RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

Solid Waste Management Unit 54
RCRA Facility Investigation/
Corrective Measures Study Report

Volume I

FINAL
SEPTEMBER 2008

PREPARED BY:

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

10/21/08

08-105

October 16, 2008

Commander,
Radford Army Ammunition Plant
Attn: SJMRF-OP-EQ (Jim McKenna)
P.O. Box 2
Radford, VA 24141-0099

P.W. Holt
Environmental Manager
Alliant Techsystems, Inc.
Radford Army Ammunition Plant
P.O. Box 1
Radford, VA 24141-0100

Re: Radford Army Ammunition Plant, Va.
Solid Waste Management Unit (SWMU) 54
Review of the Army's RCRA Facility Investigation (RFI) / Corrective Measures Study (CMS) Report

Dear Mr. McKenna and Ms. Holt:

The U.S. Environmental Protection Agency (EPA) has reviewed the U.S. Army's (Army's) September, 2008 Final RFI/CMS Report for SWMU 54, located at the Radford Army Ammunition Plant (RFAAP). Based upon our review, the report is approved, and in accordance with Part II. (E) (5) of RFAAP's Corrective Action Permit, it can now be considered final.

If you have any questions, please call me at 215-814-3413. Thanks.

Sincerely,

William Geiger
RCRA Project Manager
General Operations Branch (3WC23)

cc: James Cutler, VDEQ

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September 29, 2008

Mr. William Geiger
RCRA General Operations Branch, Mail Code: 3WC23
Waste and Chemicals Management Division
U. S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Mr. James L. Cutler, Jr.
Virginia Department of Environmental Quality
629 East Main Street
Richmond, VA 24143-0100

Subject: With Certification, Radford Army Ammunition Plant,
SWMU 54 RCRA Facility Investigation/Corrective Measures Study Report, Final Document, September 2008
EPA ID# VA1 210020730

Dear Mr. Geiger and Mr. Cutler:

Enclosed is the certification for the subject documents that were sent to you on September 24, 2008.

Also enclosed are copies of the September 24, 2008 email message that transmitted the subject document and a consolidated and revised set of responses to comments from the Environmental Protection Agency, Region III (EPA) and from the Virginia Department of Environmental (DEQ). Note we sent these responses out via email dated August 13, 2008 with EPA responding on August 19, 2008 that they were acceptable. Copies of these emails are enclosed.

Please coordinate with and provide any questions or comments to myself at (540) 639-8658, Jerry Redder of my staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 731-5782.

Sincerely,

P.W. Holt, Environmental Manager
Alliant Techsystems Inc.

c: Durwood Willis
Virginia Department of Environmental Quality
P. O. Box 10009
Richmond, VA 23240-0009

08-815-147
JMcKenna

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Coordination: J. McKenna M. A. Miano

bc: Administrative File
J. McKenna, ACO Staff
M.A. Miano
P.W. Holt
J. J. Redder
Env. File

08-815-147
JMcKenna

Concerning the following:

Radford Army Ammunition Plant
SWMU 54 RCRA Facility Investigation/Corrective Measures Study Report,
Final Document, September 2008

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

SIGNATURE:
PRINTED NAME: Jon R. Drushal
TITLE: Lieutenant Colonel, US Army
Commanding

SIGNATURE:
PRINTED NAME: Kent Holiday
TITLE: Vice President and General Manager
ATK Energetics Systems

08-815-147
JMcKenna

Greene, Anne

From: McKenna, Jim
Sent: Wednesday, September 24, 2008 2:36 PM
To: Lee_Mareck@URSCorp.com; Greene, Anne; beth lohman; dennis.druck@us.army.mil; diane.wisbeck@arcadis-us.com; durwood willis2; Geiger.William@epamail.epa.gov; Redder, Jerome; jim spencer; jlcutler@deq.virginia.gov; Llewellyn, Tim; Mendoza, Richard R Mr CIV USA IMCOM; Parks, Jeffrey N; Timothy.Leahy@shawgrp.com; Tina_Devine@URSCorp.com; Tom.Meyer@nab02.usace.army.mil
Subject: SWMU 54 RFI/CMS report, final Tracking Numbers (UNCLASSIFIED)

Importance: High

Classification: UNCLASSIFIED
Caveats: NONE

All:

Note the contractor will ship the subject document with a copy of this email to the POCs and tracking numbers below.

Certification letter will follow from Radford AAP under separate cover.

Thank you for your support of the Radford AAP Installation Restoration Program.

Jim McKenna
540 731 5782

Immediately below are the POCs with tracking numbers:

James McKenna 7905 8472 6139 2 Paper copies 7980 1974 7092 Will Geiger 7900 9264 9451 1 Paper copy/1 CD Jim Cutler 7921 1218 6266 1 Paper copy/1 CD Tom Meyer 7980 1976 1199 1 Paper copy/1 CD Richard Mendoza 7900 9265 4016 1 Paper copy/1 CD Dennis Druck 7993 7990 8610 1 CD Elizabeth Lohman 7927 5580 8465 1 CD Jennifer Murphy 7905 8474 2970 1 CD

Classification: UNCLASSIFIED
Caveats: NONE

Greene, Anne

From: McKenna, Jim

Sent: Wednesday, August 13, 2008 2:44 PM

To: Greene, Anne; beth lohman; dennis.druck@us.army.mil; diane.wisbeck@arcadis-us.com; durwood willis2; Geiger.William@epamail.epa.gov; Redder, Jerome; jim spencer; jlcutler@deq.virginia.gov; Llewellyn, Tim; Mendoza, Richard R Mr CIV USA IMCOM; Parks, Jeffrey N; Timothy.Leahy@shawgrp.com; Tina_Devine@URSCorp.com; Tom.Meyer@nab02.usace.army.mil

Subject: FW: RFAAP - Final RTC for SWMU 54 RFI/CMS (UNCLASSIFIED)

Importance: High

Attachments: Final SWMU 54 RFI-CMS RTC 7_13_2008.pdf

Classification: UNCLASSIFIED
Caveats: NONE

All,

See Tina's email below. I'm resending these SWMU 54 responses to comments so that they are all in one file and one email. My understanding is that they are acceptable so I anticipate approval from EPA and DEQ.

Thanks,
Jim

-----Original Message-----
From: Tina_Devine@URSCorp.com [mailto:Tina_Devine@URSCorp.com]
Sent: Wednesday, August 13, 2008 2:36 PM
To: McKenna, Jim J Mr CIV USA AMC
Subject: RFAAP - Final RTC for SWMU 54 RFI/CMS

Good afternoon. Attached is a final RTC for SWMU 54 RFI/CMS including the revision (per verbal discussion with VDEQ)to comment #14 and revised Tables 8-1 and 8-2 (as previously submitted) for final approval. Thanks and have a great day.

(See attached file: Final SWMU 54 RFI-CMS RTC 7_13_2008.pdf)

Tina DeVine, P.E.
Project Engineer
URS Corporation
(804)474-5448

This e-mail and any attachments are confidential. If you receive this message in error or are not the intended recipient, you should not retain, distribute, disclose or use any of this information and you should destroy the e-mail and any attachments or copies.

Classification: UNCLASSIFIED
Caveats: NONE

Final Response to Comments (7/13/2008)

EPA/VDEQ Comments Minus Risk Assessment Comments for Radford Army Ammunition Plant's Solid Waste Management Unit 54 RCRA Facility Investigation/Corrective Measures Study (January 2008) – Comments Received via E-mail 4/2/2008

GENERAL COMMENTS

1. The figures in Section 4.0 provide visual representations of the extent of soil and groundwater contamination at both Areas A and B. The extent of contamination of the following areas of interest does not appear to have been fully delineated. The RFI/CMS Report does not identify any data gaps or areas which would require the collection of additional data to fully define an area of concern during the CMS. For each bullet listed, the RFI/CMS Report needs to be revised to address the perceived data gap, or lack of data for complete delineation of the extent of contamination.

