1	1	1	1	2	2
Exposure frequency	days/year	NA	15[b]	39[b]	NA	NA	350[a]	350[a]	2[b]	5[b]	75[b]	50[b]
Exposure duration	years	NA	25[b]	25[b]	NA	NA	30[a]	6[a]	30[a]	30[a]	30[a]	10
Body weight	kg	NA	70[a]	70[a]	NA	NA	70[a]	15[a]	70[a]	70[a]	70[a]	45[a]
Carcinogen averaging time	days	NA	25,550[a]	25,550[a]	NA	NA	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]
Non-carcinogen averaging time	days	NA	9125[a]	9125[a]	NA	NA	10,950[a]	2190[a]	10,950[a]	10,950[a]	10,950[a]	3650[a]
Dermal contact while swimming/wading/showering												
Skin area	m^2	NA	0.33[d]	0.33[d]	NA	NA	0.57[d]	0.22[t]	0.52[d]	0.52[d]	0.57[d]	0.815
Exposure time	hr/day	NA	4[b]	24[b]	NA	NA	0.25[c]	0.25[c]	6[b]	4[b]	2[b]	2[b]
Exposure frequency	days/year	NA	15[b]	39[b]	NA	NA	350[a]	350[a]	2[b]	5[b]	75[b]	50[b]
Exposure duration	years	NA	25[b]	25[b]	NA	NA	30[a]	6[a]	30[a]	30[a]	30[a]	10
Body weight	kg	NA	70[a]	70[a]	NA	NA	70[a]	15[a]	70[a]	70[a]	70[a]	45[a]
Carcinogen averaging time	days	NA	25,550[a]	25,550[a]	NA	NA	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]
Non-carcinogen averaging time	days	NA	9125[a]	9125[a]	NA	NA	10,950[a]	2190[a]	10,950[a]	10,950[a]	10,950[a]	3650[a]
Conversion factor	(m/cm)/ (L/m^3)	NA	10	10	NA	NA	10	10	10	10	10	10
Inhalation of VOCs												
Inhalation rate	m^3/day	NA	44.4[t]	44.4[t]	NA	NA	20[a]	20[a]	20[a]	20[a]	20[a]	20[a]
Exposure time	hr/day	NA	4[b]	24[b]	NA	NA	2[a]	2[a]	6[b]	4[b]	2[b]	2[b]
Exposure frequency	days/year	NA	15[b]	39[b]	NA	NA	350[a]	350[a]	2[b]	5[b]	75[b]	50[b]
Exposure duration	years	NA	25[b]	25[b]	NA	NA	30[a]	6[a]	30[a]	30[a]	30[a]	10
Body weight	kg	NA	70[a]	70[a]	NA	NA	70[a]	15[a]	70[a]	70[a]	70[a]	45[a]
Carcinogen averaging time	days	NA	25,550[a]	25,550[a]	NA	NA	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]	25,550[a]
Non-carcinogen averaging time	days	NA	9125[a]	9125[a]	NA	NA	10,950[a]	2190[a]	10,950[a]	10,950[a]	10,950[a]	3650[a]
Conversion factor	days/hr	NA	0.042	0.042	NA	NA	0.042	0.042	0.042	0.042	0.042	0.042
Volatilization factor	1000 L/m^3	NA	0.5	0.5	NA	NA	0.5	0.5	0.5	0.5	0.5	0.5

Table 3-2. Exposure Factors for Receptors at RVAAP, Facility Wide (continued)

Parameter	Units	Security Guard/ Maintenance Worker	National Guard			Engineering School Instructor*	Resident Farmer		Hunter/ Trapper	Fisher Recreator	Trespasser	
			Dust/Fire Control Worker	Trainee	Range Maintenance Soldier		Adult	Child			Adult	Juvenile
Groundwater												
Drinking water ingestion												
Drinking water ingestion rate	L/day	NA	NA	2[a]	NA	NA	2[a]	1.5[t]	NA	NA	NA	NA
Exposure frequency	days/year	NA	NA	39[b]	NA	NA	350[a]	350[a]	NA	NA	NA	NA
Exposure duration	years	NA	NA	25[b]	NA	NA	30[a]	6[a]	NA	NA	NA	NA
Body weight	kg	NA	NA	70[a]	NA	NA	70[a]	15[a]	NA	NA	NA	NA
Carcinogen averaging time	days	NA	NA	25,550[a]	NA	NA	25,550[a]	25,550[a]	NA	NA	NA	NA
Non-carcinogen averaging time	days	NA	NA	9125[a]	NA	NA	10,950[a]	2190[a]	NA	NA	NA	NA
Dermal contact while showering												
Skin area	m^2	NA	NA	1.94[g]	NA	NA	1.94[g]	0.866[s]	NA	NA	NA	NA
Exposure time	hr/day	NA	NA	0.25[a]	NA	NA	0.25[a]	0.25[a]	NA	NA	NA	NA
Exposure frequency	days/year	NA	NA	39[b]	NA	NA	350[a]	350[a]	NA	NA	NA	NA
Exposure duration	years	NA	NA	25[b]	NA	NA	30[a]	6[a]	NA	NA	NA	NA
Body weight	kg	NA	NA	70[a]	NA	NA	70[a]	15[a]	NA	NA	NA	NA
Carcinogen averaging time	days	NA	NA	25,550[a]	NA	NA	25,550[a]	25,550[a]	NA	NA	NA	NA
Non-carcinogen averaging time	days	NA	NA	9125[a]	NA	NA	10,950[a]	2190[a]	NA	NA	NA	NA
Conversion factor	(m/cm)/ (L/m^3)	NA	NA	10	NA	NA	10	10	NA	NA	NA	NA
Inhalation of VOCs during household water use												
Inhalation rate	m^3/day	NA	NA	20[a]	NA	NA	20[a]	10[q]	NA	NA	NA	NA
Exposure frequency	days/year	NA	NA	39[b]	NA	NA	350[a]	350[a]	NA	NA	NA	NA
Exposure duration	years	NA	NA	25[b]	NA	NA	30[a]	6[a]	NA	NA	NA	NA
Body weight	kg	NA	NA	70[a]	NA	NA	70[a]	15[a]	NA	NA	NA	NA
Carcinogen averaging time	days	NA	NA	25,550[a]	NA	NA	25,550[a]	25,550[a]	NA	NA	NA	NA
Non-carcinogen averaging time	days	NA	NA	9125[a]	NA	NA	10,950[a]	2190[a]	NA	NA	NA	NA
Volatilization factor	1000 L/m^3	NA	NA	0.5[a]	NA	NA	0.5[a]	0.5[a]	NA	NA	NA	NA
Ingestion of Foodstuffs												
Ingestion of venison												
Conversion factor	unitless	NA	NA	NA	NA	NA	1.25	1.25	NA	NA	NA	NA
Browse ingestion rate	kg dry wt/day	NA	NA	NA	NA	NA	0.87[b]	0.87[b]	NA	NA	NA	NA
Fraction browse ingested from site	unitless	NA	NA	NA	NA	NA	1	1	NA	NA	NA	NA
Fat ratio (venison to beef)	unitless	NA	NA	NA	NA	NA	0.2	0.2	NA	NA	NA	NA
Venison ingestion rate	kg/day	NA	NA	NA	NA	NA	0.03[b]	0.03[b]	NA	NA	NA	NA
Fraction ingested	unitless	NA	NA	NA	NA	NA	1[b]	1[b]	NA	NA	NA	NA
Exposure frequency	days/year	NA	NA	NA	NA	NA	365[b]	365[b]	NA	NA	NA	NA
Exposure duration	years	NA	NA	NA	NA	NA	30[a]	6[a]	NA	NA	NA	NA
Body weight	kg	NA	NA	NA	NA	NA	70[a]	15[a]	NA	NA	NA	NA
Carcinogen averaging time	days	NA	NA	NA	NA	NA	25,550[a]	25,550[a]	NA	NA	NA	NA
Non-carcinogen averaging time	days	NA	NA	NA	NA	NA	10,950[a]	2190[a]	NA	NA	NA	NA
Ingestion of beef												
Resuspension multiplier	unitless	NA	NA	NA	NA	NA	0.25[i]	0.25[i]	NA	NA	NA	NA

Table 3-2. Exposure Factors for Receptors at RVAAP, Facility Wide (continued)

Parameter	Units	Security Guard/ Maintenance Worker	National Guard			Engineering School Instructor*	Resident Farmer		Hunter/ Trapper	Fisher Recreator	Trespasser	
			Dust/Fire Control Worker	Trainee	Range Maintenance Soldier		Adult	Child			Adult	Juvenile
Quantity of pasture ingested	kg dry wt/day	NA	NA	NA	NA	NA	7.2[j]	7.2[j]	NA	NA	NA	NA
Fraction of year cow is on-site	unitless	NA	NA	NA	NA	NA	1	1	NA	NA	NA	NA
Fraction of cow's food from on-site	unitless	NA	NA	NA	NA	NA	0.9[b]	0.9[b]	NA	NA	NA	NA
Quantity of soil ingested by cow	kg/day	NA	NA	NA	NA	NA	1[k]	1[k]	NA	NA	NA	NA
Beef ingestion rate	kg/day	NA	NA	NA	NA	NA	0.044[l]	0.044[l]	NA	NA	NA	NA
Fraction ingested	unitless	NA	NA	NA	NA	NA	1[b]	1[b]	NA	NA	NA	NA
Exposure frequency	days/year	NA	NA	NA	NA	NA	365[b]	365[b]	NA	NA	NA	NA
Exposure duration	years	NA	NA	NA	NA	NA	30[a]	6[a]	NA	NA	NA	NA
Body weight	kg	NA	NA	NA	NA	NA	70[a]	15[a]	NA	NA	NA	NA
Carcinogen averaging time	days	NA	NA	NA	NA	NA	25,550[a]	25,550[a]	NA	NA	NA	NA
Non-carcinogen averaging time	days	NA	NA	NA	NA	NA	10,950[a]	2190[a]	NA	NA	NA	NA
Ingestion of milk products												
Resuspension multiplier	unitless	NA	NA	NA	NA	NA	0.25[i]	0.25[i]	NA	NA	NA	NA
Quantity of pasture ingested	kg dry wt/day	NA	NA	NA	NA	NA	16.1[j]	16.1[j]	NA	NA	NA	NA
Fraction of year cow is on-site	unitless	NA	NA	NA	NA	NA	1[b]	1[b]	NA	NA	NA	NA
Fraction of cow's food from on-site	unitless	NA	NA	NA	NA	NA	0.6[b]	0.6[b]	NA	NA	NA	NA
Quantity of soil ingested by cow	kg/day	NA	NA	NA	NA	NA	1[k]	1[k]	NA	NA	NA	NA
Milk ingestion rate	kg/day	NA	NA	NA	NA	NA	0.305[l]	0.509[m]	NA	NA	NA	NA
Fraction ingested	unitless	NA	NA	NA	NA	NA	1[b]	1[b]	NA	NA	NA	NA
Exposure frequency	days/year	NA	NA	NA	NA	NA	365[b]	365[b]	NA	NA	NA	NA
Exposure duration	years	NA	NA	NA	NA	NA	30[a]	6[a]	NA	NA	NA	NA
Body weight	kg	NA	NA	NA	NA	NA	70[a]	15[a]	NA	NA	NA	NA
Carcinogen averaging time	days	NA	NA	NA	NA	NA	25,550[a]	25,550[a]	NA	NA	NA	NA
Non-carcinogen averaging time	days	NA	NA	NA	NA	NA	10,950[a]	2190[a]	NA	NA	NA	NA
Ingestion of vegetables												
Resuspension multiplier	unitless	NA	NA	NA	NA	NA	0.26[n]	0.26[n]	NA	NA	NA	NA
Vegetable ingestion rate	kg/day	NA	NA	NA	NA	NA	0.2[l]	0.2[l]	NA	NA	NA	NA
Fraction ingested	unitless	NA	NA	NA	NA	NA	0.4[l]	0.4[l]	NA	NA	NA	NA
Exposure frequency	days/year	NA	NA	NA	NA	NA	365[a]	365[a]	NA	NA	NA	NA
Exposure duration	years	NA	NA	NA	NA	NA	30[a]	6[a]	NA	NA	NA	NA
Body weight	kg	NA	NA	NA	NA	NA	70[a]	15[a]	NA	NA	NA	NA
Carcinogen averaging time	days	NA	NA	NA	NA	NA	25,550[a]	25,550[a]	NA	NA	NA	NA
Non-carcinogen averaging time	days	NA	NA	NA	NA	NA	10,950[a]	2190[a]	NA	NA	NA	NA

Table 3-2. Exposure Factors for Receptors at RVAAP, Facility Wide (continued)

Parameter	Units	Security Guard/ Maintenance Worker	National Guard			Engineering School Instructor*	Resident Farmer		Hunter/ Trapper	Fisher Recreator	Trespasser	
			Dust/Fire Control Worker	Trainee	Range Maintenance Soldier		Adult	Child			Adult	Juvenile
Ingestion of fish/waterfowl												
Fish ingestion rate	kg/day	NA	NA	NA	NA	NA	0.054[o]	0.054[o]	0.0132[b]	0.0154[o]	NA	NA
Fraction ingested	unitless	NA	NA	NA	NA	NA	1[a]	1[a]	1[b]	1[b]	NA	NA
Exposure frequency	days/year	NA	NA	NA	NA	NA	365[b]	365[b]	365[b]	365[b]	NA	NA
Exposure duration	years	NA	NA	NA	NA	NA	30[a]	6[a]	30[b]	30[b]	NA	NA
Body weight	kg	NA	NA	NA	NA	NA	70[a]	15[a]	70[a]	70[a]	NA	NA
Carcinogen averaging time	days	NA	NA	NA	NA	NA	25,550[a]	25,550[a]	25,550[a]	25,550[a]	NA	NA
Non-carcinogen averaging time	days	NA	NA	NA	NA	NA	10,950[a]	2190[a]	10,950[a]	10,950[a]	NA	NA

***** New receptor developed in this report.

[a] Risk Assessment Guidance for Superfund (RAGS), Part B (EPA 1991).

[b] Site-specific (value assumed for site or value obtained from site personnel). National Guard Trainee is assumed to be on-site 24 hr/day for 24 days/year for inactive duty training and 24 hr/day for 15 days/year for annual training. National Guard Fire/Dust Suppression receptor is assumed to spend 4 hr/day for 5 days/year for fire suppression and 4 hr/day for 10 days/year (i.e., 40 hr/year) for dust suppression. Both National Guard Receptors are assumed to remain at RVAAP and at the area of concern (AOC) of interest for their entire 25-year enlistment. The hunter is assumed to be on-site 6 hr/day for 2 days/year. The trapper will be exposed less (i.e., 0.5 hr/day for 6 days/year); therefore, the hunter exposure is used as the more conservative scenario. The fisher is assumed to be on-site 4 hr/day for 5 days/year. The hunter/fisher is assumed to hunt/fish as long as he/she resides in the area, so the residential default exposure duration is used. The Security Guard/Maintenance Worker is assumed to visit each AOC for 1 hr/day for a standard worker default of 250 days/year and 25 years. National Guard Trainee and Resident Farmer are assumed to ingest 0.05 L/hr [per RAGS Part A (EPA 1998)] for approximately 2 hr/day spent in the surface water. National Guard Fire/Dust Suppression receptors are assumed to ingest 0.1 L/day due to direct exposure while setting pumps/hoses in surface water or from ingesting mist while spraying. Hunter/fisher are assumed to ingest 0.05 L/day due to splashing while setting traps or wading. Hunter/trapper is assumed to catch and eat the bag limit for ducks and geese each year.

[c] Security Guard/Maintenance Worker = Adult Groundskeeper (95th percentile); Hunter/Trapper = Residential Default; National Guard Trainee = Construction Worker (95th percentile); Resident Farmer Adult = Adult Farmer (95th percentile) (RAGS, Vol. 1 Part E, *Supplemental Guidance for Dermal Risk Assessment*).

[d] Security Guard/Maintenance Worker, National Guard Trainee, and National Guard Dust/Fire Control = Industrial Default; Hunter/Fisher and Resident Farmer = Adult Residential Default. Exposure Factors Handbook (EPA 1997) (Note dermal contact for hunter/fisher during wading is 0.52 based on head, hands, forearms, and lower legs from the Exposure Factors Handbook.)

[e] Average surface area for head, hands, forearms, torso, and lower legs for a child (EPA 1992a).

[f] RAGS, Part A (EPA 1989).

[g] Average total body surface area for an adult (EPA 1992b).

[h] Average total body surface area for a child (EPA 1992b).

[i] Plant mass loading factor for pasture (Hinton 1992).

[j] International Atomic Energy Agency 1994.

[k] Soil ingestion by dairy cattle (Darwin 1990).

[l] Exposure Factors Handbook (EPA 1997). 50th percentile meat ingestion 2.1g/kg-day = 147 g/day for a 70-kg adult, 95th percentile meat ingestion 5.1g/kg-day = 357 g/day for a 70-kg adult, 50th percentile beef ingestion 2.327g/kg-day = 163 g/day for a 70-kg adult, 95th percentile beef ingestion 0.626 g/kg-day = 44 g/day for a 70-kg adult.

[m] Pao et al. (1982).

[n] Plant mass loading factor for vegetables (Pinder 1989).

[o] Standard default exposure factors for fish ingestion (EPA 1991).

[p] RAGS, Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment, Interim) (EPA 2004a).

[q] Recommended value for child age 6 to 8 (EPA 1997).

[r] 90th percentile value for child age 3 to 5 (EPA 1997).

[s] 50th percentile value for male child age 6 to 7 (EPA 1997).

[t] Per Ohio EPA comment 2002.

[u] Ecological Risk Assessment, Ohio EPA/DERR, 2003.

NA = Not applicable for this scenario.
RVAAP = Ravenna Army Ammunition Plant.
VOC = Volatile organic compound.

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4.0 CHEMICAL-SPECIFIC INFORMATION FOR CHEMICALS OF POTENTIAL CONCERN

Two types of chemical-specific information are needed to calculate FWCUGs: (1) chemical-specific migration and exposure parameters, such as volatilization factors and soil-to-plant bioconcentration factors, and (2) chemical-specific toxicity information. The manner in which this information is used in the calculations is described in Chapter 5. This chapter presents the specific data used to calculate the FWCUGs.

4.1 CHEMICAL-SPECIFIC EXPOSURE PARAMETERS

Table 4-1 presents the chemical-specific parameters for all COPCs that are used to develop the FW CUGs.

4.2 TOXICITY INFORMATION

4.2.1 Toxicity Information for Non-carcinogens

To understand non-cancer impacts, EPA has developed reference doses (RfDs), or reference concentrations (RfCs), that represent the intake or dose below which no adverse health effects are expected. The RfDs and RfCs are determined using available dose-response data from animal studies for individual chemicals. From the animal studies, scientists determine the "no effects" intake/dose and then add a safety factor (from 10 to 1,000) to determine the RfD or RfC. RfDs and RfCs are reviewed and finalized by scientific advisory boards supported by EPA. The RfDs available for the facility-wide COPCs are listed in Table 4-2. Where no oral RfD was available, RfCs, measured in milligrams per cubic meter, were converted to RfDs expressed in units of milligrams per kilogram body weight per day by using the default adult inhalation rate and body weight [i.e., (RfC $\times$ 20 m^3/day)/70 kg = RfD] (EPA 1989). Only chronic RfDs are used to develop the FWCUGs because exposures are assumed to occur over long durations. These values represent updates to the EPA Integrated Risk Information System (IRIS) database as of April 2008.

The toxic effect of a chemical depends on several factors, including how it enters the body (i.e., inhalation or dermal absorption), how the body breaks down the chemicals into metabolites, and which organ is the target of the toxic effects (e.g., effects range from eye irritation to kidney or liver damage). EPA is currently reviewing methods for accounting for the difference in severity of effects; however, existing RfDs do not address this issue.

4.2.2 Toxicity Information for Carcinogens

For carcinogens, risks are estimated as the probability that an individual will develop cancer over a lifetime as a result of exposure to a carcinogen at a site. Cancer risk from exposure to contamination is expressed as excess or incremental cancer risk, which is cancer occurrence over and above normally expected rates of cancer development. Excess cancer risk is estimated using a cancer slope factor (CSF). The CSF is defined as a plausible upper-bound estimate of the probability of contracting cancer per unit intake/dose of a chemical over a lifetime (EPA 1989).

EPA expresses inhalation cancer potency as the unit risk based on the chemical concentration in air [i.e., risk per microgram of chemical per cubic meter of ambient air]. These unit risks were converted to CSFs

Table 4-1. Chemical-Specific Exposure Parameters for Ravenna Facility-Wide COPCs

COPC	Dermal Absorption Factor[a] (unitless)	Permeability Constant[b] (cm/hr)	Volatilization Factor[c] (m^3/kg)	Soil-to-Plant Uptake Factor[d] Dry Weight (days/kg)	Soil-to-Plant Uptake Factor[d] Wet Weight (days/kg)	Beef Transfer Coefficient[d] (kg/kg)	Milk Transfer Coefficient[d] (kg/kg)	Fish Transfer Coefficient[d] (L/kg)
Inorganics								
Aluminum	1.0E-03	1.0E-03	--	4.0E-03	1.0E-03	1.5E-03	2.0E-04	5.0E+02
Antimony	1.0E-03	1.0E-03	--	5.0E-02	1.0E-02	4.0E-05	2.5E-05	1.0E+02
Arsenic	3.0E-02	1.0E-03	--	4.0E-02	1.0E-02	2.0E-03	6.0E-05	3.0E+02
Barium	1.0E-03	1.0E-03	--	1.0E-01	3.0E-03	2.0E-04	4.8E-04	4.0E+00
Cadmium	1.0E-03	1.0E-03	--	5.5E-01	1.4E-01	4.0E-04	1.0E-03	2.0E+02
Chromium	1.0E-03	2.0E-03	--	4.0E-02	1.0E-04	9.0E-03	1.0E-05	2.0E+02
Chromium, hexavalent	1.0E-03	2.0E-03	--	4.0E-02	1.0E-04	9.0E-03	1.0E-05	2.0E+02
Cobalt	1.0E-03	4.0E-04	--	5.4E-02	2.3E-02	1.0E-04	7.0E-05	3.0E+02
Copper	1.0E-03	1.0E-03	--	8.0E-01	8.0E-02	9.0E-03	1.5E-03	2.0E+02
Iron	1.0E-03	1.0E-03	--	1.0E-02	4.0E-04	2.0E-02	3.0E-05	2.0E+02
Manganese	1.0E-03	1.0E-03	--	6.8E-01	6.9E-02	5.0E-04	3.0E-05	4.0E+02
Mercury	1.0E-03	1.0E-03	--	--	--	--	--	1.0E+03
Nickel	1.0E-03	2.0E-04	--	1.8E-01	5.0E-02	5.0E-03	1.6E-02	1.0E+02
Nitrate	1.0E-03	1.0E-03	--	--	--	--	--	1.5E+05
Silver	1.0E-03	6.0E-04	--	1.0E+00	2.2E-05	3.0E-03	5.0E-05	5.0E+00
Thallium	1.0E-02	1.0E-03	--	--	--	--	--	1.0E+04
Vanadium	1.0E-03	1.0E-03	--	5.5E-03	1.4E-03	2.5E-03	2.0E-05	--
Zinc	1.0E-03	6.0E-04	--	9.9E-01	2.6E-01	1.0E-01	1.0E-02	1.0E+03
Organics								
1,1,2,2-Tetrachloroethane	--	6.9E-03	--	--	--	--	--	1.4E+01
1,2-Dichloroethane	--	4.2E-03	--	--	--	--	--	2.8E+00
1,2-Dichloroethene	--	7.7E-03	--	--	--	--	--	8.1E+00
1,3,5-Trinitrobenzene	1.9E-02	--	--	7.7E+00	1.6E+00	4.0E-07	1.3E-07	--
1,3-Dinitrobenzene	1.0E-02	2.1E-03	--	4.5E+00	9.1E-01	1.0E-06	3.1E-07	2.8E+00
1,4-Dichlorobenzene	--	4.2E-02	--	--	--	--	--	8.9E+01
2,4,6-Trinitrotoluene	3.2E-02	1.1E-03	--	1.8E+00	3.6E-01	5.0E-06	1.6E-06	3.4E+00
2,4-Dimethylphenol	--	1.1E-02	--	--	--	--	--	1.2E+01
2,4-Dinitrotoluene	1.0E-01	3.1E-03	--	2.6E+00	5.3E-01	2.5E-06	7.9E-07	6.7E+00
2,6-Dinitrotoluene	9.9E-02	2.1E-03	--	3.9E+00	8.0E-01	1.3E-06	4.0E-07	8.3E+00
2-Amino-4,6-dinitrotoluene	6.0E-03	2.4E-03	--	--	--	--	--	5.2E+00
2-Methylnaphthalene	1.0E-02	--	9.0E+04	2.1E-01	4.2E-02	2.0E-04	6.3E-05	--

Table 4-1. Chemical-specific Exposure Parameters for Ravenna Facility Wide COPCs (continued)

COPC	Dermal Absorption Factor[a] (unitless)	Permeability Constant[b] (cm/hr)	Volatilization Factor[c] (m^3/kg)	Soil-to-Plant Uptake Factor[d]		Beef Transfer Coefficient[d] (kg/kg)	Milk Transfer Coefficient[d] (kg/kg)	Fish Transfer Coefficient[d] (L/kg)
				Dry Weight (days/kg)	Wet Weight (days/kg)			
2-Nitrotoluene	1.0E-02	1.2E-02	1.9E+05	1.8E+00	3.6E-01	5.0E-06	1.6E-06	1.2E+01
4,4'-DDD	--	1.8E-01	--	--	--	--	--	8.6E+03
4,4'-DDE	1.0E-02	1.6E-01	--	1.9E-02	3.8E-03	1.3E-02	4.0E-03	2.1E+04
4,4'-DDT	--	2.7E-01	--	--	--	--	--	4.2E+04
4-Amino-2,6-dinitrotoluene	6.0E-03	2.4E-03	--	--	--	--	--	5.2E+00
4-Chloro-3-methylphenol	1.0E-02	--	--	--	--	--	--	--
4-Methylphenol	--	7.7E-03	--	--	--	--	--	6.2E+00
4-Nitrobenzenamine	--	2.7E-03	--	--	--	--	--	2.3E+00
4-Nitrophenol	1.0E-02	--	--	3.0E+00	6.1E-01	2.0E-06	6.3E-07	--
4-Nitrotoluene	1.0E-02	1.3E-02	--	1.5E+00	3.1E-01	6.3E-06	2.0E-06	1.3E+01
Aldrin	1.0E-02	1.4E-03	--	6.9E-01	1.4E-01	2.5E-05	7.9E-06	2.0E+04
Benz(*a*)anthracene	1.3E-01	4.7E-01	--	1.9E-02	3.8E-03	1.3E-02	4.0E-03	5.4E+03
Benzene	--	1.5E-02	--	--	--	--	--	8.7E+00
Benzo(*a*)pyrene	1.3E-01	7.0E-01	--	1.1E-02	2.2E-03	3.1E-02	9.9E-03	1.1E+04
Benzo(*b*)fluoranthene	1.3E-01	7.0E-01	--	1.1E-02	2.2E-03	3.1E-02	9.9E-03	5.6E+03
Benzo(*k*)fluoranthene	1.3E-01	1.2E+00	--	4.3E-03	8.8E-04	1.6E-01	5.0E-02	1.0E+04
Bis(2-chloroethoxy)methane	1.0E-02	--	--	6.7E+00	1.4E+00	5.0E-07	1.6E-07	--
Bis(2-ethylhexyl)phthalate	--	2.5E-02	--	--	--	--	--	3.1E+02
Carbazole	1.0E-02	--	--	2.4E-01	4.8E-02	1.6E-04	5.0E-05	--
Carbon Tetrachloride	--	1.6E-02	--	--	--	--	--	3.0E+01
Chloroform	--	6.8E-03	--	--	--	--	--	6.6E+00
Chrysene	1.3E-01	4.7E-01	--	1.9E-02	3.8E-03	1.3E-02	4.0E-03	5.9E+03
Dibenz(*a,h*)anthracene	1.3E-01	1.5E+00	--	4.3E-03	8.8E-04	1.6E-01	5.0E-02	2.2E+04
Dibenzofuran	1.0E-02	--	--	1.5E-01	3.1E-02	3.3E-04	1.0E-04	--
Dieldrin	1.0E-02	1.2E-02	--	8.2E-02	1.7E-02	1.0E-03	3.1E-04	2.0E+03
Endrin	1.0E-02	--	--	8.2E-02	1.7E-02	1.0E-03	3.1E-04	--
Endrin Aldehyde	--	--	--	--	--	--	--	--
Fluoranthene	1.3E-01	--	--	5.5E-02	1.1E-02	2.0E-03	6.3E-04	--
Fluorene	1.3E-01	--	4.6E+05	1.1E-01	2.2E-02	6.3E-04	2.0E-04	--
HMX	6.0E-03	1.1E-04	--	1.7E+01	3.5E+00	9.7E-08	3.1E-08	3.2E+00
Heptachlor	1.0E-02	8.6E-03	--	1.2E-01	2.5E-02	5.0E-04	1.6E-04	9.9E+03
Heptachlor Epoxide	1.0E-02	2.8E-02	--	2.8E-02	5.7E-03	6.3E-03	2.0E-03	1.4E+03
Indeno(1,2,3-*cd*)pyrene	1.3E-01	1.0E+00	--	5.6E-03	1.1E-03	1.0E-01	3.1E-02	2.9E+04

Table 4-1. Chemical-specific Exposure Parameters for Ravenna Facility Wide COPCs (continued)

COPC	Dermal Absorption Factor[a] (unitless)	Permeability Constant[b] (cm/hr)	Volatilization Factor[c] (m^3/kg)	Soil-to-Plant Uptake Factor[d]		Beef Transfer Coefficient[d] (kg/kg)	Milk Transfer Coefficient[d] (kg/kg)	Fish Transfer Coefficient[d] (L/kg)
				Dry Weight (days/kg)	Wet Weight (days/kg)			
Lindane	--	1.1E-02	--	--	--	--	--	3.1E+02
Methylene Chloride	--	3.5E-03	--	--	--	--	--	1.8E+00
N-Nitroso-di-n-propylamine	1.0E-02	--	--	5.9E+00	1.2E+00	6.3E-07	2.0E-07	--
Naphthalene	1.3E-01	--	6.9E+04	4.6E-01	9.4E-02	5.0E-05	1.6E-05	--
Nitrobenzene	--	7.0E-03	--	--	--	--	--	5.3E+00
Nitroglycerin	1.0E-02	1.1E-03	--	--	--	--	--	3.5E+00
PCB-1016	1.4E-01	--	--	1.4E-02	2.9E-03	2.0E-02	6.3E-03	--
PCB-1242	--	9.2E-01	--	--	--	--	--	5.8E+04
PCB-1248	1.4E-01	--	--	1.6E-02	3.3E-03	1.6E-02	5.0E-03	--
PCB-1254	1.4E-01	1.3E+00	--	1.3E-02	2.5E-03	2.5E-02	7.9E-03	1.4E+05
PCB-1260	1.4E-01	5.5E+00	--	2.9E-03	5.9E-04	3.1E-01	9.9E-02	4.9E+03
Pentachlorophenol	2.5E-01	3.9E-01	--	1.4E-02	2.9E-03	2.0E-02	6.3E-03	7.0E+02
Pyrene	1.3E-01	3.2E-01	--	5.5E-02	1.1E-02	2.0E-03	6.3E-04	1.1E+03
RDX	1.5E-02	3.5E-04	--	4.6E-01	9.4E-02	5.0E-05	1.6E-05	3.2E+00
Tetrachloroethene	--	3.3E-02	--	--	--	--	--	8.3E+01
Toxaphene	--	1.2E-02	--	--	--	--	--	5.6E+03
Trichloroethene	--	1.2E-02	--	--	--	--	--	1.5E+01
alpha-BHC	--	2.8E-02	--	--	--	--	--	3.1E+02
alpha-Chlordane	--	--	--	--	--	--	--	--
beta-BHC	1.0E-02	2.8E-02	--	1.8E-01	3.7E-02	2.5E-04	7.9E-05	3.1E+02
cis-1,2-Dichloroethene	--	1.5E-02	--	--	--	--	--	8.1E+00
gamma-Chlordane	--	--	--	--	--	--	--	--

[a] Chemical-specific absorption factor values from Risk Assessment Information System (RAIS). When chemical-specific values are not available, the following default values are used for soil and sediment only: semivolatile organic compounds = 0.1, volatile organic compounds (VOCs) = 0.01, inorganics = 0.001, per the U. S. Environmental Protection Agency (EPA) Region 4 Supplemental Guidance to Risk Assessment Guidance for Superfund.
[b] From RAIS *http://risk.lsd.ornl.gov/tox/tox_values.shtml* for groundwater and surface water.
[c] Volatilization factors calculated using the 1996 EPA Soil Screening Guidance Methodology, using site-specific parameter values for Los Angeles, California. Only used for soil and sediment VOCs.
[d] Parameter used to evaluate food pathways.
COPC = Chemical of potential concern.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine
-- = No value available or chemical is not a COPC for the appropriate media requiring the exposure parameter in a calculation.