   - Figure 4-2, Area A – Extent of Pesticides and PCBs in Soil: The extent of heptachlor epoxide contamination in the immediate vicinity of sample 54SB25B is not immediately evident as the sample location just south of 54SB25B (54SB28) was not analyzed for heptachlor epoxide. According to the proposed remedial boundaries for Area A (Figure 8-1), sample 54SB28 is specifically excluded from the area requiring remediation. However, without adequate data for this sample and others shown on Figure 4-2, it is not clear that the extent of heptachlor epoxide has been adequately characterized. Since sidewall and bottom of excavation sampling is proposed during remedy implementation, it may be acceptable to address this concern at that time. However, the CMS should identify this potential data gap and discuss how it will be addressed during remedy implementation.

     Response: Figure 8-1 is intended to show the approximate limits where corrective measures will be implemented for purposes of the CMS. For remedy implementation, the specific limits of corrective measures will be defined by the collection of bottom and sidewall confirmatory samples within the excavation areas as discussed in Sections 10.2 and 10.3.

     It is proposed that the potential nature and extent data gap for heptachlor epoxide be addressed in the remedy implementation phase by the collection of bottom and sidewall confirmatory samples, which will be used to define the precise limits of the excavation and remedial area and verify that the lateral and vertical extent of soil with COC concentrations above RGs is removed.

     The RFI/CMS text will be revised in the following sections to address this comment:

     Section 4.1.2.2 (page 4-5, paragraph one) will include the following revised text: "Heptachlor epoxide was the only pesticide detected in soil at a

concentration above its adjusted R-RBC; two non-contiguous areas of impact were identified around borings 54SB25 and 54SB32 as shown on Figure 4-2. The precise lateral limit of impact of these non-contiguous areas is uncertain and therefore estimated given the lack of sample data immediately south, east, and west of 54SB25 near the center of the SWMU area."

Section 10.2 (page 10-2, Confirmatory Soil Sampling) will include the following revised text: "Any uncertainties associated with the precise limits of COCs with concentrations above RGs, such as heptachlor epoxide and 2,3,7,8-TCDD, as identified in the Sections 4.0, 5.0, and 8.0, will be addressed during remedy implementation by confirmatory soil sampling. Confirmatory soil sampling will be conducted to define the precise limits of the excavation and remedial area and verify that the lateral and vertical extent of soil with COC concentrations above RGs is removed. Samples will be collected from base and sidewalls of the excavation. The anticipated confirmatory soil sampling program is outlined in Table 10-1." The same edit will be made to Section 10.3 for Corrective Measures Alternative Three.

Table 10-1 will include the following additions: "Heptachlor epoxide will be added as an analyte for confirmatory soil sample analysis."

- Figure 4-3, Area A – Extent of Dioxin/Furans in Soil: The extent of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) toxicity equivalent concentration (TEQ) contamination north and west of samples 54SB25, 54SB23, and 54SB83 does not appear to have been adequately defined. Samples were not collected for dioxin/furan analysis in the above-noted areas, which includes the northern one-third area of this solid waste management unit (SWMU). Additionally, the extent of contamination does not appear to be defined west of sample 54SB33, which reported a 2,3,7,8-TCDD TEQ concentration above the Region 3 industrial risk-based screening concentration (RBC). Please revise Figure 4-3 to clearly indicate those samples which are contributing to the presented extent of contamination and revise the RFI/CMS Report to address these data gaps.

  Response: The inferred and approximate extent of 2,3,7-8-TCDD TEQ in soil at concentrations above the residential RBC is based on a combination of specific sample data for dioxins (green and yellow dots on Figure 4-3) and inferences made from more extensive testing for lead and explosives at the site. Lead and explosives are indicator COCs for propellant ash and one or both of these compounds would be expected to be co-located with elevated concentrations of dioxins, as shown by 54SB33 (lead) and 54SB32 (explosives).

  Regarding the northern one third of the SWMU area, Additional samples for dioxin analysis were not collected from borings completed in this area (54SB17 through 54SB20) given the lack of evidence of propellant ash or burned material (possibly resulting in dioxins) in the borings and non detect explosives concentrations and low-level lead concentrations below risk-

screening criteria. Given these results and the lack of detected dioxin concentrations above risk-screening criteria in borings 54SB23, 54SB25, 54SB27, 54SB30, 54SB83, and 54SB84 completed south of this area, the interpreted limits shown on Figure 4-3 are in the southern portion of the SWMU.

It should be noted that detected concentrations at boring 54SB33 were below the industrial RBC. The delineation shown in area west of 54SB33 is not precise given the lack of dioxin specific data in this area but is based on sample results from borings 54SB30 (dioxins) and lead/explosives data from borings 54SB35 and 54SB37. As shown on Figure 8-1, the area west of 54SB33 is part of the corrective measures area where soil will be excavated to address COC concentrations above RGs. It is proposed that any potential nature and extent data gaps for dioxins be addressed in the remedy implementation phase by the collection of bottom and sidewall confirmatory samples, which will be used to define the precise limits of the excavation and remedial area and verify that the lateral and vertical extent of soil with COC concentrations above RGs is removed.

The RFI/CMS text will be revised in the following sections to address this comment:

Section 4.1.2.4 (page 4-5, paragraph one) will include the following revised text: "The extent of 2,3,7-8-TCDD TEQ in soil at concentrations above the R-RBC shown on Figure 4-3 around the area of borings 54SB32 and 54SB33 has not been precisely delineated and is based on a combination of specific sample data for dioxins and inferences made from more extensive testing for lead and explosives at the site. Lead and explosives are indicator chemicals for propellant ash at Area A and one or both of these compounds would be expected to be co-located with elevated concentrations of dioxins. Impacts are not shown on Figure 4-3 in the northern portion of the SWMU given the lack of evidence of propellant ash or burned material (possibly resulting in dioxins) in the borings and low concentrations of lead and non detect explosives concentrations below risk-screening criteria. Given these results and the lack of detected concentrations above risk-screening criteria in borings 54SB23, 54SB25, 54SB27, 54SB30, 54SB83, and 54SB84 completed south of this area, the interpreted limits shown on Figure 4-3 are in the southern portion of the SWMU."

"As shown on Figure 4-3, the vertical extent of dioxin impact at boring 54SB32 extends from the surface to a depth greater than 10 ft bgs and at boring 54SB33 the vertical extent of dioxin impact extends from the surface to a depth less than 9 ft bgs. Detected concentrations of dioxins were below the adjusted I-RBC."

Figure 4-3 will be modified to include additional explanations and information regarding the inferences made in estimating the extent of

concentrations above the residential RBC and approximate nature of the delineation.

Section 10.2 (page 10-2, Confirmatory Soil Sampling) will include the following revised text: "Any uncertainties associated with the precise limits of COCs with concentrations above RGs, such as heptachlor epoxide and 2,3,7,8-TCDD, as identified in the Sections 4.0, 5.0, and 8.0, will be addressed during remedy implementation by confirmatory soil sampling. Confirmatory soil sampling will be conducted to define the precise limits of the excavation and remedial area and verify that the lateral and vertical extent of soil with COC concentrations above RGs is removed. Samples will be collected from base and sidewalls of the excavation. The anticipated confirmatory soil sampling program is outlined in Table 10-1. The same edit will be made to Section 10.3 for Corrective Measures Alternative Three."

- Figure 4-5, 2,4,6-TNT in Groundwater Isoconcentration Map, and Figure 4-6, RDX in Groundwater Isoconcentration Map: The extent of groundwater contamination south of existing wells existing wells 54MW-2 and 54MW-10 is not adequately characterized (as evidenced by the dashed isoconcentration contours). Monitoring well 54MW-10 reported some of the highest levels of groundwater contamination at the site during the September 2007 sampling round (Table 4-6). Given the east/southeastern groundwater flow direction at the site, it will be important to complete delineation of the groundwater plume in the vicinity of monitoring well 54MW-10 at the site (specifically with respect to 2,4,6-TNT and RDX). It is noted that a groundwater monitoring well (54MW13) is proposed in this area in Section 10.0 of the RFI/CMS Report. However, if concentrations exceed remedial goals (RGs) in this new well, further plume definition to the south will be warranted. The RFI/CMS Report should also document this area as a data gap when discussing the current nature and extent of contamination in Section 4.0.

  Response: The dashed approximate isoconcentration lines that are shown on Figures 4-5 and 4-6 reflect the lack of groundwater data to precisely define and characterize dissolved phase concentrations of 2,4,6-TNT and RDX in groundwater south of 54MW2 and 54MW10. The inferences made for 2,4,6-TNT and RDX concentrations on Figures 4-5 and 4-6 south of 54MW2 and 54MW10 are based on the more extensive perchlorate data available for this area as shown on Figure 4-7. Perchlorate is typically co-located with the explosives in groundwater and occurs at the leading edge of the dissolved phase plume because of its higher solubility and mobility than 2,4,6-TNT and RDX. As shown on Figures 4-5 and 4-6, the distribution of 2,4,6-TNT and RDX in groundwater south of the SWMU has been conservatively assumed to be approximately equivalent to that shown for perchlorate on Figure 4-7.

  As noted in the comment, an additional monitoring well 54MW13 is proposed south of the SWMU area where the above comment noted the data gap. This monitoring well is intended to fill the identified data gap and provide for more

complete characterization of the extent of COC concentrations in groundwater above RGs and confirm interpretations presented in the RFI/CMS Report. Additionally, the well location shown is positioned to the south of the interpreted area where concentrations are above RGs to verify during remedy implementation that the plume is not expanding to the south. The performance monitoring plan prepared for remedy implementation will outline contingency plans should concentrations exceed one or more RGs at this location.

The RFI/CMS text will be revised as follows to address this comment:

Section 4.2.1 (page 4-7, paragraph one) will include the following revised text as a third paragraph: " The dashed approximate isoconcentration lines that are shown on Figures 4-5 and 4-6 reflect the lack of groundwater data to precisely define and characterize dissolved phase concentrations of 2,4,6-TNT and RDX in groundwater south of 54MW2 and 54MW10. The inferences made for 2,4,6-TNT and RDX concentrations on Figures 4-5 and 4-6 south of 54MW2 and 54MW10 are based on the more extensive perchlorate data available for this area as shown on Figure 4-7. Perchlorate is typically co-located with the explosives in groundwater and occurs at the leading edge of the dissolved phase plume because of its higher solubility and mobility than 2,4,6-TNT and RDX. As shown on Figures 4-5 and 4-6, the distribution of 2,4,6-TNT and RDX in groundwater south of the SWMU has been conservatively assumed to be approximately equivalent to that shown for perchlorate on Figure 4-7."

- Figure 4-11, Area B – Extent of Dioxin/Furans in Soil: The extent of dioxin contamination east of sample 54SB53 and southeast of sample 54SB43 does not appear to be defined as no samples were collected in this area. Since sidewall and bottom of excavation sampling is proposed during remedy implementation, it may be acceptable to address this concern at that time. However, the CMS should identify this potential data gap and discuss how it will be addressed during remedy implementation.

  Response: It is proposed that the potential nature and extent data gaps identified for dioxins be addressed in the remedy implementation phase by the collection of bottom and sidewall confirmatory samples, which will be used to define the precise limits of the excavation and remedial area and verify that the lateral and vertical extent of soil with COC concentrations above RGs is removed.

  The RFI/CMS text will be revised as follows to address this comment:

  Section 4.3.2.4 will include the following revised text: "The precise lateral limit of dioxins in soil east of 54SB53 and southeast of 54SB43 is uncertain and therefore estimated given the lack of sample data in these areas."

Section 10.2 (page 10-2, Confirmatory Soil Sampling) will include the following revised text: "Any uncertainties associated with the precise limits of COCs with concentrations above RGs, such as heptachlor epoxide and 2,3,7,8-TCDD, as identified in the Sections 4.0, 5.0, and 8.0, will be addressed during remedy implementation by confirmatory soil sampling. Confirmatory soil sampling will be conducted to define the precise limits of the excavation and remedial area and verify that the lateral and vertical extent of soil with COC concentrations above RGs is removed. Samples will be collected from base and sidewalls of the excavation. The anticipated confirmatory soil sampling program is outlined in Table 10-1. The same edit will be made to Section 10.3 for Corrective Measures Alternative Three.

2. Appendix G.6 (Corrective Measures Alternative Four: Excavation of Soil to Industrial RGs) is included as an attachment, yet this appendix apparently has not been discussed in the main text of the RFI/CMS Report, and excavation of soil to industrial RGs is not evaluated as one of the three alternatives in the CMS. This alternative is, however, mentioned in the Executive Summary, as follows: "As part of the development of these alternatives, initial evaluations were conducted to compare implementation of an additional corrective measure alternative that addressed identified risks associated with current and future industrial land use scenarios at the site to Alternative Nos. Two and Three, which in addition to the identified industrial risks also address identified risks associated with the soil-to-groundwater pathway and groundwater (Appendix G.6). These evaluations indicated that the estimated total cost of implementing an industrial based alternative ($5,941,375) was approximately 54% higher than implementing Alternative No. Two ($3,585,547) and 46% higher than implementing Alternative No. Three ($4,081,562). The difference in cost between the industrial based alternative and the other alternatives was related to leaving waste in place at concentrations that would require long-term monitoring and maintenance beyond the period of remedy implementation for Alternative Nos. Two and Three. Based on this initial evaluation, the alternative based only on addressing industrial risk in soil was not carried forward as a corrective measures alternative for further evaluation in the CMS." Although this information is presented in the Executive Summary, it also needs to be presented in the CMS portion of the RFI/CMS Report. The explanation presented above needs to be included in the CMS to justify why a potentially more protective approach was selected. Please revise the RFI/CMS Report to discuss Alternative Four within the CMS portion of the Report.

   Response: The discussion of Alternative Four – Industrial based will be included in Section 10.0 of the CMS portion of the report.

3. Figures 2-9, 2-10, 2-11, and 2-12 appear to show that monitoring well MW-9 is located downgradient of Area B, yet data from this well was not included in the nature and extent evaluation at Area B or in the risk assessment for Area B. The RFI/CMS Report does address the possibility that monitoring well MW-9 may have been impacted by Area A contaminants due to the variable groundwater flow directions at the site under high flow conditions of the New River; however, under normal base flow conditions, groundwater flow direction at the site is towards the New River. Please revise the

RFI/CMS Report to clarify why monitoring well MW-9 was not considered a dual-purpose well, used to monitor both areas, and why MW-9 was not selected as a point of compliance well for long-term monitoring for Area B. If adequate justification cannot be provided for limiting the data set for Area B, the nature and extent evaluation and risk assessment should be revised to include data from MW-9.