Table 4-2. Non-Carcinogenic Reference Doses for Ravenna Facility-Wide COPCs

COPC	Oral Chronic RfD (mg/kg-day)	Confidence Level	% GI Absorption[a]	Dermal Chronic RfD (mg/kg-day)	Inhalation Chronic RfD (mg/kg-day)	RfD Basis (vehicle)	Critical Effect	Uncertainty/ Modifying Factor
Inorganics								
Aluminum	1.0E+00	(O) Low	0.1	1.0E-01	1.4E-03	Oral (mice)	Minimal neurotoxicity in offspring	(O) MF=1 (O) UF=100
Antimony	4.0E-04	(O) Low	0.02	8.0E-06	--	Oral (rat)	Longevity, blood glucose, and cholesterol	(O) MF=1 (O) UF=1000
Arsenic	3.0E-04	(O) Medium	0.41	1.2E-04	--	Oral (human)	Hyperpigmentation, keratosis, and possible vascular complications	(O) MF=1 (O) UF=3
Barium	2.0E-01	(O) Medium	0.07	1.4E-02	1.4E-04	Oral (mice)	Nephropathy	(O) MF=1 (O) UF=300
Cadmium (soil)	1.0E-03	(O) High	0.01	1.0E-05	--	Oral	Significant proteinuria	(O) MF=1 (O) UF=10
Cadmium (water)	5.0E-04	(O) High	0.01	5.0E-06	--	Oral	Significant proteinuria	(O) MF=1 (O) UF=10
Chromium (as Chromium VI)	3.0E-03	(O) Low	0.02	6.0E-05	2.3E-06	Oral (rat)	Stomach ulcers, convulsions, kidney and liver damage	(O) MF=10 (O) UF=100
Chromium, hexavalent	3.0E-03	(O) Low	0.02	6.0E-05	2.3E-06	Oral (rat)	Stomach ulcers, convulsions, kidney and liver damage	(O) MF=10 (O) UF=100
Cobalt	2.0E-02	NA	0.8	2.0E-02	5.7E-06	NA	NA	NA
Copper	4.0E-02	(O) Medium	0.3	1.2E-02	--	Oral (animals)	Gastrointestinal, hepatic, and renal effects, abdominal pain, vomiting, diarrhea, hemolysis, hepatic necrosis, hematuria, proteinuria, hypotension, tachycardia, convulsions, coma, and death	(O) UF=1000

Table 4-2. Non-carcinogenic Reference Doses for Ravenna Facility Wide COPCs (continued)

COPC	Oral Chronic RfD (mg/kg-day)	Confidence Level	% GI Absorption[a]	Dermal Chronic RfD (mg/kg-day)	Inhalation Chronic RfD (mg/kg-day)	RfD Basis (vehicle)	Critical Effect	Uncertainty/ Modifying Factor
Iron	3.0E-01	NA	0.15	4.5E-02	--	NA	Gastrointestinal	NA
Manganese	4.6E-02	(O) Medium	0.04	1.8E-03	1.4E-05	Oral (human)	Central nervous system effects	(O) MF=1 (O) UF=1
Mercury	3.0E-04	(I) Medium	0.07	2.1E-05	--	Inhalation (human)	Hand tremor, memory disturbance, objective autonomic dysfunction	(I) MF=1 (I) UF=30
Nickel	2.0E-02	(O) Medium	0.27	5.4E-03	--	Oral: diet (rat)	Decreased body and major organ weights (rat)	(O) UF=100
Nitrate	1.6E+00	(O) High	0.5	1.6E+00	--	Oral (human)	Iron oxidation in hemoglobin of the blood, cardiovascular system	(O) MF=1 (O) UF=1
Silver	5.0E-03	(O) Low	0.18	9.0E-04	--	Oral (rats)	Gastrointestinal tract, abdominal pain, diarrhea, vomiting, shock, convulsions, skin, mucous membranes, eyes and death	(O) UF=3
Thallium	8.0E-05	(O) Low	0.5	8.0E-05	--	Oral (human)	Vomiting, diarrhea, temporary hair loss, and effects on the nervous system, lungs, heart, liver, and kidneys	(O) MF=1 (O) UF=3000
Vanadium	7.0E-03	(O) Low	0.01	7.0E-05	--	Inhalation (animals)	Lungs, throat, and eyes	(O) MF=1 (O) UF=100

Table 4-2. Non-carcinogenic Reference Doses for Ravenna Facility Wide COPCs (continued)

COPC	Oral Chronic RfD (mg/kg-day)	Confidence Level	% GI Absorption[a]	Dermal Chronic RfD (mg/kg-day)	Inhalation Chronic RfD (mg/kg-day)	RfD Basis (vehicle)	Critical Effect	Uncertainty/ Modifying Factor
Zinc	3.0E-01	(O) Medium	0.2	6.0E-02	--	Oral (rats)	(O) Copper deficiency & hypochromic microcytic anemia (human) (I) pulmonary and gastrointestinal effects (human)	(O) UF=3
Organics								
1,1,2,2-Tetrachloroethane	6.0E-02	(O) Low	0.7	6.0E-02	--	Oral (human)	Pulmonary congestion, edema, lung collapse, shallow breathing, low blood pressure, a faint pulse, epicardial and endocardial anoxic hemorrhage, mucosal irritation, nausea and vomiting, eye mucosal irritation, and dizziness	(O) MF=1 (O) UF=300
1,2-Dichloroethane	2.0E-02	(O) Low	1	2.0E-02	--	Oral, inhalation (animals)	Heart, central nervous system, liver, kidneys, skin, eyes, tumors, and lungs	(O) MF=1 (O) UF=3000
1,2-Dichloroethene	9.0E-03	NA	0.8	9.0E-03	--	Oral (rats)	Lesions in liver, eyes, central nervous system	(O) UF=1000
1,3,5-Trinitrobenzene	3.0E-02	NA	0.65	3.0E-02	--	NA	NA	NA
1,3-Dinitrobenzene	1.0E-04	NA	0.65	1.0E-04	--	NA	NA	NA
1,4-Dichlorobenzene	--	(I) Medium	0.9	--	2.3E-01	Inhalation (mice)	Dizziness, headaches, liver problems, increased weight in females	(I) MF=1 (I) UF=100
2,4,6-Trinitrotoluene	5.0E-04	(O) Medium	0.6	5.0E-04	--	Oral (dog)	Liver effects	(O) UF=1000
2,4-Dimethylphenol	2.0E-02	NA	0.5	2.0E-02	--	NA	NA	NA

Table 4-2. Non-carcinogenic Reference Doses for Ravenna Facility Wide COPCs (continued)

COPC	Oral Chronic RfD (mg/kg-day)	Confidence Level	% GI Absorption[a]	Dermal Chronic RfD (mg/kg-day)	Inhalation Chronic RfD (mg/kg-day)	RfD Basis (vehicle)	Critical Effect	Uncertainty/ Modifying Factor
2,4-Dinitrotoluene	2.0E-03	(O) High	0.85	2.0E-03	--	Oral (rats)	Neurotoxicity, heinz bodies, biliary tract hyperplasia, ischemic heart disease, hematological effects, cyanosis, anemia, leukocytosis, neurological, dizziness, insomnia, nausea, blood, liver, nervous system, reproductive system	(O) UF=1 (O) MF=100
2,6-Dinitrotoluene	1.0E-03	NA	0.85	1.0E-03	--	Oral (dogs)	Blood, reproductive system, neurological, hematological and liver histopathology	(O) MF=1 (O) UF=3000
2-Amino-4,6-dinitrotoluene	2.0E-04	NA	0.5	2.0E-04	--	NA	NA	NA
2-Methylnaphthalene	4.0E-03	NA	0.8	4.0E-03	--	NA	NA	NA
2-Nitrotoluene	1.0E-02	NA	0.8	1.0E-02	--	NA	NA	NA
4,4'-DDD	2.0E-03	NA	0.7	2.0E-03	--	NA	NA	NA
4,4'-DDT	5.0E-04	NA	0.7	5.0E-04	--	NA	NA	NA
4-Amino-2,6-dinitrotoluene	2.0E-04	NA	0.5	2.0E-04	--	NA	NA	NA
4-Methylphenol	5.0E-03	NA	0.65	5.0E-03	--	NA	NA	NA
4-Nitrobenzenamine	3.0E-03	NA	0.8	3.0E-03	--	NA	NA	NA
4-Nitrophenol	8.0E-03	NA	1	8.0E-03	--	NA	NA	NA
4-Nitrotoluene	1.0E-02	NA	0.8	1.0E-02	--	NA	NA	NA
Aldrin	3.0E-05	NA	0.5	3.0E-05	--	NA	NA	NA
Benzene	4.0E-03	(I) Medium (O) Medium	0.97	4.0E-03	8.6E-03	Inhalation (human) Oral (animals)	Decreased lymphocyte count	(I) MF=1 (I) UF=300 (O) MF=1 (O) UF=300
Bis(2-chloroethoxy)methane	3.0E-03	NA	0.5	3.0E-03	--	NA	NA	NA
Bis(2-ethylhexyl)phthalate	2.0E-02	(O) Medium	0.19	3.8E-03	--	Oral (rats, mice)	Liver and kidney damage, increased relative weight	(O) MF=1 (O) UF=1000

Table 4-2. Non-carcinogenic Reference Doses for Ravenna Facility Wide COPCs (continued)

COPC	Oral Chronic RfD (mg/kg-day)	Confidence Level	% GI Absorption[a]	Dermal Chronic RfD (mg/kg-day)	Inhalation Chronic RfD (mg/kg-day)	RfD Basis (vehicle)	Critical Effect	Uncertainty/ Modifying Factor
Carbon Tetrachloride	7.0E-04	(O) Medium	0.65	7.0E-04	--	Oral (rats, mice, hamsters)	Liver, kidney, and central nervous system, headaches, dizziness, sleepiness, and nausea and vomiting	(O) MF=1 (O) UF=1000
Chloroform	1.0E-02	(O) Medium	0.2	2.0E-03	--	Oral (rats) Inhalation (mice)	Fatty cyst formation on liver	(O) MF=1 (O) UF=1000
Dibenzofuran	2.0E-03	NA	0.8	2.0E-03	--	NA	NA	NA
Dieldrin	5.0E-05	NA	0.5	5.0E-05	--	NA	NA	NA
Endrin	3.0E-04	NA	0.02	6.0E-06	--	NA	NA	NA
Fluoranthene	4.0E-02	(O) Low	0.31	1.2E-02	--	Dermal (mice)	Nephropathy, increased weight, alterations and clinical effects on liver	(O) MF=1 (O) UF=3000
Fluorene	4.0E-02	(O) Low	0.5	4.0E-02	--	Dermal (mice)	Nephropathy, increased weight, alterations and clinical effects on liver	(O) MF=1 (O) UF=3000
HMX	5.0E-02	NA	0.15	7.5E-03	--	NA	NA	NA
Heptachlor	5.0E-04	(O) Low	0.72	5.0E-04	--	Oral (mice)	Nervous system, liver and adrenal glands	(O) MF=1 (O) UF=300
Heptachlor Epoxide	1.3E-05	(O) Low	0.72	1.3E-05	--	Oral (mice)	Nervous system, liver and adrenal glands	(O) MF=1 (O) UF=300
Lindane	3.0E-04	NA	0.97	3.0E-04	--	NA	NA	NA
Methylene Chloride	6.0E-02	(O) Medium	0.95	6.0E-02	8.6E-01	Inhalation (human)	Fatigue, liver toxicity, irritability, analgesia, narcosis, and death	(O) MF=1 (O) UF=100

Table 4-2. Non-carcinogenic Reference Doses for Ravenna Facility Wide COPCs (continued)

COPC	Oral Chronic RfD (mg/kg-day)	Confidence Level	% GI Absorption[a]	Dermal Chronic RfD (mg/kg-day)	Inhalation Chronic RfD (mg/kg-day)	RfD Basis (vehicle)	Critical Effect	Uncertainty/ Modifying Factor
Naphthalene	2.0E-02	(O) Low	0.8	2.0E-02	8.6E-04	Oral (mice)	Red blood cells, gastrointestinal distress, neurotoxic, hepatic, renal, and ocular effects, decreased mean terminal body weights in males	(O) MF=1 (O) UF=3000
Nitrobenzene	5.0E-04	(O) Low	0.97	5.0E-04	5.7E-04	Oral (animals)	Irritation to the skin or eyes, methemoglobinemia, nausea, vomiting, shortness of breath, headache, irritability, dizziness, weakness, drowsiness, liver damage, thyroid, and kidney tumors	(O) MF=1 (O) UF=10,000
PCB-1016	7.0E-05	NA	0.9	7.0E-05	--	NA	NA	NA
PCB-1254	2.0E-05	(O) Medium	0.9	2.0E-05	--	Oral (rats)	Ocular exudate, inflamed and prominent Meibomian glands	(O) MF=1 (O) UF=300
Pentachlorophenol	3.0E-02	(O) Medium	1	3.0E-02	--	Oral (mice)	Liver, kidneys, blood, lungs, nervous system, immune system, and digestive tract	(O) MF=1 (O) UF=100
Pyrene	3.0E-02	(O) Low	0.31	9.3E-03	--	Oral (mice, rats)	Nephropathy, decreased kidney weights, increased liver weights, hematological	(O) MF=1 (O) UF=3000
RDX	3.0E-03	NA	1	3.0E-03	--	NA	NA	NA

Table 4-2. Non-carcinogenic Reference Doses for Ravenna Facility Wide COPCs (continued)

COPC	Oral Chronic RfD (mg/kg-day)	Confidence Level	% GI Absorption[a]	Dermal Chronic RfD (mg/kg-day)	Inhalation Chronic RfD (mg/kg-day)	RfD Basis (vehicle)	Critical Effect	Uncertainty/ Modifying Factor
Tetrachloroethene	1.0E-02	(O) Medium	1	1.0E-02	1.7E-01	Oral (human)	Dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death, liver and kidney damage, hepatotoxicity and weight gain	(O) MF=1 (O) UF=1000
Trichloroethene	3.0E-04	NA	0.15	4.5E-05	1.1E-02	Inhalation (human)	Liver, kidney, and developing fetus	NA
cis-1,2-Dichloroethene	1.0E-02	NA	1	1.0E-02	--	Oral (rats)	Nauseous, drowsiness, tiredness, death, liver, heart and lung damage, decreased hematocrit	(O) MF=1 (O) UF=3000

[a] % GI absorption values from the Risk Assessment Information System.
COPC = Chemical of potential concern.
GI = Gastrointestinal.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
(I) = Inhalation.
MF = Modifying factor (the default modifying factor is 1).
NA = Not available.
(O) = Oral.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
RfD = Reference dose.
UF = Uncertainty factor.
-- = No value available.

expressed in units of risk per milligram of chemical per kilogram body weight per day by using the default adult inhalation rate and body weight [i.e., (unit risk × 70 kg × 1,000 μg/mg)/20 m^3/day]. CSFs used to develop the FWCUGs are presented in Table 4-3. These values represent updates to the IRIS database as of April 2008.

4.2.3 Estimated Toxicity Values for Dermal Exposures

Oral and inhalation RfDs and CSFs are currently available; however, dermal values are not. Dermal RfDs and CSFs were estimated from oral toxicity values using chemical-specific gastrointestinal absorption factors (GAFs) to calculate total absorbed dose. This conversion is necessary because most oral RfDs and CSFs are expressed as the amount of chemical administered per time and body weight; however, dermal exposure is expressed as an absorbed dose. Dermal toxicity factors are calculated from oral toxicity factors as shown below (EPA 2004a):

$$RfD_{dermal} = RfD_{oral} \times GAF$$

$$CSF_{dermal} = CSF_{oral}/GAF$$

Chemical-specific GAF values available from EPA's *Risk Assessment Guidance for Superfund, Vol. 1: Human Health Evaluation Manual (Part E)* (EPA 2004a) are used whenever possible. Not all COPCs have specific GAF values. When quantitative data are insufficient, a default GAF is used. A default value of 1.0 for organic and inorganic chemicals is used (EPA 2004a). Per EPA guidance (EPA 2004a), dermal CSFs and RfDs are estimated from the oral toxicity values using chemical-specific GAFs to calculate the total absorbed dose only for chemicals with GAF values <0.5 (i.e., for chemicals with GAF values between 0.5 and 1, the oral toxicity value itself is used to evaluate the dermal pathway). The GAF and resulting dermal toxicity values used in this effort are listed in Tables 4-2 and 4-3, respectively.

Table 4-3. Cancer Slope Factors for Ravenna Facility-Wide COPCs

COPC	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	% GI Absorption[a]	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	EPA Class	TEF	Type of Cancer
Inorganics							
Arsenic	1.5E+00	0.41	3.7E+00	1.5E+01	A	--	Respiratory system tumors
Cadmium	--	0.01	--	6.3E+00	B1	--	Respiratory tract and lung tumors
Chromium	--	0.02	--	4.2E+01	A	--	Lung tumors
Chromium, hexavalent	--	0.02	--	4.2E+01	A	--	Lung tumors
Cobalt	--	0.8	--	9.8E+00	NA	--	NA
Organics							
1,1,2,2-Tetrachloroethane	2.0E-01	0.7	2.0E-01	2.0E-01	C	--	Carcinoma
1,2-Dichloroethane	9.1E-02	1	9.1E-02	9.1E-02	B2	--	Hemangiosarcomas
1,4-Dichlorobenzene	2.4E-02	0.9	2.4E-02	--	C	--	Liver tumors
2,4,6-Trinitrotoluene	3.0E-02	0.6	3.0E-02	--	C	--	Bladder transitional cell papilloma
2,4-Dinitrotoluene	6.8E-01	0.85	6.8E-01	--	B2	--	Liver carcinoma, mammary adenomas, fibromas (mouse)
2,6-Dinitrotoluene	6.8E-01	0.85	6.8E-01	--	B2	--	Liver carcinoma, mammary adenomas, fibromas (mouse)
2-Nitrotoluene	2.3E-01	0.8	2.3E-01	--	NA	--	Mesotheliomas of the tunica vaginalis (rat)
4,4'-DDD	2.4E-01	0.7	2.4E-01	--	B2	--	Increased tumor incidence (mouse)
4,4'-DDE	3.4E-01	0.7	3.4E-01	--	B2	--	Hepatocellular carcinoma (mouse)
4,4'-DDT	3.4E-01	0.7	3.4E-01	3.4E-01	B2	--	Liver tumors (mouse)
4-Nitrobenzenamine	2.1E-02	0.8	2.1E-02	--	NA	--	NA
4-Nitrotoluene	1.7E-02	0.8	1.7E-02	--	NA	--	NA
Aldrin	1.7E+01	0.5	1.7E+01	1.7E+01	B2	--	Tumor induction (mouse)
Benz(*a*)anthracene	7.3E-01	0.31	2.4E+00	3.1E-01	B2	0.1	Stomach tumors (mouse)
Benzene	5.5E-02	0.97	5.5E-02	2.7E-02	A	--	Acute nonlymphocytic leukemia
Benzo(*a*)pyrene	7.3E+00	0.31	2.4E+01	3.1E+00	B2	1	Stomach, nasal cavity, larynx, tracheak, and pharnyx
Benzo(*b*)fluoranthene	7.3E-01	0.31	2.4E+00	3.1E-01	B2	0.1	Tumors
Benzo(*k*)fluoranthene	7.3E-02	0.31	2.4E-01	3.1E-02	B2	0.01	Tumors (mouse)

Table 4-3. Cancer Slope Factors for Ravenna Facility Wide COPCs (continued)

COPC	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	% GI Absorption[a]	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	EPA Class	TEF	Type of Cancer
Bis(2-ethylhexyl)phthalate	1.4E-02	0.19	7.4E-02	--	B2	--	Liver neoplastic nodule and nepatocellular carcinoma (mouse)
Carbazole	2.0E-02	0.7	2.0E-02	--	B2	--	Liver tumors (mouse)
Carbon Tetrachloride	1.3E-01	0.65	1.3E-01	5.3E-02	B2	--	Liver tumors (mouse)
Chloroform	6.1E-03	0.2	3.1E-02	8.1E-02	B2	--	Colon, rectum, bladder, and liver carcinoma (mouse)
Chrysene	7.3E-03	0.31	2.4E-02	3.1E-03	B2	0.001	Carcinomas and malignant lymphoma (mouse)
Dibenz(*a,h*)anthracene	7.3E+00	0.31	2.4E+01	3.1E+00	B2	1	Immunodepressive effects (mouse)
Dieldrin	1.6E+01	0.5	1.6E+01	1.6E+01	B2	--	Liver carcinoma (mouse)
Heptachlor	4.5E+00	0.72	4.5E+00	4.6E+00	B2	--	Hepatocellular carcinoma (mouse)
Heptachlor Epoxide	9.1E+00	0.72	9.1E+00	9.1E+00	B2	--	Hepatocellular carcinoma (mouse)
Indeno(1,2,3-*cd*)pyrene	7.3E-01	0.31	2.4E+00	3.1E-01	B2	0.1	Tumors
Lindane	1.3E+00	0.97	1.3E+00	--	B2	--	NA
Methylene Chloride	7.5E-03	0.95	7.5E-03	1.7E-03	B2	--	Hepatocellular carcinoma, adinomas (mouse)
N-Nitroso-di-n-propylamine	7.0E+00	0.25	2.8E+01	--	B2	--	NA
Nitroglycerin	1.7E-02	0.5	1.7E-02	--	NA	--	NA
PCB-1016	2.0E+00	0.9	2.0E+00	2.0E+00	B2	--	Liver hepatocellular adenomas, carcinomas, cholangiiomas, or cholangiocarcinomas (rat)
PCB-1242	4.0E-01	0.9	4.0E-01	3.5E-01	B2	--	Liver hepatocellular adenomas, carcinomas, cholangiiomas, or cholangiocarcinomas (rat)
PCB-1248	2.0E+00	0.9	2.0E+00	2.0E+00	B2	--	Liver hepatocellular adenomas, carcinomas, cholangiiomas, or cholangiocarcinomas (rat)
PCB-1254 (soil)	2.0E+00	0.9	2.0E+00	2.0E+00	B2	--	Liver hepatocellular adenomas, carcinomas, cholangiiomas, or cholangiocarcinomas (rat)
PCB-1254 (water)	4.0E-01	0.9	4.0E-01	3.5E-01	B2	--	Liver hepatocellular adenomas, carcinomas, cholangiiomas, or cholangiocarcinomas (rat)

Table 4-3. Cancer Slope Factors for Ravenna Facility Wide COPCs (continued)

COPC	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	% GI Absorption[a]	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	EPA Class	TEF	Type of Cancer
PCB-1260 (soil)	2.0E+00	0.9	2.0E+00	2.0E+00	B2	--	Liver hepatocellular adenomas, carcinomas, cholangiiomas, or cholangiocarcinomas (rat)
PCB-1260 (water)	4.0E-01	0.9	4.0E-01	3.5E-01	B2	--	Liver hepatocellular adenomas, carcinomas, cholangiiomas, or cholangiocarcinomas (rat)
Pentachlorophenol	1.2E-01	1	1.2E-01	--	B2	--	Carcinoma/adenoma
RDX	1.1E-01	1	1.1E-01	--	C	--	Liver hepatocellular carcinomas/adenomas (mouse)
Tetrachloroethene	5.4E-01	1	5.4E-01	2.1E-02	NA	--	Liver cancer
Toxaphene	1.1E+00	0.5	1.1E+00	1.1E+00	B2	--	NA
Trichloroethene	4.0E-01	0.15	2.7E+00	4.0E-01	NA	--	Liver or lung cancer
alpha-BHC	6.3E+00	0.97	6.3E+00	6.3E+00	B2	--	NA
beta-BHC	1.8E+00	0.91	1.8E+00	1.9E+00	C	--	Hepatic nodules, hepatocellular carcinoma

[a] % GI absorption values from the Risk Assessment Information System.
COPC = Chemical of potential concern.
EPA = U. S. Environmental Protection Agency.
GI = Gastrointestinal.
NA = Not available.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
TEF = Toxicity equivalency factor is based on the relative potency of each carcinogenic polycyclic aromatic hydrocarbon relative to that of benzo(*a*)pyrene.
-- = No value available.

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5.0 FACILITY-WIDE CLEANUP GOALS CALCULATION METHODS AND RESULTS

FWCUGs were developed for each COPC identified in Tables 2-1 through 2-4 and each of the land use/receptor scenarios identified in Table 3-1. The process for developing the FWCUGs involves rearranging the equations presented in the Risk Manual to solve for the FWCUG concentrations instead of solving for risk. Provided below is an example of taking the equations used to estimate intake and risk associated with ingestion of groundwater (Equations A, B, and C) and rearranging them to calculate an "acceptable intake" or CUG (Equation D).

Intake for drinking water ingestion (for groundwater COPCs) is estimated as follows:

$$\textbf{(Equation A)}\ \text{Chemical Intake}\,(\text{mg}/\text{kg}-\text{day}) = \frac{C_w \times IR_w \times EF \times ED}{BW \times AT},$$

where

C_w = chemical concentration in water (mg/L),
IR_w = ingestion rate of water (L/day),
EF = exposure frequency (days/year),
ED = exposure duration (years),
BW = body weight (kg),
AT = averaging (days) for carcinogens or non-carcinogens.

And the incremental lifetime cancer risk (ILCR) associated with this intake is calculated as follows (EPA 1989):

$$\textbf{(Equation B)}\ \text{ILCR} = I \times CSF$$

where

I = chemical intake for a specific chemical and pathway (mg/kg-day),
CSF = cancer slope factor for a specific chemical and pathway $(\text{mg/kg-day})^{-1}$.

These two equations are combined to produce the following equation:

$$\textbf{(Equation C)}\ \text{ILCR} = \frac{SF \times C_w \times IR_w \times EF \times ED}{BW \times AT \times 365\ \text{days}/\text{year}}$$

For a typical calculation of ILCR, the site exposure concentration C_w is known and a corresponding ILCR is the result. For the CUG concentration back calculation, the ILCR is replaced by the acceptable ILCR, which is referred to as the target risk (TR in the equation), and the equation is then rearranged to solve for the unknown site concentration C_w, that results in an acceptable intake. The site concentration that achieves the target risk level is the resulting CUG concentration as follows:

$$\textbf{(Equation D)}\ CUG = \frac{TR \times BW \times AT \times 356\ days/yr}{EF \times ED \times (SF \times IR_w)}$$

Using this approach for rearranging the Risk Manual equations, FWCUGs have been calculated using the exposure models and parameters presented in the Risk Manual and the White Paper (Appendix A) for each of the eight receptor/exposure pathway combinations discussed in Chapter 4.

The one model parameter value that is unique to the development of the FWCUGs and is not discussed in the Risk Manual is the target risk for carcinogens and the target HI for non-carcinogens. These parameter values represent the quantitative goals of a remediation effort (e.g., reduce the risk of contracting cancer to 1×10^{-5} or 1×10^{-4}, whichever is deemed acceptable to all stakeholders). To provide maximum flexibility to decision makers during upcoming RI/FS processes, FWCUGs have been calculated based on a range of target risks and target HIs

- FWCUGs for carcinogenic contaminants have been developed for target risks of 1×10^{-4}, 1×10^{-5}, and 1×10^{-6}; and
- FWCUGs for non-carcinogenic contaminants have been developed for target HIs of 0.1 and 1.

To address the issue of accounting for multiple chemicals and multiple exposures to noncarcinogens projects should use a process referred to as "Sum of Ratios". Figure 5-1 provides an example of this approach. Using this approach, determine the ratio of the chemical EPC to the FWCUG . In general, a ratio > 1 = unacceptable hazard; Ratio < 1 = acceptable. In cases where an individual may be exposed to multiple noncarcinogenic chemicals, sum the ratios for those chemicals. If the Sum of the Ratios is > 1, there is a potential unacceptable hazard. A sum of ratios should be developed for chemicals that affect similar target organs and therefore the effect could be additive.

The process can be summarized as follows:

- For noncarcinogens, compare the chemical-specific EPCs to the target risk FWCUG.
- If the ratio of the EPC/FWCUG > 1, the chemical is a chemical of concern (COC).
- Sum the ratios of chemicals that effect similar target organs. If the sum of ratios > 1, chemicals contributing at least 10% to the sum are also considered COCs for the site.

Chemical of Potential Concern(a)	AOC Exposure Point Concentration (mg/kg)	Cleanup Goal based on HI=1 (mg/kg)	Ratio of EPC/FWCUG	Percent contribution to Sum of Ratios	Chemical of Concern?
Chemical X	2	2.1	0.952	89%	Yes
Chemical Y	5	56	0.089	8%	No
Chemical Z	8	320	0.025	2%	No
Sum of Ratios			1.067		

[a] Chemicals of potential concern that effect same target organ.

Figure 5-1. Example of Sum of Ratio Approach to evaluating cumulative impacts

Tables 5-1 through 5-11 present calculated FWCUGs for the COPCs at RVAAP for soil, subsurface soil, groundwater, surface water, and sediment, respectively. As indicated in Figure 1-1, future remediation efforts will identify the appropriate land use and receptor scenario for a given AOC to determine the proper set of likely FWCUGs for FSs and eventual RODs. Table 5-12 presents a small lists of chemicals for which a final Record of Decision has been made at the RVAAP resulting in a precedent CUG that reflect other risk management considerations. These precedent GUS should be carried into the risk assessment process for new AOCs so that decision makers have the benefits of factors considers in previous RODs.

Table 5-1. Ravenna Facility-Wide CUGs for Adult Trespasser COPCs

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Surface Soil								
Inorganics								
Aluminum	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	17,700
Antimony	mg/kg	111	1114	3342	--	--	--	0.96
Arsenic	mg/kg	58.3	583	1750	3.03	30.3	303	15.4
Barium	mg/kg	156,890	1.0E+06	1.0E+06	--	--	--	88.4
Cadmium	mg/kg	144	1441	4324	69,950	699,502	1.0E+06	0
Chromium (as Cr-3)	mg/kg	110,050	1.0E+06	1.0E+06	--	--	--	17.4
Chromium, hexavalent	mg/kg	820	8196	24,588	10,493	104,925	1.0E+06	NA
Cobalt	mg/kg	40,241	402,413	1.0E+06	44,968	449,680	1.0E+06	10.4
Copper	mg/kg	85,523	855,230	1.0E+06	--	--	--	17.7
Iron	mg/kg	434,278	1.0E+06	1.0E+06	--	--	--	23,100
Manganese	mg/kg	22,029	220,293	660,879	--	--	--	1450
Mercury	mg/kg	250	2498	7495	--	--	--	0.036
Nickel	mg/kg	40,609	406,093	1.0E+06	--	--	--	21.1
Nitrate	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	NA
Silver	mg/kg	8111	81,111	243,333	--	--	--	0
Thallium	mg/kg	87.5	875	2626	--	--	--	0
Vanadium	mg/kg	1009	10,090	30,271	--	--	--	31.1
Zinc	mg/kg	517,905	1.0E+06	1.0E+06	--	--	--	61.8
Organics								
1,3,5-Trinitrobenzene	mg/kg	19,786	197,858	593,573	--	--	--	NA
1,3-Dinitrobenzene	mg/kg	109	1094	3283	--	--	--	NA
2,4,6-Trinitrotoluene	mg/kg	210	2095	6286	326	3259	32,593	NA
2,4-Dinitrotoluene	mg/kg	283	2828	8485	4.85	48.5	485	NA
2,6-Dinitrotoluene	mg/kg	146	1456	4367	4.99	49.9	499	NA
2-Amino-4,6-dinitrotoluene	mg/kg	310	3095	9285	--	--	--	NA
2-Methylnaphthalene	mg/kg	4377	43,769	131,306	--	--	--	NA
2-Nitrotoluene	mg/kg	10,942	109,422	328,266	111	1110	11,101	NA
4,4'-DDE	mg/kg	--	--	--	75.1	751	7509	NA
4-Amino-2,6-dinitrotoluene	mg/kg	310	3095	9285	--	--	--	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA
4-Nitrophenol	mg/kg	8754	87,537	262,612	--	--	--	NA
4-Nitrotoluene	mg/kg	10,942	109,422	328,266	1502	15,019	150,187	NA
Aldrin	mg/kg	32.8	328	985	1.5	15.0	150	NA
Benz(a)anthracene	mg/kg	--	--	--	1.13	11.3	113	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.113	1.13	11.3	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	1.13	11.3	113	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	11.3	113	1129	NA
Bis(2-chloroethoxy)methane	mg/kg	3283	32,827	98,480	--	--	--	NA
Carbazole	mg/kg	--	--	--	1277	12,766	127,659	NA
Chrysene	mg/kg	--	--	--	113	1129	11,290	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.113	1.13	11.3	NA
Dibenzofuran	mg/kg	2188	21,884	65,653	--	--	--	NA
Dieldrin	mg/kg	54.7	547	1641	1.6	16.0	160	NA
Endrin	mg/kg	8.9	89.0	267	--	--	--	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA
Fluoranthene	mg/kg	1413	14,129	42,386	--	--	--	NA
Fluorene	mg/kg	4472	44,717	134,150	--	--	--	NA
HMX	mg/kg	17,113	171,132	513,396	--	--	--	NA
Heptachlor	mg/kg	547	5471	16,413	5.67	56.7	567	NA
Heptachlor epoxide	mg/kg	14.2	142	427	2.81	28.1	281	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	1.13	11.3	113	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	1.14	11.4	114	NA
Naphthalene	mg/kg	2236	22,355	67,066	--	--	--	NA
Nitroglycerin	mg/kg	--	--	--	1502	15,019	150,187	NA
PCB-1016	mg/kg	7.28	72.8	218	1.21	12.1	121	NA

Table 5-1. Ravenna Facility-Wide CUGs for Adult Trespasser COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
PCB-1248	mg/kg	--	--	--	1.21	12.1	121	NA
PCB-1254	mg/kg	2.08	20.8	62.4	1.21	12.1	121	NA
PCB-1260	mg/kg	--	--	--	1.21	12.1	121	NA
Pentachlorophenol	mg/kg	1767	17,671	53,014	11.5	115	1145	NA
Pyrene	mg/kg	1060	10,597	31,790	--	--	--	NA
RDX	mg/kg	2403	24,028	72,085	170	1699	16,990	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
beta-BHC	mg/kg	--	--	--	14.2	142	1418	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA
Surface Water								
Inorganics								
Aluminum	mg/L	159,190	1.6E+06	4.8E+06	--	--	--	3370
Antimony	mg/L	20.3	203	610	--	--	--	0
Arsenic	mg/L	80.0	800	2399	4.15	41.5	415	3.2
Barium	mg/L	25,920	259,203	777,609	--	--	--	47.5
Cadmium	mg/L	13.7	137	412	--	--	--	0
Chromium (as Cr-3)	mg/L	21,471	214,706	644,118	--	--	--	0
Chromium, hexavalent	mg/L	82.4	824	2473	--	--	--	NA
Copper	mg/L	9874	98,744	296,232	--	--	--	7.9
Iron	mg/L	58,068	580,682	1.7E+06	--	--	--	2560
Manganese	mg/L	4070	40,703	122,109	--	--	--	391
Mercury	mg/L	38.9	389	1166	--	--	--	0
Nickel	mg/L	6283	62,828	188,484	--	--	--	0
Nitrate	mg/L	489,288	4.9E+06	1.5E+07	--	--	--	NA
Silver	mg/L	1234	12,343	37,029	--	--	--	0
Thallium	mg/L	24.5	245	734	--	--	--	0
Vanadium	mg/L	192	1923	5769	--	--	--	0
Zinc	mg/L	76,155	761,550	2.3E+06	--	--	--	42
Organics								
1,1,2,2-Tetrachloroethane	mg/L	8233	82,334	247,003	3.63	36.3	363	NA
1,2-Dichloroethene	mg/L	1392	13,920	41,760	--	--	--	NA
1,4-Dichlorobenzene	mg/L	--	--	--	36.6	366	3660	NA
2,4,6-Trinitrotoluene	mg/L	170	1703	5110	265	2650	26,496	NA
2,4-Dimethylphenol	mg/L	2345	23,445	70,335	--	--	--	NA
2,4-Dinitrotoluene	mg/L	394	3936	11,809	6.75	67.5	675	NA
2,6-Dinitrotoluene	mg/L	228	2278	6835	7.82	78.2	782	NA
2-Amino-4,6-dinitrotoluene	mg/L	68.1	681	2044	--	--	--	NA
2-Nitrotoluene	mg/L	3407	34,067	102,200	34.6	346	3456	NA
4,4'-DDT	mg/L	1.24	12.4	37.3	0.17	1.7	17.0	NA
4-Amino-2,6-dinitrotoluene	mg/L	68.1	681	2044	--	--	--	NA
4-Methylphenol	mg/L	755	7553	22,658	--	--	--	NA
4-Nitrotoluene	mg/L	3407	34,067	102,200	468	4676	46,758	NA
Aldrin	mg/L	4.92	49.2	148	0.225	2.25	22.5	NA
Benz(a)anthracene	mg/L	--	--	--	0.023	0.226	2.26	NA
Benzo(a)pyrene	mg/L	--	--	--	0.001	0.013	0.132	NA
Benzo(b)fluoranthene	mg/L	--	--	--	0.013	0.13	1.3	NA
Benzo(k)fluoranthene	mg/L	--	--	--	109	1089	10,889	NA
Bis(2-ethylhexyl)phthalate	mg/L	70.5	705	2114	5.87	58.7	587	NA
Chloroform	mg/L	500	5000	14,999	11.2	112	1116	NA
Chrysene	mg/L	--	--	--	2.26	22.6	226	NA
Dibenz(a,h)anthracene	mg/L	--	--	--	8.5E-04	0.009	0.085	NA
HMX	mg/L	17,033	170,333	511,000	--	--	--	NA
Heptachlor epoxide	mg/L	4.43	44.3	133	0.874	8.74	87.4	NA
Indeno(1,2,3-cd)pyrene	mg/L	--	--	--	0.013	0.13	1.3	NA
Methylene chloride	mg/L	9687	96,867	290,601	315	3154	31,543	NA

Table 5-1. Ravenna Facility-Wide CUGs for Adult Trespasser COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
PCB-1254	mg/L	6.81	68.1	204.4	19.9	199	1987	NA
Pentachlorophenol	mg/L	71.1	711	2133	0.461	4.61	46.1	NA
Pyrene	mg/L	10,220	102,200	306,600	--	--	--	NA
RDX	mg/L	1022	10,220	30,660	72.3	723	7226	NA
Tetrachloroethene	mg/L	401	4007	12,022	1.77	17.7	177	NA
Trichloroethene	mg/L	6.67	66.7	200	0.848	8.48	84.8	NA
beta-BHC	mg/L	--	--	--	4.42	44.2	442	NA
cis-1,2-Dichloroethene	mg/L	3407	34,067	102,200	--	--	--	NA
Sediment								
Inorganics								
Aluminum	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	13,900
Antimony	mg/kg	111	1114	3342	--	--	--	0
Arsenic	mg/kg	58.3	583	1750	3.03	30.3	303	19.5
Barium	mg/kg	156,890	1.0E+06	1.0E+06	--	--	--	123
Cadmium	mg/kg	144	1441	4324	69,950	699,502	1.0E+06	0
Chromium (as Cr-3)	mg/kg	110,050	1.0E+06	1.0E+06	--	--	--	18.1
Chromium, hexavalent	mg/kg	820	8196	24,588	10,493	104,925	1.0E+06	NA
Copper	mg/kg	85,523	855,230	1.0E+06	--	--	--	27.6
Iron	mg/kg	434,278	1.0E+06	1.0E+06	--	--	--	28,200
Manganese	mg/kg	22,029	220,293	660,879	--	--	--	1950
Mercury	mg/kg	250	2498	7495	--	--	--	0.059
Nickel	mg/kg	40,609	406,093	1.0E+06	--	--	--	17.7
Silver	mg/kg	8111	81,111	243,333	--	--	--	0
Thallium	mg/kg	87.5	875	2626	--	--	--	0.89
Vanadium	mg/kg	1009	10,090	30,271	--	--	--	26.1
Zinc	mg/kg	517,905	1.0E+06	1.0E+06	--	--	--	532
Organics								
2,4,6-Trinitrotoluene	mg/kg	210	2095	6286	326	3259	32,593	NA
2,4-Dinitrotoluene	mg/kg	283	2828	8485	4.85	48.5	485	NA
2-Amino-4,6-dinitrotoluene	mg/kg	310	3095	9285	--	--	--	NA
4-Amino-2,6-dinitrotoluene	mg/kg	310	3095	9285	--	--	--	NA
Benz(a)anthracene	mg/kg	--	--	--	1.13	11.3	113	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.113	1.13	11.3	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	1.13	11.3	113	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	11.3	113	1129	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.113	1.13	11.3	NA
Dieldrin	mg/kg	54.7	547	1641	1.6	16.0	160	NA
HMX	mg/kg	17,113	171,132	513,396	--	--	--	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	1.13	11.3	113	NA
Nitroglycerin	mg/kg	--	--	--	1502	15,019	150,187	NA
PCB-1016	mg/kg	7.28	72.8	218	1.21	12.1	121	NA
PCB-1254	mg/kg	2.08	20.8	62.4	1.21	12.1	121	NA
PCB-1260	mg/kg	--	--	--	1.21	12.1	121	NA
RDX	mg/kg	2403	24,028	72,085	170	1699	16,990	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA

COPC = Chemical of potential concern.
CUG = Cleanup goal across all pathways (ingestion, dermal, and inhalation).
HI = Hazard index.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
NA = Not available.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
-- = No CUG could be quantified based on lack of approved toxicity value.