Response: As indicated in Section 3.1.3 (paragraph 2) the RFI/CMS, monitoring well MW-9 was installed as a result of direct push investigations of the groundwater constituent plume (explosives and perchlorate) associated with Area A. Groundwater data collected during the direct push investigation indicated a progressive extension of the plume area for explosives and perchlorate northward from Area A to a location in and around 54MW9 as shown on Figures 4-6 and 4-7. Conversely, the groundwater data collected from monitoring wells 54MW4 and 54MW7 (2003 and quarterly sampling in 2006/2007) located downgradient of Area B did not indicate a release of these constituents of potential concern to groundwater and therefore, 54MW9 was considered appropriate to measure the extent of contamination for Area A given the results of groundwater investigations.

The RFI/CMS text will be revised as follows to address this comment:

Section 3.1.3 will include the following revised text inserted after the end of the first paragraph: "Groundwater data collected during the direct push investigation indicated a progressive extension of the plume area for explosives and perchlorate northward from Area A along the New River."

SPECIFIC COMMENTS

4. **Table 2-4, Groundwater Elevation Data:** The last two columns of this table appear to present data for the September 28, 2005, groundwater monitoring event, but groundwater elevations from this date were already presented in the third and fourth columns of the table, and do not match the values presented in the last two columns. Although the data presented in the last two columns is titled September 28, 2005, it appears that they may actually represent another monitoring event, possibly the September 2007 event. Please revise Table 2-4 to correct this discrepancy, and assure that groundwater elevations for the September 2007 monitoring event are also included on the table.

   Response: The header will be revised to reflect the date of the September 18, 2007 groundwater monitoring event.

5. **Section 4.1.1, Analytical Results, Page 4-2:** The first paragraph indicates that an "A" sample represents a surface soil sample. However, Table 3-1, Field Sample Identifiers, Depths, and Analytical Methods, included in Section 3.0, identifies a few exceptions to this statement. For example, Table 3-1 indicates that sample 54SB18A was collected at a depth of 9-10 feet (ft) below ground surface (bgs). Sample 54SB19A was also collected 9-10 ft bgs. Please revise the RI/CMS Report to address this discrepancy, and

assure that the nature and extent evaluation, as well as the risk assessments take these sample depths into account during site characterization. It is recommended that the sample designation be noted in some way to document this exception to ensure that all users of the data are aware of it.

Response: The depths on Table 3-1 will be revised to reflect the following sample depths 54SB18A (0-1 ft bgs), 54SB18B (9-10 ft bgs), 54SB19A (0-1 ft bgs), and 54SB19B (9-10 ft bgs).

6. **Table 4-1, Summary of Detected Chemicals in Soil Analytical Samples at Area A:** A note included at the end of this table states that bold italic type is used to identify concentrations that exceed soil screening levels (SSLs) based on a dilution attenuation factor (DAF) of 20. The table actually screens contaminants against a DAF based on a conservative DAF of 1. Please revise the notes section of Table 4-1 to accurately state what the bold italic type identifies within the table.

Response: The note on Table 4-1 will be updated to the correct DAF of 1.

7. **Section 5.1.4.6, Dioxins, Page 5-11:** This section is supposed to address dioxin soil data in comparison to site specific soil-to-groundwater SSLs, but the third and fourth paragraphs in this section appear to describe polychlorinated biphenyls (PCBs) at Area B instead, although some text does appear to discuss dioxins. Dioxins at Area B need to be described consistently. Please revise this section to include a discussion of the potential for dioxins detected in soil at Area B to leach to groundwater.

Response: The third and fourth paragraphs of Section 5.1.4.6 will be revised as follows:

"The following table indicates that detected concentrations of dioxins in eight soil samples at Area B are above the site specific SSL.

Area B- Comparison of Dioxin Soil Data to Site Specific Soil-to-Groundwater SSLs

	Detected Concentrations (mg/kg)			
COPC	Minimum	Maximum	Site-Specific SSL	Above SSL
2,3,7,8-TCDD TEQ	7.00E-09	1.83E-04	6.52E-06	Yes (8)

The detected concentrations of dioxins above the site-specific SSL suggest a potential for this chemical to leach to groundwater in the future at levels of potential concern; although this potential is considered low given the immobile nature of dioxins in soil and the lack of dioxin detections in groundwater at concentrations above adjusted T-RBCs."

8. **Section 5.1.4.7, Explosives, Page 5-11:** The site-specific SSL for 2,4,6-DNT at Area A is identified as 0.498 milligram per kilogram (mg/kg) on this page. However, Appendix C.8 notes that the SSL for 2,4,6-DNT at Area A is 0.408 mg/kg. Please address this discrepancy and assure that the total number of samples exceeding the calculated SSL is accurate.

Response: The table in section 5.1.4.7 will be updated to the correct site specific soil-to-groundwater SSL of 0.408 mg/kg and the total number of samples exceeding the SSL will be revised to 8.

9. **Section 5.1.4.7, Explosives, Page 5-12:** The third paragraph on this page indicates that 2,4,6-TNT, DNT mixture, amino DNTs, and nitroglycerin have the potential to leach to groundwater. According to the table directly above this paragraph (Area B-Comparison of Explosives Soil Data to Site Specific Soil-to-Groundwater SSLs), RDX was also detected above the site-specific SSL, and therefore, has the potential to leach to groundwater. Please revise the RFI/CMS Report to address the potential for RDX to leach to groundwater at Area B.

Response: The third paragraph of Section 5.1.2.7 will be revised as follows: "The following table compares the soil data for explosives at Area B to site-specific SSLs and indicates that 2,4,6-TNT, DNT mixture, amino DNTs, RDX, and nitroglycerin were detected in soil at concentrations above their site-specific SSLs."

10. **Section 5.2.1, Volatilization, Page 5-13**: This section references Table 5-1 for the chemical-specific Henry's Law constants. It appears that the appropriate reference for this information is actually Table 5-2 (Chemical Properties Affecting Fate and Transport) since Table 5-1 describes the fate processes affecting organisms. Please revise the RFI/CMS Report to make the necessary change.

Response: In Section 5.2.1, the reference to the table providing Henry's Law constants will be revised to Table 5-2.

11. **Section 8.1.2, Area B, Page 8-2:** The table for Area B – Chemicals and Media of Interest, does not appear to include dieldrin or nitroglycerin for soil to groundwater migration potential at Area B. Page 5-10 notes that dieldrin was detected above its site-specific SSL in one sample. Additionally, nitroglycerin was detected above its site-specific SSL in two samples. Both of these constituents have the potential to leach to groundwater, and should therefore, be identified as Chemicals of Interest in the table on Page 8-2 for Soil-to-Groundwater Migration. Please revise the RFI/CMS Report to include these constituents, or provide additional justification for excluding them. Identification of dieldrin in only one sample is not necessarily adequate justification as several other constituents were only detected in one sample above their respective SSLs, but they were included as Chemicals of Interest in Section 8.0 (i.e., 2,3,7,8-TCDD TEQ and nitroglycerin at Area A).

Response: In Section 8.1 on page 8-2, dieldrin and nitroglycerin will be added as chemicals of interest for the soil to groundwater migration pathway for Area B.

12. **Section 8.2.2, Area B, Page 8-3:** Only one corrective measure objective (CMO) has been stated for Area B, and it does not appear to take into account the results of the human health or ecological risk assessments. The table on Page 8-2 noted that lead, 2,4,6-TNT and nitroglycerin were identified as chemicals of interest in the HHRAs

(and in particular, lead for the future construction worker since this is the most likely receptor scenario). A CMO that addresses protection of human health associated with soil impacts must also be developed. Upon further review, it appears that Section 13.0 includes a more thorough list of CMOs for Area B. These CMOs appear adequate provided that they are included in the initial discussion of CMOs in Section 8.0. Please revise the RFI/CMS Report to make the necessary changes to Section 8.0.

Response: Text in Section 8.2.2 will be revised as follows:

"The following CMOs have been developed for Area B based on the results of the fate and transport assessment and risk assessments:

- CMO No. 1 – Mitigate the potential future risks that have been identified for exposure to soil under a future construction worker scenario for lead; and
- CMO No. 2 – Prevent leaching of COCs from soil to groundwater at levels that would potentially adversely impact future beneficial use of groundwater."

13. **Section 8.2, Corrective Measures Objectives:** Please clarify why Initial CMOs make no mention of goals for soil remediation.

Response: Due to the most likely future use of the site remaining industrial in nature, the corrective measures objectives in Section 8.2.2 will be revised to include goals for soil remediation as related to the identified future risks for the construction worker.

14. **Section 8.3, Remedial Goals:** It is not clear how remedial goals (RGs) are being addressed. It appears that all possible RGs are presented rather than the RGs that relate to specific remediation objectives. Note that if risk is present for GW then ARARs are triggered (VA MCLs) to establish RGs. However there are no MCLs that apply to the GW COCs for this site.

Response: Section 8 will be updated to include revised description of remedial goal calculation as follows: For Area A, although the risk assessments resulted in risks and hazards within EPA ranges with the exception of 2,4,6-TNT in groundwater which resulted in an HI of 2 for the liver for the hypothetical future child resident, the soil-to groundwater pathway assessment indicated the potential for impacts to groundwater from chemicals in soil at the site (2,4,6-TNT, DNT mix, nitroglycerin, 2,3,7,8-TCDD TEQ, amino-DNTs, and heptachlor epoxide) and the groundwater results indicated impacts to groundwater above screening levels (2,4,6-TNT, DNT Mix, RDX, and perchlorate). Groundwater remedial goals were calculated for carcinogenic COCs in groundwater (2,4,6-TNT, DNT Mix, and RDX) based on a target risk of 1E-05 for the lifetime resident and for noncarcinogenic COCs in groundwater (perchlorate) based on a target hazard of 1E+00 for the child resident. The equations used for groundwater remedial goal calculation and the remedial goal calculations will be provided in Appendix G. These calculated groundwater remedial goals were used as the target groundwater concentrations to calculate soil remedial goals for the soil-to-groundwater pathway using site-specific SSL equations as presented in Appendix G. For chemicals not identified as COCs in groundwater, but identified as COCs for the soil to groundwater pathway (i.e., amino-DNTs, nitroglycerin, heptachlor epoxide, and dioxins), the chemical's T-RBC was used as the target groundwater

concentration to calculate soil remedial goals for the soil-to-groundwater pathway using site-specific SSL equations as presented in Appendix G.

For Area B, the risk assessments resulted in risks and hazards within EPA ranges except for the child resident hazards for 2,4,6-TNT with a target organ of the liver and nitroglycerin with a target organ of the vascular system for total soil and the soil-to groundwater pathway assessment indicated the potential for impacts to groundwater from chemicals in soil at the site (2,4,6-TNT, DNT mix, amino-DNTs, RDX, 2,3,7,8-TCDD TEQ, Aroclor 1254, heptachlor epoxide, dieldrin, and nitroglycerin). Given that the hazards for 2,4,6-TNT and nitroglycerin exceed 1E+00, hazard-based RGs for the child resident for these COCs were calculated using a target hazard of 1E+00. The equations used for soil remedial goal calculation and the remedial goal calculations will be provided in Appendix G. Lead was also identified as a COC for Area B for the hypothetical future construction worker and hypothetical child resident based on the results of the lead exposure assessment.

The soil-to groundwater pathway assessment for Area B indicated the potential for impacts to groundwater from soil at the site, but groundwater results did not indicate impacts to groundwater above screening levels. Given that groundwater COCs were not identified for Area B, groundwater RGs calculated for Area A (2,4,6-TNT, Dinitrotoluene mix, RDX, and perchlorate) were used as the target groundwater concentrations to calculate soil remedial goals for the soil-to-groundwater pathway using site-specific SSL equations as presented in Appendix G. For chemicals not identified as COCs in groundwater, but identified as COCs for the soil to groundwater pathway (i.e., amino-DNTs, nitroglycerin, Aroclor 1254, heptachlor epoxide, dieldrin, and dioxins), the chemical's T-RBC was used as the target groundwater concentration to calculate soil remedial goals for the soil-to-groundwater pathway using site-specific SSL equations as presented in Appendix G.

For 2,4,6-TNT and nitroglycerin, which were identified as COCs in total soil for the child resident and COCs for the soil-to-groundwater migration pathway, the lower of the calculated RGs (child resident hazard-based and soil-to-groundwater migration pathway) was then selected as the RG for that chemical. For lead, a soil remedial goal of 400 mg/kg was selected as recommended by the USEPA for a residential scenario.

See attached revised Tables for Section 8 and remedial goal revisions/additional information for Appendix G (Attachment 1).

15. **Table 8-1, Remedial Goals:** This table documents the proposed RGs for soil and groundwater at the site. Some of the groundwater RGs are the Region 3 tapwater RBC values (T-RBCs). However, there are several discrepancies that need to be corrected. First, the T-RBC for 2,3,7,8-TCDD (TEQ) is identified as 4.50E-07 mg/l. The T-RBC listed in the October 2007 RBC table is 4.50E-07 *micrograms per liter (ug/l)* or 4.50E-10 mg/l. The T-RBC for heptachlor epoxide is listed in Table 8-1 as 0.0074 mg/l, but the actual T-RBC is 7.4E-03 ug/l or 7.4E-6 mg/l. Please make careful notice of the units of measure when establishing RGs based on the T-RBCs. It appears that the

correct T-RBC values were used when calculating the site-specific soil RGs for the soil to groundwater migration pathway. Please revise the RFI/CMS Report to document the correct T-RBC values as RGs for 2,3,7,8-TCDD (TEQ) and heptachlor epoxide.

Response: Table 8-1 will be revised to document the correct values used as groundwater RGs (7.4E-6 mg/L for heptachlor epoxide and 4.50E-10 mg/L for 2,3,7,8-TCDD TEQ).

16. **Table 8-1, Remedial Goals:** Some of the groundwater RGs were calculated using total groundwater risk for a lifetime resident of equal to or less than 1E-05, according to the note presented on Table 8-1. Although calculations are provided in Appendix G, there still appears to be a disconnect between how the RGs were originally selected in the risk calculations. Often, RGs are back-calculated from the estimated risk level, but the calculations in Appendix G do not show this. Additionally, neither Appendix G nor Section 8.0 of the RFI/CMS Report describes the equations used to calculate the RGs and the exposure assumptions that are inherent in these calculations. Please revise Section 8.0 to include the equations used to calculate the groundwater RGs for the site. Additionally, please discuss the exposure assumptions that are inherent in these calculations. Review of the proposed groundwater RGs will be reserved until this information is provided.

Response: See response to comment #14. The equations used for groundwater remedial goal calculation and the remedial goal calculations will be provided in Appendix G. See Attachment 1 Tables G.1-1a (Area A) and G.2-1a (Area B). Section 8 will be updated to reflect the updated remedial goals. Note that Table 8-1 is now Tables 8-1 (Remedial Goals – Area A) and Table 8-2 (Remedial Goals – Area B). See attached Tables 8-1 and 8-2.

17. **Section 8.4, Area and Volume of Impacted Area:** Again, it is not clear how the impacted area is being delineated. Is the soil-to-GW pathway the primary driver or just the most conservative?

Response: See response to comment #14. Section 8 will be revised to clarify the remedial goal selection process for both Area A and Area B, as well as, the impacted area to be addressed under corrective measures.