Table 5-2. Ravenna Facility-Wide CUGs for Engineering School Instructor COPCs

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Surface Soil								
Inorganics								
Aluminum	mg/kg	6210	62,103	186,308	--	--	--	17,700
Antimony	mg/kg	63.7	637	1912	--	--	--	0.96
Arsenic	mg/kg	38.0	380	1140	1.84	18.4	184	15.4
Barium	mg/kg	627	6272	18,817	--	--	--	88.4
Cadmium	mg/kg	102	1024	3073	19.7	197	1973	0
Chromium (as Cr-3)	mg/kg	89,618	896,177	1.0E+06	--	--	--	17.4
Chromium, hexavalent	mg/kg	10.0	100	299	2.96	29.6	296	NA
Cobalt	mg/kg	25.3	253	758	12.7	127	1268	10.4
Copper	mg/kg	13,240	132,401	397,202	--	--	--	17.7
Iron	mg/kg	92,205	922,050	1.0E+06	--	--	--	23,100
Manganese	mg/kg	63.1	631	1892	--	--	--	1450
Mercury	mg/kg	79.3	793	2378	--	--	--	0.036
Nickel	mg/kg	6564	65,639	196,917	--	--	--	21.1
Nitrate	mg/kg	559,755	1.0E+06	1.0E+06	--	--	--	NA
Silver	mg/kg	1574	15,742	47,227	--	--	--	0
Thallium	mg/kg	22.9	229	688	--	--	--	0
Vanadium	mg/kg	717	7170	21,509	--	--	--	31.1
Zinc	mg/kg	95,621	956,213	1.0E+06	--	--	--	61.8
Organics								
1,3,5-Trinitrobenzene	mg/kg	7292	72,925	218,775	--	--	--	NA
1,3-Dinitrobenzene	mg/kg	28.7	287	861	--	--	--	NA
2,4,6-Trinitrotoluene	mg/kg	100	996	2988	186	1859	18,590	NA
2,4-Dinitrotoluene	mg/kg	202	2020	6059	4.16	41.6	416	NA
2,6-Dinitrotoluene	mg/kg	103	1032	3095	4.25	42.5	425	NA
2-Amino-4,6-dinitrotoluene	mg/kg	62.4	624	1871	--	--	--	NA
2-Methylnaphthalene	mg/kg	1147	11,474	34,422	--	--	--	NA
2-Nitrotoluene	mg/kg	2869	28,685	86,056	34.9	349	3492	NA
4,4'-DDE	mg/kg	--	--	--	23.6	236	2362	NA
4-Amino-2,6-dinitrotoluene	mg/kg	62.4	624	1871	--	--	--	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA
4-Nitrophenol	mg/kg	2295	22,948	68,845	--	--	--	NA
4-Nitrotoluene	mg/kg	2869	28,685	86,056	472	4725	47,246	NA
Aldrin	mg/kg	8.61	86.1	258	0.443	4.43	44.3	NA
Benz(a)anthracene	mg/kg	--	--	--	1.19	11.9	119	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.119	1.19	11.9	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	1.19	11.9	119	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	11.9	119	1194	NA
Bis(2-chloroethoxy)methane	mg/kg	861	8606	25,817	--	--	--	NA
Carbazole	mg/kg	--	--	--	402	4016	40,159	NA
Chrysene	mg/kg	--	--	--	119	1194	11,937	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.119	1.19	11.9	NA
Dibenzofuran	mg/kg	574	5737	17,211	--	--	--	NA
Dieldrin	mg/kg	14.3	143	430	0.471	4.71	47.1	NA
Endrin	mg/kg	7.97	79.7	239	--	--	--	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA
Fluoranthene	mg/kg	1249	12,486	37,457	--	--	--	NA
Fluorene	mg/kg	3374	33,739	101,218	--	--	--	NA
HMX	mg/kg	8963	89,630	268,891	--	--	--	NA
Heptachlor	mg/kg	143	1434	4303	1.68	16.8	168	NA
Heptachlor epoxide	mg/kg	3.73	37.3	112	0.829	8.29	82.9	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	1.19	11.9	119	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	0.717	7.17	71.7	NA
Naphthalene	mg/kg	1169	11,687	35,061	--	--	--	NA

Table 5-2. Ravenna Facility-Wide CUGs for Engineering School Instructor COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Nitroglycerin	mg/kg	--	--	--	472	4725	47,246	NA
PCB-1016	mg/kg	5.58	55.8	167	1.1	11.0	110	NA
PCB-1248	mg/kg	--	--	--	1.1	11.0	110	NA
PCB-1254	mg/kg	1.59	15.9	47.8	1.1	11.0	110	NA
PCB-1260	mg/kg	--	--	--	1.1	11.0	110	NA
Pentachlorophenol	mg/kg	1483	14,833	44,499	11.5	115	1154	NA
Pyrene	mg/kg	936	9364	28,093	--	--	--	NA
RDX	mg/kg	782	7823	23,469	66.4	664	6638	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
beta-BHC	mg/kg	--	--	--	4.18	41.8	418	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA

COPC = Chemical of potential concern.
CUG = Cleanup goal across all pathways (ingestion, dermal, and inhalation).
HI = Hazard index.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
NA = Not available.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
-- = No CUG could be quantified based on lack of approved toxicity value.

Table 5-3. Ravenna Facility-Wide CUGs for Fisher Recreator COPCs

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Surface Soil								
Inorganics								
Aluminum	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	17,700
Antimony	mg/kg	2001	20,007	60,020	--	--	--	0.96
Arsenic	mg/kg	1081	10,812	32,436	56.0	560	5605	15.4
Barium	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	88.4
Cadmium	mg/kg	2723	27,229	81,687	524,627	1.0E+06	1.0E+06	0
Chromium (as Cr-3)	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	17.4
Chromium, hexavalent	mg/kg	14,341	143,415	430,245	78,694	786,940	1.0E+06	NA
Cobalt	mg/kg	329,546	1.0E+06	1.0E+06	337,260	1.0E+06	1.0E+06	10.4
Copper	mg/kg	913,860	1.0E+06	1.0E+06	--	--	--	17.7
Iron	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	23,100
Manganese	mg/kg	330,971	1.0E+06	1.0E+06	--	--	--	1450
Mercury	mg/kg	3730	37,304	111,911	--	--	--	0.036
Nickel	mg/kg	444,348	1.0E+06	1.0E+06	--	--	--	21.1
Nitrate	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	NA
Silver	mg/kg	97,643	976,433	1.0E+06	--	--	--	0
Thallium	mg/kg	1211	12,107	36,320	--	--	--	0
Vanadium	mg/kg	19,060	190,604	571,812	--	--	--	31.1
Zinc	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	61.8
Organics								
1,3,5-Trinitrobenzene	mg/kg	311,860	1.0E+06	1.0E+06	--	--	--	NA
1,3-Dinitrobenzene	mg/kg	1513	15,133	45,400	--	--	--	NA
2,4,6-Trinitrotoluene	mg/kg	3579	35,791	107,373	5567	55,675	556,749	NA
2,4-Dinitrotoluene	mg/kg	5348	53,484	160,451	91.8	918	9176	NA
2,6-Dinitrotoluene	mg/kg	2748	27,480	82,439	94.3	943	9429	NA
2-Amino-4,6-dinitrotoluene	mg/kg	3795	37,955	113,865	--	--	--	NA
2-Methylnaphthalene	mg/kg	60,533	605,331	1.0E+06	--	--	--	NA
2-Nitrotoluene	mg/kg	151,333	1.0E+06	1.0E+06	1535	15,353	153,526	NA
4,4'-DDE	mg/kg	--	--	--	1039	10,386	103,856	NA
4-Amino-2,6-dinitrotoluene	mg/kg	3795	37,955	113,865	--	--	--	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA
4-Nitrophenol	mg/kg	121,066	1.0E+06	1.0E+06	--	--	--	NA
4-Nitrotoluene	mg/kg	151,333	1.0E+06	1.0E+06	20,771	207,712	1.0E+06	NA
Aldrin	mg/kg	454	4540	13,620	20.8	208	2077	NA
Benz(a)anthracene	mg/kg	--	--	--	22.3	223	2226	NA
Benzo(a)pyrene	mg/kg	--	--	--	2.23	22.3	223	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	22.3	223	2226	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	223	2226	22,260	NA
Bis(2-chloroethoxy)methane	mg/kg	45,400	453,998	1.0E+06	--	--	--	NA
Carbazole	mg/kg	--	--	--	17,655	176,555	1.0E+06	NA
Chrysene	mg/kg	--	--	--	2226	22,260	222,596	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	2.23	22.3	223	NA
Dibenzofuran	mg/kg	30,267	302,665	907,996	--	--	--	NA
Dieldrin	mg/kg	757	7567	22,700	22.1	221	2207	NA
Endrin	mg/kg	176	1759	5276	--	--	--	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA
Fluoranthene	mg/kg	27,856	278,564	835,692	--	--	--	NA
Fluorene	mg/kg	85,535	855,349	1.0E+06	--	--	--	NA
HMX	mg/kg	300,353	1.0E+06	1.0E+06	--	--	--	NA
Heptachlor	mg/kg	7567	75,666	226,999	78.5	785	7846	NA
Heptachlor epoxide	mg/kg	197	1967	5902	38.8	388	3880	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	22.3	223	2226	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	20.0	200	2002	NA
Naphthalene	mg/kg	42,752	427,524	1.0E+06	--	--	--	NA

Table 5-3. Ravenna Facility-Wide CUGs for Fisher Recreator COPCs (continued)

		Non-carcinogenic CUG			Carcinogenic CUG			
COPC	**Units**	**HI = 0.1**	**HI = 1**	**HI = 3**	**Risk = 10^{-6}**	**Risk = 10^{-5}**	**Risk = 10^{-4}**	**Background**
Nitroglycerin	mg/kg	--	--	--	20,771	207,712	1.0E+06	NA
PCB-1016	mg/kg	140	1397	4191	23.3	233	2328	NA
PCB-1248	mg/kg	--	--	--	23.3	233	2328	NA
PCB-1254	mg/kg	39.9	399	1197	23.3	233	2328	NA
PCB-1260	mg/kg	--	--	--	23.3	233	2328	NA
Pentachlorophenol	mg/kg	34,514	345,141	1.0E+06	224	2237	22,370	NA
Pyrene	mg/kg	20,892	208,923	626,769	--	--	--	NA
RDX	mg/kg	36,227	362,269	1.0E+06	2561	25,615	256,150	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
beta-BHC	mg/kg	--	--	--	196	1962	19,615	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA
Surface Water								
Inorganics								
Aluminum	µg/L	1.7E+06	1.7E+07	5.0E+07	--	--	--	3370
Antimony	µg/L	179	1793	5379	--	--	--	0
Arsenic	µg/L	1017	10,170	30,511	52.7	527	5274	3.2
Barium	µg/L	257,338	2.6E+06	7.7E+06	--	--	--	47.5
Cadmium	µg/L	117	1172	3516	--	--	--	0
Chromium (as Cr-3)	µg/L	179,930	1.8E+06	5.4E+06	--	--	--	0
Chromium, hexavalent	µg/L	703	7032	21,096	--	--	--	NA
Copper	µg/L	120,709	1.2E+06	3.6E+06	--	--	--	7.9
Iron	µg/L	642,318	6.4E+06	1.9E+07	--	--	--	2560
Manganese	µg/L	37,913	379,129	1.1E+06	--	--	--	391
Mercury	µg/L	386	3860	11,580	--	--	--	0
Nickel	µg/L	88,556	885,558	2.7E+06	--	--	--	0
Nitrate	µg/L	6.8E+06	6.8E+07	2.0E+08	--	--	--	NA
Silver	µg/L	15,089	150,886	452,657	--	--	--	0
Thallium	µg/L	338	3384	10,152	--	--	--	0
Vanadium	µg/L	1641	16,408	49,225	--	--	--	0
Zinc	µg/L	943,966	9.4E+06	2.8E+07	--	--	--	42
Organics								
1,1,2,2-Tetrachloroethane	µg/L	98,821	988,214	3.0E+06	29.8	298	2978	NA
1,2-Dichloroethene	µg/L	15,870	158,701	476,104	--	--	--	NA
1,4-Dichlorobenzene	µg/L	--	--	--	415	4145	41,455	NA
2,4,6-Trinitrotoluene	µg/L	2555	25,550	76,650	3974	39,744	397,444	NA
2,4-Dimethylphenol	µg/L	26,321	263,207	789,620	--	--	--	NA
2,4-Dinitrotoluene	µg/L	5095	50,950	152,850	87.4	874	8741	NA
2,6-Dinitrotoluene	µg/L	3039	30,391	91,174	104	1043	10,428	NA
2-Amino-4,6-dinitrotoluene	µg/L	1022	10,220	30,660	--	--	--	NA
2-Nitrotoluene	µg/L	51,100	511,000	1.5E+06	518	5184	51,841	NA
4,4'-DDT	µg/L	14.5	145	434	1.99	19.9	199	NA
4-Amino-2,6-dinitrotoluene	µg/L	1022	10,220	30,660	--	--	--	NA
4-Methylphenol	µg/L	8673	86,729	260,188	--	--	--	NA
4-Nitrotoluene	µg/L	51,100	511,000	1.5E+06	7014	70,137	701,373	NA
Aldrin	µg/L	64.2	642	1926	2.94	29.4	294	NA
Benz(a)anthracene	µg/L	--	--	--	0.263	2.63	26.3	NA
Benzo(a)pyrene	µg/L	--	--	--	0.015	0.153	1.53	NA
Benzo(b)fluoranthene	µg/L	--	--	--	0.151	1.51	15.1	NA
Benzo(k)fluoranthene	µg/L	--	--	--	1633	16,333	163,333	NA
Bis(2-ethylhexyl)phthalate	µg/L	821	8214	24,641	68.4	684	6845	NA
Chloroform	µg/L	5193	51,931	155,793	85.1	851	8506	NA
Chrysene	µg/L	--	--	--	26.3	263	2626	NA
Dibenz(a,h)anthracene	µg/L	--	--	--	0.01	0.099	0.993	NA
HMX	µg/L	255,500	2.6E+06	7.7E+06	--	--	--	NA
Heptachlor epoxide	µg/L	66.4	664	1993	13.1	131	1310	NA
Indeno(1,2,3-cd)pyrene	µg/L	--	--	--	0.151	1.51	15.1	NA
Methylene chloride	µg/L	101,815	1.0E+06	3.1E+06	2885	28,847	288,466	NA

Table 5-3. Ravenna Facility-Wide CUGs for Fisher Recreator COPCs (continued)

		Non-carcinogenic CUG			Carcinogenic CUG			
COPC	**Units**	**HI = 0.1**	**HI = 1**	**HI = 3**	**Risk = 10^{-6}**	**Risk = 10^{-5}**	**Risk = 10^{-4}**	**Background**
PCB-1254	µg/L	102.2	1022	3066	298	2981	29,808	NA
Pentachlorophenol	µg/L	828	8281	24,844	5.37	53.7	537	NA
Pyrene	µg/L	153,300	1.5E+06	4.6E+06	--	--	--	NA
RDX	µg/L	15,330	153,300	459,900	1084	10,839	108,394	NA
Tetrachloroethene	µg/L	4473	44,726	134,179	19.9	199	1991	NA
Trichloroethene	µg/L	70.1	701	2103	7.82	78.2	782	NA
beta-BHC	µg/L	--	--	--	66.2	662	6624	NA
cis-1,2-Dichloroethene	µg/L	51,100	511,000	1.5E+06	--	--	--	NA
Ingestion of Fish/Waterfowl from Surface Water								
Inorganics								
Aluminum	µg/L	909	9091	27,273	--	--	--	3370
Antimony	µg/L	1.82	18.2	54.5	--	--	--	0
Arsenic	µg/L	0.455	4.55	13.6	0.024	0.236	2.36	3.2
Barium	µg/L	22,727	227,273	681,818	--	--	--	47.5
Cadmium	µg/L	1.14	11.4	34.1	--	--	--	0
Chromium (as Cr-3)	µg/L	3409	34,091	102,273	--	--	--	0
Chromium, hexavalent	µg/L	6.82	68.2	205	--	--	--	NA
Copper	µg/L	90.9	909	2727	--	--	--	7.9
Iron	µg/L	682	6818	20,455	--	--	--	2560
Manganese	µg/L	52.3	523	1568	--	--	--	391
Mercury	µg/L	0.136	1.36	4.09	--	--	--	0
Nickel	µg/L	90.9	909	2727	--	--	--	0
Nitrate	µg/L	4.85	48.5	145	--	--	--	NA
Silver	µg/L	455	4545	13,636	--	--	--	0
Thallium	µg/L	0.004	0.036	0.109	--	--	--	0
Vanadium	µg/L	--	--	--	--	--	--	0
Zinc	µg/L	136	1364	4091	--	--	--	42
Organics								
1,1,2,2-Tetrachloroethane	µg/L	1948	19,481	58,442	3.79	37.9	379	NA
1,2-Dichloroethene	µg/L	505	5051	15,152	--	--	--	NA
1,4-Dichlorobenzene	µg/L	--	--	--	4.97	49.7	497	NA
2,4,6-Trinitrotoluene	µg/L	66.8	668	2005	104	1040	10,398	NA
2,4-Dimethylphenol	µg/L	758	7576	22,727	--	--	--	NA
2,4-Dinitrotoluene	µg/L	136	1357	4071	2.33	23.3	233	NA
2,6-Dinitrotoluene	µg/L	54.8	548	1643	1.88	18.8	188	NA
2-Amino-4,6-Dinitrotoluene	µg/L	17.5	175	524	--	--	--	NA
2-Amino-4,6-dinitrotoluene	µg/L	17.5	175	524	--	--	--	NA
2-Nitrotoluene	µg/L	379	3788	11,364	3.84	38.4	384	NA
4,4'-DDT	µg/L	0.005	0.054	0.162	7.4E-04	0.007	0.074	NA
4-Amino-2,6-Dinitrotoluene	µg/L	17.5	175	524	--	--	--	NA
4-Amino-2,6-dinitrotoluene	µg/L	17.5	175	524	--	--	--	NA
4-Methylphenol	µg/L	367	3666	10,997	--	--	--	NA
4-Nitrotoluene	µg/L	350	3497	10,490	48.0	480	4799	NA
Aldrin	µg/L	6.8E-04	0.007	0.02	3.1E-05	3.1E-04	0.003	NA
Benz(a)anthracene	µg/L	--	--	--	0.003	0.027	0.269	NA
Benzo(a)pyrene	µg/L	--	--	--	1.3E-04	0.001	0.013	NA
Benzo(b)fluoranthene	µg/L	--	--	--	0.003	0.026	0.259	NA
Benzo(k)fluoranthene	µg/L	--	--	--	0.015	0.145	1.45	NA
Bis(2-ethylhexyl)phthalate	µg/L	29.3	293	880	2.44	24.4	244	NA
Chloroform	µg/L	689	6887	20,661	263	2634	26,344	NA
Chrysene	µg/L	--	--	--	0.246	2.46	24.6	NA
Dibenz(a,h)anthracene	µg/L	--	--	--	6.6E-05	6.6E-04	0.007	NA
HMX	µg/L	7102	71,023	213,068	--	--	--	NA
Heptachlor epoxide	µg/L	0.004	0.042	0.127	8.3E-04	0.008	0.083	NA
Indeno(1,2,3-cd)pyrene	µg/L	--	--	--	5.0E-04	0.005	0.05	NA
Methylene chloride	µg/L	15,152	151,515	454,545	786	7856	78,563	NA
PCB-1254	µg/L	6.5E-05	6.5E-04	0.002	1.9E-04	0.002	0.019	NA

Table 5-3. Ravenna Facility-Wide CUGs for Fisher Recreator COPCs (continued)

		Non-carcinogenic CUG			Carcinogenic CUG			
COPC	**Units**	**HI = 0.1**	**HI = 1**	**HI = 3**	**Risk = 10^{-6}**	**Risk = 10^{-5}**	**Risk = 10^{-4}**	**Background**
Pentachlorophenol	µg/L	19.5	195	584	0.126	1.26	12.6	NA
Pyrene	µg/L	12.4	124	372	--	--	--	NA
RDX	µg/L	426	4261	12,784	30.1	301	3013	NA
Tetrachloroethene	µg/L	54.8	548	1643	0.237	2.37	23.7	NA
Trichloroethene	µg/L	9.09	90.9	273	1.77	17.7	177	NA
beta-BHC	µg/L	--	--	--	0.019	0.19	1.9	NA
cis-1,2-Dichloroethene	µg/L	561	5612	16,835	--	--	--	NA
Sediment								
Inorganics								
Aluminum	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	13,900
Antimony	mg/kg	2159	21,592	64,775	--	--	--	0
Arsenic	mg/kg	1172	11,719	35,157	60.7	607	6075	19.5
Barium	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	123
Cadmium	mg/kg	2959	29,595	88,784	524,627	1.0E+06	1.0E+06	0
Chromium (as Cr-3)	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	18.1
Chromium, hexavalent	mg/kg	15,424	154,237	462,710	78,694	786,940	1.0E+06	NA
Copper	mg/kg	934,756	1.0E+06	1.0E+06	--	--	--	27.6
Iron	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	28,200
Manganese	mg/kg	349,421	1.0E+06	1.0E+06	--	--	--	1950
Mercury	mg/kg	3936	39,356	118,067	--	--	--	0.059
Nickel	mg/kg	455,347	1.0E+06	1.0E+06	--	--	--	17.7
Silver	mg/kg	100,855	1.0E+06	1.0E+06	--	--	--	0
Thallium	mg/kg	1267	12,669	38,008	--	--	--	0.89
Vanadium	mg/kg	20,716	207,162	621,486	--	--	--	26.1
Zinc	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	532
Organics								
2,4,6-Trinitrotoluene	mg/kg	3837	38,371	115,113	5969	59,688	596,883	NA
2,4-Dinitrotoluene	mg/kg	5814	58,139	174,416	100	997	9975	NA
2-Amino-4,6-dinitrotoluene	mg/kg	3927	39,267	117,802	--	--	--	NA
4-Amino-2,6-dinitrotoluene	mg/kg	3927	39,267	117,802	--	--	--	NA
Benz(a)anthracene	mg/kg	--	--	--	24.3	243	2435	NA
Benzo(a)pyrene	mg/kg	--	--	--	2.43	24.3	243	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	24.3	243	2435	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	243	2435	24,347	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	2.43	24.3	243	NA
Dieldrin	mg/kg	792	7918	23,755	23.1	231	2309	NA
HMX	mg/kg	323,145	1.0E+06	1.0E+06	--	--	--	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	24.3	243	2435	NA
Nitroglycerin	mg/kg	--	--	--	21,737	217,368	1.0E+06	NA
PCB-1016	mg/kg	152	1522	4565	25.4	254	2536	NA
PCB-1254	mg/kg	43.5	435	1304	25.4	254	2536	NA
PCB-1260	mg/kg	--	--	--	25.4	254	2536	NA
RDX	mg/kg	38,261	382,612	1.0E+06	2705	27,053	270,534	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA

COPC = Chemical of potential concern.
CUG = Cleanup goal across all pathways (ingestion, dermal, and inhalation).
HI = Hazard index.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
NA = Not available.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
-- = No CUG could be quantified based on lack of approved toxicity value.

Table 5-4. Ravenna Facility-Wide CUGs for Hunter/Trapper COPCs

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Surface Soil								
Inorganics								
Aluminum	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	17,700
Antimony	mg/kg	4624	46,244	138,733	--	--	--	0.96
Arsenic	mg/kg	2553	25,529	76,588	132	1323	13,233	15.4
Barium	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	88.4
Cadmium	mg/kg	6518	65,179	195,536	874,378	1.0E+06	1.0E+06	0
Chromium (as Cr-3)	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	17.4
Chromium, hexavalent	mg/kg	32,592	325,923	977,770	131,157	1.0E+06	1.0E+06	NA
Cobalt	mg/kg	559,527	1.0E+06	1.0E+06	562,100	1.0E+06	1.0E+06	10.4
Copper	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	17.7
Iron	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	23,100
Manganese	mg/kg	690,080	1.0E+06	1.0E+06	--	--	--	1450
Mercury	mg/kg	7754	77,536	232,608	--	--	--	0.036
Nickel	mg/kg	815,426	1.0E+06	1.0E+06	--	--	--	21.1
Nitrate	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	NA
Silver	mg/kg	185,145	1.0E+06	1.0E+06	--	--	--	0
Thallium	mg/kg	2428	24,276	72,827	--	--	--	0
Vanadium	mg/kg	45,625	456,250	1.0E+06	--	--	--	31.1
Zinc	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	61.8
Organics								
1,3,5-Trinitrobenzene	mg/kg	666,638	1.0E+06	1.0E+06	--	--	--	NA
1,3-Dinitrobenzene	mg/kg	3034	30,344	91,033	--	--	--	NA
2,4,6-Trinitrotoluene	mg/kg	8012	80,124	240,373	12,464	124,638	1.0E+06	NA
2,4-Dinitrotoluene	mg/kg	12,812	128,122	384,365	220	2198	21,982	NA
2,6-Dinitrotoluene	mg/kg	6575	65,752	197,257	226	2256	22,562	NA
2-Amino-4,6-dinitrotoluene	mg/kg	7246	72,462	217,385	--	--	--	NA
2-Methylnaphthalene	mg/kg	121,378	1.0E+06	1.0E+06	--	--	--	NA
2-Nitrotoluene	mg/kg	303,444	1.0E+06	1.0E+06	3078	30,784	307,842	NA
4,4'-DDE	mg/kg	--	--	--	2082	20,825	208,246	NA
4-Amino-2,6-dinitrotoluene	mg/kg	7246	72,462	217,385	--	--	--	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA
4-Nitrophenol	mg/kg	242,755	1.0E+06	1.0E+06	--	--	--	NA
4-Nitrotoluene	mg/kg	303,444	1.0E+06	1.0E+06	41,649	416,492	1.0E+06	NA
Aldrin	mg/kg	910	9103	27,310	41.6	416	4164	NA
Benz(a)anthracene	mg/kg	--	--	--	55.0	550	5502	NA
Benzo(a)pyrene	mg/kg	--	--	--	5.5	55.0	550	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	55.0	550	5502	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	550	5502	55,024	NA
Bis(2-chloroethoxy)methane	mg/kg	91,033	910,333	1.0E+06	--	--	--	NA
Carbazole	mg/kg	--	--	--	35,402	354,018	1.0E+06	NA
Chrysene	mg/kg	--	--	--	5502	55,024	550,241	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	5.5	55.0	550	NA
Dibenzofuran	mg/kg	60,689	606,888	1.0E+06	--	--	--	NA
Dieldrin	mg/kg	1517	15,172	45,517	44.2	442	4425	NA
Endrin	mg/kg	436	4355	13,065	--	--	--	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA
Fluoranthene	mg/kg	68,859	688,589	1.0E+06	--	--	--	NA
Fluorene	mg/kg	206,632	1.0E+06	1.0E+06	--	--	--	NA
HMX	mg/kg	683,887	1.0E+06	1.0E+06	--	--	--	NA
Heptachlor	mg/kg	15,172	151,722	455,166	157	1573	15,732	NA
Heptachlor epoxide	mg/kg	394	3945	11,834	77.8	778	7780	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	55.0	550	5502	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	45.6	456	4559	NA
Naphthalene	mg/kg	103,263	1.0E+06	1.0E+06	--	--	--	NA

Table 5-4. Ravenna Facility-Wide CUGs for Hunter/Trapper COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Nitroglycerin	mg/kg	--	--	--	41,649	416,492	1.0E+06	NA
PCB-1016	mg/kg	338	3382	10,147	56.4	564	5637	NA
PCB-1248	mg/kg	--	--	--	56.4	564	5637	NA
PCB-1254	mg/kg	96.6	966	2899	56.4	564	5637	NA
PCB-1260	mg/kg	--	--	--	56.4	564	5637	NA
Pentachlorophenol	mg/kg	84,696	846,961	1.0E+06	549	5490	54,896	NA
Pyrene	mg/kg	51,644	516,442	1.0E+06	--	--	--	NA
RDX	mg/kg	75,666	756,663	1.0E+06	5350	53,501	535,015	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
beta-BHC	mg/kg	--	--	--	393	3933	39,330	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA
Surface Water								
Inorganics								
Aluminum	µg/L	3.1E+06	3.1E+07	9.3E+07	--	--	--	3370
Antimony	µg/L	308	3078	9235	--	--	--	0
Arsenic	µg/L	2176	21,764	65,291	113	1128	11,285	3.2
Barium	µg/L	468,194	4.7E+06	1.4E+07	--	--	--	47.5
Cadmium	µg/L	198	1984	5951	--	--	--	0
Chromium (as Cr-3)	µg/L	302,248	3.0E+06	9.1E+06	--	--	--	0
Chromium, hexavalent	µg/L	1190	11,902	35,707	--	--	--	NA
Copper	µg/L	250,490	2.5E+06	7.5E+06	--	--	--	7.9
Iron	µg/L	1.2E+06	1.2E+07	3.7E+07	--	--	--	2560
Manganese	µg/L	66,778	667,784	2.0E+06	--	--	--	391
Mercury	µg/L	702	7023	21,069	--	--	--	0
Nickel	µg/L	207,536	2.1E+06	6.2E+06	--	--	--	0
Nitrate	µg/L	1.6E+07	1.6E+08	4.7E+08	--	--	--	NA
Silver	µg/L	31,311	313,113	939,338	--	--	--	0
Thallium	µg/L	779	7790	23,369	--	--	--	0
Vanadium	µg/L	2777	27,772	83,315	--	--	--	0
Zinc	µg/L	2.0E+06	2.0E+07	5.9E+07	--	--	--	42
Organics								
1,1,2,2-Tetrachloroethane	µg/L	200,646	2.0E+06	6.0E+06	51.1	511	5105	NA
1,2-Dichloroethene	µg/L	31,085	310,853	932,558	--	--	--	NA
1,4-Dichlorobenzene	µg/L	--	--	--	795	7949	79,492	NA
2,4,6-Trinitrotoluene	µg/L	6388	63,875	191,625	9936	99,361	993,611	NA
2,4-Dimethylphenol	µg/L	50,827	508,268	1.5E+06	--	--	--	NA
2,4-Dinitrotoluene	µg/L	10,974	109,737	329,212	188	1883	18,827	NA
2,6-Dinitrotoluene	µg/L	6724	67,244	201,731	231	2307	23,074	NA
2-Amino-4,6-dinitrotoluene	µg/L	2555	25,550	76,650	--	--	--	NA
2-Nitrotoluene	µg/L	127,750	1.3E+06	3.8E+06	1296	12,960	129,601	NA
4,4'-DDT	µg/L	29.6	296	887	4.06	40.6	406	NA
4-Amino-2,6-dinitrotoluene	µg/L	2555	25,550	76,650	--	--	--	NA
4-Methylphenol	µg/L	17,048	170,481	511,444	--	--	--	NA
4-Nitrotoluene	µg/L	127,750	1.3E+06	3.8E+06	17,534	175,343	1.8E+06	NA
Aldrin	µg/L	142	1420	4259	6.5	65.0	650	NA
Benz(a)anthracene	µg/L	--	--	--	0.536	5.36	53.6	NA
Benzo(a)pyrene	µg/L	--	--	--	0.031	0.313	3.13	NA
Benzo(b)fluoranthene	µg/L	--	--	--	0.308	3.08	30.8	NA
Benzo(k)fluoranthene	µg/L	--	--	--	4083	40,833	408,333	NA
Bis(2-ethylhexyl)phthalate	µg/L	1679	16,791	50,372	140	1399	13,992	NA
Chloroform	µg/L	9551	95,507	286,521	142	1423	14,234	NA
Chrysene	µg/L	--	--	--	53.6	536	5362	NA
Dibenz(a,h)anthracene	µg/L	--	--	--	0.02	0.203	2.03	NA
HMX	µg/L	638,750	6.4E+06	1.9E+07	--	--	--	NA
Heptachlor epoxide	µg/L	166	1661	4982	32.8	328	3276	NA
Indeno(1,2,3-cd)pyrene	µg/L	--	--	--	0.308	3.08	30.8	NA
Methylene chloride	µg/L	193,621	1.9E+06	5.8E+06	5156	51,559	515,594	NA

Table 5-4. Ravenna Facility-Wide CUGs for Hunter/Trapper COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
PCB-1254	µg/L	255.5	2555	7665	745	7452	74,521	NA
Pentachlorophenol	µg/L	1692	16,921	50,762	11.0	110	1097	NA
Pyrene	µg/L	383,250	3.8E+06	1.1E+07	--	--	--	NA
RDX	µg/L	38,325	383,250	1.1E+06	2710	27,098	270,985	NA
Tetrachloroethene	µg/L	8648	86,479	259,437	38.7	387	3869	NA
Trichloroethene	µg/L	129	1292	3877	13.8	138	1380	NA
beta-BHC	µg/L	--	--	--	166	1656	16,560	NA
cis-1,2-Dichloroethene	µg/L	127,750	1.3E+06	3.8E+06	--	--	--	NA
Ingestion of Fish/Waterfowl from Surface Water								
Inorganics								
Aluminum	µg/L	1061	10,606	31,818	--	--	--	3370
Antimony	µg/L	2.12	21.2	63.6	--	--	--	0
Arsenic	µg/L	0.53	5.3	15.9	0.027	0.275	2.75	3.2
Barium	µg/L	26,515	265,152	795,455	--	--	--	47.5
Cadmium	µg/L	1.33	13.3	39.8	--	--	--	0
Chromium (as Cr-3)	µg/L	3977	39,773	119,318	--	--	--	0
Chromium, hexavalent	µg/L	7.95	79.5	239	--	--	--	NA
Copper	µg/L	106	1061	3182	--	--	--	7.9
Iron	µg/L	795	7955	23,864	--	--	--	2560
Manganese	µg/L	61.0	610	1830	--	--	--	391
Mercury	µg/L	0.159	1.59	4.77	--	--	--	0
Nickel	µg/L	106	1061	3182	--	--	--	0
Nitrate	µg/L	5.66	56.6	170	--	--	--	NA
Silver	µg/L	530	5303	15,909	--	--	--	0
Thallium	µg/L	0.004	0.042	0.127	--	--	--	0
Vanadium	µg/L	--	--	--	--	--	--	0
Zinc	µg/L	159	1591	4773	--	--	--	42
Organics								
1,1,2,2-Tetrachloroethane	µg/L	2273	22,727	68,182	4.42	44.2	442	NA
1,2-Dichloroethene	µg/L	589	5892	17,677	--	--	--	NA
1,4-Dichlorobenzene	µg/L	--	--	--	5.79	57.9	579	NA
2,4,6-Trinitrotoluene	µg/L	78.0	780	2340	121	1213	12,131	NA
2,4-Dimethylphenol	µg/L	884	8838	26,515	--	--	--	NA
2,4-Dinitrotoluene	µg/L	158	1583	4749	2.72	27.2	272	NA
2,6-Dinitrotoluene	µg/L	63.9	639	1917	2.19	21.9	219	NA
2-Amino-4,6-Dinitrotoluene	µg/L	20.4	204	612	--	--	--	NA
2-Amino-4,6-dinitrotoluene	µg/L	20.4	204	612	--	--	--	NA
2-Nitrotoluene	µg/L	442	4419	13,258	4.48	44.8	448	NA
4,4'-DDT	µg/L	0.006	0.063	0.189	8.7E-04	0.009	0.087	NA
4-Amino-2,6-Dinitrotoluene	µg/L	20.4	204	612	--	--	--	NA
4-Amino-2,6-dinitrotoluene	µg/L	20.4	204	612	--	--	--	NA
4-Methylphenol	µg/L	428	4277	12,830	--	--	--	NA
4-Nitrotoluene	µg/L	408	4079	12,238	56.0	560	5599	NA
Aldrin	µg/L	8.0E-04	0.008	0.024	3.6E-05	3.6E-04	0.004	NA
Benz(a)anthracene	µg/L	--	--	--	0.003	0.031	0.314	NA
Benzo(a)pyrene	µg/L	--	--	--	1.5E-04	0.002	0.015	NA
Benzo(b)fluoranthene	µg/L	--	--	--	0.003	0.03	0.303	NA
Benzo(k)fluoranthene	µg/L	--	--	--	0.017	0.17	1.7	NA
Bis(2-ethylhexyl)phthalate	µg/L	34.2	342	1026	2.85	28.5	285	NA
Chloroform	µg/L	803	8035	24,105	307	3073	30,735	NA
Chrysene	µg/L	--	--	--	0.287	2.87	28.7	NA
Dibenz(a,h)anthracene	µg/L	--	--	--	7.7E-05	7.7E-04	0.008	NA
HMX	µg/L	8286	82,860	248,580	--	--	--	NA
Heptachlor epoxide	µg/L	0.005	0.049	0.148	9.7E-04	0.01	0.097	NA
Indeno(1,2,3-cd)pyrene	µg/L	--	--	--	5.8E-04	0.006	0.058	NA
Methylene chloride	µg/L	17,677	176,768	530,303	917	9166	91,657	NA
PCB-1254	µg/L	7.6E-05	7.6E-04	0.002	2.2E-04	0.002	0.022	NA

Table 5-4. Ravenna Facility-Wide CUGs for Hunter/Trapper COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Pentachlorophenol	µg/L	22.7	227	682	0.147	1.47	14.7	NA
Pyrene	µg/L	14.5	145	434	--	--	--	NA
RDX	µg/L	497	4972	14,915	35.2	352	3515	NA
Tetrachloroethene	µg/L	63.9	639	1917	0.276	2.76	27.6	NA
Trichloroethene	µg/L	10.6	106	318	2.06	20.6	206	NA
beta-BHC	µg/L	--	--	--	0.022	0.222	2.22	NA
cis-1,2-Dichloroethene	µg/L	655	6547	19,641	--	--	--	NA
Sediment								
Inorganics								
Aluminum	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	13,900
Antimony	mg/kg	4961	49,612	148,835	--	--	--	0
Arsenic	mg/kg	2754	27,543	82,629	143	1428	14,276	19.5
Barium	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	123
Cadmium	mg/kg	7058	70,580	211,740	874,378	1.0E+06	1.0E+06	0
Chromium (as Cr-3)	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	18.1
Chromium, hexavalent	mg/kg	34,813	348,127	1.0E+06	131,157	1.0E+06	1.0E+06	NA
Copper	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	27.6
Iron	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	28,200
Manganese	mg/kg	721,868	1.0E+06	1.0E+06	--	--	--	1950
Mercury	mg/kg	8105	81,050	243,150	--	--	--	0.059
Nickel	mg/kg	830,144	1.0E+06	1.0E+06	--	--	--	17.7
Silver	mg/kg	189,728	1.0E+06	1.0E+06	--	--	--	0
Thallium	mg/kg	2517	25,172	75,517	--	--	--	0.89
Vanadium	mg/kg	49,406	494,061	1.0E+06	--	--	--	26.1
Zinc	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	532
Organics								
2,4,6-Trinitrotoluene	mg/kg	8526	85,258	255,773	13,262	132,623	1.0E+06	NA
2,4-Dinitrotoluene	mg/kg	13,877	138,768	416,305	238	2381	23,808	NA
2-Amino-4,6-dinitrotoluene	mg/kg	7436	74,360	223,079	--	--	--	NA
4-Amino-2,6-dinitrotoluene	mg/kg	7436	74,360	223,079	--	--	--	NA
Benz(a)anthracene	mg/kg	--	--	--	60.1	601	6012	NA
Benzo(a)pyrene	mg/kg	--	--	--	6.01	60.1	601	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	60.1	601	6012	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	601	6012	60,120	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	6.01	60.1	601	NA
Dieldrin	mg/kg	1573	15,733	47,198	45.9	459	4588	NA
HMX	mg/kg	730,835	1.0E+06	1.0E+06	--	--	--	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	60.1	601	6012	NA
Nitroglycerin	mg/kg	--	--	--	43,188	431,880	1.0E+06	NA
PCB-1016	mg/kg	367	3674	11,022	61.2	612	6123	NA
PCB-1254	mg/kg	105	1050	3149	61.2	612	6123	NA
PCB-1260	mg/kg	--	--	--	61.2	612	6123	NA
RDX	mg/kg	79,184	791,839	1.0E+06	5599	55,989	559,886	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA

COPC = Chemical of potential concern.
CUG = Cleanup goal across all pathways (ingestion, dermal, and inhalation).
HI = Hazard index.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
NA = Not available.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
-- = No CUG could be quantified based on lack of approved toxicity value.

Table 5-5. Ravenna Facility-Wide CUGs for Juvenile Trespasser COPCs

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Surface Soil								
Inorganics								
Aluminum	mg/kg	959,740	1.0E+06	1.0E+06	--	--	--	17,700
Antimony	mg/kg	134	1339	4016	--	--	--	0.96
Arsenic	mg/kg	72.5	725	2175	11.3	113	1128	15.4
Barium	mg/kg	154,679	1.0E+06	1.0E+06	--	--	--	88.4
Cadmium	mg/kg	183	1828	5485	202,356	1.0E+06	1.0E+06	0
Chromium (as Cr-3)	mg/kg	143,799	1.0E+06	1.0E+06	--	--	--	17.4
Chromium, hexavalent	mg/kg	980	9803	29,409	30,353	303,534	1.0E+06	NA
Cobalt	mg/kg	26,692	266,915	800,746	130,086	1.0E+06	1.0E+06	10.4
Copper	mg/kg	59,457	594,570	1.0E+06	--	--	--	17.7
Iron	mg/kg	357,930	1.0E+06	1.0E+06	--	--	--	23,100
Manganese	mg/kg	23,903	239,026	717,079	--	--	--	1450
Mercury	mg/kg	247	2467	7400	--	--	--	0.036
Nickel	mg/kg	28,938	289,380	868,140	--	--	--	21.1
Nitrate	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	NA
Silver	mg/kg	6386	63,855	191,566	--	--	--	0
Thallium	mg/kg	79.7	797	2392	--	--	--	0
Vanadium	mg/kg	1280	12,799	38,396	--	--	--	31.1
Zinc	mg/kg	397,112	1.0E+06	1.0E+06	--	--	--	61.8
Organics								
1,3,5-Trinitrobenzene	mg/kg	20,688	206,878	620,635	--	--	--	NA
1,3-Dinitrobenzene	mg/kg	100	996	2989	--	--	--	NA
2,4,6-Trinitrotoluene	mg/kg	239	2386	7159	1114	11,137	111,367	NA
2,4-Dinitrotoluene	mg/kg	359	3592	10,775	18.5	185	1849	NA
2,6-Dinitrotoluene	mg/kg	185	1845	5535	19.0	190	1899	NA
2-Amino-4,6-dinitrotoluene	mg/kg	248	2484	7453	--	--	--	NA
2-Methylnaphthalene	mg/kg	3986	39,858	119,575	--	--	--	NA
2-Nitrotoluene	mg/kg	9965	99,646	298,938	303	3033	30,327	NA
4,4'-DDE	mg/kg	--	--	--	205	2052	20,515	NA
4-Amino-2,6-dinitrotoluene	mg/kg	248	2484	7453	--	--	--	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA
4-Nitrophenol	mg/kg	7972	79,717	239,151	--	--	--	NA
4-Nitrotoluene	mg/kg	9965	99,646	298,938	4103	41,031	410,308	NA
Aldrin	mg/kg	29.9	299	897	4.1	41.0	410	NA
Benz(a)anthracene	mg/kg	--	--	--	4.5	45.0	450	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.45	4.5	45.0	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	4.5	45.0	450	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	45.0	450	4499	NA
Bis(2-chloroethoxy)methane	mg/kg	2989	29,894	89,681	--	--	--	NA
Carbazole	mg/kg	--	--	--	3488	34,876	348,761	NA
Chrysene	mg/kg	--	--	--	450	4499	44,986	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.45	4.5	45.0	NA
Dibenzofuran	mg/kg	1993	19,929	59,788	--	--	--	NA
Dieldrin	mg/kg	49.8	498	1495	4.36	43.6	436	NA
Endrin	mg/kg	11.8	118	355	--	--	--	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA
Fluoranthene	mg/kg	1877	18,766	56,297	--	--	--	NA
Fluorene	mg/kg	5749	57,489	172,466	--	--	--	NA
HMX	mg/kg	20,063	200,631	601,893	--	--	--	NA
Heptachlor	mg/kg	498	4982	14,947	15.5	155	1550	NA
Heptachlor epoxide	mg/kg	13.0	130	389	7.66	76.6	766	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	4.5	45.0	450	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	4.01	40.1	401	NA
Naphthalene	mg/kg	2874	28,739	86,217	--	--	--	NA

Table 5-5. Ravenna Facility-Wide CUGs for Juvenile Trespasser COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Nitroglycerin	mg/kg	--	--	--	4103	41,031	410,308	NA
PCB-1016	mg/kg	9.39	93.9	282	4.7	47.0	470	NA
PCB-1248	mg/kg	--	--	--	4.7	47.0	470	NA
PCB-1254	mg/kg	2.68	26.8	80.5	4.7	47.0	470	NA
PCB-1260	mg/kg	--	--	--	4.7	47.0	470	NA
Pentachlorophenol	mg/kg	2323	23,234	69,701	45.2	452	4518	NA
Pyrene	mg/kg	1407	14,074	42,223	--	--	--	NA
RDX	mg/kg	2397	23,968	71,905	508	5084	50,842	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
beta-BHC	mg/kg	--	--	--	38.7	387	3875	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA
Surface Water								
Inorganics								
Aluminum	µg/L	124,905	1.2E+06	3.7E+06	--	--	--	3370
Antimony	µg/L	14.4	144	431	--	--	--	0
Arsenic	µg/L	70.5	705	2115	11.0	110	1097	3.2
Barium	µg/L	19,738	197,382	592,146	--	--	--	47.5
Cadmium	µg/L	9.49	94.9	285	--	--	--	0
Chromium (as Cr-3)	µg/L	14,665	146,652	439,955	--	--	--	0
Chromium, hexavalent	µg/L	57.0	570	1709	--	--	--	NA
Copper	µg/L	8514	85,140	255,421	--	--	--	7.9
Iron	µg/L	47,228	472,284	1.4E+06	--	--	--	2560
Manganese	µg/L	2978	29,775	89,326	--	--	--	391
Mercury	µg/L	29.6	296	888	--	--	--	0
Nickel	µg/L	5862	58,622	175,866	--	--	--	0
Nitrate	µg/L	451,935	4.5E+06	1.4E+07	--	--	--	NA
Silver	µg/L	1064	10,643	31,928	--	--	--	0
Thallium	µg/L	22.6	226	678	--	--	--	0
Vanadium	µg/L	133	1329	3988	--	--	--	0
Zinc	µg/L	66,185	661,854	2.0E+06	--	--	--	42
Organics								
1,1,2,2-Tetrachloroethane	µg/L	6318	63,177	189,532	9.93	99.3	993	NA
1,2-Dichloroethene	µg/L	1087	10,872	32,615	--	--	--	NA
1,4-Dichlorobenzene	µg/L	--	--	--	76.6	766	7658	NA
2,4,6-Trinitrotoluene	µg/L	164	1643	4928	766.5	7665	76,650	NA
2,4-Dimethylphenol	µg/L	1764	17,636	52,908	--	--	--	NA
2,4-Dinitrotoluene	µg/L	321	3212	9637	16.5	165	1653	NA
2,6-Dinitrotoluene	µg/L	192	1923	5770	19.8	198	1980	NA
2-Amino-4,6-dinitrotoluene	µg/L	65.7	657	1971	--	--	--	NA
2-Nitrotoluene	µg/L	3285	32,850	98,550	100	1000	9,998	NA
4,4'-DDT	µg/L	0.84	8.4	25.2	0.346	3.46	34.6	NA
4-Amino-2,6-dinitrotoluene	µg/L	65.7	657	1971	--	--	--	NA
4-Methylphenol	µg/L	588	5877	17,631	--	--	--	NA
4-Nitrotoluene	µg/L	3285	32,850	98,550	1353	13,526	135,265	NA
Aldrin	µg/L	3.88	38.8	116	0.533	5.33	53.3	NA
Benz(a)anthracene	µg/L	--	--	--	0.046	0.457	4.57	NA
Benzo(a)pyrene	µg/L	--	--	--	0.003	0.027	0.267	NA
Benzo(b)fluoranthene	µg/L	--	--	--	0.026	0.263	2.63	NA
Benzo(k)fluoranthene	µg/L	--	--	--	315	3150	31,500	NA
Bis(2-ethylhexyl)phthalate	µg/L	47.7	477	1430	11.9	119	1192	NA
Chloroform	µg/L	353	3527	10,582	31.6	316	3160	NA
Chrysene	µg/L	--	--	--	4.57	45.7	457	NA
Dibenz(a,h)anthracene	µg/L	--	--	--	0.002	0.017	0.173	NA
HMX	µg/L	16,425	164,250	492,750	--	--	--	NA
Heptachlor epoxide	µg/L	4.27	42.7	128	2.53	25.3	253	NA

Table 5-5. Ravenna Facility-Wide CUGs for Juvenile Trespasser COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Indeno(1,2,3-cd)pyrene	µg/L	--	--	--	0.026	0.263	2.63	NA
Methylene chloride	µg/L	8436	84,357	253,072	855	8549	85,490	NA
PCB-1254	µg/L	6.57	65.7	197	57.5	575	5749	NA
Pentachlorophenol	µg/L	48.1	481	1442	0.935	9.35	93.5	NA
Pyrene	µg/L	9855	98,550	295,650	--	--	--	NA
RDX	µg/L	985.5	9855	29,565	209	2090	20,905	NA
Tetrachloroethene	µg/L	285	2853	8558	3.75	37.5	375	NA
Trichloroethene	µg/L	4.61	46.1	138	1.95	19.5	195	NA
beta-BHC	µg/L	--	--	--	12.8	128	1277.5	NA
cis-1,2-Dichloroethene	µg/L	3285	32,850	98,550	--	--	--	NA
Sediment								
Inorganics								
Aluminum	mg/kg	959,740	1.0E+06	1.0E+06	--	--	--	13,900
Antimony	mg/kg	134	1339	4016	--	--	--	0
Arsenic	mg/kg	72.5	725	2175	11.3	113	1128	19.5
Barium	mg/kg	154,679	1.0E+06	1.0E+06	--	--	--	123
Cadmium	mg/kg	183	1828	5485	202,356	1.0E+06	1.0E+06	0
Chromium (as Cr-3)	mg/kg	143,799	1.0E+06	1.0E+06	--	--	--	18.1
Chromium, hexavalent	mg/kg	980	9803	29,409	30,353	303,534	1.0E+06	NA
Copper	mg/kg	59,457	594,570	1.0E+06	--	--	--	27.6
Iron	mg/kg	357,930	1.0E+06	1.0E+06	--	--	--	28,200
Manganese	mg/kg	23,903	239,026	717,079	--	--	--	1950
Mercury	mg/kg	247	2467	7400	--	--	--	0.059
Nickel	mg/kg	28,938	289,380	868,140	--	--	--	17.7
Silver	mg/kg	6386	63,855	191,566	--	--	--	0
Thallium	mg/kg	79.7	797	2392	--	--	--	0.89
Vanadium	mg/kg	1280	12,799	38,396	--	--	--	26.1
Zinc	mg/kg	397,112	1.0E+06	1.0E+06	--	--	--	532
Organics								
2,4,6-Trinitrotoluene	mg/kg	239	2386	7159	1114	11,137	111,367	NA
2,4-Dinitrotoluene	mg/kg	359	3592	10,775	18.5	185	1849	NA
2-Amino-4,6-dinitrotoluene	mg/kg	248	2484	7453	--	--	--	NA
4-Amino-2,6-dinitrotoluene	mg/kg	248	2484	7453	--	--	--	NA
Benz(a)anthracene	mg/kg	--	--	--	4.5	45.0	450	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.45	4.5	45.0	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	4.5	45.0	450	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	45.0	450	4499	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.45	4.5	45.0	NA
Dieldrin	mg/kg	49.8	498	1495	4.36	43.6	436	NA
HMX	mg/kg	20,063	200,631	601,893	--	--	--	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	4.5	45.0	450	NA
Nitroglycerin	mg/kg	--	--	--	4103	41,031	410,308	NA
PCB-1016	mg/kg	9.39	93.9	282	4.7	47.0	470	NA
PCB-1254	mg/kg	2.68	26.8	80.5	4.7	47.0	470	NA
PCB-1260	mg/kg	--	--	--	4.7	47.0	470	NA
RDX	mg/kg	2397	23,968	71,905	508	5084	50,842	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA

COPC = Chemical of potential concern.
CUG = Cleanup goal across all pathways (ingestion, dermal, and inhalation).
HI = Hazard index.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
NA = Not available.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
-- = No CUG could be quantified based on lack of approved toxicity value.

Table 5-6. Ravenna Facility-Wide CUGs for National Guard Dust/Fire Control Worker COPCs

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Surface Soil								
Inorganics								
Aluminum	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	17,700
Antimony	mg/kg	1030	10,297	30,892	--	--	--	0.96
Arsenic	mg/kg	573	5735	17,204	35.7	357	3565	15.4
Barium	mg/kg	810,909	1.0E+06	1.0E+06	--	--	--	88.4
Cadmium	mg/kg	1473	14,726	44,179	94,527	945,273	1.0E+06	0
Chromium (as Cr-3)	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	17.4
Chromium, hexavalent	mg/kg	6666	66,659	199,978	14,179	141,791	1.0E+06	NA
Cobalt	mg/kg	74,531	745,311	1.0E+06	60,768	607,676	1.0E+06	10.4
Copper	mg/kg	341,235	1.0E+06	1.0E+06	--	--	--	17.7
Iron	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	23,100
Manganese	mg/kg	116,634	1.0E+06	1.0E+06	--	--	--	1450
Mercury	mg/kg	1659	16,586	49,757	--	--	--	0.036
Nickel	mg/kg	167,541	1.0E+06	1.0E+06	--	--	--	21.1
Nitrate	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	NA
Silver	mg/kg	38,421	384,211	1.0E+06	--	--	--	0
Thallium	mg/kg	513	5129	15,388	--	--	--	0
Vanadium	mg/kg	10,308	103,084	309,251	--	--	--	31.1
Zinc	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	61.8
Organics								
1,3,5-Trinitrobenzene	mg/kg	144,038	1.0E+06	1.0E+06	--	--	--	NA
1,3-Dinitrobenzene	mg/kg	641	6412	19,235	--	--	--	NA
2,4,6-Trinitrotoluene	mg/kg	1762	17,616	52,847	3288	32,883	328,829	NA
2,4-Dinitrotoluene	mg/kg	2896	28,957	86,870	59.6	596	5962	NA
2,6-Dinitrotoluene	mg/kg	1485	14,853	44,560	61.2	612	6116	NA
2-Amino-4,6-dinitrotoluene	mg/kg	1507	15,069	45,208	--	--	--	NA
2-Methylnaphthalene	mg/kg	25,646	256,462	769,385	--	--	--	NA
2-Nitrotoluene	mg/kg	64,115	641,154	1.0E+06	781	7805	78,054	NA
4,4'-DDE	mg/kg	--	--	--	528	5280	52,801	NA
4-Amino-2,6-dinitrotoluene	mg/kg	1507	15,069	45,208	--	--	--	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA
4-Nitrophenol	mg/kg	51,292	512,923	1.0E+06	--	--	--	NA
4-Nitrotoluene	mg/kg	64,115	641,154	1.0E+06	10,560	105,602	1.0E+06	NA
Aldrin	mg/kg	192	1923	5770	10.6	106	1056	NA
Benz(a)anthracene	mg/kg	--	--	--	15.1	151	1513	NA
Benzo(a)pyrene	mg/kg	--	--	--	1.51	15.1	151	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	15.1	151	1513	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	151	1513	15,129	NA
Bis(2-chloroethoxy)methane	mg/kg	19,235	192,346	577,039	--	--	--	NA
Carbazole	mg/kg	--	--	--	8976	89,762	897,616	NA
Chrysene	mg/kg	--	--	--	1513	15,129	151,294	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	1.51	15.1	151	NA
Dibenzofuran	mg/kg	12,823	128,231	384,693	--	--	--	NA
Dieldrin	mg/kg	321	3206	9617	11.2	112	1122	NA
Endrin	mg/kg	100	999	2996	--	--	--	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA
Fluoranthene	mg/kg	15,778	157,779	473,337	--	--	--	NA
Fluorene	mg/kg	46,870	468,700	1.0E+06	--	--	--	NA
HMX	mg/kg	151,363	1.0E+06	1.0E+06	--	--	--	NA
Heptachlor	mg/kg	3206	32,058	96,173	39.9	399	3988	NA
Heptachlor epoxide	mg/kg	83.4	834	2501	19.7	197	1972	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	15.1	151	1513	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	12.1	121	1211	NA
Naphthalene	mg/kg	23,405	234,049	702,147	--	--	--	NA

Table 5-6. Ravenna Facility-Wide CUGs for National Guard Dust/Fire Control Worker COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Nitroglycerin	mg/kg	--	--	--	10,560	105,602	1.0E+06	NA
PCB-1016	mg/kg	76.8	768	2304	15.4	154	1536	NA
PCB-1248	mg/kg	--	--	--	15.4	154	1536	NA
PCB-1254	mg/kg	21.9	219	658	15.4	154	1536	NA
PCB-1260	mg/kg	--	--	--	15.4	154	1536	NA
Pentachlorophenol	mg/kg	19,344	193,438	580,315	150	1505	15,045	NA
Pyrene	mg/kg	11,833	118,334	355,002	--	--	--	NA
RDX	mg/kg	16,214	162,136	486,409	1376	13,757	137,570	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
beta-BHC	mg/kg	--	--	--	100	997	9970	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA
Surface Water								
Inorganics								
Aluminum	µg/L	734,195	7.3E+06	2.2E+07	--	--	--	3370
Antimony	µg/L	89.6	896	2689	--	--	--	0
Arsenic	µg/L	387	3865	11,596	24.1	241	2405	3.2
Barium	µg/L	118,053	1.2E+06	3.5E+06	--	--	--	47.5
Cadmium	µg/L	60.0	600	1799	--	--	--	0
Chromium (as Cr-3)	µg/L	93,248	932,482	2.8E+06	--	--	--	0
Chromium, hexavalent	µg/L	360	3599	10,796	--	--	--	NA
Copper	µg/L	47,315	473,148	1.4E+06	--	--	--	7.9
Iron	µg/L	271,809	2.7E+06	8.2E+06	--	--	--	2560
Manganese	µg/L	18,222	182,217	546,651	--	--	--	391
Mercury	µg/L	177	1771	5312	--	--	--	0
Nickel	µg/L	31,032	310,324	930,972	--	--	--	0
Nitrate	µg/L	2.4E+06	2.4E+07	7.2E+07	--	--	--	NA
Silver	µg/L	5914	59,144	177,431	--	--	--	0
Thallium	µg/L	120	1204	3611	--	--	--	0
Vanadium	µg/L	840	8397	25,190	--	--	--	0
Zinc	µg/L	366,046	3.7E+06	1.1E+07	--	--	--	42
Organics								
1,1,2,2-Tetrachloroethane	µg/L	43,781	437,814	1.3E+06	5.98	59.8	598	NA
1,2-Dichloroethene	µg/L	6954	69,542	208,625	--	--	--	NA
1,4-Dichlorobenzene	µg/L	--	--	--	249	2493	24,931	NA
2,4,6-Trinitrotoluene	µg/L	852	8517	25,550	1590	15,898	158,978	NA
2,4-Dimethylphenol	µg/L	12,040	120,397	361,192	--	--	--	NA
2,4-Dinitrotoluene	µg/L	2079	20,793	62,380	42.8	428	4281	NA
2,6-Dinitrotoluene	µg/L	1189	11,891	35,674	49.0	490	4896	NA
2-Amino-4,6-dinitrotoluene	µg/L	341	3407	10,220	--	--	--	NA
2-Nitrotoluene	µg/L	17,033	170,333	511,000	207	2074	20,736	NA
4,4'-DDT	µg/L	7.57	75.7	227	1.25	12.5	125	NA
4-Amino-2,6-dinitrotoluene	µg/L	341	3407	10,220	--	--	--	NA
4-Methylphenol	µg/L	3811	38,107	114,321	--	--	--	NA
4-Nitrotoluene	µg/L	17,033	170,333	511,000	2805	28,055	280,549	NA
Aldrin	µg/L	27.2	272	815	1.49	14.9	149	NA
Benz(a)anthracene	µg/L	--	--	--	0.165	1.65	16.5	NA
Benzo(a)pyrene	µg/L	--	--	--	0.01	0.097	0.966	NA
Benzo(b)fluoranthene	µg/L	--	--	--	0.095	0.952	9.52	NA
Benzo(k)fluoranthene	µg/L	--	--	--	653	6533	65,333	NA
Bis(2-ethylhexyl)phthalate	µg/L	429	4294	12,883	42.9	429	4294	NA
Chloroform	µg/L	2577	25,769	77,307	15.8	158	1580	NA
Chrysene	µg/L	--	--	--	16.5	165	1654	NA
Dibenz(a,h)anthracene	µg/L	--	--	--	0.006	0.063	0.626	NA
HMX	µg/L	85,167	851,667	2.6E+06	--	--	--	NA
Heptachlor epoxide	µg/L	22.1	221	664.3	5.24	52.4	524	NA
Indeno(1,2,3-cd)pyrene	µg/L	--	--	--	0.095	0.95	9.5	NA
Methylene chloride	µg/L	24,768	247,676	743,029	657	6572	65,721	NA

Table 5-6. Ravenna Facility-Wide CUGs for National Guard Dust/Fire Control Worker COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
PCB-1254	µg/L	34.1	341	1022	119	1192	11,923	NA
Pentachlorophenol	µg/L	434	4336	13,009	3.37	33.7	337	NA
Pyrene	µg/L	51,100	511,000	1.5E+06	--	--	--	NA
RDX	µg/L	5110	51,100	153,300	434	4336	43,358	NA
Tetrachloroethene	µg/L	1859	18,593	55,779	10.5	105	1049	NA
Trichloroethene	µg/L	34.2	342	1026	2.34	23.4	234	NA
beta-BHC	µg/L	--	--	--	26.5	265	2650	NA
cis-1,2-Dichloroethene	µg/L	17,033	170,333	511,000	--	--	--	NA
Sediment								
Inorganics								
Aluminum	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	13,900
Antimony	mg/kg	1030	10,297	30,892	--	--	--	0
Arsenic	mg/kg	573	5735	17,204	35.7	357	3565	19.5
Barium	mg/kg	810,909	1.0E+06	1.0E+06	--	--	--	123
Cadmium	mg/kg	1473	14,726	44,179	94,527	945,273	1.0E+06	0
Chromium (as Cr-3)	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	18.1
Chromium, hexavalent	mg/kg	6666	66,659	199,978	14,179	141,791	1.0E+06	NA
Copper	mg/kg	341,235	1.0E+06	1.0E+06	--	--	--	27.6
Iron	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	28,200
Manganese	mg/kg	116,634	1.0E+06	1.0E+06	--	--	--	1950
Mercury	mg/kg	1659	16,586	49,757	--	--	--	0.059
Nickel	mg/kg	167,541	1.0E+06	1.0E+06	--	--	--	17.7
Silver	mg/kg	38,421	384,211	1.0E+06	--	--	--	0
Thallium	mg/kg	513	5129	15,388	--	--	--	0.89
Vanadium	mg/kg	10,308	103,084	309,251	--	--	--	26.1
Zinc	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	532
Organics								
2,4,6-Trinitrotoluene	mg/kg	1762	17,616	52,847	3288	32,883	328,829	NA
2,4-Dinitrotoluene	mg/kg	2896	28,957	86,870	59.6	596	5962	NA
2-Amino-4,6-dinitrotoluene	mg/kg	1507	15,069	45,208	--	--	--	NA
4-Amino-2,6-dinitrotoluene	mg/kg	1507	15,069	45,208	--	--	--	NA
Benz(a)anthracene	mg/kg	--	--	--	15.1	151	1513	NA
Benzo(a)pyrene	mg/kg	--	--	--	1.51	15.1	151	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	15.1	151	1513	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	151	1513	15,129	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	1.51	15.1	151	NA
Dieldrin	mg/kg	321	3206	9617	11.2	112	1122	NA
HMX	mg/kg	151,363	1.0E+06	1.0E+06	--	--	--	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	15.1	151	1513	NA
Nitroglycerin	mg/kg	--	--	--	10,560	105,602	1.0E+06	NA
PCB-1016	mg/kg	76.8	768	2304	15.4	154	1536	NA
PCB-1254	mg/kg	21.9	219	658	15.4	154	1536	NA
PCB-1260	mg/kg	--	--	--	15.4	154	1536	NA
RDX	mg/kg	16,214	162,136	486,409	1376	13,757	137,570	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA

COPC = Chemical of potential concern.
CUG = Cleanup goal across all pathways (ingestion, dermal, and inhalation).
HI = Hazard index.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
NA = Not available.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
-- = No CUG could be quantified based on lack of approved toxicity value.

Table 5-7. Ravenna Facility-Wide CUGs for National Guard Range Maintenance Soldier COPCs

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Surface Soil								
Inorganics								
Aluminum	mg/kg	775,289	1.0E+06	1.0E+06	--	--	--	17,700
Antimony	mg/kg	161	1614	4842	--	--	--	0.96
Arsenic	mg/kg	92.5	925	2776	5.76	57.6	576	15.4
Barium	mg/kg	128,223	1.0E+06	1.0E+06	--	--	--	88.4
Cadmium	mg/kg	242	2424	7272	24,133	241,332	1.0E+06	0
Chromium (as Cr-3)	mg/kg	202,189	1.0E+06	1.0E+06	--	--	--	17.4
Chromium, hexavalent	mg/kg	1103	11,030	33,091	3620	36,200	361,999	NA
Cobalt	mg/kg	13,248	132,477	397,432	15,514	155,142	1.0E+06	10.4
Copper	mg/kg	42,486	424,860	1.0E+06	--	--	--	17.7
Iron	mg/kg	285,369	1.0E+06	1.0E+06	--	--	--	23,100
Manganese	mg/kg	20,467	204,672	614,016	--	--	--	1450
Mercury	mg/kg	230	2304	6911	--	--	--	0.036
Nickel	mg/kg	20,971	209,713	629,138	--	--	--	21.1
Nitrate	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	NA
Silver	mg/kg	4928	49,277	147,830	--	--	--	0
Thallium	mg/kg	68.9	689	2067	--	--	--	0
Vanadium	mg/kg	1697	16,969	50,906	--	--	--	31.1
Zinc	mg/kg	301,090	1.0E+06	1.0E+06	--	--	--	61.8
Organics								
1,3,5-Trinitrobenzene	mg/kg	20,584	205,835	617,506	--	--	--	NA
1,3-Dinitrobenzene	mg/kg	86.1	861	2584	--	--	--	NA
2,4,6-Trinitrotoluene	mg/kg	265	2652	7955	495	4950	49,497	NA
2,4-Dinitrotoluene	mg/kg	477	4772	14,316	9.82	98.2	982	NA
2,6-Dinitrotoluene	mg/kg	244	2444	7331	10.1	101	1006	NA
2-Amino-4,6-dinitrotoluene	mg/kg	194	1943	5829	--	--	--	NA
2-Methylnaphthalene	mg/kg	3445	34,451	103,354	--	--	--	NA
2-Nitrotoluene	mg/kg	8613	86,128	258,385	105	1049	10,485	NA
4,4'-DDE	mg/kg	--	--	--	70.9	709	7093	NA
4-Amino-2,6-dinitrotoluene	mg/kg	194	1943	5829	--	--	--	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA
4-Nitrophenol	mg/kg	6890	68,903	206,708	--	--	--	NA
4-Nitrotoluene	mg/kg	8613	86,128	258,385	1419	14,186	141,859	NA
Aldrin	mg/kg	25.8	258	775	1.42	14.2	142	NA
Benz(a)anthracene	mg/kg	--	--	--	2.62	26.2	262	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.262	2.62	26.2	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	2.62	26.2	262	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	26.2	262	2619	NA
Bis(2-chloroethoxy)methane	mg/kg	2584	25,839	77,516	--	--	--	NA
Carbazole	mg/kg	--	--	--	1206	12,058	120,580	NA
Chrysene	mg/kg	--	--	--	262	2619	26,193	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.262	2.62	26.2	NA
Dibenzofuran	mg/kg	1723	17,226	51,677	--	--	--	NA
Dieldrin	mg/kg	43.1	431	1292	1.51	15.1	151	NA
Endrin	mg/kg	17.3	173	520	--	--	--	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA
Fluoranthene	mg/kg	2732	27,316	81,949	--	--	--	NA
Fluorene	mg/kg	7823	78,227	234,682	--	--	--	NA
HMX	mg/kg	23,265	232,653	697,960	--	--	--	NA
Heptachlor	mg/kg	431	4306	12,919	5.36	53.6	536	NA
Heptachlor epoxide	mg/kg	11.2	112	336	2.65	26.5	265	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	2.62	26.2	262	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	1.86	18.6	186	NA
Naphthalene	mg/kg	3908	39,081	117,242	--	--	--	NA

Table 5-7. Ravenna Facility-Wide CUGs for National Guard Range Maintenance Soldier COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Nitroglycerin	mg/kg	--	--	--	1419	14,186	141,859	NA
PCB-1016	mg/kg	12.9	129	386	2.57	25.7	257	NA
PCB-1248	mg/kg	--	--	--	2.57	25.7	257	NA
PCB-1254	mg/kg	3.67	36.7	110	2.57	25.7	257	NA
PCB-1260	mg/kg	--	--	--	2.57	25.7	257	NA
Pentachlorophenol	mg/kg	3309	33,092	99,277	25.7	257	2574	NA
Pyrene	mg/kg	2049	20,487	61,461	--	--	--	NA
RDX	mg/kg	2263	22,629	67,887	192	1920	19,200	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
beta-BHC	mg/kg	--	--	--	13.4	134	1340	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA

COPC = Chemical of potential concern.
CUG = Cleanup goal across all pathways (ingestion, dermal, and inhalation).
HI = Hazard index.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
NA = Not available.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
-- = No CUG could be quantified based on lack of approved toxicity value.