18. **Section 8.4.1, Area A, and Section 8.4.2, Area B, Pages 8-4 and 8-5:** Residual risk and hazard were calculated to address any remaining contamination at the site after remedy implementation. However, the samples that were used in these calculations have not been documented. To assure the samples that remain in place after remedy implementation have been included in the risk/hazard calculations, please provide a list of the sample IDs that were used in the residual risk assessment.

Response: A table listing the samples used in the residual risk/hazard calculations will be provided in Appendix G.3.

19. **Figure 10-1, Monitored Natural Attenuation Performance Monitoring Network:** The approximate lateral extent of impacted groundwater above RGs (2007) is delineated on this figure, but monitoring well 54MW10 is not located within this area. Since monitoring well 54MW10 reported 2,4,6-TNT, DNT mixture, and RDX above the proposed RGs in September 2007, the approximate extent of groundwater contamination should encompass this well. Please revise Figure 10-1 and any other figures which include this approximate lateral extent so that it encompasses monitoring well 54MW10.

Response: Figure 10-1 and 10-3 will be revised to show the approximate area of groundwater that will be addressed by corrective measures as it is shown Figure 8-2. The area on Figure 8-2 includes 54MW10 within the corrective measures area.

20. **Section 11.2.2, Compliance with Media Standards and Criteria:** The use of the word "after" suggests that more restoration will be performed in addition to meeting RGs?

Response: The text in Section 11.2.2 for Alternative Two will be revised as follows: "This alternative is designed to achieve media standards and criteria to provide for restoration of groundwater upon achievement of RGs through source removal and MNA."

21. **Section 11.3.1, Technical, Page 11-6:** The second paragraph on Page 11-6 states that it is anticipated that CMOs and RGs for groundwater will be achieved by Alternative Two (Monitored Natural Attenuation) within 5 years after completion of soil excavation activities. This estimated timeframe for compliance is not substantiated by any calculations or modeling efforts. It should be noted that this time frame is key to remedy selection, as currently the remedial time frames projected for Alternatives Two and Three are similar. Also, any MNA remedy needs to achieve RGs within a reasonable time frame. The RFI/CMS Report has not described estimated rates of attenuation, or other means used to calculate this 5-year timeframe to achieve CMOs and RGs for groundwater. Please revise the RFI/CMS Report to include the estimated rates of attenuation at the site, and describe how the estimated compliance date of 5 years was determined.

Response: The RFI/CMS Report will be revised to provide additional information on how the estimated rates of attenuation were calculated and the basis for 5 year estimate. Supporting calculations and information will be included in the report, as appropriate.

22. **Table 11-1: Cost Estimate: Corrective Measures Alternative Two:** It does not appear that this cost estimate includes costs for several items that are described in Section 10.2 of the RFI/CMS Report. For example, the cost estimate does not appear to include labor costs for onsite geologists or other site personnel, who may be sampling or providing oversight. It is noted in Task 1.2, Soil Excavation and Backfill, that per diem costs for three onsite personnel have been included in the cost estimate, but hourly

or daily costs for the personnel have not been included. Additional discrepancies which require clarification are identified below:

- Task 1.2 of the cost estimate does not include costs associated with the decontamination station (which are to include a high density polyethylene liner and a tank to contain water, as noted on Page 10-2).
- Page 10-2 notes that a water truck will be required for dust suppression during excavation activities. Costs associated with the water truck do not appear to have been included in the cost estimate.
- Task 1.2 of the cost estimate notes that Area A confirmatory samples will be analyzed for explosives, lead, dioxins, perchlorate, and pesticides. Table 10-1 includes all of those analyte classes with the exception of pesticides.
- Task 2.1 only includes 21 55-gallon drums whereas Page 10-4 indicates that at least 23 55-gallon drums will likely be generated during monitoring well installation and development (including 14 drums for soil, 7 drums for decontamination and well development water, and 2 drums for personal protection equipment (PPE)).
- Page 10-4 also indicates that approximately one 55-gallon drum will be generated during each groundwater sampling event. The costs associated with this drum generation are not specifically included in the Annual O&M costs associated with quarterly sampling.

Please revise the cost estimate for Alternative Two to address the above-noted concerns. It should be noted that many of these concerns also apply to the cost estimate for Alternative Three in Table 11-2, specifically with regard to the soil excavation. Corrections to this table should also be made to reflect any necessary changes.

Response: For capital costs developed for the CMS for each alternative, the percentage method (as a function of capital costs) was used to estimate costs for professional labor as shown in Tables 11-1 and 11-2 below the subtotal for Tasks 1 and 2. Labor costs are subdivided into several categories including project management, planning documents, construction oversight, reporting, as built drawings, permitting, and engineering design. For example labor for onsite geologists are captured under construction oversight which covers on-site activities related to remedy implementation. The RFI/CMS Report will be revised to include specific information on the methods used to develop the cost estimates.

Specific responses to comments on the cost estimates are as follows:

- Task 1.2 – Costs for the decontamination station will be itemized in the estimates.
- Water truck costs will be itemized in each cost estimate.
- As indicated in a previous comment response, Table 10-1 will be revised to include analysis for pesticides.

- Task 2.1 – discrepancies in drum quantities between the CMS text and cost estimates will be resolved.
- For purposes of the CMS and cost estimate, it is assumed that purge water will be disposed of in the RFAAP wastewater treatment plant, so that additional drums will not be required for each sampling event. Costs associated for temporary containment of water for transport to the treatment plant are included under the groundwater sampling equipment and supplies line item of the cost estimate.

23. **Section 13, Substantiation/Justification of Final Remedy:** This section should include some contingency wording if RGs aren't met in some specified timeframe to include the potential for implementing Alternative 3, which appears to be "practicable".

Response: Section 13 will include additional discussion of contingencies should RGs not be achieved as expected. It is anticipated that the remedy implementation plans will include more specific information on implementation of contingencies if the monitored natural attenuation remedy does not perform as expected.

Attachment 1

Area A

Table 8-1 Remedial Goals – Area A

Appendix G – Remedial Goal Calculations

- Table G.1-1a Remedial Goal Calculation Equations – Area A
- Table G.1-1b Noncarcinogenic Remedial Goal Calculation – Groundwater – Adult and Child Resident – Area A
- Table G.1-1c Carcinogenic Remedial Goal Calculation – Groundwater – Lifetime Resident – Area A
- Tables G.1-2a – G.1-2g Soil-to-Groundwater Remedial Goal Calculation using Groundwater Remedial Goals

Area B

Table 8-2 Remedial Goals – Area B

Appendix G – Remedial Goal Calculations

- Table G.2-1a Remedial Goal Calculation Equations – Area A
- Table G.2-1b Noncarcinogenic Remedial Goal Calculation – Soil – Child Resident – Area B
- Tables G.2-2a – G.1-2i Soil-to-Groundwater Remedial Goal Calculation using Groundwater Remedial Goals

Area A Remedial Goals

Table 8-1
Remedial Goals - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Chemical of Interest	Groundwater RG (mg/L)	Groundwater RG Source[3]	Area A - Soil RG (mg/kg)	Soil RG Source
2,4,6-TNT	0.00782	RG	1.7	SSL[4]
DNT Mixture	0.000938	RG	0.045 or Lab RL (if higher)	SSL[4]
RDX	0.0061	RG	0.161 (not detected in soil)	SSL[4]
Perchlorate	0.0109	RG	--	--
Amino DNTs[1]	--	--	1.095	SSL[5]
Nitroglycerin[2]	--	--	0.069 or Lab RL (if higher)	SSL[5]
Heptachlor Epoxide[2]	--	--	0.0047	SSL[5]
2,3,7,8-TCDD (TEQ) [1]	--	--	7.89E-06	SSL[5]