Table 5-8. Ravenna Facility-Wide CUGs for National Guard Trainee COPCs

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Surface Soil										
Inorganics										
Aluminum	mg/kg	3496	34,960	104,881	--	--	--	17,700	NA	NA
Antimony	mg/kg	175	1753	5259	--	--	--	0.96	NA	NA
Arsenic	mg/kg	114	1140	3419	2.78	27.8	278	15.4	NA	NA
Barium	mg/kg	351	3506	10,518	--	--	--	88.4	NA	NA
Cadmium	mg/kg	329	3292	9876	10.9	109	1093	0	NA	NA
Chromium (as Cr-3)	mg/kg	329,763	1.0E+06	1.0E+06	--	--	--	17.4	NA	NA
Chromium, hexavalent	mg/kg	5.61	56.1	168	1.64	16.4	164	NA	NA	NA
Cobalt	mg/kg	14.0	140	421	7.03	70.3	703	10.4	NA	NA
Copper	mg/kg	25,368	253,680	761,040	--	--	--	17.7	NA	NA
Iron	mg/kg	184,370	1.0E+06	1.0E+06	--	--	--	23,100	NA	NA
Manganese	mg/kg	35.1	351	1053	--	--	--	1450	NA	NA
Mercury	mg/kg	172	1722	5166	--	--	--	0.036	NA	NA
Nickel	mg/kg	12,639	126,391	379,174	--	--	--	21.1	NA	NA
Nitrate	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	NA	NA	NA
Silver	mg/kg	3105	31,049	93,146	--	--	--	0	NA	NA
Thallium	mg/kg	47.7	477	1431	--	--	--	0	NA	NA
Vanadium	mg/kg	2304	23,045	69,134	--	--	--	31.1	NA	NA
Zinc	mg/kg	187,269	1.0E+06	1.0E+06	--	--	--	61.8	NA	NA
Organics										
1,3,5-Trinitrobenzene	mg/kg	16,542	165,422	496,267	--	--	--	NA	NA	NA
1,3-Dinitrobenzene	mg/kg	59.6	596	1788	--	--	--	NA	NA	NA
2,4,6-Trinitrotoluene	mg/kg	249	2488	7463	464	4643	46,435	NA	NA	NA
2,4-Dinitrotoluene	mg/kg	652	6519	19,558	13.4	134	1342	NA	NA	NA
2,6-Dinitrotoluene	mg/kg	331	3309	9926	13.6	136	1362	NA	NA	NA
2-Amino-4,6-dinitrotoluene	mg/kg	124	1237	3710	--	--	--	NA	NA	NA
2-Methylnaphthalene	mg/kg	2384	23,845	71,534	--	--	--	NA	NA	NA
2-Nitrotoluene	mg/kg	5961	59,611	178,834	72.6	726	7257	NA	NA	NA
4,4'-DDE	mg/kg	--	--	--	49.1	491	4909	NA	NA	NA
4-Amino-2,6-dinitrotoluene	mg/kg	124	1237	3710	--	--	--	NA	NA	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA	NA	NA
4-Nitrophenol	mg/kg	4769	47,689	143,067	--	--	--	NA	NA	NA
4-Nitrotoluene	mg/kg	5961	59,611	178,834	982	9818	98,183	NA	NA	NA
Aldrin	mg/kg	17.9	179	537	0.788	7.88	78.8	NA	NA	NA
Benz(a)anthracene	mg/kg	--	--	--	4.77	47.7	477	NA	NA	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.477	4.77	47.7	NA	NA	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	4.77	47.7	477	NA	NA	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	47.7	477	4774	NA	NA	NA
Bis(2-chloroethoxy)methane	mg/kg	1788	17,883	53,650	--	--	--	NA	NA	NA
Carbazole	mg/kg	--	--	--	835	8346	83,456	NA	NA	NA
Chrysene	mg/kg	--	--	--	477	4774	47,736	NA	NA	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.477	4.77	47.7	NA	NA	NA
Dibenzofuran	mg/kg	1192	11,922	35,767	--	--	--	NA	NA	NA
Dieldrin	mg/kg	29.8	298	894	0.839	8.39	83.9	NA	NA	NA
Endrin	mg/kg	33.0	330	991	--	--	--	NA	NA	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA	NA	NA
Fluoranthene	mg/kg	5087	50,868	152,603	--	--	--	NA	NA	NA
Fluorene	mg/kg	11,458	114,583	343,749	--	--	--	NA	NA	NA
HMX	mg/kg	23,464	234,645	703,934	--	--	--	NA	NA	NA
Heptachlor	mg/kg	298	2981	8942	2.98	29.8	298	NA	NA	NA
Heptachlor epoxide	mg/kg	7.75	77.5	232	1.48	14.8	148	NA	NA	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	4.77	47.7	477	NA	NA	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	1.88	18.8	188	NA	NA	NA

Table 5-8. Ravenna Facility-Wide CUGs for National Guard Trainee COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Naphthalene	mg/kg	1541	15,407	46,222	--	--	--	NA	NA	NA
Nitroglycerin	mg/kg	--	--	--	982	9818	98,183	NA	NA	NA
PCB-1016	mg/kg	19.2	192	577	3.46	34.6	346	NA	NA	NA
PCB-1248	mg/kg	--	--	--	3.46	34.6	346	NA	NA	NA
PCB-1254	mg/kg	5.49	54.9	165	3.46	34.6	346	NA	NA	NA
PCB-1260	mg/kg	--	--	--	3.46	34.6	346	NA	NA	NA
Pentachlorophenol	mg/kg	5656	56,558	169,673	44.0	440	4399	NA	NA	NA
Pyrene	mg/kg	3815	38,151	114,453	--	--	--	NA	NA	NA
RDX	mg/kg	1711	17,113	51,338	145	1452	14,520	NA	NA	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
beta-BHC	mg/kg	--	--	--	7.42	74.2	742	NA	NA	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
Subsurface Soil										
Inorganics										
Aluminum	mg/kg	3496	34,960	104,881	--	--	--	19,500	NA	NA
Antimony	mg/kg	175	1753	5259	--	--	--	0.96	NA	NA
Arsenic	mg/kg	114	1140	3419	2.78	27.8	278	19.8	NA	NA
Barium	mg/kg	351	3506	10,518	--	--	--	124	NA	NA
Cadmium	mg/kg	329	3292	9876	10.9	109	1093	0	NA	NA
Chromium (as Cr-3)	mg/kg	329,763	1.0E+06	1.0E+06	--	--	--	27.2	NA	NA
Chromium, hexavalent	mg/kg	5.61	56.1	168	1.64	16.4	164	NA	NA	NA
Cobalt	mg/kg	14.0	140	421	7.03	70.3	703	23.2	NA	NA
Copper	mg/kg	25,368	253,680	761,040	--	--	--	32.3	NA	NA
Iron	mg/kg	184,370	1.0E+06	1.0E+06	--	--	--	35,200	NA	NA
Manganese	mg/kg	35.1	351	1053	--	--	--	3030	NA	NA
Mercury	mg/kg	172	1722	5166	--	--	--	0.044	NA	NA
Nickel	mg/kg	12,639	126,391	379,174	--	--	--	60.7	NA	NA
Nitrate	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	NA	NA	NA
Silver	mg/kg	3105	31,049	93,146	--	--	--	0	NA	NA
Thallium	mg/kg	47.7	477	1431	--	--	--	0.91	NA	NA
Vanadium	mg/kg	2304	23,045	69,134	--	--	--	37.6	NA	NA
Zinc	mg/kg	187,269	1.0E+06	1.0E+06	--	--	--	93.3	NA	NA
Organics										
1,3,5-Trinitrobenzene	mg/kg	16,542	165,422	496,267	--	--	--	NA	NA	NA
1,3-Dinitrobenzene	mg/kg	59.6	596	1788	--	--	--	NA	NA	NA
2,4,6-Trinitrotoluene	mg/kg	249	2488	7463	464	4643	46,435	NA	NA	NA
2,4-Dinitrotoluene	mg/kg	652	6519	19,558	13.4	134	1342	NA	NA	NA
2,6-Dinitrotoluene	mg/kg	331	3309	9926	13.6	136	1362	NA	NA	NA
2-Amino-4,6-dinitrotoluene	mg/kg	124	1237	3710	--	--	--	NA	NA	NA
2-Methylnaphthalene	mg/kg	2384	23,845	71,534	--	--	--	NA	NA	NA
2-Nitrotoluene	mg/kg	5961	59,611	178,834	72.6	726	7257	NA	NA	NA
4,4'-DDE	mg/kg	--	--	--	49.1	491	4909	NA	NA	NA
4-Amino-2,6-dinitrotoluene	mg/kg	124	1237	3710	--	--	--	NA	NA	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA	NA	NA
4-Nitrophenol	mg/kg	4769	47,689	143,067	--	--	--	NA	NA	NA
4-Nitrotoluene	mg/kg	5961	59,611	178,834	982	9818	98,183	NA	NA	NA
Aldrin	mg/kg	17.9	179	537	0.788	7.88	78.8	NA	NA	NA
Benz(a)anthracene	mg/kg	--	--	--	4.77	47.7	477	NA	NA	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.477	4.77	47.7	NA	NA	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	4.77	47.7	477	NA	NA	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	47.7	477	4774	NA	NA	NA
Bis(2-chloroethoxy)methane	mg/kg	1788	17,883	53,650	--	--	--	NA	NA	NA
Carbazole	mg/kg	--	--	--	835	8346	83,456	NA	NA	NA
Chrysene	mg/kg	--	--	--	477	4774	47,736	NA	NA	NA

Table 5-8. Ravenna Facility-Wide CUGs for National Guard Trainee COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.477	4.77	47.7	NA	NA	NA
Dibenzofuran	mg/kg	1192	11,922	35,767	--	--	--	NA	NA	NA
Dieldrin	mg/kg	29.8	298	894	0.839	8.39	83.9	NA	NA	NA
Endrin	mg/kg	33.0	330	991	--	--	--	NA	NA	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA	NA	NA
Fluoranthene	mg/kg	5087	50,868	152,603	--	--	--	NA	NA	NA
Fluorene	mg/kg	11,458	114,583	343,749	--	--	--	NA	NA	NA
HMX	mg/kg	23,464	234,645	703,934	--	--	--	NA	NA	NA
Heptachlor	mg/kg	298	2981	8942	2.98	29.8	298	NA	NA	NA
Heptachlor epoxide	mg/kg	7.75	77.5	232	1.48	14.8	148	NA	NA	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	4.77	47.7	477	NA	NA	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	1.88	18.8	188	NA	NA	NA
Naphthalene	mg/kg	1541	15,407	46,222	--	--	--	NA	NA	NA
Nitroglycerin	mg/kg	--	--	--	982	9818	98,183	NA	NA	NA
PCB-1016	mg/kg	19.2	192	577	3.46	34.6	346	NA	NA	NA
PCB-1248	mg/kg	--	--	--	3.46	34.6	346	NA	NA	NA
PCB-1254	mg/kg	5.49	54.9	165	3.46	34.6	346	NA	NA	NA
PCB-1260	mg/kg	--	--	--	3.46	34.6	346	NA	NA	NA
Pentachlorophenol	mg/kg	5656	56,558	169,673	44.0	440	4399	NA	NA	NA
Pyrene	mg/kg	3815	38,151	114,453	--	--	--	NA	NA	NA
RDX	mg/kg	1711	17,113	51,338	145	1452	14,520	NA	NA	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
beta-BHC	mg/kg	--	--	--	7.42	74.2	742	NA	NA	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
Groundwater										
Inorganics										
Aluminum	µg/L	31,981	319,809	959,426	--	--	--	NA	48,000	9410
Antimony	µg/L	11.7	117	351	--	--	--	NA	4.3	0
Arsenic	µg/L	9.77	97.7	293	0.608	6.08	60.8	NA	215	19.1
Barium	µg/L	6332	63,319	189,958	--	--	--	NA	327	241
Cadmium	µg/L	13.2	132	395	--	--	--	NA	0	0
Chromium (as Cr-3)	µg/L	33,087	330,873	992,618	--	--	--	NA	85.2	19.5
Cobalt	µg/L	654	6545	19,635	--	--	--	NA	46.3	0
Iron	µg/L	9671	96,706	290,117	--	--	--	NA	195,000	21,500
Manganese	µg/L	1421	14,207	42,620	--	--	--	NA	2860	1260
Nickel	µg/L	654	6540	19,619	--	--	--	NA	117	85.3
Nitrate	µg/L	52,283	522,835	1.6E+06	--	--	--	NA	NA	NA
Thallium	µg/L	2.61	26.1	78.4	--	--	--	NA	2.4	0
Vanadium	µg/L	185	1845	5536	--	--	--	NA	98.1	15.5
Zinc	µg/L	9756	97,559	292,678	--	--	--	NA	888	193
Organics										
1,1,2,2-Tetrachloroethane	µg/L	1804	18,044	54,133	0.744	7.44	74.4	NA	NA	NA
1,2-Dichloroethane	µg/L	633	6332	18,995	1.67	16.7	167	NA	NA	NA
1,3-Dinitrobenzene	µg/L	3.28	32.8	98.3	--	--	--	NA	NA	NA
2,4,6-Trinitrotoluene	µg/L	16.4	164	491	30.6	306	3057	NA	NA	NA
2,4-Dinitrotoluene	µg/L	62.8	628	1883	1.29	12.9	129	NA	NA	NA
2,6-Dinitrotoluene	µg/L	31.8	318	954	1.31	13.1	131	NA	NA	NA
2-Amino-4,6-dinitrotoluene	µg/L	6.55	65.5	197	--	--	--	NA	NA	NA
2-Nitrotoluene	µg/L	328	3276	9827	3.99	39.9	399	NA	NA	NA
4,4'-DDD	µg/L	11.0	110	329	0.639	6.39	63.9	NA	NA	NA
4,4'-DDE	µg/L	--	--	--	0.503	5.03	50.3	NA	NA	NA
4,4'-DDT	µg/L	1.78	17.8	53.5	0.294	2.94	29.4	NA	NA	NA
4-Amino-2,6-dinitrotoluene	µg/L	6.55	65.5	197	--	--	--	NA	NA	NA

Table 5-8. Ravenna Facility-Wide CUGs for National Guard Trainee COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
4-Nitrobenzenamine	µg/L	98.3	983	2948	43.7	437	4368	NA	NA	NA
4-Nitrotoluene	µg/L	328	3276	9827	54.0	540	5395	NA	NA	NA
Aldrin	µg/L	0.923	9.23	27.7	0.051	0.507	5.07	NA	NA	NA
Benz(a)anthracene	µg/L	--	--	--	0.042	0.419	4.19	NA	NA	NA
Benzene	µg/L	38.1	381	1142	4.64	46.4	464	NA	NA	NA
Benzo(a)pyrene	µg/L	--	--	--	0.002	0.025	0.248	NA	NA	NA
Benzo(b)fluoranthene	µg/L	--	--	--	0.024	0.245	2.45	NA	NA	NA
Bis(2-ethylhexyl)phthalate	µg/L	97.0	970	2909	9.7	97.0	970	NA	NA	NA
Carbon tetrachloride	µg/L	19.3	193	578	2.2	22.0	220	NA	NA	NA
Chloroform	µg/L	248	2477	7432	2.23	22.3	223	NA	NA	NA
Dibenz(a,h)anthracene	µg/L	--	--	--	0.002	0.016	0.162	NA	NA	NA
Dieldrin	µg/L	1.1	11.0	32.9	0.038	0.384	3.84	NA	NA	NA
Heptachlor	µg/L	12.3	123	368	0.153	1.53	15.3	NA	NA	NA
Heptachlor epoxide	µg/L	0.426	4.26	12.8	0.101	1.01	10.1	NA	NA	NA
Indeno(1,2,3-cd)pyrene	µg/L	--	--	--	0.024	0.244	2.44	NA	NA	NA
Lindane	µg/L	7.66	76.6	230	0.55	5.5	55.0	NA	NA	NA
Methylene chloride	µg/L	1428	14,277	42,831	57.5	575	5751	NA	NA	NA
Nitrobenzene	µg/L	16.4	164	491	--	--	--	NA	NA	NA
Nitroglycerin	µg/L	--	--	--	54.0	540	5395	NA	NA	NA
PCB-1242	µg/L	--	--	--	2.29	22.9	229	NA	NA	NA
PCB-1254	µg/L	0.655	6.55	19.7	2.29	22.9	229	NA	NA	NA
PCB-1260	µg/L	--	--	--	2.29	22.9	229	NA	NA	NA
Pentachlorophenol	µg/L	103	1025	3075	0.797	7.97	79.7	NA	NA	NA
RDX	µg/L	98.3	983	2948	8.34	83.4	834	NA	NA	NA
Tetrachloroethene	µg/L	191	1911	5732	1.05	10.5	105	NA	NA	NA
Toxaphene	µg/L	--	--	--	0.518	5.18	51.8	NA	NA	NA
Trichloroethene	µg/L	5.04	50.4	151	0.336	3.36	33.6	NA	NA	NA
alpha-BHC	µg/L	--	--	--	0.146	1.46	14.6	NA	NA	NA
beta-BHC	µg/L	--	--	--	0.51	5.1	51.0	NA	NA	NA
Surface Water										
Inorganics										
Aluminum	µg/L	73,445	734,449	2.2E+06	--	--	--	3370	NA	NA
Antimony	µg/L	6.45	64.5	194	--	--	--	0	NA	NA
Arsenic	µg/L	67.0	670	2011	4.17	41.7	417	3.2	NA	NA
Barium	µg/L	10,640	106,401	319,204	--	--	--	47.5	NA	NA
Cadmium	µg/L	4.08	40.8	123	--	--	--	0	NA	NA
Chromium (as Cr-3)	µg/L	6165	61,649	184,948	--	--	--	0	NA	NA
Chromium, hexavalent	µg/L	24.5	245	735	--	--	--	NA	NA	NA
Copper	µg/L	7199	71,992	215,976	--	--	--	7.9	NA	NA
Iron	µg/L	31,296	312,959	938,878	--	--	--	2560	NA	NA
Manganese	µg/L	1449	14,488	43,465	--	--	--	391	NA	NA
Mercury	µg/L	16.0	160	479	--	--	--	0	NA	NA
Nickel	µg/L	8258	82,579	247,738	--	--	--	0	NA	NA
Nitrate	µg/L	584,936	5.8E+06	1.8E+07	--	--	--	NA	NA	NA
Silver	µg/L	900	8999	26,997	--	--	--	0	NA	NA
Thallium	µg/L	29.2	292	877	--	--	--	0	NA	NA
Vanadium	µg/L	57.2	572	1715	--	--	--	0	NA	NA
Zinc	µg/L	58,216	582,164	1.7E+06	--	--	--	42	NA	NA
Organics										
1,1,2,2-Tetrachloroethane	µg/L	5706	57,064	171,193	0.395	3.95	39.5	NA	NA	NA
1,2-Dichloroethene	µg/L	809	8092	24,276	--	--	--	NA	NA	NA
1,4-Dichlorobenzene	µg/L	--	--	--	24.6	246	2460	NA	NA	NA

Table 5-8. Ravenna Facility-Wide CUGs for National Guard Trainee COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
2,4,6-Trinitrotoluene	µg/L	328	3276	9827	611	6115	61,145	NA	NA	NA
2,4-Dimethylphenol	µg/L	1299	12,986	38,959	--	--	--	NA	NA	NA
2,4-Dinitrotoluene	µg/L	356	3556	10,669	7.32	73.2	732	NA	NA	NA
2,6-Dinitrotoluene	µg/L	232	2324	6973	9.57	95.7	957	NA	NA	NA
2-Amino-4,6-dinitrotoluene	µg/L	131	1310	3931	--	--	--	NA	NA	NA
2-Nitrotoluene	µg/L	6551	65,513	196,538	79.8	798	7975	NA	NA	NA
4,4'-DDT	µg/L	1.2	12.0	35.9	0.197	1.97	19.7	NA	NA	NA
4-Amino-2,6-dinitrotoluene	µg/L	131	1310	3931	--	--	--	NA	NA	NA
4-Methylphenol	µg/L	448	4477	13,430	--	--	--	NA	NA	NA
4-Nitrotoluene	µg/L	6551	65,513	196,538	1079	10,790	107,903	NA	NA	NA
Aldrin	µg/L	6.23	62.3	187	0.342	3.42	34.2	NA	NA	NA
Benz(a)anthracene	µg/L	--	--	--	0.032	0.322	3.22	NA	NA	NA
Benzo(a)pyrene	µg/L	--	--	--	0.002	0.019	0.189	NA	NA	NA
Benzo(b)fluoranthene	µg/L	--	--	--	0.019	0.185	1.85	NA	NA	NA
Benzo(k)fluoranthene	µg/L	--	--	--	251	2513	25,128	NA	NA	NA
Bis(2-ethylhexyl)phthalate	µg/L	67.9	679	2038	6.79	67.9	679	NA	NA	NA
Chloroform	µg/L	226	2255	6766	1.02	10.2	102	NA	NA	NA
Chrysene	µg/L	--	--	--	3.22	32.2	322	NA	NA	NA
Dibenz(a,h)anthracene	µg/L	--	--	--	0.001	0.011	0.112	NA	NA	NA
HMX	µg/L	32,756	327,564	982,692	--	--	--	NA	NA	NA
Heptachlor epoxide	µg/L	8.52	85.2	256	2.02	20.2	202	NA	NA	NA
Indeno(1,2,3-cd)pyrene	µg/L	--	--	--	0.017	0.171	1.71	NA	NA	NA
Methylene chloride	µg/L	2027	20,274	60,821	46.4	464	4642	NA	NA	NA
PCB-1254	µg/L	13.1	131	393	45.9	459	4586	NA	NA	NA
Pentachlorophenol	µg/L	78.0	780	2339	0.607	6.07	60.7	NA	NA	NA
Pyrene	µg/L	19,654	196,538	589,615	--	--	--	NA	NA	NA
RDX	µg/L	1965	19,654	58,962	167	1668	16,676	NA	NA	NA
Tetrachloroethene	µg/L	172	1718	5154	1.01	10.1	101	NA	NA	NA
Trichloroethene	µg/L	2.9	29.0	87.0	0.161	1.61	16.1	NA	NA	NA
beta-BHC	µg/L	--	--	--	10.2	102	1019	NA	NA	NA
cis-1,2-Dichloroethene	µg/L	6551	65,513	196,538	--	--	--	NA	NA	NA
Sediment										
Inorganics										
Aluminum	mg/kg	3496	34,960	104,881	--	--	--	13,900	NA	NA
Antimony	mg/kg	175	1753	5259	--	--	--	0	NA	NA
Arsenic	mg/kg	114	1140	3419	2.78	27.8	278	19.5	NA	NA
Barium	mg/kg	351	3506	10,518	--	--	--	123	NA	NA
Cadmium	mg/kg	329	3292	9876	10.9	109	1093	0	NA	NA
Chromium (as Cr-3)	mg/kg	329,763	1.0E+06	1.0E+06	--	--	--	18.1	NA	NA
Chromium, hexavalent	mg/kg	5.61	56.1	168	1.64	16.4	164	NA	NA	NA
Copper	mg/kg	25,368	253,680	761,040	--	--	--	27.6	NA	NA
Iron	mg/kg	184,370	1.0E+06	1.0E+06	--	--	--	28,200	NA	NA
Manganese	mg/kg	35.1	351	1053	--	--	--	1950	NA	NA
Mercury	mg/kg	172	1722	5166	--	--	--	0.059	NA	NA
Nickel	mg/kg	12,639	126,391	379,174	--	--	--	17.7	NA	NA
Silver	mg/kg	3105	31,049	93,146	--	--	--	0	NA	NA
Thallium	mg/kg	47.7	477	1431	--	--	--	0.89	NA	NA
Vanadium	mg/kg	2304	23,045	69,134	--	--	--	26.1	NA	NA
Zinc	mg/kg	187,269	1.0E+06	1.0E+06	--	--	--	532	NA	NA
Organics										
2,4,6-Trinitrotoluene	mg/kg	249	2488	7463	464	4643	46,435	NA	NA	NA
2,4-Dinitrotoluene	mg/kg	652	6519	19,558	13.4	134	1342	NA	NA	NA
2-Amino-4,6-dinitrotoluene	mg/kg	124	1237	3710	--	--	--	NA	NA	NA

Table 5-8. Ravenna Facility-Wide CUGs for National Guard Trainee COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
4-Amino-2,6-dinitrotoluene	mg/kg	124	1237	3710	--	--	--	NA	NA	NA
Benz(a)anthracene	mg/kg	--	--	--	4.77	47.7	477	NA	NA	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.477	4.77	47.7	NA	NA	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	4.77	47.7	477	NA	NA	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	47.7	477	4774	NA	NA	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.477	4.77	47.7	NA	NA	NA
Dieldrin	mg/kg	29.8	298	894	0.839	8.39	83.9	NA	NA	NA
HMX	mg/kg	23,464	234,645	703,934	--	--	--	NA	NA	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	4.77	47.7	477	NA	NA	NA
Nitroglycerin	mg/kg	--	--	--	982	9818	98,183	NA	NA	NA
PCB-1016	mg/kg	19.2	192	577	3.46	34.6	346	NA	NA	NA
PCB-1254	mg/kg	5.49	54.9	165	3.46	34.6	346	NA	NA	NA
PCB-1260	mg/kg	--	--	--	3.46	34.6	346	NA	NA	NA
RDX	mg/kg	1711	17,113	51,338	145	1452	14,520	NA	NA	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA

COPC = Chemical of potential concern.
CUG = Cleanup goal across all pathways (ingestion, dermal, and inhalation).
GW = Groundwater.
HI = Hazard index.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
NA = Not available.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
-- = No CUG could be quantified based on lack of approved toxicity value.

Table 5-9. Ravenna Facility-Wide CUGs for Resident Farmer Adult COPCs

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Surface Soil										
Inorganics										
Aluminum	mg/kg	52,923	529,229	1.0E+06	--	--	--	17,700	NA	NA
Antimony	mg/kg	13.6	136	409	--	--	--	0.96	NA	NA
Arsenic	mg/kg	8.21	82.1	246	0.425	4.25	42.5	15.4	NA	NA
Barium	mg/kg	8966	89,656	268,969	--	--	--	88.4	NA	NA
Cadmium	mg/kg	22.3	223	668	1249	12,491	124,911	0	NA	NA
Chromium (as Cr-3)	mg/kg	19,694	196,942	590,827	--	--	--	17.4	NA	NA
Chromium, hexavalent	mg/kg	90.4	904	2711	187	1874	18,737	NA	NA	NA
Cobalt	mg/kg	820	8198	24,594	803	8030	80,300	10.4	NA	NA
Copper	mg/kg	2714	27,138	81,413	--	--	--	17.7	NA	NA
Iron	mg/kg	19,010	190,104	570,313	--	--	--	23,100	NA	NA
Manganese	mg/kg	1482	14,817	44,452	--	--	--	1450	NA	NA
Mercury	mg/kg	16.5	165	496	--	--	--	0.036	NA	NA
Nickel	mg/kg	1346	13,463	40,389	--	--	--	21.1	NA	NA
Nitrate	mg/kg	114,196	1.0E+06	1.0E+06	--	--	--	NA	NA	NA
Silver	mg/kg	324	3240	9719	--	--	--	0	NA	NA
Thallium	mg/kg	4.76	47.6	143	--	--	--	0	NA	NA
Vanadium	mg/kg	156	1558	4674	--	--	--	31.1	NA	NA
Zinc	mg/kg	19,659	196,589	589,767	--	--	--	61.8	NA	NA
Organics										
1,3,5-Trinitrobenzene	mg/kg	1528	15,280	45,841	--	--	--	NA	NA	NA
1,3-Dinitrobenzene	mg/kg	5.94	59.4	178	--	--	--	NA	NA	NA
2,4,6-Trinitrotoluene	mg/kg	21.1	211	633	32.8	328	3283	NA	NA	NA
2,4-Dinitrotoluene	mg/kg	43.9	439	1317	0.753	7.53	75.3	NA	NA	NA
2,6-Dinitrotoluene	mg/kg	22.4	224	672	0.769	7.69	76.9	NA	NA	NA
2-Amino-4,6-dinitrotoluene	mg/kg	12.8	128	385	--	--	--	NA	NA	NA
2-Methylnaphthalene	mg/kg	238	2378	7134	--	--	--	NA	NA	NA
2-Nitrotoluene	mg/kg	594	5945	17,834	6.03	60.3	603	NA	NA	NA
4,4'-DDE	mg/kg	--	--	--	4.08	40.8	408	NA	NA	NA
4-Amino-2,6-dinitrotoluene	mg/kg	12.8	128	385	--	--	--	NA	NA	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA	NA	NA
4-Nitrophenol	mg/kg	476	4756	14,267	--	--	--	NA	NA	NA
4-Nitrotoluene	mg/kg	594	5945	17,834	81.6	816	8159	NA	NA	NA
Aldrin	mg/kg	1.78	17.8	53.5	0.082	0.816	8.16	NA	NA	NA
Benz(a)anthracene	mg/kg	--	--	--	0.221	2.21	22.1	NA	NA	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.022	0.221	2.21	NA	NA	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	0.221	2.21	22.1	NA	NA	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	2.21	22.1	221	NA	NA	NA
Bis(2-chloroethoxy)methane	mg/kg	178	1783	5350	--	--	--	NA	NA	NA
Carbazole	mg/kg	--	--	--	69.4	694	6935	NA	NA	NA
Chrysene	mg/kg	--	--	--	22.1	221	2209	NA	NA	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.022	0.221	2.21	NA	NA	NA
Dibenzofuran	mg/kg	119	1189	3567	--	--	--	NA	NA	NA
Dieldrin	mg/kg	2.97	29.7	89.2	0.087	0.867	8.67	NA	NA	NA
Endrin	mg/kg	1.77	17.7	53.0	--	--	--	NA	NA	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA	NA	NA
Fluoranthene	mg/kg	276	2765	8294	--	--	--	NA	NA	NA
Fluorene	mg/kg	737	7366	22,099	--	--	--	NA	NA	NA
HMX	mg/kg	1909	19,090	57,270	--	--	--	NA	NA	NA
Heptachlor	mg/kg	29.7	297	892	0.308	3.08	30.8	NA	NA	NA
Heptachlor epoxide	mg/kg	0.773	7.73	23.2	0.152	1.52	15.2	NA	NA	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	0.221	2.21	22.1	NA	NA	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	0.127	1.27	12.7	NA	NA	NA

Table 5-9. Ravenna Facility-Wide CUGs for Resident Farmer Adult COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Naphthalene	mg/kg	368	3678	11,035	--	--	--	NA	NA	NA
Nitroglycerin	mg/kg	--	--	--	81.6	816	8159	NA	NA	NA
PCB-1016	mg/kg	1.22	12.2	36.6	0.203	2.03	20.3	NA	NA	NA
PCB-1248	mg/kg	--	--	--	0.203	2.03	20.3	NA	NA	NA
PCB-1254	mg/kg	0.348	3.48	10.4	0.203	2.03	20.3	NA	NA	NA
PCB-1260	mg/kg	--	--	--	0.203	2.03	20.3	NA	NA	NA
Pentachlorophenol	mg/kg	327	3269	9806	2.12	21.2	212	NA	NA	NA
Pyrene	mg/kg	207	2074	6221	--	--	--	NA	NA	NA
RDX	mg/kg	163	1632	4896	11.5	115	1154	NA	NA	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
beta-BHC	mg/kg	--	--	--	0.77	7.7	77.0	NA	NA	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
Ingestion of Foodstuffs from Surface Soil										
Inorganics										
Aluminum	mg/kg	329	3292	9875	--	--	--	NA	NA	NA
Antimony	mg/kg	0.129	1.29	3.88	--	--	--	NA	NA	NA
Arsenic	mg/kg	0.096	0.958	2.87	0.005	0.05	0.497	NA	NA	NA
Barium	mg/kg	64.5	645	1935	--	--	--	NA	NA	NA
Cadmium	mg/kg	0.201	2.01	6.04	--	--	--	NA	NA	NA
Chromium (as Cr-3)	mg/kg	478	4779	14,337	--	--	--	NA	NA	NA
Chromium, hexavalent	mg/kg	0.956	9.56	28.7	--	--	--	NA	NA	NA
Cobalt	mg/kg	6.16	61.6	185	--	--	--	NA	NA	NA
Copper	mg/kg	7.86	78.6	236	--	--	--	NA	NA	NA
Iron	mg/kg	90.4	904	2712	--	--	--	NA	NA	NA
Manganese	mg/kg	12.1	121	363	--	--	--	NA	NA	NA
Mercury	mg/kg	--	--	--	--	--	--	NA	NA	NA
Nickel	mg/kg	2.76	27.6	82.7	--	--	--	NA	NA	NA
Nitrate	mg/kg	--	--	--	--	--	--	NA	NA	NA
Silver	mg/kg	1.57	15.7	47.1	--	--	--	NA	NA	NA
Thallium	mg/kg	--	--	--	--	--	--	NA	NA	NA
Vanadium	mg/kg	2.31	23.1	69.3	--	--	--	NA	NA	NA
Zinc	mg/kg	16.9	169	507	--	--	--	NA	NA	NA
Organics										
1,3,5-Trinitrobenzene	mg/kg	1.41	14.1	42.3	--	--	--	NA	NA	NA
1,3-Dinitrobenzene	mg/kg	0.007	0.075	0.224	--	--	--	NA	NA	NA
2,4,6-Trinitrotoluene	mg/kg	0.071	0.705	2.12	0.11	1.1	11.0	NA	NA	NA
2,4-Dinitrotoluene	mg/kg	0.221	2.21	6.64	0.004	0.038	0.38	NA	NA	NA
2,6-Dinitrotoluene	mg/kg	0.083	0.825	2.48	0.003	0.028	0.283	NA	NA	NA
2-Amino-4,6-dinitrotoluene	mg/kg	--	--	--	--	--	--	NA	NA	NA
2-Methylnaphthalene	mg/kg	1.15	11.5	34.6	--	--	--	NA	NA	NA
2-Nitrotoluene	mg/kg	1.41	14.1	42.3	0.014	0.143	1.43	NA	NA	NA
4,4'-DDE	mg/kg	--	--	--	0.018	0.177	1.77	NA	NA	NA
4-Amino-2,6-dinitrotoluene	mg/kg	--	--	--	--	--	--	NA	NA	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA	NA	NA
4-Nitrophenol	mg/kg	0.805	8.05	24.1	--	--	--	NA	NA	NA
4-Nitrotoluene	mg/kg	1.53	15.3	46.0	0.211	2.11	21.1	NA	NA	NA
Aldrin	mg/kg	0.007	0.066	0.197	3.0E-04	0.003	0.03	NA	NA	NA
Benz(a)anthracene	mg/kg	--	--	--	0.008	0.083	0.827	NA	NA	NA
Benzo(a)pyrene	mg/kg	--	--	--	6.3E-04	0.006	0.063	NA	NA	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	0.006	0.063	0.634	NA	NA	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	0.024	0.243	2.43	NA	NA	NA
Bis(2-chloroethoxy)methane	mg/kg	0.158	1.58	4.74	--	--	--	NA	NA	NA
Carbazole	mg/kg	--	--	--	0.33	3.3	33.0	NA	NA	NA
Chrysene	mg/kg	--	--	--	0.827	8.27	82.7	NA	NA	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	2.4E-04	0.002	0.024	NA	NA	NA

Table 5-9. Ravenna Facility-Wide CUGs for Resident Farmer Adult COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Dibenzofuran	mg/kg	0.596	5.96	17.9	--	--	--	NA	NA	NA
Dieldrin	mg/kg	0.015	0.154	0.463	4.5E-04	0.004	0.045	NA	NA	NA
Endrin	mg/kg	0.093	0.925	2.78	--	--	--	NA	NA	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA	NA	NA
Fluoranthene	mg/kg	12.3	123	370	--	--	--	NA	NA	NA
Fluorene	mg/kg	12.2	122	366	--	--	--	NA	NA	NA
HMX	mg/kg	1.16	11.6	34.9	--	--	--	NA	NA	NA
Heptachlor	mg/kg	0.152	1.52	4.55	0.002	0.016	0.157	NA	NA	NA
Heptachlor epoxide	mg/kg	0.004	0.037	0.112	7.4E-04	0.007	0.074	NA	NA	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	0.003	0.034	0.342	NA	NA	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	2.0E-04	0.002	0.02	NA	NA	NA
Naphthalene	mg/kg	4.93	49.3	148	--	--	--	NA	NA	NA
Nitroglycerin	mg/kg	--	--	--	--	--	--	NA	NA	NA
PCB-1016	mg/kg	0.016	0.162	0.486	0.003	0.027	0.27	NA	NA	NA
PCB-1248	mg/kg	--	--	--	0.003	0.029	0.287	NA	NA	NA
PCB-1254	mg/kg	0.004	0.043	0.129	0.003	0.025	0.251	NA	NA	NA
PCB-1260	mg/kg	--	--	--	5.1E-04	0.005	0.051	NA	NA	NA
Pentachlorophenol	mg/kg	6.94	69.4	208	0.045	0.45	4.5	NA	NA	NA
Pyrene	mg/kg	9.25	92.5	278	--	--	--	NA	NA	NA
RDX	mg/kg	0.74	7.4	22.2	0.052	0.523	5.23	NA	NA	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
beta-BHC	mg/kg	--	--	--	0.004	0.038	0.379	NA	NA	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
Subsurface Soil										
Inorganics										
Aluminum	mg/kg	52,923	529,229	1.0E+06	--	--	--	19,500	NA	NA
Antimony	mg/kg	13.6	136	409	--	--	--	0.96	NA	NA
Arsenic	mg/kg	8.21	82.1	246	0.425	4.25	42.5	19.8	NA	NA
Barium	mg/kg	8966	89,656	268,969	--	--	--	124	NA	NA
Cadmium	mg/kg	22.3	223	668	1249	12,491	124,911	0	NA	NA
Chromium (as Cr-3)	mg/kg	19,694	196,942	590,827	--	--	--	27.2	NA	NA
Chromium, hexavalent	mg/kg	90.4	904	2711	187	1874	18,737	NA	NA	NA
Cobalt	mg/kg	820	8198	24,594	803	8030	80,300	23.2	NA	NA
Copper	mg/kg	2714	27,138	81,413	--	--	--	32.3	NA	NA
Iron	mg/kg	19,010	190,104	570,313	--	--	--	35,200	NA	NA
Manganese	mg/kg	1482	14,817	44,452	--	--	--	3030	NA	NA
Mercury	mg/kg	16.5	165	496	--	--	--	0.044	NA	NA
Nickel	mg/kg	1346	13,463	40,389	--	--	--	60.7	NA	NA
Nitrate	mg/kg	114,196	1.0E+06	1.0E+06	--	--	--	NA	NA	NA
Silver	mg/kg	324	3240	9719	--	--	--	0	NA	NA
Thallium	mg/kg	4.76	47.6	143	--	--	--	0.91	NA	NA
Vanadium	mg/kg	156	1558	4674	--	--	--	37.6	NA	NA
Zinc	mg/kg	19,659	196,589	589,767	--	--	--	93.3	NA	NA
Organics										
1,3,5-Trinitrobenzene	mg/kg	1528	15,280	45,841	--	--	--	NA	NA	NA
1,3-Dinitrobenzene	mg/kg	5.94	59.4	178	--	--	--	NA	NA	NA
2,4,6-Trinitrotoluene	mg/kg	21.1	211	633	32.8	328	3283	NA	NA	NA
2,4-Dinitrotoluene	mg/kg	43.9	439	1317	0.753	7.53	75.3	NA	NA	NA
2,6-Dinitrotoluene	mg/kg	22.4	224	672	0.769	7.69	76.9	NA	NA	NA
2-Amino-4,6-dinitrotoluene	mg/kg	12.8	128	385	--	--	--	NA	NA	NA
2-Methylnaphthalene	mg/kg	238	2378	7134	--	--	--	NA	NA	NA
2-Nitrotoluene	mg/kg	594	5945	17,834	6.03	60.3	603	NA	NA	NA
4,4'-DDE	mg/kg	--	--	--	4.08	40.8	408	NA	NA	NA
4-Amino-2,6-dinitrotoluene	mg/kg	12.8	128	385	--	--	--	NA	NA	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA	NA	NA

Table 5-9. Ravenna Facility-Wide CUGs for Resident Farmer Adult COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
4-Nitrophenol	mg/kg	476	4756	14,267	--	--	--	NA	NA	NA
4-Nitrotoluene	mg/kg	594	5945	17,834	81.6	816	8159	NA	NA	NA
Aldrin	mg/kg	1.78	17.8	53.5	0.082	0.816	8.16	NA	NA	NA
Benz(a)anthracene	mg/kg	--	--	--	0.221	2.21	22.1	NA	NA	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.022	0.221	2.21	NA	NA	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	0.221	2.21	22.1	NA	NA	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	2.21	22.1	221	NA	NA	NA
Bis(2-chloroethoxy)methane	mg/kg	178	1783	5350	--	--	--	NA	NA	NA
Carbazole	mg/kg	--	--	--	69.4	694	6935	NA	NA	NA
Chrysene	mg/kg	--	--	--	22.1	221	2209	NA	NA	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.022	0.221	2.21	NA	NA	NA
Dibenzofuran	mg/kg	119	1189	3567	--	--	--	NA	NA	NA
Dieldrin	mg/kg	2.97	29.7	89.2	0.087	0.867	8.67	NA	NA	NA
Endrin	mg/kg	1.77	17.7	53.0	--	--	--	NA	NA	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA	NA	NA
Fluoranthene	mg/kg	276	2765	8294	--	--	--	NA	NA	NA
Fluorene	mg/kg	737	7366	22,099	--	--	--	NA	NA	NA
HMX	mg/kg	1909	19,090	57,270	--	--	--	NA	NA	NA
Heptachlor	mg/kg	29.7	297	892	0.308	3.08	30.8	NA	NA	NA
Heptachlor epoxide	mg/kg	0.773	7.73	23.2	0.152	1.52	15.2	NA	NA	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	0.221	2.21	22.1	NA	NA	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	0.127	1.27	12.7	NA	NA	NA
Naphthalene	mg/kg	368	3678	11,035	--	--	--	NA	NA	NA
Nitroglycerin	mg/kg	--	--	--	81.6	816	8159	NA	NA	NA
PCB-1016	mg/kg	1.22	12.2	36.6	0.203	2.03	20.3	NA	NA	NA
PCB-1248	mg/kg	--	--	--	0.203	2.03	20.3	NA	NA	NA
PCB-1254	mg/kg	0.348	3.48	10.4	0.203	2.03	20.3	NA	NA	NA
PCB-1260	mg/kg	--	--	--	0.203	2.03	20.3	NA	NA	NA
Pentachlorophenol	mg/kg	327	3269	9806	2.12	21.2	212	NA	NA	NA
Pyrene	mg/kg	207	2074	6221	--	--	--	NA	NA	NA
RDX	mg/kg	163	1632	4896	11.5	115	1154	NA	NA	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
beta-BHC	mg/kg	--	--	--	0.77	7.7	77.0	NA	NA	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
Groundwater										
Inorganics										
Aluminum	µg/L	3564	35,636	106,907	--	--	--	NA	48,000	9410
Antimony	µg/L	1.3	13.0	39.1	--	--	--	NA	4.3	0
Arsenic	µg/L	1.09	10.9	32.7	0.056	0.564	5.64	NA	215	19.1
Barium	µg/L	706	7056	21,167	--	--	--	NA	327	241
Cadmium	µg/L	1.47	14.7	44.1	--	--	--	NA	0	0
Chromium (as Cr-3)	µg/L	3687	36,869	110,606	--	--	--	NA	85.2	19.5
Cobalt	µg/L	72.9	729	2188	--	--	--	NA	46.3	0
Iron	µg/L	1078	10,776	32,327	--	--	--	NA	195,000	21,500
Manganese	µg/L	158	1583	4749	--	--	--	NA	2860	1260
Nickel	µg/L	72.9	729	2186	--	--	--	NA	117	85.3
Nitrate	µg/L	5826	58,259	174,776	--	--	--	NA	NA	NA
Thallium	µg/L	0.291	2.91	8.74	--	--	--	NA	2.4	0
Vanadium	µg/L	20.6	206	617	--	--	--	NA	98.1	15.5
Zinc	µg/L	1087	10,871	32,613	--	--	--	NA	888	193
Organics										
1,1,2,2-Tetrachloroethane	µg/L	201	2011	6032	0.069	0.691	6.91	NA	NA	NA
1,2-Dichloroethane	µg/L	70.6	706	2117	0.155	1.55	15.5	NA	NA	NA
1,3-Dinitrobenzene	µg/L	0.365	3.65	11.0	--	--	--	NA	NA	NA

Table 5-9. Ravenna Facility-Wide CUGs for Resident Farmer Adult COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
2,4,6-Trinitrotoluene	µg/L	1.83	18.3	54.8	2.84	28.4	284	NA	NA	NA
2,4-Dinitrotoluene	µg/L	6.99	69.9	210	0.12	1.2	12.0	NA	NA	NA
2,6-Dinitrotoluene	µg/L	3.54	35.4	106	0.122	1.22	12.2	NA	NA	NA
2-Amino-4,6-dinitrotoluene	µg/L	0.73	7.3	21.9	--	--	--	NA	NA	NA
2-Nitrotoluene	µg/L	36.5	365	1095	0.37	3.7	37.0	NA	NA	NA
4,4'-DDD	µg/L	1.22	12.2	36.6	0.059	0.594	5.94	NA	NA	NA
4,4'-DDE	µg/L	--	--	--	0.047	0.467	4.67	NA	NA	NA
4,4'-DDT	µg/L	0.199	1.99	5.96	0.027	0.273	2.73	NA	NA	NA
4-Amino-2,6-dinitrotoluene	µg/L	0.73	7.3	21.9	--	--	--	NA	NA	NA
4-Nitrobenzenamine	µg/L	11.0	109.5	328.5	4.06	40.6	406	NA	NA	NA
4-Nitrotoluene	µg/L	36.5	365	1095	5.01	50.1	501	NA	NA	NA
Aldrin	µg/L	0.103	1.03	3.09	0.005	0.047	0.471	NA	NA	NA
Benz(a)anthracene	µg/L	--	--	--	0.004	0.039	0.389	NA	NA	NA
Benzene	µg/L	4.24	42.4	127	0.431	4.31	43.1	NA	NA	NA
Benzo(a)pyrene	µg/L	--	--	--	2.3E-04	0.002	0.023	NA	NA	NA
Benzo(b)fluoranthene	µg/L	--	--	--	0.002	0.023	0.227	NA	NA	NA
Bis(2-ethylhexyl)phthalate	µg/L	10.8	108	324	0.9	9.0	90.0	NA	NA	NA
Carbon tetrachloride	µg/L	2.15	21.5	64.4	0.204	2.04	20.4	NA	NA	NA
Chloroform	µg/L	27.6	276	828	0.207	2.07	20.7	NA	NA	NA
Dibenz(a,h)anthracene	µg/L	--	--	--	1.5E-04	0.002	0.015	NA	NA	NA
Dieldrin	µg/L	0.122	1.22	3.67	0.004	0.036	0.357	NA	NA	NA
Heptachlor	µg/L	1.37	13.7	41.0	0.014	0.142	1.42	NA	NA	NA
Heptachlor epoxide	µg/L	0.047	0.475	1.42	0.009	0.094	0.936	NA	NA	NA
Indeno(1,2,3-cd)pyrene	µg/L	--	--	--	0.002	0.023	0.227	NA	NA	NA
Lindane	µg/L	0.853	8.53	25.6	0.051	0.51	5.1	NA	NA	NA
Methylene chloride	µg/L	159	1591	4773	5.34	53.4	534	NA	NA	NA
Nitrobenzene	µg/L	1.83	18.3	54.8	--	--	--	NA	NA	NA
Nitroglycerin	µg/L	--	--	--	5.01	50.1	501	NA	NA	NA
PCB-1242	µg/L	--	--	--	0.213	2.13	21.3	NA	NA	NA
PCB-1254	µg/L	0.073	0.73	2.19	0.213	2.13	21.3	NA	NA	NA
PCB-1260	µg/L	--	--	--	0.213	2.13	21.3	NA	NA	NA
Pentachlorophenol	µg/L	11.4	114	343	0.074	0.74	7.4	NA	NA	NA
RDX	µg/L	11.0	110	329	0.774	7.74	77.4	NA	NA	NA
Tetrachloroethene	µg/L	21.3	213	639	0.098	0.977	9.77	NA	NA	NA
Toxaphene	µg/L	--	--	--	0.048	0.481	4.81	NA	NA	NA
Trichloroethene	µg/L	0.562	5.62	16.9	0.031	0.312	3.12	NA	NA	NA
alpha-BHC	µg/L	--	--	--	0.014	0.135	1.35	NA	NA	NA
beta-BHC	µg/L	--	--	--	0.047	0.473	4.73	NA	NA	NA
Surface Water										
Inorganics										
Aluminum	µg/L	63,895	638,950	1.9E+06	--	--	--	3370	NA	NA
Antimony	µg/L	17.1	171	512	--	--	--	0	NA	NA
Arsenic	µg/L	21.2	212	635	1.1	11.0	110	3.2	NA	NA
Barium	µg/L	12,131	121,306	363,917	--	--	--	47.5	NA	NA
Cadmium	µg/L	15.1	151	452	--	--	--	0	NA	NA
Chromium (as Cr-3)	µg/L	28,442	284,416	853,247	--	--	--	0	NA	NA
Chromium, hexavalent	µg/L	90.3	903	2709	--	--	--	NA	NA	NA
Copper	µg/L	2788	27,876	83,628	--	--	--	7.9	NA	NA
Iron	µg/L	20,000	200,000	600,000	--	--	--	2560	NA	NA
Manganese	µg/L	2476	24,759	74,278	--	--	--	391	NA	NA
Mercury	µg/L	18.2	182	546	--	--	--	0	NA	NA
Nickel	µg/L	1445	14,447	43,342	--	--	--	0	NA	NA

Table 5-9. Ravenna Facility-Wide CUGs for Resident Farmer Adult COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Nitrate	µg/L	115,159	1.2E+06	3.5E+06	--	--	--	NA	NA	NA
Silver	µg/L	348	3484	10,453	--	--	--	0	NA	NA
Thallium	µg/L	5.76	57.6	173	--	--	--	0	NA	NA
Vanadium	µg/L	211	2107	6322	--	--	--	0	NA	NA
Zinc	µg/L	21,002	210,022	630,065	--	--	--	42	NA	NA
Organics										
1,1,2,2-Tetrachloroethane	µg/L	2874	28,737	86,211	0.853	8.53	85.3	NA	NA	NA
1,2-Dichloroethene	µg/L	480	4799	14,398	--	--	--	NA	NA	NA
1,4-Dichlorobenzene	µg/L	--	--	--	18.7	187	1874	NA	NA	NA
2,4,6-Trinitrotoluene	µg/L	36.5	365	1095	56.8	568	5678	NA	NA	NA
2,4-Dimethylphenol	µg/L	899	8985	26,956	--	--	--	NA	NA	NA
2,4-Dinitrotoluene	µg/L	116	1160	3481	1.99	19.9	199	NA	NA	NA
2,6-Dinitrotoluene	µg/L	62.1	621	1864	2.13	21.3	213	NA	NA	NA
2-Amino-4,6-dinitrotoluene	µg/L	14.6	146	438	--	--	--	NA	NA	NA
2-Nitrotoluene	µg/L	730	7300	21,900	7.41	74.1	741	NA	NA	NA
4,4'-DDT	µg/L	0.743	7.43	22.3	0.102	1.02	10.2	NA	NA	NA
4-Amino-2,6-dinitrotoluene	µg/L	14.6	146	438	--	--	--	NA	NA	NA
4-Methylphenol	µg/L	261	2611	7834	--	--	--	NA	NA	NA
4-Nitrotoluene	µg/L	730	7300	21,900	100	1002	10,020	NA	NA	NA
Aldrin	µg/L	1.59	15.9	47.6	0.073	0.726	7.26	NA	NA	NA
Benz(a)anthracene	µg/L	--	--	--	0.014	0.136	1.36	NA	NA	NA
Benzo(a)pyrene	µg/L	--	--	--	8.0E-04	0.008	0.08	NA	NA	NA
Benzo(b)fluoranthene	µg/L	--	--	--	0.008	0.079	0.786	NA	NA	NA
Benzo(k)fluoranthene	µg/L	--	--	--	23.3	233	2333	NA	NA	NA
Bis(2-ethylhexyl)phthalate	µg/L	41.9	419	1258	3.49	34.9	349	NA	NA	NA
Chloroform	µg/L	252	2523	7568	2.47	24.7	247	NA	NA	NA
Chrysene	µg/L	--	--	--	1.36	13.6	136	NA	NA	NA
Dibenz(a,h)anthracene	µg/L	--	--	--	5.2E-04	0.005	0.052	NA	NA	NA
HMX	µg/L	3650	36,500	109,500	--	--	--	NA	NA	NA
Heptachlor epoxide	µg/L	0.949	9.49	28.5	0.187	1.87	18.7	NA	NA	NA
Indeno(1,2,3-cd)pyrene	µg/L	--	--	--	0.008	0.078	0.785	NA	NA	NA
Methylene chloride	µg/L	2518	25,181	75,544	76.0	760	7597	NA	NA	NA
PCB-1254	µg/L	1.46	14.6	43.8	4.26	42.6	426	NA	NA	NA
Pentachlorophenol	µg/L	42.6	426	1277	0.276	2.76	27.6	NA	NA	NA
Pyrene	µg/L	2190	21,900	65,700	--	--	--	NA	NA	NA
RDX	µg/L	219	2190	6570	15.5	155	1548	NA	NA	NA
Tetrachloroethene	µg/L	184	1840	5520	0.83	8.3	83.0	NA	NA	NA
Trichloroethene	µg/L	3.64	36.4	109	0.301	3.01	30.1	NA	NA	NA
beta-BHC	µg/L	--	--	--	0.946	9.46	94.6	NA	NA	NA
cis-1,2-Dichloroethene	µg/L	730	7300	21,900	--	--	--	NA	NA	NA
Sediment										
Inorganics										
Aluminum	mg/kg	52,923	529,229	1.0E+06	--	--	--	13,900	NA	NA
Antimony	mg/kg	13.6	136	409	--	--	--	0	NA	NA
Arsenic	mg/kg	8.21	82.1	246	0.425	4.25	42.5	19.5	NA	NA
Barium	mg/kg	8966	89,656	268,969	--	--	--	123	NA	NA
Cadmium	mg/kg	22.3	223	668	1249	12,491	124,911	0	NA	NA
Chromium (as Cr-3)	mg/kg	19,694	196,942	590,827	--	--	--	18.1	NA	NA
Chromium, hexavalent	mg/kg	90.4	904	2711	187	1874	18,737	NA	NA	NA
Copper	mg/kg	2714	27,138	81,413	--	--	--	27.6	NA	NA
Iron	mg/kg	19,010	190,104	570,313	--	--	--	28,200	NA	NA
Manganese	mg/kg	1482	14,817	44,452	--	--	--	1950	NA	NA
Mercury	mg/kg	16.5	165	496	--	--	--	0.059	NA	NA

Table 5-9. Ravenna Facility-Wide CUGs for Resident Farmer Adult COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Nickel	mg/kg	1346	13,463	40,389	--	--	--	17.7	NA	NA
Silver	mg/kg	324	3240	9719	--	--	--	0	NA	NA
Thallium	mg/kg	4.76	47.6	143	--	--	--	0.89	NA	NA
Vanadium	mg/kg	156	1558	4674	--	--	--	26.1	NA	NA
Zinc	mg/kg	19,659	196,589	589,767	--	--	--	532	NA	NA
Organics										
2,4,6-Trinitrotoluene	mg/kg	21.1	211	633	32.8	328	3283	NA	NA	NA
2,4-Dinitrotoluene	mg/kg	43.9	439	1317	0.753	7.53	75.3	NA	NA	NA
2-Amino-4,6-dinitrotoluene	mg/kg	12.8	128	385	--	--	--	NA	NA	NA
4-Amino-2,6-dinitrotoluene	mg/kg	12.8	128	385	--	--	--	NA	NA	NA
Benz(a)anthracene	mg/kg	--	--	--	0.221	2.21	22.1	NA	NA	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.022	0.221	2.21	NA	NA	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	0.221	2.21	22.1	NA	NA	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	2.21	22.1	221	NA	NA	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.022	0.221	2.21	NA	NA	NA
Dieldrin	mg/kg	2.97	29.7	89.2	0.087	0.867	8.67	NA	NA	NA
HMX	mg/kg	1909	19,090	57,270	--	--	--	NA	NA	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	0.221	2.21	22.1	NA	NA	NA
Nitroglycerin	mg/kg	--	--	--	81.6	816	8159	NA	NA	NA
PCB-1016	mg/kg	1.22	12.2	36.6	0.203	2.03	20.3	NA	NA	NA
PCB-1254	mg/kg	0.348	3.48	10.4	0.203	2.03	20.3	NA	NA	NA
PCB-1260	mg/kg	--	--	--	0.203	2.03	20.3	NA	NA	NA
RDX	mg/kg	163	1632	4896	11.5	115	1154	NA	NA	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA

COPC = Chemical of potential concern.
CUG = Cleanup goal across all pathways (ingestion, dermal, and inhalation).
GW = Groundwater.
HI = Hazard index.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
NA = Not available.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
-- = No CUG could be quantified based on lack of approved toxicity value.

Table 5-10. Ravenna Facility-Wide CUGs for Resident Farmer Child COPCs

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Surface Soil										
Inorganics										
Aluminum	mg/kg	7380	73,798	221,394	--	--	--	17,700	NA	NA
Antimony	mg/kg	2.82	28.2	84.6	--	--	--	0.96	NA	NA
Arsenic	mg/kg	2.02	20.2	60.6	0.524	5.24	52.4	15.4	NA	NA
Barium	mg/kg	1413	14,129	42,388	--	--	--	88.4	NA	NA
Cadmium	mg/kg	6.41	64.1	192	2677	26,767	267,667	0	NA	NA
Chromium (as Cr-3)	mg/kg	8147	81,473	244,420	--	--	--	17.4	NA	NA
Chromium, hexavalent	mg/kg	19.9	199	596	401.5	4015	40,150	NA	NA	NA
Cobalt	mg/kg	131	1313	3938	1721	17,207	172,071	10.4	NA	NA
Copper	mg/kg	311	3106	9317	--	--	--	17.7	NA	NA
Iron	mg/kg	2313	23,125	69,375	--	--	--	23,100	NA	NA
Manganese	mg/kg	293	2927	8782	--	--	--	1450	NA	NA
Mercury	mg/kg	2.27	22.7	68.2	--	--	--	0.036	NA	NA
Nickel	mg/kg	155	1552	4655	--	--	--	21.1	NA	NA
Nitrate	mg/kg	12,487	124,868	374,604	--	--	--	NA	NA	NA
Silver	mg/kg	38.6	386	1159	--	--	--	0	NA	NA
Thallium	mg/kg	0.612	6.12	18.4	--	--	--	0	NA	NA
Vanadium	mg/kg	44.9	449	1346	--	--	--	31.1	NA	NA
Zinc	mg/kg	2321	23,209	69,627	--	--	--	61.8	NA	NA
Organics										
1,3,5-Trinitrobenzene	mg/kg	225	2252	6757	--	--	--	NA	NA	NA
1,3-Dinitrobenzene	mg/kg	0.765	7.65	23.0	--	--	--	NA	NA	NA
2,4,6-Trinitrotoluene	mg/kg	3.65	36.5	110	28.4	284	2842	NA	NA	NA
2,4-Dinitrotoluene	mg/kg	12.8	128	383	1.1	11.0	110	NA	NA	NA
2,6-Dinitrotoluene	mg/kg	6.42	64.2	193	1.1	11.0	110	NA	NA	NA
2-Amino-4,6-dinitrotoluene	mg/kg	1.54	15.4	46.3	--	--	--	NA	NA	NA
2-Methylnaphthalene	mg/kg	30.6	306	918	--	--	--	NA	NA	NA
2-Nitrotoluene	mg/kg	76.5	765	2296	3.88	38.8	388	NA	NA	NA
4,4'-DDE	mg/kg	--	--	--	2.63	26.3	263	NA	NA	NA
4-Amino-2,6-dinitrotoluene	mg/kg	1.54	15.4	46.3	--	--	--	NA	NA	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA	NA	NA
4-Nitrophenol	mg/kg	61.2	612	1837	--	--	--	NA	NA	NA
4-Nitrotoluene	mg/kg	76.5	765	2296	52.5	525	5252	NA	NA	NA
Aldrin	mg/kg	0.23	2.3	6.89	0.053	0.525	5.25	NA	NA	NA
Benz(a)anthracene	mg/kg	--	--	--	0.65	6.5	65.0	NA	NA	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.065	0.65	6.5	NA	NA	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	0.65	6.5	65.0	NA	NA	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	6.5	65.0	650	NA	NA	NA
Bis(2-chloroethoxy)methane	mg/kg	23.0	230	689	--	--	--	NA	NA	NA
Carbazole	mg/kg	--	--	--	44.6	446	4464	NA	NA	NA
Chrysene	mg/kg	--	--	--	65.0	650	6502	NA	NA	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.065	0.65	6.5	NA	NA	NA
Dibenzofuran	mg/kg	15.3	153	459	--	--	--	NA	NA	NA
Dieldrin	mg/kg	0.383	3.83	11.5	0.056	0.558	5.58	NA	NA	NA
Endrin	mg/kg	1.12	11.2	33.5	--	--	--	NA	NA	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA	NA	NA
Fluoranthene	mg/kg	163	1627	4882	--	--	--	NA	NA	NA
Fluorene	mg/kg	243	2433	7298	--	--	--	NA	NA	NA
HMX	mg/kg	359	3594	10,783	--	--	--	NA	NA	NA
Heptachlor	mg/kg	3.83	38.3	115	0.198	1.98	19.8	NA	NA	NA
Heptachlor epoxide	mg/kg	0.099	0.995	2.98	0.098	0.981	9.81	NA	NA	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	0.65	6.5	65.0	NA	NA	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	0.12	1.2	12.0	NA	NA	NA
Naphthalene	mg/kg	122	1215	3646	--	--	--	NA	NA	NA

Table 5-10. Ravenna Facility-Wide CUGs for Resident Farmer Child COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Nitroglycerin	mg/kg	--	--	--	52.5	525	5252	NA	NA	NA
PCB-1016	mg/kg	0.419	4.19	12.6	0.349	3.49	34.9	NA	NA	NA
PCB-1248	mg/kg	--	--	--	0.349	3.49	34.9	NA	NA	NA
PCB-1254	mg/kg	0.12	1.2	3.59	0.349	3.49	34.9	NA	NA	NA
PCB-1260	mg/kg	--	--	--	0.349	3.49	34.9	NA	NA	NA
Pentachlorophenol	mg/kg	151	1514	4541	4.91	49.1	491	NA	NA	NA
Pyrene	mg/kg	122	1220	3661	--	--	--	NA	NA	NA
RDX	mg/kg	22.7	227	681	8.03	80.3	803	NA	NA	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
beta-BHC	mg/kg	--	--	--	0.496	4.96	49.6	NA	NA	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
Ingestion of Foodstuffs from Surface Soil										
Inorganics										
Aluminum	mg/kg	70.1	701	2102	--	--	--	NA	NA	NA
Antimony	mg/kg	0.028	0.277	0.831	--	--	--	NA	NA	NA
Arsenic	mg/kg	0.02	0.205	0.614	0.005	0.053	0.531	NA	NA	NA
Barium	mg/kg	13.6	136	407	--	--	--	NA	NA	NA
Cadmium	mg/kg	0.041	0.41	1.23	--	--	--	NA	NA	NA
Chromium (as Cr-3)	mg/kg	102	1024	3071	--	--	--	NA	NA	NA
Chromium, hexavalent	mg/kg	0.205	2.05	6.14	--	--	--	NA	NA	NA
Cobalt	mg/kg	1.32	13.2	39.5	--	--	--	NA	NA	NA
Copper	mg/kg	1.54	15.4	46.1	--	--	--	NA	NA	NA
Iron	mg/kg	19.4	194	581	--	--	--	NA	NA	NA
Manganese	mg/kg	2.59	25.9	77.7	--	--	--	NA	NA	NA
Mercury	mg/kg	--	--	--	--	--	--	NA	NA	NA
Nickel	mg/kg	0.444	4.44	13.3	--	--	--	NA	NA	NA
Nitrate	mg/kg	--	--	--	--	--	--	NA	NA	NA
Silver	mg/kg	0.334	3.34	10.0	--	--	--	NA	NA	NA
Thallium	mg/kg	--	--	--	--	--	--	NA	NA	NA
Vanadium	mg/kg	0.494	4.94	14.8	--	--	--	NA	NA	NA
Zinc	mg/kg	2.99	29.9	89.6	--	--	--	NA	NA	NA
Organics										
1,3,5-Trinitrobenzene	mg/kg	0.302	3.02	9.07	--	--	--	NA	NA	NA
1,3-Dinitrobenzene	mg/kg	0.002	0.016	0.048	--	--	--	NA	NA	NA
2,4,6-Trinitrotoluene	mg/kg	0.015	0.151	0.453	0.118	1.18	11.8	NA	NA	NA
2,4-Dinitrotoluene	mg/kg	0.047	0.475	1.42	0.004	0.041	0.407	NA	NA	NA
2,6-Dinitrotoluene	mg/kg	0.018	0.177	0.531	0.003	0.03	0.303	NA	NA	NA
2-Amino-4,6-dinitrotoluene	mg/kg	--	--	--	--	--	--	NA	NA	NA
2-Methylnaphthalene	mg/kg	0.246	2.46	7.39	--	--	--	NA	NA	NA
2-Nitrotoluene	mg/kg	0.302	3.02	9.07	0.015	0.153	1.53	NA	NA	NA
4,4'-DDE	mg/kg	--	--	--	0.017	0.172	1.72	NA	NA	NA
4-Amino-2,6-dinitrotoluene	mg/kg	--	--	--	--	--	--	NA	NA	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA	NA	NA
4-Nitrophenol	mg/kg	0.172	1.72	5.17	--	--	--	NA	NA	NA
4-Nitrotoluene	mg/kg	0.329	3.29	9.86	0.226	2.26	22.6	NA	NA	NA
Aldrin	mg/kg	0.001	0.014	0.042	3.2E-04	0.003	0.032	NA	NA	NA
Benz(a)anthracene	mg/kg	--	--	--	0.008	0.08	0.799	NA	NA	NA
Benzo(a)pyrene	mg/kg	--	--	--	5.7E-04	0.006	0.057	NA	NA	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	0.006	0.057	0.565	NA	NA	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	0.019	0.188	1.88	NA	NA	NA
Bis(2-chloroethoxy)methane	mg/kg	0.034	0.339	1.02	--	--	--	NA	NA	NA
Carbazole	mg/kg	--	--	--	0.353	3.53	35.3	NA	NA	NA
Chrysene	mg/kg	--	--	--	0.799	7.99	79.9	NA	NA	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	1.9E-04	0.002	0.019	NA	NA	NA
Dibenzofuran	mg/kg	0.127	1.27	3.82	--	--	--	NA	NA	NA