Notes:
AL = Action Level
TNT = Trinitrotoluene
DNT = Dinitrotoluene
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazacyclohexane
TCDD = Tetrachlorodibenzodioxin
mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter
RG = Remedial Goals
[1] =Not identified as COPC in GW
[2] =Not detected in groundwater
[3] = The lowest of calculated carcinogenic and noncarcinogenic groundwater RGs used (see Appendix G.1, Table G.1-1c) Carcinogenic and noncarinogenic RGs values for groundwater COCs (2,4,6-TNT, DNT Mixture, RDX, and perchlorate) calculated using target risk 1E.-05 for the lifetime resident (see Appendix G.1 Table G.1-1c) and a target hazard of 1 for the adult and child resident (see Appendix G.1 Table G.1-1b)
[4] = Soil SSL RG values for soil-to-groundwater migration pathway calculated with SSL equation using groundwater RGs as target groundwater concentrations (See Tables G.1-2a - G.1-2g)
[5] = Soil SSL RG values for soil-to-groundwater migration pathway calculated with SSL equation using T-RBCs as target groundwater concentrations (See Tables G.1-2a - G.1-2g)

Table G.1-1a
Remedial Goal Calculation Equations - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Remedial Goal Equations used for Groundwater Noncarcinogens - Adult and Child Resident

Ingestion
Noncarcinogens

$$RG_o = \frac{THQ*BW*AT\text{-}N*RfD_o}{EF*ED*IR\text{-}W*CF_3}$$

Dermal
Noncarcinogens
Inorganic:

$$RG_d = \frac{THQ*BW*AT\text{-}N*RfD_d}{SA*K_p*EF*t_{event}*ED*EV*CF_2*CF_3}$$

For organics if t_{event} is less than t*:

$$RG_d = \frac{THQ*BW*AT\text{-}N*RfD_d}{SA*EF*ED*EV*2*FA*K_p*CF_2*CF_3 \over (6*tau*t_{event}/pi)^{1/2}}$$

For organics if ET is greater than t*:

$$RG_d = \frac{THQ*BW*AT\text{-}N*RfD_d}{SA*EF*ED*EV*FA*K_p*CF_2*CF_3* \\ ((t_{event}(1+B))+2*tau*((1+3B+B^2)/((1+3B)^2)))}$$

Inhalation
Note - VOCs not Identified as COPC for site
Indoor Vapors
Carcinogens and Noncarcinogens
RG_i= Modeled Using Johnson and Ettinger Model

Vapors While Showering
Carcinogens and Noncarcinogens
RG_i= Modeled Using Foster and Chrostowski Inhalation Model

Table G.1-1a
Remedial Goal Calculation Equations - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Remedial Goal Equations used for Groundwater-Lifetime Resident-Carcinogens

Ingestion

Carcinogens

$$RG_o = \left(\frac{TR}{CSF_o}\right) * \left[\left(\frac{BW * AT - C}{EF * ED * IR - W * CF_3}\right)_{child} + \left(\frac{BW * AT - C}{EF * ED * IR - W * CF_3}\right)_{adult}\right]$$

Dermal

Carcinogens

Inorganic:

$$RG_d = \left(\frac{TR}{CSF_d}\right) * \left[\left(\frac{BW * AT - C}{SA * K_p * t_{event} * EF * ED * EV * CF_2 * CF_3}\right)_{child} + \left(\frac{BW * AT - C}{SA * K_p * t_{event} * EF * ED * EV * CF_2 * CF_3}\right)_{adult}\right]$$

For organics if t_{event} is less than t*:

$$RG_d = \left(\frac{TR}{CSF_d}\right) * \left[\left(\frac{BW * AT - C}{SA * EF * ED * EV * 2 * FA * K_p * CF_2 * CF_3 * (6 * tau * t_{event} / pi)^{1/2}}\right)_{child} + \left(\frac{BW * AT - C}{SA * EF * ED * EV * 2 * FA * K_p * CF_2 * CF_3 * (6 * tau * t_{event} / pi)^{1/2}}\right)_{adult}\right]$$

For organics if ET is greater than t*:

$$RG_d = \left(\frac{TR}{CSF_d}\right) * \left[\left(\frac{BW * AT - C}{SA * EF * ED * EV * FA * K_p * CF_2 * CF_3 * (t_{event}(1+B) + 2tau((1+3B+3B^2)/(1+B)^2))}\right)_{child} + \left(\frac{BW * AT - C}{SA * EF * ED * EV * FA * K_p * CF_2 * CF_3 * (t_{event}(1+B) + 2tau((1+3B+3B^2)/(1+B)^2))}\right)_{adult}\right]$$

Inhalation

Note: VOCs not identified as COPC for the site

Overall Remedial Goal Equation

$$RG = \frac{1}{(1/RG_o + 1/RG_d + 1/RG_i)}$$

Table G.1-1a
Remedial Goal Calculation Equations - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

NOTES:

RG =	remedial goal groundwater	ug/L
TR =	target risk	unitless
THQ =	target hazard quotient	unitless

Receptor specific parameters provided in Appendix E.1, Table E.1-4.2

BW =	body weight (receptor specific - kg)	kg
AT-C =	averaging time (25,550 days)	days
AT-N =	averaging time (receptor specific)	days
EF =	exposure frequency (receptor specific)	days/year
ED =	exposure duration (receptor specific)	years
ET =	exposure time (receptor specific)	hours/day
EV =	event frequency (receptor specific)	events/day
t_{event} =	event duration (receptor specific)	hr/event
SA =	skin surface contact area (receptor specific)	cm^2
IR-W =	ingestion rate - water (receptor specific)	L/day

Toxicity Data provided in Appendix E.1, Tables E.1-5.1, E.1-5.2, E.1-6.1, and E.1-6.2

RfD_o =	oral reference dose (see Table E.1-5.1)	mg/kg-day
RfD_d =	dermal reference dose (see Table E.1-5.1)	mg/kg-day
RfD_i =	inhalation reference dose (see Table E.1-5.2)	mg/kg-day
CSF_o =	oral carcinogenic slope factor (see Table E.1-6.1)	$(mg/kg-day)^{-1}$
CSF_d =	dermal carcinogenic slope factor (see Table E.1-6.1)	$(mg/kg-day)^{-1}$
CSF_i =	inhalation carcinogenic slope factor (see Table E.1-6.2)	$(mg/kg-day)^{-1}$

Additional parameters used for groundwater calculations provided in Appendix E.1, Table E.1-4.5

K_p =	permeability constant	cm/hr
FA =	fraction absorbed	unitless
tau =	lag time	hours
t* =	time to reach steady state	hours
pi =	pi (approximate value 3.14)	unitless
B =	lipophilic property	unitless
CF_1 =	conversion factor (1E-06)	kg/mg
CF_2 =	conversion factor (1E-03)	cm^3/L
CF_3 =	conversion factor (1E-03)	mg/ug

Table G.1-1b
Noncarcinogenic Remedial Goal Calculation - Groundwater - Adult and Child Resident - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammuntion Plant, Radford, Virginia

Scenario Timeframe:	Future
Medium:	Groundwater
Receptor:	Adult Resident

	INGESTION	DERMAL			INHALATION		Remedial Goal Calculation				
								Noncancer RG (ug/L)			
Chemical	RfDo (mg/kg-day)	RfDd (mg/kg-day)	Adult DA event	Ingestion/Dermal Target Organ	RfDi (mg/kg-day)	Inhalation Target Organ	THQ	RG_o	RG_d	RG_i	RG
2,4,6-Trinitrotoluene	0.0005	5.00E-04	3.16E-09	liver	--	--	1	1.83E+01	3.91E+07	--	1.82E+01
Dinitrotoluene Mix	--	--	6.84E-09	--	--	--	--	--	--	--	--
RDX	0.003	3.00E-03	9.97E-10	prostate	--	--	1	1.10E+02	7.42E+08	--	1.09E+02
Perchlorate	0.0007	7.00E-04	5.80E-10	thyroid	--	--	1	2.56E+01	2.98E+08	--	2.55E+01