Table 5-10. Ravenna Facility-Wide CUGs for Resident Farmer Child COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Dieldrin	mg/kg	0.003	0.033	0.098	4.8E-04	0.005	0.048	NA	NA	NA
Endrin	mg/kg	0.02	0.196	0.588	--	--	--	NA	NA	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA	NA	NA
Fluoranthene	mg/kg	2.59	25.9	77.6	--	--	--	NA	NA	NA
Fluorene	mg/kg	2.6	26.0	77.9	--	--	--	NA	NA	NA
HMX	mg/kg	0.249	2.49	7.48	--	--	--	NA	NA	NA
Heptachlor	mg/kg	0.032	0.323	0.968	0.002	0.017	0.167	NA	NA	NA
Heptachlor epoxide	mg/kg	7.6E-04	0.008	0.023	7.5E-04	0.007	0.075	NA	NA	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	0.003	0.027	0.275	NA	NA	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	2.1E-04	0.002	0.021	NA	NA	NA
Naphthalene	mg/kg	1.06	10.6	31.7	--	--	--	NA	NA	NA
Nitroglycerin	mg/kg	--	--	--	--	--	--	NA	NA	NA
PCB-1016	mg/kg	0.003	0.03	0.091	0.003	0.025	0.251	NA	NA	NA
PCB-1248	mg/kg	--	--	--	0.003	0.027	0.273	NA	NA	NA
PCB-1254	mg/kg	7.9E-04	0.008	0.024	0.002	0.023	0.229	NA	NA	NA
PCB-1260	mg/kg	--	--	--	3.8E-04	0.004	0.038	NA	NA	NA
Pentachlorophenol	mg/kg	1.29	12.9	38.8	0.042	0.419	4.19	NA	NA	NA
Pyrene	mg/kg	1.94	19.4	58.2	--	--	--	NA	NA	NA
RDX	mg/kg	0.158	1.58	4.75	0.056	0.56	5.6	NA	NA	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
beta-BHC	mg/kg	--	--	--	0.004	0.04	0.405	NA	NA	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
Subsurface Soil										
Inorganics										
Aluminum	mg/kg	7380	73,798	221,394	--	--	--	19,500	NA	NA
Antimony	mg/kg	2.82	28.2	84.6	--	--	--	0.96	NA	NA
Arsenic	mg/kg	2.02	20.2	60.6	0.524	5.24	52.4	19.8	NA	NA
Barium	mg/kg	1413	14,129	42,388	--	--	--	124	NA	NA
Cadmium	mg/kg	6.41	64.1	192	2677	26,767	267,667	0	NA	NA
Chromium (as Cr-3)	mg/kg	8147	81,473	244,420	--	--	--	27.2	NA	NA
Chromium, hexavalent	mg/kg	19.9	199	596	401.5	4015	40,150	NA	NA	NA
Cobalt	mg/kg	131	1313	3938	1721	17,207	172,071	23.2	NA	NA
Copper	mg/kg	311	3106	9317	--	--	--	32.3	NA	NA
Iron	mg/kg	2313	23,125	69,375	--	--	--	35,200	NA	NA
Manganese	mg/kg	293	2927	8782	--	--	--	3030	NA	NA
Mercury	mg/kg	2.27	22.7	68.2	--	--	--	0.044	NA	NA
Nickel	mg/kg	155	1552	4655	--	--	--	60.7	NA	NA
Nitrate	mg/kg	12,487	124,868	374,604	--	--	--	NA	NA	NA
Silver	mg/kg	38.6	386	1159	--	--	--	0	NA	NA
Thallium	mg/kg	0.612	6.12	18.4	--	--	--	0.91	NA	NA
Vanadium	mg/kg	44.9	449	1346	--	--	--	37.6	NA	NA
Zinc	mg/kg	2321	23,209	69,627	--	--	--	93.3	NA	NA
Organics										
1,3,5-Trinitrobenzene	mg/kg	225	2252	6757	--	--	--	NA	NA	NA
1,3-Dinitrobenzene	mg/kg	0.765	7.65	23.0	--	--	--	NA	NA	NA
2,4,6-Trinitrotoluene	mg/kg	3.65	36.5	110	28.4	284	2842	NA	NA	NA
2,4-Dinitrotoluene	mg/kg	12.8	128	383	1.1	11.0	110	NA	NA	NA
2,6-Dinitrotoluene	mg/kg	6.42	64.2	193	1.1	11.0	110	NA	NA	NA
2-Amino-4,6-dinitrotoluene	mg/kg	1.54	15.4	46.3	--	--	--	NA	NA	NA
2-Methylnaphthalene	mg/kg	30.6	306	918	--	--	--	NA	NA	NA
2-Nitrotoluene	mg/kg	76.5	765	2296	3.88	38.8	388	NA	NA	NA
4,4'-DDE	mg/kg	--	--	--	2.63	26.3	263	NA	NA	NA
4-Amino-2,6-dinitrotoluene	mg/kg	1.54	15.4	46.3	--	--	--	NA	NA	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA	NA	NA
4-Nitrophenol	mg/kg	61.2	612	1837	--	--	--	NA	NA	NA

Table 5-10. Ravenna Facility-Wide CUGs for Resident Farmer Child COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
4-Nitrotoluene	mg/kg	76.5	765	2296	52.5	525	5252	NA	NA	NA
Aldrin	mg/kg	0.23	2.3	6.89	0.053	0.525	5.25	NA	NA	NA
Benz(a)anthracene	mg/kg	--	--	--	0.65	6.5	65.0	NA	NA	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.065	0.65	6.5	NA	NA	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	0.65	6.5	65.0	NA	NA	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	6.5	65.0	650	NA	NA	NA
Bis(2-chloroethoxy)methane	mg/kg	23.0	230	689	--	--	--	NA	NA	NA
Carbazole	mg/kg	--	--	--	44.6	446	4464	NA	NA	NA
Chrysene	mg/kg	--	--	--	65.0	650	6502	NA	NA	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.065	0.65	6.5	NA	NA	NA
Dibenzofuran	mg/kg	15.3	153	459	--	--	--	NA	NA	NA
Dieldrin	mg/kg	0.383	3.83	11.5	0.056	0.558	5.58	NA	NA	NA
Endrin	mg/kg	1.12	11.2	33.5	--	--	--	NA	NA	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA	NA	NA
Fluoranthene	mg/kg	163	1627	4882	--	--	--	NA	NA	NA
Fluorene	mg/kg	243	2433	7298	--	--	--	NA	NA	NA
HMX	mg/kg	359	3594	10,783	--	--	--	NA	NA	NA
Heptachlor	mg/kg	3.83	38.3	115	0.198	1.98	19.8	NA	NA	NA
Heptachlor epoxide	mg/kg	0.099	0.995	2.98	0.098	0.981	9.81	NA	NA	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	0.65	6.5	65.0	NA	NA	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	0.12	1.2	12.0	NA	NA	NA
Naphthalene	mg/kg	122	1215	3646	--	--	--	NA	NA	NA
Nitroglycerin	mg/kg	--	--	--	52.5	525	5252	NA	NA	NA
PCB-1016	mg/kg	0.419	4.19	12.6	0.349	3.49	34.9	NA	NA	NA
PCB-1248	mg/kg	--	--	--	0.349	3.49	34.9	NA	NA	NA
PCB-1254	mg/kg	0.12	1.2	3.59	0.349	3.49	34.9	NA	NA	NA
PCB-1260	mg/kg	--	--	--	0.349	3.49	34.9	NA	NA	NA
Pentachlorophenol	mg/kg	151	1514	4541	4.91	49.1	491	NA	NA	NA
Pyrene	mg/kg	122	1220	3661	--	--	--	NA	NA	NA
RDX	mg/kg	22.7	227	681	8.03	80.3	803	NA	NA	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
beta-BHC	mg/kg	--	--	--	0.496	4.96	49.6	NA	NA	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
Groundwater										
Inorganics										
Aluminum	µg/L	1028	10,280	30,841	--	--	--	NA	48,000	9410
Antimony	µg/L	0.389	3.89	11.7	--	--	--	NA	4.3	0
Arsenic	µg/L	0.312	3.12	9.35	0.081	0.808	8.08	NA	215	19.1
Barium	µg/L	204	2044	6131	--	--	--	NA	327	241
Cadmium	µg/L	0.456	4.56	13.7	--	--	--	NA	0	0
Chromium (as Cr-3)	µg/L	1214	12,139	36,416	--	--	--	NA	85.2	19.5
Cobalt	µg/L	20.8	208	625	--	--	--	NA	46.3	0
Iron	µg/L	310	3099	9296	--	--	--	NA	195,000	21,500
Manganese	µg/L	46.3	463	1389	--	--	--	NA	2860	1260
Nickel	µg/L	20.8	208	625	--	--	--	NA	117	85.3
Nitrate	µg/L	1666	16,662	49,985	--	--	--	NA	NA	NA
Thallium	µg/L	0.083	0.833	2.5	--	--	--	NA	2.4	0
Vanadium	µg/L	6.38	63.8	191	--	--	--	NA	98.1	15.5
Zinc	µg/L	312	3115	9345	--	--	--	NA	888	193
Organics										
1,1,2,2-Tetrachloroethane	µg/L	59.4	594	1783	0.137	1.37	13.7	NA	NA	NA
1,2-Dichloroethane	µg/L	20.4	204	613	0.307	3.07	30.7	NA	NA	NA
1,3-Dinitrobenzene	µg/L	0.104	1.04	3.13	--	--	--	NA	NA	NA
2,4,6-Trinitrotoluene	µg/L	0.521	5.21	15.6	4.06	40.6	406	NA	NA	NA

Table 5-10. Ravenna Facility-Wide CUGs for Resident Farmer Child COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
2,4-Dinitrotoluene	µg/L	2.03	20.3	61.0	0.174	1.74	17.4	NA	NA	NA
2,6-Dinitrotoluene	µg/L	1.02	10.2	30.7	0.176	1.76	17.6	NA	NA	NA
2-Amino-4,6-dinitrotoluene	µg/L	0.209	2.09	6.26	--	--	--	NA	NA	NA
2-Nitrotoluene	µg/L	10.4	104	313	0.529	5.29	52.9	NA	NA	NA
4,4'-DDD	µg/L	0.526	5.26	15.8	0.128	1.28	12.8	NA	NA	NA
4,4'-DDE	µg/L	--	--	--	0.099	0.994	9.94	NA	NA	NA
4,4'-DDT	µg/L	0.089	0.888	2.66	0.061	0.609	6.09	NA	NA	NA
4-Amino-2,6-dinitrotoluene	µg/L	0.209	2.09	6.26	--	--	--	NA	NA	NA
4-Nitrobenzenamine	µg/L	3.13	31.3	93.9	5.79	57.9	579	NA	NA	NA
4-Nitrotoluene	µg/L	10.4	104	313	7.16	71.6	716	NA	NA	NA
Aldrin	µg/L	0.03	0.301	0.904	0.007	0.069	0.689	NA	NA	NA
Benz(a)anthracene	µg/L	--	--	--	0.009	0.091	0.914	NA	NA	NA
Benzene	µg/L	1.59	15.9	47.8	0.814	8.14	81.4	NA	NA	NA
Benzo(a)pyrene	µg/L	--	--	--	5.5E-04	0.005	0.055	NA	NA	NA
Benzo(b)fluoranthene	µg/L	--	--	--	0.005	0.054	0.538	NA	NA	NA
Bis(2-ethylhexyl)phthalate	µg/L	4.71	47.1	141	1.96	19.6	196	NA	NA	NA
Carbon tetrachloride	µg/L	0.656	6.56	19.7	0.381	3.81	38.1	NA	NA	NA
Chloroform	µg/L	8.75	87.5	263	0.441	4.41	44.1	NA	NA	NA
Dibenz(a,h)anthracene	µg/L	--	--	--	3.6E-04	0.004	0.036	NA	NA	NA
Dieldrin	µg/L	0.04	0.403	1.21	0.006	0.059	0.588	NA	NA	NA
Heptachlor	µg/L	0.435	4.35	13.0	0.023	0.225	2.25	NA	NA	NA
Heptachlor epoxide	µg/L	0.014	0.136	0.407	0.013	0.134	1.34	NA	NA	NA
Indeno(1,2,3-cd)pyrene	µg/L	--	--	--	0.005	0.054	0.537	NA	NA	NA
Lindane	µg/L	0.268	2.68	8.03	0.08	0.801	8.01	NA	NA	NA
Methylene chloride	µg/L	50.1	501	1503	9.27	92.7	927	NA	NA	NA
Nitrobenzene	µg/L	0.521	5.21	15.6	--	--	--	NA	NA	NA
Nitroglycerin	µg/L	--	--	--	7.16	71.6	716	NA	NA	NA
PCB-1242	µg/L	--	--	--	0.304	3.04	30.4	NA	NA	NA
PCB-1254	µg/L	0.021	0.209	0.626	0.304	3.04	30.4	NA	NA	NA
PCB-1260	µg/L	--	--	--	0.304	3.04	30.4	NA	NA	NA
Pentachlorophenol	µg/L	5.12	51.2	154	0.166	1.66	16.6	NA	NA	NA
RDX	µg/L	3.13	31.3	93.9	1.11	11.1	111	NA	NA	NA
Tetrachloroethene	µg/L	7.21	72.1	216	0.163	1.63	16.3	NA	NA	NA
Toxaphene	µg/L	--	--	--	0.081	0.812	8.12	NA	NA	NA
Trichloroethene	µg/L	0.199	1.99	5.96	0.063	0.631	6.31	NA	NA	NA
alpha-BHC	µg/L	--	--	--	0.019	0.193	1.93	NA	NA	NA
beta-BHC	µg/L	--	--	--	0.068	0.676	6.76	NA	NA	NA
Surface Water										
Inorganics										
Aluminum	µg/L	14,827	148,274	444,821	--	--	--	3370	NA	NA
Antimony	µg/L	4.91	49.1	147	--	--	--	0	NA	NA
Arsenic	µg/L	4.63	46.3	139	1.2	12.0	120	3.2	NA	NA
Barium	µg/L	2901	29,007	87,020	--	--	--	47.5	NA	NA
Cadmium	µg/L	5.05	50.5	151	--	--	--	0	NA	NA
Chromium (as Cr-3)	µg/L	11,173	111,735	335,204	--	--	--	0	NA	NA
Chromium, hexavalent	µg/L	30.3	303	908	--	--	--	NA	NA	NA
Copper	µg/L	614	6144	18,433	--	--	--	7.9	NA	NA
Iron	µg/L	4527	45,269	135,806	--	--	--	2560	NA	NA
Manganese	µg/L	633	6326	18,978	--	--	--	391	NA	NA
Mercury	µg/L	4.35	43.5	131	--	--	--	0	NA	NA
Nickel	µg/L	312	3116	9348	--	--	--	0	NA	NA
Nitrate	µg/L	24,892	248,917	746,750	--	--	--	NA	NA	NA

Table 5-10. Ravenna Facility-Wide CUGs for Resident Farmer Child COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Silver	µg/L	76.8	768	2304	--	--	--	0	NA	NA
Thallium	µg/L	1.24	12.4	37.3	--	--	--	0	NA	NA
Vanadium	µg/L	70.6	706	2119	--	--	--	0	NA	NA
Zinc	µg/L	4617	46,167	138,500	--	--	--	42	NA	NA
Organics										
1,1,2,2-Tetrachloroethane	µg/L	781	7806	23,419	0.945	9.45	94.5	NA	NA	NA
1,2-Dichloroethene	µg/L	123	1232	3697	--	--	--	NA	NA	NA
1,4-Dichlorobenzene	µg/L	--	--	--	36.6	366	3663	NA	NA	NA
2,4,6-Trinitrotoluene	µg/L	7.82	78.2	235	60.8	608	6083	NA	NA	NA
2,4-Dimethylphenol	µg/L	252	2521	7562	--	--	--	NA	NA	NA
2,4-Dinitrotoluene	µg/L	28.4	284	853	2.44	24.4	244	NA	NA	NA
2,6-Dinitrotoluene	µg/L	14.7	147	440	2.51	25.1	251	NA	NA	NA
2-Amino-4,6-dinitrotoluene	µg/L	3.13	31.3	93.9	--	--	--	NA	NA	NA
2-Nitrotoluene	µg/L	156	1564	4693	7.93	79.3	793	NA	NA	NA
4,4'-DDT	µg/L	0.4	4.0	12.0	0.274	2.74	27.4	NA	NA	NA
4-Amino-2,6-dinitrotoluene	µg/L	3.13	31.3	93.9	--	--	--	NA	NA	NA
4-Methylphenol	µg/L	67.8	678	2034	--	--	--	NA	NA	NA
4-Nitrotoluene	µg/L	156	1564	4693	107	1074	10,735	NA	NA	NA
Aldrin	µg/L	0.409	4.09	12.3	0.094	0.936	9.36	NA	NA	NA
Benz(a)anthracene	µg/L	--	--	--	0.037	0.375	3.75	NA	NA	NA
Benzo(a)pyrene	µg/L	--	--	--	0.002	0.022	0.22	NA	NA	NA
Benzo(b)fluoranthene	µg/L	--	--	--	0.022	0.217	2.17	NA	NA	NA
Benzo(k)fluoranthene	µg/L	--	--	--	25	250	2500	NA	NA	NA
Bis(2-ethylhexyl)phthalate	µg/L	22.3	223	668	9.27	92.7	927	NA	NA	NA
Chloroform	µg/L	90.4	904	2711	2.68	26.8	268	NA	NA	NA
Chrysene	µg/L	--	--	--	3.75	37.5	375	NA	NA	NA
Dibenz(a,h)anthracene	µg/L	--	--	--	0.001	0.014	0.143	NA	NA	NA
HMX	µg/L	782	7821	23,464	--	--	--	NA	NA	NA
Heptachlor epoxide	µg/L	0.203	2.03	6.1	0.201	2.01	20.1	NA	NA	NA
Indeno(1,2,3-cd)pyrene	µg/L	--	--	--	0.022	0.217	2.17	NA	NA	NA
Methylene chloride	µg/L	571	5710	17,131	84.1	841	8410	NA	NA	NA
PCB-1254	µg/L	0.313	3.13	9.39	4.56	45.6	456	NA	NA	NA
Pentachlorophenol	µg/L	22.9	229	688	0.743	7.43	74.3	NA	NA	NA
Pyrene	µg/L	469	4693	14,079	--	--	--	NA	NA	NA
RDX	µg/L	46.9	469	1408	16.6	166	1659	NA	NA	NA
Tetrachloroethene	µg/L	64.0	640	1920	1.48	14.8	148	NA	NA	NA
Trichloroethene	µg/L	1.53	15.3	45.8	0.408	4.08	40.8	NA	NA	NA
beta-BHC	µg/L	--	--	--	1.01	10.1	101	NA	NA	NA
cis-1,2-Dichloroethene	µg/L	156	1564	4693	--	--	--	NA	NA	NA
Sediment										
Inorganics										
Aluminum	mg/kg	7380	73,798	221,394	--	--	--	13,900	NA	NA
Antimony	mg/kg	2.82	28.2	84.6	--	--	--	0	NA	NA
Arsenic	mg/kg	2.02	20.2	60.6	0.524	5.24	52.4	19.5	NA	NA
Barium	mg/kg	1413	14,129	42,388	--	--	--	123	NA	NA
Cadmium	mg/kg	6.41	64.1	192	2677	26,767	267,667	0	NA	NA
Chromium (as Cr-3)	mg/kg	8147	81,473	244,420	--	--	--	18.1	NA	NA
Chromium, hexavalent	mg/kg	19.9	199	596	402	4015	40,150	NA	NA	NA
Copper	mg/kg	311	3106	9317	--	--	--	27.6	NA	NA
Iron	mg/kg	2313	23,125	69,375	--	--	--	28,200	NA	NA
Manganese	mg/kg	293	2927	8782	--	--	--	1950	NA	NA
Mercury	mg/kg	2.27	22.7	68.2	--	--	--	0.059	NA	NA
Nickel	mg/kg	155	1552	4655	--	--	--	17.7	NA	NA

Table 5-10. Ravenna Facility-Wide CUGs for Resident Farmer Child COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background	GW Background	
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}		Uncon.	Bedrock
Silver	mg/kg	38.6	386	1159	--	--	--	0	NA	NA
Thallium	mg/kg	0.612	6.12	18.4	--	--	--	0.89	NA	NA
Vanadium	mg/kg	44.9	449	1346	--	--	--	26.1	NA	NA
Zinc	mg/kg	2321	23,209	69,627	--	--	--	532	NA	NA
Organics										
2,4,6-Trinitrotoluene	mg/kg	3.65	36.5	110	28.4	284	2842	NA	NA	NA
2,4-Dinitrotoluene	mg/kg	12.8	128	383	1.1	11.0	110	NA	NA	NA
2-Amino-4,6-dinitrotoluene	mg/kg	1.54	15.4	46.3	--	--	--	NA	NA	NA
4-Amino-2,6-dinitrotoluene	mg/kg	1.54	15.4	46.3	--	--	--	NA	NA	NA
Benz(a)anthracene	mg/kg	--	--	--	0.65	6.5	65.0	NA	NA	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.065	0.65	6.5	NA	NA	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	0.65	6.5	65.0	NA	NA	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	6.5	65.0	650	NA	NA	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.065	0.65	6.5	NA	NA	NA
Dieldrin	mg/kg	0.383	3.83	11.5	0.056	0.558	5.58	NA	NA	NA
HMX	mg/kg	359	3594	10,783	--	--	--	NA	NA	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	0.65	6.5	65.0	NA	NA	NA
Nitroglycerin	mg/kg	--	--	--	52.5	525	5252	NA	NA	NA
PCB-1016	mg/kg	0.419	4.19	12.6	0.349	3.49	34.9	NA	NA	NA
PCB-1254	mg/kg	0.12	1.2	3.59	0.349	3.49	34.9	NA	NA	NA
PCB-1260	mg/kg	--	--	--	0.349	3.49	34.9	NA	NA	NA
RDX	mg/kg	22.7	227	681	8.03	80.3	803	NA	NA	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA	NA	NA

COPC = Chemical of potential concern.
CUG = Cleanup goal across all pathways (ingestion, dermal, and inhalation).
GW = Groundwater.
HI = Hazard index.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
NA = Not available.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
-- = No CUG could be quantified based on lack of approved toxicity value.

Table 5-11. Ravenna Facility-Wide CUGs for Security Guard/Maintenance Worker COPCs

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Surface Soil								
Inorganics								
Aluminum	mg/kg	366,343	1.0E+06	1.0E+06	--	--	--	17,700
Antimony	mg/kg	34.2	342	1025	--	--	--	0.96
Arsenic	mg/kg	17.7	177	531	1.1	11.0	110	15.4
Barium	mg/kg	53,190	531,903	1.0E+06	--	--	--	88.4
Cadmium	mg/kg	43.5	435	1304	50,364	503,642	1.0E+06	0
Chromium (as Cr-3)	mg/kg	32,885	328,852	986,557	--	--	--	17.4
Chromium, hexavalent	mg/kg	254	2537	7611	7555	75,546	755,462	NA
Cobalt	mg/kg	21,213	212,130	636,390	32,377	323,770	1.0E+06	10.4
Copper	mg/kg	34,449	344,494	1.0E+06	--	--	--	17.7
Iron	mg/kg	156,695	1.0E+06	1.0E+06	--	--	--	23,100
Manganese	mg/kg	7253	72,529	217,588	--	--	--	1450
Mercury	mg/kg	82.5	825	2475	--	--	--	0.036
Nickel	mg/kg	16,066	160,664	481,991	--	--	--	21.1
Nitrate	mg/kg	1.0E+06	1.0E+06	1.0E+06	--	--	--	NA
Silver	mg/kg	3006	30,059	90,176	--	--	--	0
Thallium	mg/kg	30.0	300	900	--	--	--	0
Vanadium	mg/kg	304	3042	9126	--	--	--	31.1
Zinc	mg/kg	195,080	1.0E+06	1.0E+06	--	--	--	61.8
Organics								
1,3,5-Trinitrobenzene	mg/kg	6380	63,800	191,399	--	--	--	NA
1,3-Dinitrobenzene	mg/kg	37.5	375	1124	--	--	--	NA
2,4,6-Trinitrotoluene	mg/kg	65.4	654	1963	122	1222	12,215	NA
2,4-Dinitrotoluene	mg/kg	85.2	852	2557	1.75	17.5	175	NA
2,6-Dinitrotoluene	mg/kg	43.9	439	1317	1.81	18.1	181	NA
2-Amino-4,6-dinitrotoluene	mg/kg	113	1134	3402	--	--	--	NA
2-Methylnaphthalene	mg/kg	1499	14,993	44,978	--	--	--	NA
2-Nitrotoluene	mg/kg	3748	37,482	112,445	45.6	456	4563	NA
4,4'-DDE	mg/kg	--	--	--	30.9	309	3087	NA
4-Amino-2,6-dinitrotoluene	mg/kg	113	1134	3402	--	--	--	NA
4-Chloro-3-methylphenol	mg/kg	--	--	--	--	--	--	NA
4-Nitrophenol	mg/kg	2999	29,985	89,956	--	--	--	NA
4-Nitrotoluene	mg/kg	3748	37,482	112,445	617	6173	61,735	NA
Aldrin	mg/kg	11.2	112	337	0.617	6.17	61.7	NA
Benz(a)anthracene	mg/kg	--	--	--	0.403	4.03	40.3	NA
Benzo(a)pyrene	mg/kg	--	--	--	0.04	0.403	4.03	NA
Benzo(b)fluoranthene	mg/kg	--	--	--	0.403	4.03	40.3	NA
Benzo(k)fluoranthene	mg/kg	--	--	--	4.03	40.3	403	NA
Bis(2-chloroethoxy)methane	mg/kg	1124	11,244	33,733	--	--	--	NA
Carbazole	mg/kg	--	--	--	525	5247	52,474	NA
Chrysene	mg/kg	--	--	--	40.3	403	4029	NA
Dibenz(a,h)anthracene	mg/kg	--	--	--	0.04	0.403	4.03	NA
Dibenzofuran	mg/kg	750	7496	22,489	--	--	--	NA
Dieldrin	mg/kg	18.7	187	562	0.656	6.56	65.6	NA
Endrin	mg/kg	2.65	26.5	79.4	--	--	--	NA
Endrin aldehyde	mg/kg	--	--	--	--	--	--	NA
Fluoranthene	mg/kg	420	4202	12,606	--	--	--	NA
Fluorene	mg/kg	1343	13,427	40,280	--	--	--	NA
HMX	mg/kg	5292	52,917	158,750	--	--	--	NA
Heptachlor	mg/kg	187	1874	5622	2.33	23.3	233	NA
Heptachlor epoxide	mg/kg	4.87	48.7	146	1.15	11.5	115	NA
Indeno(1,2,3-cd)pyrene	mg/kg	--	--	--	0.403	4.03	40.3	NA
N-Nitroso-di-n-propylamine	mg/kg	--	--	--	0.423	4.23	42.3	NA
Naphthalene	mg/kg	671	6713	20,139	--	--	--	NA

Table 5-11. Ravenna Facility-Wide CUGs for Security Guard/Maintenance Worker COPCs (continued)

COPC	Units	Non-carcinogenic CUG			Carcinogenic CUG			Background
		HI = 0.1	HI = 1	HI = 3	Risk = 10^{-6}	Risk = 10^{-5}	Risk = 10^{-4}	
Nitroglycerin	mg/kg	--	--	--	617	6173	61,735	NA
PCB-1016	mg/kg	2.18	21.8	65.5	0.437	4.37	43.7	NA
PCB-1248	mg/kg	--	--	--	0.437	4.37	43.7	NA
PCB-1254	mg/kg	0.624	6.24	18.7	0.437	4.37	43.7	NA
PCB-1260	mg/kg	--	--	--	0.437	4.37	43.7	NA
Pentachlorophenol	mg/kg	527	5271	15,813	4.1	41.0	410	NA
Pyrene	mg/kg	315	3151	9454	--	--	--	NA
RDX	mg/kg	790	7899	23,696	67.0	670	6702	NA
alpha-Chlordane	mg/kg	--	--	--	--	--	--	NA
beta-BHC	mg/kg	--	--	--	5.83	58.3	583	NA
gamma-Chlordane	mg/kg	--	--	--	--	--	--	NA

COPC = Chemical of potential concern.
CUG = Cleanup goal across all pathways (ingestion, dermal, and inhalation).
HI = Hazard index.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
NA = Not available.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
-- = No CUG could be quantified based on lack of approved toxicity value.

Table 5-12. Published Soil Remediation Goals in RVAAP Records of Decision

Chemical	Area of Concern	Soil Remediation Goal		Land Use Basis
		mg/kg	Ref.	
Metals				
Aluminum	Load Lines 1 - 4	34,942	a	National Guard Trainee (mounted training, no digging)
Antimony	Load Lines 1 - 4	2,458	a	National Guard Trainee (mounted training, no digging)
Arsenic	Load Line 12	31	b	National Guard Trainee
	Load Lines 1 - 4	31	a	National Guard Trainee (mounted training, no digging)
Barium	Load Lines 1 - 4	3,483	a	National Guard Trainee (mounted training, no digging)
Cadmium	Load Lines 1 - 4	109.0	a	National Guard Trainee (mounted training, no digging)
Chromium+6	Load Lines 1 - 4	16.0	a	National Guard Trainee (mounted training, no digging)
Lead	Load Lines 1 - 4	1,995	a	National Guard Trainee (mounted training, no digging)
Manganese	Fuze and Booster Quarry Landfill/Ponds	1,800	c	EPA Region 9 residential PRG
	Load Lines 1 - 4 (surface)	1,800	a	EPA Region 9 residential PRG
	Load Lines 1 - 4 (subsurface)	3,030	a	National Guard Trainee (mounted training, no digging)
Organics				
2,4,6-Trinitrotoluene	Load Lines 1 - 4	1,646	a	National Guard Trainee (mounted training, no digging)
RDX	Load Lines 1 - 4	838	a	National Guard Trainee (mounted training, no digging)
	Winklepeck Burning Ground	617	d	Range Maintenance Soldier
Aroclor-1254	Load Lines 1 - 4	35	a	National Guard Trainee (mounted training, no digging)
Benzo(a)anthracene	Load Lines 1 - 4	105	a	National Guard Trainee (mounted training, no digging)
	Ramsdell Quarry	13.0	e	Security Guard/Maintenance Worker
Benzo(a)pyrene	Load Lines 1 - 4	10	a	National Guard Trainee (mounted training, no digging)
	Winklepeck Burning Ground	7.50	d	Range Maintenance Soldier
	Ramsdell Quarry	1.30	e	Security Guard/Maintenance Worker
Benzo(b)fluoranthene	Load Lines 1 - 4	105	a	National Guard Trainee (mounted training, no digging)
	Winklepeck Burning Ground	75	d	Range Maintenance Soldier
	Ramsdell Quarry	13	e	Security Guard/Maintenance Worker
Dibenz(a,h)anthracene	Load Lines 1 - 4	10	a	National Guard Trainee (mounted training, no digging)
	Ramsdell Quarry	1.30	e	Security Guard/Maintenance Worker
Indeno(1,2,3-cd)pyrene	Ramsdell Quarry	13	e	Security Guard/Maintenance Worker

a. Interim Record of Decision for the Remediation of Soils at Load Lines 1 through 4 at the Ravenna Army Ammunition Plant, January 2007
b. Record of Decision for Soil and Dry Sediment for RVAAP-12 Load Line 12 Ravenna Army Ammunition Plant, March 2009
c. Final Record of Decision for Soil and Dry Sediment at the Fuze and Booster Quarry Landfill/Ponds (RVAAP-16) Ravenna Army Ammunition Plant, March 2010
d. Final Record of Decision for Soil and Dry Sediment for RVAAP-05 Winklepeck Burning Ground at Ravenna Army Ammunition Plant, August 2008
e. Final Record of Decision for Soil and Dry Sediment for RVAAP-01 Ramsdell Quarry Landfill at Ravenna Army Ammunition Plant, March 2009

The process for applying the FWCUGs at future AOCs is provided below.

1. AOC projects complete characterization activities (presumably based on approved Sampling and Analysis Plans).

2. Project risk assessors:

    - Identify the future land-use at AOC;

    - Select the appropriate receptor based on the land use and identify the related FWCUGs in Tables 5-1 through 5-11;

    - Identify EUs within the AOC, and calculate EPCs for each EU;

    - Select the FWCUG related to the desired target risk and/or target HI (see Sect. 1 for guidance on the appropriate target risk/target HI); and

    - Compare the chemical-specific EPCs to the selected FWCUGs to identify AOC-specific COCs for use in the FS.

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APPENDIX A.
White Paper for RVAAP Facility-Wide Human Health Cleanup Goal Development

Final

White Paper
Ravenna Army Ammunition Plant
Facility-Wide Human Health Cleanup Goal Development

Ravenna Army Ammunition Plant
Ravenna, Ohio

September 2008

Contract No. W912QR-04-D-0019
Delivery Order No. 008

Prepared for:

US Army Corps of Engineers®
Louisville District

Prepared by:

SAIC®
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REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
19-09-2008	Technical	May 2008 - September 2008

4. TITLE AND SUBTITLE

Final
Facility-Wide Human Health Cleanup Goals
at the Ravenna Army Ammunition Plant,
Ravenna, Ohio

5a. CONTRACT NUMBER
W912QR-04-D-0019

5b. GRANT NUMBER
NA

5c. PROGRAM ELEMENT NUMBER
NA

6. AUTHOR(S)
Samantha Pack

5d. PROJECT NUMBER
Delivery Order 008

5e. TASK NUMBER
NA

5f. WORK UNIT NUMBER
NA

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Science Applications International Corporation, Inc.
151 Lafayette Drive
Oak Ridge, TN 37831

8. PERFORMING ORGANIZATION REPORT NUMBER
08-016NE

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
USACE - Louisville District
U.S. Army Corps of Engineers, Louisville District
600 Martin Luther King, Jr. Place
P.O. Box 59
Louisville, Kentucky 40202-0059

10. SPONSOR/MONITOR'S ACRONYM(S)
CELRL-ED-EE

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
NA

12. DISTRIBUTION/AVAILABILITY STATEMENT
Reference Distribution Page

13. SUPPLEMENTARY NOTES
None.

14. ABSTRACT

This report presents the technical basis, calculations, and results for developing facility-wide risk-based cleanup goals for environmental media and human receptors at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio.

15. SUBJECT TERMS
remediation, human health risk, cleanup goals

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			NA
NA	NA	NA	NA		19b. TELEPHONE NUMBER *(Include area code)* NA

DOCUMENT DISTRIBUTION

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BRACO – Base Realignment and Closure Technical Support Office.
RTLS-ENV – Ravenna Training and Logistics Site Environmental Specialists.
RVAAP – Ravenna Army Ammunition Plant.
TACOM – U.S. Tank-Automotive and Armaments Command.
USACE – U.S. Army Corps of Engineers – Louisville District.
USAEC – U.S. Army Environmental Center.
Ohio EPA-NEDO – Ohio Environmental Protection Agency – Northeast District Office.
Ohio EPA-OFFO – Ohio Environmental Protection Agency – Office of Federal Facilities Oversight.

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Science Applications International Corporation (SAIC) has completed the Final White Paper for Facility-Wide Human Health Cleanup Goal Development at the Ravenna Army Ammunition Plant, Ravenna, Ohio. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions; methods, procedures, and materials to be used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing Corps policy.

Samantha Pack
Study/Design Team Leader

May 20, 2008
Date

David King
Independent Technical Review Team Leader

May 20, 2008
Date

Significant concerns and the explanation of the resolution are as follows:

Internal SAIC Independent Technical Review comments are recorded on a Document Review Record per SAIC quality assurance procedure QAAP 3.1. This Document Review Record is maintained in the project file. Changes to the report addressing the comments have been verified by the Study/Design Team Leader. As noted above, all concerns resulting from independent technical review of the project have been considered.

Principal w/ A-E firm

May 20, 2008
Date

FINAL
WHITE PAPER
RVAAP FACILITY-WIDE HUMAN HEALTH CLEANUP GOAL DEVELOPMENT

May 2008

1.0 FORWARD

The *Ravenna Army Ammunition Plant Facility-Wide Human Health Risk Assessor Manual, Amendment 1* (USACE 2005), herein referred to as the Risk Manual, requires that prior to commencing any risk assessment activities at the Ravenna Army Ammunition Plant (RVAAP), a White Paper be developed to ensure regulatory agreement with the processes proposed. This White Paper has been developed to comply with this requirement as the U. S. Army Corps of Engineers, Louisville District prepares to develop facility-wide risk-based cleanup goals.

2.0 INTRODUCTION

RVAAP utilizes an Installation Action Plan (IAP) to cover remedial investigations (RIs) and cleanup needed for closure of RVAAP. The purpose of the IAP is to outline the total multi-year restoration program for an Installation. The IAP defines Installation Restoration Program (IRP) requirements and proposes a comprehensive approach to investigation and cleanup of each area of concern (AOC) at the Installation. This effort to develop facility-wide cleanup goals is part of the path forward for identifying cleanup requirements for remaining AOCs. These goals will not be used to re-evaluate past decisions.

The purpose of this White Paper includes the following:

- Clarify technical issues related to developing facility-wide human health cleanup goals for RVAAP. Most of the technical requirements for performing this work have been clearly defined in the RVAAP Risk Manual. However, a few issues specific to developing cleanup goals must be agreed to prior to calculating these goals.

- Define the exposure pathways and parameters pertinent to two newly identified future land uses: the Engineering School use and the Small Arms Range use.

Following RVAAP stakeholder input, this White Paper will be incorporated in its final form into a subsequent report that presents the final assumptions, methods, and calculated facility-wide cleanup goals.

3.0 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN FOR CLEANUP GOAL DEVELOPMENT

The first step in developing facility-wide cleanup goals is to define the universe of chemicals at RVAAP that may be encountered and may require a numeric cleanup goal. Two possible methods for identifying the universe of contaminants at the Installation were evaluated:

1. Consolidate the lists of chemicals of potential concern (COPCs) from completed RI reports.

2. Perform a new COPC screen against all chemicals in the Ravenna Environmental Information Management System.

Option 2 was selected as the best option for identifying a facility-wide list of COPCs because risk assessment requirements for RVAAP and risk model information (e.g., toxicity factors, chemical-specific factors, etc.) may have changed since the earliest RIs and a new COPC screen can accommodate any guidance updates and information changes.

The facility-wide COPC screen will follow the general guidance of the RVAAP Risk Manual (Sections 3.4 and 3.5) with few exceptions:

1. Because the facility-wide data set is likely to be large, chemicals meeting the <5% detection rule will not be screened out per Section 3.4.1 of the Risk Manual (5% of the large data set could represent a valid contamination issue).

2. A background screen will be used to eliminate chemicals from the facility-wide COPC list. The calculated cleanup goals and background values will be presented for naturally occurring chemicals.

3. Chemicals will be screened against the U. S. Environmental Protection Agency (EPA) Region 9 preliminary remediation goals (PRGs). Any chemical for which the maximum detected value exceeds the PRG will be retained as a facility-wide COPC unless there is evidence that a single detection is a true anomaly. An explanation of the chemical anomaly will be presented for review.

4. Consistent with the Risk Manual, chemicals identified as essential nutrients will be screened out. Chemicals that are considered essential nutrients (e.g., calcium, chloride, iodine, iron, magnesium, potassium, phosphorous, and sodium) are an integral part of the human food supply and are often added to foods as supplements. EPA recommends that these chemicals not be evaluated as COPCs as long as they are: (1) present at low concentrations (i.e., only slightly elevated above naturally occurring levels), and (2) toxic at very high doses (i.e., much higher than those that could be associated with contact at an AOC).

4.0 EXPOSURE ASSESSMENT CONSIDERATIONS IN CLEANUP GOAL DEVELOPMENT

When the RVAAP IRP began in 1989, RVAAP was identified as a 21,419-acre installation. The property boundary was resurveyed by the Ohio Army National Guard (OHARNG) over a 2-year period (2002 and 2003) and the actual total acreage of the property was found to be 21,683.289 acres. As of February 2006, a total of 20,403 acres of the former 21,683-acre RVAAP have been transferred to the National Guard Bureau (NGB) and subsequently licensed to OHARNG for use as a military training site [Ravenna Training and Logistics Site (RTLS)]. When RVAAP was operational, RTLS did not exist and the entire 21,683-acre parcel was a government-owned, contractor-operated industrial facility. The RVAAP IRP encompasses investigation and cleanup of contamination from past activities over the entire 21,683 acres

of the former RVAAP. The current RVAAP consists of 1,280 acres in various parcels (including AOCs) throughout the OHARNG RTLS. At present, workers infrequently visit the RVAAP AOCs for maintenance purposes, such as mowing; to conduct environmental investigations; and to perform remediation activities. As cleanup of AOCs is completed, they will also be transferred to NGB.

Under these current and future planned land use scenarios, the Risk Manual identified human receptors and exposure pathways that must be evaluated in RVAAP risk assessments. The identified receptors include:

- Security and Maintenance Personnel,
- National Guard – Fire/Dust Suppression Worker,
- National Guard Trainee,
- Resident Farmer,
- Trespasser Adult/Juvenile, and
- Recreators – Hunter/Trapper/Fisher.

A full set of exposure pathways and exposure factors has been developed for each of these receptors, as documented in the Risk Manual. These assumptions will be carried into the development of the cleanup goals.

As planning for OHARNG training activities has progressed, two specific training activities have been identified that may not be adequately covered under the above receptor assumptions. These activities include:

- National Guard Engineering School, and
- National Guard Range Maintenance Soldier.

4.1 LAND USE AND POTENTIAL RECEPTORS

The objective of this section is to define the exposure assessment considerations (i.e., magnitude, frequency, and duration of potential human exposure to COPCs) for the two new training activities, keeping in mind that the current receptor scenarios may be adequate for one or both of the these two new land uses. The three primary steps in defining the considerations are listed below.

1. Identify the exposure setting for the proposed Engineering School and Small Arms Range and the human receptors associated with these land uses.

2. Identify exposure pathways associated with the land uses.

3. Quantify the receptor's potential intake of each COPC.

4.1.1 Engineering School

To obtain information needed to quantify potential exposures for Engineering School land use, members of OHARNG were interviewed, and the detailed "Program of Instruction" (TRADOC 2007, Course 052-21E10(R), "Heavy Construction Equipment Operators Course," Engineering School) that defines the detailed processes for each training activities was reviewed. The purpose of the Engineering School is to train personnel in construction engineering, carpentry, and combat engineering. Activities resulting in a "reasonable maximum exposure" include dirt excavation during which trainees would move dirt down to 36 to 42 in. deep for 10 to 12 hr/day (minus breaks) and would be trained on using heavy excavation

equipment. The training sessions would typically last 2 weeks (10 to 14 days in the field, with 14 days representing a conservative maximum time in the field). For example, the Program of Instruction for the "Heavy Construction Equipment Operators Course" requires three, 40-hr training sessions (120 hr) on a Scoop Loader, a Small Emplacement Excavator, and a Hydraulic Excavator. These sessions are broken up into four primary parts: classroom, demonstration, hands-on, and testing, with 60 to 80% of the time in hands-on training [POI 052-21E10(R)]. Trainees could have follow-up training if they fail to meet course requirements for graduation, with a maximum three attempts to pass the course of instruction. Discussion with OHARNG on a reasonable number of years that a single trainee may serve in this type of training resulted in an estimate of three, 14-day training sessions.

The receptor of primary concern under this land use scenario is the training instructor. The instructor is assumed to be in the field at all times when excavation activities are taking place. Current plans include 10, 2-week classes per year, resulting in a maximum number of days in the field of 140 days/year. Discussion with OHARNG on a reasonable number of years that a soldier would be qualified and participate as a trainer resulted in an estimate of 12 to 13 years maximum, assuming that the soldier would be qualified to serve as a trainer for one-half of the 25-year service.

Therefore, a National Guard Engineering School Instructor is considered to be the relevant receptor for this land use:

- This receptor is responsible for overseeing all excavation training activities in the field.

- The soldier performs these duties using a combination of walking through the field or driving in an all-terrain-vehicle-style vehicle to provide continuous instruction and driving the heavy equipment excavators to demonstrate their use. This soldier may also be responsible for returning the dirt moved during exercises to its original location.

- At a minimum, the soldier wears a short-sleeved shirt, long pants, and boots.

- The receptor is present at the Engineering School field site for a total of 180 days/year: 140 days/year for 10, 2-week training sessions; 20 days of site refurbishing and maintenance work (1 day prior to and after each session); plus 20 additional days representing 2 work weeks of mobilization and demobilization activities prior to and after the annual training season.

- During training, it is assumed that the instructor is in the field 10 hr/day. During maintenance and mobilization work, it is assumed the instructor is in the field 8 hr/day. The total hours over the 180-day period totals 1,730, or an average of 9.5 hr/day.

- This scenario assumes the same soldier performs these duties for half of his 25-year enlistment (12 years).

- For the dust inhalation exposure, the Engineering School Instructor is assumed to have an inhalation rate of 19.8 m^3/day. This assumes the receptor spends 49% of their day in light activities, 5% of their day in moderate activities, 3% of their day in heavy activities, and 43% of their day at rest. The inhalation rate is a weighted average that accounts for the 49% of the day spent doing light activities at an inhalation rate of 1.0 m^3/hr, 5% of the day spent doing moderate activities in the field at an inhalation rate of 1.6 m^3/hr, 3% of the time doing heavy excavation activities at an inhalation rate of 3.2 m^3/hr, and 43% of the day at rest at an inhalation rate of 0.4 m^3/hr. This results in an estimated point value of 0.83 m^3/hr, which converts to a daily inhalation rate of 0.83 m^3/hr × 24 hr/day = 19.8 m^3/day (see Figure 1). This breathing rate is a conservative daily inhalation rate compared to a recommendation rate of 15.2 m^3/day for normal activities (EPA 1997).

- To ensure that the various exposure factors do not multiply into an overly conservative scenario, the fact that, for a portion of the year, there is no dust loading due to precipitation is accounted for. In an interview with OHARNG staff, they indicated that during much of the training time there is mud present. It is recommended that the particulate emission factor be modified to account for the fact that, 32% of the time, there is precipitation >1 mm, the soil is wet, and there is no dust loading (National Oceanic and Atmospheric Administration lists the mean precipitation days with precipitation >1 mm for the Cleveland area as 115 days/year). The exposure days have been adjusted by 68% (0.68) to indicate that only 250 days/year are dry enough for fugitive dusts.

- This scenario will be protective of the Engineering School trainees and part-time instructors who will be present for a much shorter time periods.

Engineering School Instructor						
	Hours Off Duty	**Hours On Duty**	**Total**	**% of Day in Activity**	**Breathing Rate**	**Breathing Volume**
Rest	8	2.4	10.4	0.43	0.4	0.17
Light	4	7.8	11.8	0.49	1	0.49
Moderate		1.2	1.2	0.05	1.6	0.08
Heavy		0.6	0.6	0.03	3.2	0.08
Total	12	12	24	1.00		0.83 m^3/h
						19.8 m^3/day
Range Maintenance Soldier						
	Hours in Office/Home	**Hours in Field**	**Total**	**% of Day in Activity**	**Breathing Rate**	**Breathing Volume**
Rest	8	1.2	9.2	0.38	0.4	0.15
Light	10	3.9	13.9	0.58	1	0.58
Moderate		0.6	0.6	0.03	1.6	0.04
Heavy		0.3	0.3	0.01	3.2	0.04
Total	18	6	24	1.00		0.81 m^3/h
						19.5 m^3/day

Figure 1. Process for Developing Inhalation Rates for the Engineering School Instructor and the Range Maintenance Soldier

4.1.2 Range Maintenance

Plans for the development of arms ranges at the Ravenna Training and Logistics Site (RTLS) are currently underway. These ranges will vary in the types of munitions being trained against, from practice rounds, which will be 40 mm or less to Mark-19 type munitions. There are no plans to utilize high-explosive rounds.

A Mark 19 range land use scenario was developed and evaluated in the *Winklepeck Burning Ground Focused Feasibility Study* (USACE 2004). The Mark 19 is a belt-fed, automatic, 40-mm grenade launcher or grenade machine gun. In the process of developing the receptor exposure scenario for this land use, it was determined that the relevant receptor was a National Guard Range Maintenance Soldier, or the maintenance personnel responsible for maintaining the range throughout the training year. The Range Maintenance Soldier activities would include target maintenance, range maintenance, and controlled burns to clear the range impact area of woody growth and burn-off grasses.

For the facility-wide cleanup goal development, the National Guard Range Maintenance Soldier with a revised inhalation value (see below) is adopted:

- This receptor is assumed to be responsible for both routine maintenance of the range and targets and annual clearance of practice rounds.

- The soldier performs these duties using a combination of walking over the range, driving over the range in an all-terrain-vehicle-style vehicle, and driving on access roads in a closed vehicle, such as a pickup truck.

- At a minimum, the soldier wears a short-sleeved shirt, long pants, and boots.

- The receptor is assumed to be present at the range 85 days/year, for 6 hr/day (i.e., 42 weekends per year, 4 hr before use and 8 hr after use, plus 1 day for annual clearance). This equates to 12 hr over 2 days (4 hr 1 day before use, plus 8 hr 1 day after use = 12 hr) or an average of 6 hr/day. The Range Maintenance Soldier spends the rest of the workday performing other duties at the RTLS. This scenario assumes the same soldier (or soldiers) performs these duties all year for a 25-year enlistment.

- To identify breathing patterns, it is assumed that the receptor is in the field for 6 hours per workday and in the home/office for 18 hours/workday. When the soldier is in the field, he/she spends 0.9 hours at rest (e.g. sitting in vehicle), 3.9 hours in light activity (e.g. walking slowly), 0.9 hours in moderate activity (e.g., lifting), and 0.3 hours in heavy activity (running, climbing). When the soldier is not in the field, it is assumed that he/she spends 8 hours/day at rest, 9 hours/day in light activity, and 1 hour/day at moderate exercise. This results in an estimated daily inhalation rate of 20.5 5 m^3/day (see Figure 1). This is a conservative daily inhalation rate compared to a recommendation rate of 15.2 m^3/day for normal activities (EPA 1997).

- This scenario will be protective of users of the range who are present for a much shorter time.

Table 1. Range Maintenance Soldier Breathing Rate Analysis

Activity level	Hours/day			Percent of Day	Breathing rate (m3/hr) (b)	Breathing Volume
	Office/Home	Field (a)	Total	Total		
Rest	8	0.9	8.9	37%	0.4	0.15
Light	9	3.9	12.9	54%	1.0	0.54
Moderate	1	0.9	1.9	8%	1.6	0.13
Heavy		0.3	0.3	1%	3.2	0.04
Total	18	6	24	100%		0.85 m3/hr
						20.46 m3/day

(a) Based on activity patterns provided by ORARNG.
(b) From EPA, 1997..

4.2 IDENTIFY EXPOSURE PATHWAYS

The exposure pathways associated with the Engineering School Instructor and the National Guard Range Maintenance Soldier are shown in 2.

Table 2. Conceptual Exposure Model for the Revised National Guard Range Maintenance Soldier at Winklepeck Burning Grounds

Pathway	Engineering School Instructor	National Guard Range Maintenance Soldier
Surface Soils Only (0 to 4 ft BGS)		
Incidental soil ingestion	-	X
Dermal contact with soil	-	X
Inhalation of VOCs and dust	-	X
Surface and Deep Soils (0 to 4 ft BGS)		
Incidental soil ingestion	X	-
Dermal contact with soil	X	-
Inhalation of VOCs and dust	X	-

BGS = Below ground surface.
VOC = Volatile organic compound.
- = Pathway is not evaluated for cleanup goal development.
X = Pathway is evaluated for cleanup goal development.

4.3 QUANTIFY EXPOSURE PARAMETERS

Exposure parameters used to calculate intake for the Engineering School Instructor and the National Guard Range Maintenance Soldier are listed in Tables 3 and 43, respectively.

5.0 DEVELOP CLEANUP GOALS

Cleanup goals will be developed for each of the land use/receptor scenarios identified in the Risk Manual and for the Engineering School and Small Arms Range uses. These will be "back-calculated" using the equations presented in the Risk Manual, starting with the following remedial action objectives:

- cleanup of carcinogenic contaminants will be consistent with achieving a target risk of 1×10^{-4}, 1×10^{-5}, and 1×10^{-6}, respectively; and

- cleanup of non-carcinogenic contaminants will be consistent with achieving a target hazard index of 0.1 and 3, respectively.

Once facility-wide cleanup goals have been developed, they will be tabulated to show cleanup goals for all land-use/receptor scenarios along with naturally occurring background values.

Table 3. Exposure Parameters for the Engineering School Instructor

Parameter	Units	Value	Source
Incidental Ingestion			
Soil ingestion rate	kg/day	0.0001	RAGS Part B (EPA 1991)[a]
Exposure time	hr/day	9.5	Activity/land use-specific per OHARNG [b]
Exposure frequency	days/year	180	Activity/land use-specific per OHARNG[b]
Exposure duration	years	25	Assumed enlistment period[a]
Body weight	kg	70	RAGS Part B (EPA 1991)[a]
Carcinogen averaging time	days	25,550	RAGS Part B (EPA 1991)[a]
Non-carcinogen averaging time	days	9,125	RAGS Part B (EPA 1991)[a]
Fraction ingested	unitless	1	Conservative assumption[a]
Conversion factor	days/hr	0.042	
Dermal Contact			
Skin area	m^2/event	0.33	Head, hands, and forearms, *Exposure Factors Handbook* (EPA 1997)[a]
Adherence factor	mg/cm^2	0.3	Value for construction worker (95th percentile); values from RAGS Part E (EPA 2004)[a]
Absorption fraction	unitless	chemical-specific	Chemical-specific absorption fraction values from RAGS Part E (EPA 2004) or default values from the FWHHRAM (USACE 2005): SVOCs = 10%; VOCs = 1%; and inorganics = 0.1[a]
Exposure frequency	events/year	180	Activity/land use-specific per OHARNG[b]
Exposure duration	years	25	Assumed enlistment period[a]
Body weight	kg	70	RAGS Part B (EPA 1991)[a]
Carcinogen averaging time	days	25,550	RAGS Part B (EPA 1991)[a]
Non-carcinogen averaging time	days	9,125	RAGS Part B (EPA 1991)[a]
Conversion factor	$(kg\text{-}cm^2)/(mg\text{-}m^2)$	0.01	
Inhalation of VOCs and Dust			
Inhalation rate	m^3/day	19.8	Activity/land use-specific[c]
Exposure time	hr/day	9.5	Activity-specific per OHARNG[b]
Exposure frequency	days/year	180	Activity-specific per OHARNG[b]
Precipitation modifying factor	unitless	.68	Per NOAA, 250 days precipitation <1 mm/365 total days
Exposure duration	years	25	Assumed enlistment period[a]
Body weight	kg	70	RAGS Part B (EPA 1991)[a]
Carcinogen averaging time	days	25,550	RAGS Part B (EPA 1991)[a]
Non-carcinogen averaging time	days	9,125	RAGS Part B (EPA 1991)[a]
Particulate emission factor	m^3/kg	1.67E+06	Default value for Cleveland, Ohio, assuming a 0.5-acre source area[d]
Conversion factor	days/hr	0.042	

[a] Value is the same as that cited in the FWHHRAM for the National Guard Trainee.
[b] Per OHARNG staff interviews and the detailed training "Programs of Instruction."
[c] The receptor spends 49% of their day in light activities, 5% of their day in moderate activities, 3% of their day in heavy activities, and 43% at rest.
[d] A smaller particulate emission factor (PEF) value (1.67×10^6) is used for the Engineering School because the activities of this receptor are assumed to generate more dust. This PEF value was calculated from a dust loading factor (DLF) of 600 $\mu g/m^3$ (DOE 1993) as: PEF = 1/(DLF × Conversion Factor) = 1/(600 $\mu g/m^3$ × 1E-09 kg/μg) = 1.67E+06 m^3/kg.
FWHHRAM = *RVAAP Facility-Wide Human Health Risk Assessor's Manual* (USACE 2005).
NOAA = National Oceanic and Atmospheric Administration.
OHARNG = Ohio Army National Guard.
RAGS = Risk Assessment Guidance for Superfund.
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.

Table 4. Exposure Parameters for the National Guard Range Maintenance Soldier

Parameter	Units	Value	Source
Incidental Ingestion			
Soil ingestion rate	kg/day	0.0001	RAGS Part B (EPA 1991)[a]
Exposure time	hr/day	6	Site-specific per LTC Tadsen[b]
Exposure frequency	days/year	85	Site-specific per LTC Tadsen[b]
Exposure duration	years	25	Assumed enlistment period[a]
Body weight	kg	70	RAGS Part B (EPA 1991)[a]
Carcinogen averaging time	days	25,550	RAGS Part B (EPA 1991)[a]
Non-carcinogen averaging time	days	9,125	RAGS Part B (EPA 1991)[a]
Fraction ingested	unitless	1	Conservative assumption[a]
Conversion factor	days/hr	0.042	
Dermal Contact			
Skin area	m^2/event	0.33	Head, hands, and forearms, *Exposure Factors Handbook* (EPA 1997)[a]
Adherence factor	mg/cm^2	0.3	Value for construction worker (95^{th} percentile); values from RAGS Part E (EPA 2004)[a]
Absorption fraction	unitless	chemical-specific	Chemical-specific absorption fraction values from RAGS Part E (EPA 2004) or default values from the FWHHRAM (USACE 2005): SVOCs = 10%; VOCs = 1%; and inorganics = 0.1[a]
Exposure frequency	events/year	85	Site-specific per LTC Tadsen[b]
Exposure duration	years	25	Assumed enlistment period[a]
Body weight	kg	70	RAGS Part B (EPA 1991)[a]
Carcinogen averaging time	days	25,550	RAGS Part B (EPA 1991)[a]
Non-carcinogen averaging time	days	9,125	RAGS Part B (EPA 1991)[a]
Conversion factor	$(kg\text{-}cm^2)/(mg\text{-}m^2)$	0.01	
Inhalation of VOCs and Dust			
Inhalation rate	m^3/day	20.5	Activity/land use-specific[c]
Exposure time	hr/day	6	Site-specific per LTC Tadsen[b]
Exposure frequency	days/year	85	Site-specific per LTC Tadsen[b]
Exposure duration	years	25	Assumed enlistment period[a]
Body weight	kg	70	RAGS Part B (EPA 1991)[a]
Carcinogen averaging time	days	25,550	RAGS Part B (EPA 1991)[a]
Non-carcinogen averaging time	days	9,125	RAGS Part B (EPA 1991)[a]
Particulate emission factor	m^3/kg	9.24E+08	Default value for Cleveland, Ohio, assuming a 0.5-acre source area[d]
Conversion factor	days/hr	0.042	

[a] Value is the same as that cited in the FWHHRAM for the National Guard Trainee.
[b] Personal communication, LTC Tom Tadsen, Ohio Army National Guard - Ravenna Training and Logistics Site.
[c] The receptor spends 58% of their time in light activities, 3% of their time in moderate activities, 1% of their time in heavy activities, and 38% of their time at rest.
[d] Value is the same as that cited in FWHHRAM for all receptors except the National Guard Trainee. The lower National Guard Trainee value is not used because the Range Maintenance Soldier will not be generating large quantities of dust (i.e., there will be no tanks).
FWHHRAM = *RVAAP's Facility-Wide Human Health Risk Assessor's Manual* (USACE 2005).
RAGS = Risk Assessment Guidance for Superfund.
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.

6.0 REFERENCES

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APPENDIX B.
Position Paper For The Application And Use Of Facility-Wide Human Health Cleanup Goals

Final

United States Army Corps of Engineers
Ravenna Army Ammunition Plant (RVAAP)
Position Paper for the Application and Use of Facility-Wide Human Health Cleanup Goals

Ravenna Army Ammunition Plant
Ravenna, Ohio

June 2009

Prepared by:

US Army Corps of Engineers®

LOUISVILLE DISTRICT

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United States Army Corps of Engineers, Ravenna Army Ammunition Plant (RVAAP) Position Paper for the Application and Use of Facility-Wide Human Health Cleanup Goals

1.0 PURPOSE AND NEED

The purpose of this Position Paper is to provide *interim* guidance from the United States Army Corps of Engineers, Louisville District (USACE) to Contractors regarding the use and application of facility-wide cleanup goals as part of the path forward in the risk assessment process for

- Determining presence/absence of contamination,
- Assessing data gaps,
- Evaluating nature and extent of contamination, and
- Identifying cleanup requirements.

Ravenna Army Ammunition Plant (RVAAP) has worked closely with the Ohio Environmental Protection Agency (Ohio EPA) and other stakeholders such as the Ohio Army National Guard (OHANG) to develop an acceptable approach to the completion of human health risk assessments. Because of the initial successes of the human health risk assessment program, there was mutual agreement to streamline the process. Streamlining the Human Health Risk Assessment process resulted in the establishment of Facility-wide Cleanup Goals (CUGs). Currently, the CUGs are in draft form and are being developed by Science Applications International Corporation (SAIC) in the document *Preliminary Draft Facility-wide Human Health Remediation Goals, Ravenna Army Ammunition Plant, Ravenna, Ohio, May 2008* (FWCUG Report). The original intent of developing the CUGs was to eliminate the need for baseline risk assessments. Since the development of the CUGs, they also have been recognized as appropriate tools to be used in screening-level assessments.

The CUGs were developed to reduce the level of effort and to limit the amount of time required to make informed risk management decisions regarding sampling locations, delineations of contamination, data gaps, and remediation of contaminants without needing to complete a baseline risk assessment. The selection of chemicals requiring a CUG is based upon the screening process outlined in the *Ravenna Army Ammunition Plant Facility-Wide Human Health Risk Assessor Manual, Amendment 1* (USACE 2005), herein referred to as the Risk Manual.

Besides the screening process, the Risk Manual requires that prior to commencing any risk assessment activities at the Ravenna Army Ammunition Plant (RVAAP), a White Paper should be developed to ensure regulatory agreement with the processes proposed. The White Paper for the development of the CUGs can be found as an attachment to the FWCUG Report. The White Paper provided clarification of technical issues related to developing the CUGs that were not defined in the Risk Manual. The White Paper also included the exposure pathways and parameters pertinent to two newly identified future land uses: the Engineering School use and the Small Arms Range use.

The intent of USACE is to develop a single document that includes pertinent information from the Risk Manual, FWCUG Report (including the White Paper), CUGs, risk assessment information found in previously published documents, and technical guidance and agreements that USACE has developed in conjunction with the Ohio EPA. It is planned that the FWCUG Report will be modified and updated to include all these items. The FWCUG Report will then replace the Risk Manual. The USACE believes that this approach will clarify requirements for the completion of screening level human health risk assessments, selection of appropriate CUGs, and the determination of remediation levels that are risk-based. Because this unified document will not be available for several months, USACE identified the need for this Interim Guidance.

2.0 DATA EVALUATION – DETERMINATION OF THE CHEMICALS OF POTENTIAL CONCERN

The first step in using the CUGs and determining which ones should be used depends upon what phase of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process is being investigated and what decisions will be made using the CUGs. If the data is being evaluated to determine the presence or absence of contamination, nature and extent of contamination, characterization of contamination, sampling locations, or for other reasons where the data identifies potential contamination, then the initial evaluation step should be completed. The end result of the initial data screening process is a list of chemicals of potential concern (COPCs). The COPC screen shall follow the general guidance of the Risk Manual (Sections 3.4 and 3.5):

1.) The concentrations of inorganics shall be compared to the soil background concentrations in the report titled *Phase II Remedial Investigation Report for the Winklepeck Burning Ground at RVAAP, OH* (USACE April 2001). If exceedances above background occur, then the respective metals are retained as COPCs.

2.) Consistent with the Risk Manual (Section 3.5), chemicals identified as essential nutrients will be screened out. Chemicals that are considered essential nutrients (e.g., calcium, chloride, iodine, iron, magnesium, potassium, phosphorous, and sodium) are an integral part of the human food supply and are often added to foods as supplements. The USEPA recommends that these chemicals not be evaluated as COPCs as long as they are: (1) present at low concentrations (i.e., only slightly elevated above naturally occurring levels), and (2) toxic at very high doses (i.e., much higher than those that could be associated with contact at an Area of Concern (AOC).

3.) Chemicals meeting the <5% detection rule may be screened out per Section 3.4.1 of the Risk Manual; however, this screening step is based upon having a statistically valid data set (sample size of at least 20).

4.) For the determination of the COPCs, all chemicals that have not been eliminated should be screened against their specific CUG at the 1.0 X 10-6 cancer risk level and non-carcinogenic risk Hazard Quotient (HQ) using the 0.1 risk value for the Residential Farmer Adult, Residential Farmer Child, and the National Guard Trainee. If there are no CUGs developed for the particular chemical, then the USEPA Regional Screening Levels (RSLs) should be used. The Risk Manual required that the maximum concentrations be compared to the USEPA Region 9 Preliminary Remediation Goals (PRGs); however, the RSLs have replaced the USEPA's Region 9 PRGs. The RSLs should only be used if a CUG is not available for the chemical. The RSL for the Residential Receptor should be used. This Interim Guidance requires that the comparison be completed using the Draft CUGs. Once the CUGs have been finalized, this Interim Guidance will be superseded by the Final FW CUG Report. The steps listed below should be followed for the comparison process to be acceptable and complete when establishing COPCs or characterizing the contamination in an area:

- Use the CUGs developed for the Residential Farmer Adult and Child Receptors and the National Guard Trainee for each chemical. If no CUG is available, use the USEPA's RSL for the chemical. If neither the CUG nor the RSL is available, then a CUG should be developed or another approach must be developed with concurrence from USACE and Ohio EPA.

- Select the CUGs at the 1.0×10^{-6} carcinogenic value and the non-carcinogenic risk value termed Hazard Quotient (HQ) using the 0.1 risk value.

- Report all carcinogenic and non-carcinogenic risk values for each chemical for the Adult and Child Residential Farmer and the National Guard Trainee.

- Complete a comparison of the selected CUG to the Exposure Point Concentration (EPC). The EPC will be either the 95% Upper Confidence Limit (UCL) of the mean for each chemical concentration or the maximum value detected, depending upon whichever value is the lowest. In comparisons where the 95% UCL can not be determined, the maximum concentration of the chemical should be compared to the appropriate CUGs.

- Consider the chemical as a COPC if the EPC exceeds the most stringent risk value for the Adult Resident Farmer, the Child Resident Farmer, or the National Guard Trainee for either one of the 1.0×10^{-6} carcinogenic value and the non-carcinogenic risk value termed Hazard Quotient (HQ) using the 0.1 risk value.

3.0 DETERMINATION OF THE CHEMICALS OF CONCERN

The original application of the CUGs was that they would be used to determine remediation levels and to assist in the completion of remedial design and processes. Once the COPCs are established and all sampling has been completed so that the nature and extent of the contamination is known, the next step is to determine which of the COPCs are Chemicals of Concern (COCs). The determination of the COCs consists of a screening of the chemical concentration to specific CUGs. However, unlike the COPC comparison, the COCs are determined by comparing the chemical concentration to different risk levels and potentially, for different receptors.

The determination of the COCs uses a less stringent risk value but must address the potential for additive effects. To account for the potential additive effects from exposure to multiple chemicals or exposure to multiple chemicals that can cause the same effect (e.g., cancer) or affect the same target organ, then the "Sum of Ratios" approach should be used. This approach compares the chemical concentration (e.g., mean concentration or concentration in confirmation samples) of the COPC to the individual CUG to determine a ratio. The Sum of Ratios method is based upon the principle that a ratio greater than 1 represents unacceptable risk and a ratio less than or equal to 1.0 represents acceptable risk. If there are multiple chemicals in the samples that are being evaluated and they are carcinogens or if there are non-carcinogens that affect the same target organ, then the Sum of Ratios of both the carcinogens and the non-carcinogens, respectively, must be less than or equal to 1.0. If the Sum of Ratios is > 1 and there are chemicals contributing at least 10% to the sum, then they are also considered COCs for the site.

Several examples of the Sum of Ratios approach are presented in the following. Example 1 of the Sum of Ratios is for three chemicals (i.e., A, B, and C) that may affect the same target organ.

Example 1. Sum of Ratios less than 1 and no chemical identified as a COC.

Chemical	EPC or Maximum Concentration	FW CUG	Ratio of EPC to FWCUG	% Contribution to the total sum	COC Yes or No
Chemical A	1	2.1	0.5	88	No
Chemical B	2	56	0.04	7	No
Chemical C	8	320	0.03	5	No
		Sum of Ratios	0.57		

In Example 1, Chemical B and Chemical C are eliminated because they do not contribute more than 10% of the total Sum of Ratios. Chemical A is not retained as a COC although it is contributing more than 10% of the total Sum of Ratios, but the total is less than 1. Without doing the Sum of Ratios approach, no consideration would have given to the chemicals collectively to determine if there was potential for any of them being a COC since their EPCs was less than their CUGs.

Example 2 shows the Sum of Ratios follows for three chemicals (i.e., E, F, and G) that may affect the same target organ where the Sum of Ratios is greater than 1.0 and several COCs are identified.

Chemical	EPC or Maximum Concentration	FW CUG	Ratio of EPC to FWCUG	% Contribution to the total sum	COC Yes or No
Chemical E	1	2	0.5	0.32	Yes
Chemical F	57	56	1.02	0.66	Yes
Chemical G	8	320	0.03	0.02	No
		Sum of Ratios	1.55		

In this example, Chemical G is eliminated because its ratio does not contribute more than 10% of the total Sum of Ratios. Chemicals E and F are retained as a COC because their ratios are contributing more than 10% of the total Sum of Ratios. Without the Sum of Ratios approach, only chemical F would have been considered a COC since its EPC exceeds its CUG value.

The determination of the COCs should follow this Interim Guidance until the Final FW CUG Report is available. The screening process is as follows:

- Select the CUGs developed for the Resident Farmer Adult and Child Receptors and the receptor for the planned future land use by the Ohio Army National Guard.
- Select the CUGs at the 1.0×10^{-5} carcinogenic value and the non-carcinogenic risk value termed Hazard Quotient (HQ) using the 1.0 risk value.
- Report all carcinogenic and non-carcinogenic risk values for each chemical for all receptors.
- Report critical effect and target organ for each of the non-carcinogenic risk values.
- Complete a comparison of the selected CUG to the EPC. The EPC will be either the 95% UCL of the mean for each chemical concentration or the maximum value detected, depending upon whichever value is the lowest. In comparisons where the 95% UCL cannot be determined, the maximum concentration of the chemical should be compared to the appropriate CUGs.

- .For non-carcinogens, compare the chemical-specific concentration to the target risk CUG. Sum the ratios of chemicals that affect similar target organs.

- For carcinogens, compare the chemical-specific concentration to the target risk CUG. Sum the ratios of all carcinogens.

- Consider the chemical as a COC if the EPC exceeds the most stringent risk value for either the Adult Resident Farmer or the Child Resident Farmer, and/or the OHARNG planned future use receptor, for either one of the 1.0×10^{-5} carcinogenic value and the non-carcinogenic risk value termed Hazard Quotient (HQ) using the 1.0 risk value. The Sum of Ratios for all carcinogens and all non-carcinogens that may affect the same organ must be less than or equal to 1.0 as well. If the Sum of Ratios for all carcinogens and all non-carcinogens (that may affect the same organ) are greater than 1 then the chemicals contributing at least 10% to the sum are considered COCs.

4.0 USE OF CUGS DURING REMEDIATION AND CONFIRMATION

In general, the CUGs for each of the COCs identified are the actual remediation levels unless there are additive effects. In some circumstances there may be a risk management analysis such as a "Weight of Evidence" approach that may allow the COC to be re-assessed. As described in the previous section, the Sum of Ratios is used to account for the potential additive effects from exposure to multiple chemicals that can cause the same effect (e.g., cancer) or affect the same target organ. This approach compares the chemical concentration (e.g., mean concentration or concentration in confirmation samples, the EPC) of the COC to the individual CUG to determine a ratio.

This final application of CUGs would generally occur during the Feasibility Study (FS) or during remediation. During the determination of COCs, and accounting for potential additive effects, the numbers that were obtained are essentially the remediation levels and would be used for the confirmation samples. The target risk values are the same for remediation levels as they are for the determination of the COCs. The cancer risk is 1.0×10^{-5} and the non-carcinogenic HQ is 1.0.

Chemicals that are identified in confirmation samples that were not identified as COCs need to be considered in the overall estimation of the success of the remediation. For example, if a chemical is detected and is shown to affect the same target organ as one that has a remediation level established, then the chemical should be considered using a Sum of Ratio approach to determine if there are any risks remaining for the designated end user.

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