Scenario Timeframe:	Future
Medium:	Groundwater
Receptor:	Child Resident

	INGESTION	DERMAL			INHALATION		Remedial Goal Calculation				
								Noncancer RG (ug/L)			
Chemical	RfDo (mg/kg-day)	RfDd (mg/kg-day)	Adult DA event	Ingestion/Dermal Target Organ	RfDi (mg/kg-day)	Inhalation Target Organ	THQ	RG_o	RG_d	RG_i	RG
2,4,6-Trinitrotoluene	0.0005	5.00E-04	4.14E-09	liver	--	--	1	7.82E+00	5.09E+07	--	7.82E+00
Dinitrotoluene Mix	--	--	8.99E-09	--	--	--	--	--	--	--	--
RDX	0.003	3.00E-03	1.31E-09	prostate	--	--	1	4.69E+01	9.67E+08	--	4.69E+01
Perchlorate	0.0007	7.00E-04	1.00E-09	thyroid	--	--	1	1.10E+01	2.95E+08	--	1.09E+01

Notes:

See Table G.1-1a for Remedial Goal Equations and acronyms

Table G.1-1c
Carcinogenic Remedial Goal Calculation - Groundwater - Lifetime Resident - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammuntion Plant, Radford, Virginia

Scenario Timeframe:	Future
Medium:	Groundwater
Receptor:	Lifetime Resident

	INGESTION	DERMAL		INHALATION	Remedial Goal Calculation								
						Cancer RG (ug/L)				Noncancer RG (ug/L)		Lowest RG	Lowest RG
Chemical	CSF_o (mg/kg-day -1)	CSF_d (mg/kg-day -1)	Adult DA event	Child DA event	CSF_i (mg/kg-day -1)	TR	RG_o	RG_d	RG_i	$RG_{lifetime}$	$RG_{child\ resid}$	$RG_{adult\ resid}$	(ug/L)	Source
2,4,6-Trinitrotoluene	0.03	0.03	3.16E-09	4.14E-09	--	1.00E-05	2.24E+01	8.00E+02	--	2.18E+01	7.82E+00	1.82E+01	7.82E+00	Child Resident - Noncarc
Dinitrotoluene Mix	0.68	0.68	6.84E-09	8.99E-09	--	1.00E-05	9.89E-01	1.63E+01	--	9.32E-01	--	--	9.32E-01	Lifetime Resident - Carc
RDX	0.11	0.03	9.97E-10	1.31E-09	--	1.00E-05	6.11E+00	2.53E+03	--	6.10E+00	4.69E+01	1.09E+02	6.10E+00	Lifetime Resident - Carc
Perchlorate	--	--	5.80E-10	1.00E-09	--	--	--	--	--	--	1.09E+01	2.55E+01	1.09E+01	Child Resident - Noncarc

Notes:
See Table G.1-1a for Remedial Goal Equations and acronyms
See Table G.1-1b for Adult and Child Resident Noncarcinogenic Remedial Goal Calculations

Table G.1-2a
Soil-to-Groundwater RG for 2,4,6-Trinitrotoluene using RG_{gw}
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	12	--
RG_{gw}	GW Concentration Source=	0.00782	mg/L
C_w =	Target Leachate Conc =	0.09384	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	1.870E-05	--
P_b =	Dry Soil Bulk Density =	1.35	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	1834	L/kg

$RG_{soil\text{-}to\text{-}gw}$ (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/Pb]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	18.34	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**1.7**	**mg/kg**

Table G.1-2b
Soil-to-Groundwater RG for DNT Mixture (50% 2,4-DNT, 50% 2,6-DNT) using RG_{gw}
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	12	--
RG_{gw}	GW Concentration Source=	0.000938	mg/L
C_w =	Target Leachate Conc =	0.01126	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	1.620E-05	--
P_b =	Dry Soil Bulk Density =	1.35	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	371	L/kg

$RG_{soil\text{-}to\text{-}gw}$ (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/Pb]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	3.714	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**0.045**	**mg/kg**

Table G.1-2c
Soil-to-Groundwater RG for RDX using RGgw
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	12	--
RG_{gw}	GW Concentration Source=	0.0061	mg/L
C_w =	Target Leachate Conc =	0.07320	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	2.580E-06	--
P_b =	Dry Soil Bulk Density =	1.35	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	195	L/kg

SSL (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/Pb]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	1.95	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**0.161**	**mg/kg**

Table G.1-2d
Soil-to-Groundwater RG for Aminodinitrotoluenes using RG_{gw} (T-RBC)
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	12	--
RG_{gw}/T-RBC	GW Concentration Source=	0.073	mg/L
C_w =	Target Leachate Conc =	0.87600	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	6.620E-09	--
P_b =	Dry Soil Bulk Density =	1.35	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	101	L/kg

$RG_{soil\text{-}to\text{-}gw}$ (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/Pb]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	1.005	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**1.095**	**mg/kg**

Table G.1-2e
Soil-to-Groundwater RG for Nitroglycerin using RG_{gw} (T-RBC)
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	12	--
RG_{gw}/T-RBC	GW Concentration Source=	0.0037	mg/L
C_w =	Target Leachate Conc =	0.04440	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	1.040E-07	--
P_b =	Dry Soil Bulk Density =	1.35	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	130.8	L/kg

$RG_{soil\text{-}to\text{-}gw}$ (mg/kg) : $C_w [K_d + (\theta_w + \theta_a H')/Pb]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	1.308	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**0.069**	**mg/kg**

Table G.1-2f
Soil-to-Groundwater RG for Heptachlor Epoxide using RG_{gw} (T-RBC)
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	12	--
RG_{gw}/T-RBC	GW Concentration Source=	7.4E-06	mg/L
C_w =	Target Leachate Conc =	8.88E-05	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	8.590E-04	--
P_b =	Dry Soil Bulk Density =	1.5	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	5.26E+03	L/kg
	$RG_{soil\text{-}to\text{-}gw}$ (mg/kg) = C_w [K_d + (θ_w + θ_aH')/Pb]		
foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	52.6	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**0.0047**	**mg/kg**

Table G.1-2g
Soil-to-Groundwater RG for 2,3,7,8-TCDD TEQ using RG_{gw} (T-RBC)
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	12	--
RG_{gw}/T-RBC	GW Concentration Source=	4.5E-10	mg/L
C_w =	Target Leachate Conc =	5.40E-09	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	2.040E-03	--
P_b =	Dry Soil Bulk Density =	1.5	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	1.46E+05	L/kg

$RG_{soil\text{-}to\text{-}gw}$ (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/Pb]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	1460	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**7.89E-06**	**mg/kg**

Area B Remedial Goals

Table 8-2
Remedial Goals - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Chemical of Interest	Area B - Soil RG (mg/kg)	Soil RG Basis
2,4,6-TNT [2]	1.45	SSL[4]
DNT Mixture [2]	0.037 or Lab RL (if higher)	SSL[4]
RDX [2]	0.134	SSL[4]
Amino DNTs[2]	0.912	SSL[5]
Nitroglycerin[2]	0.057 or Lab RL (if higher)	SSL[5]
Lead[1,3]	400	AL
Aroclor 1254 [2]	0.25	SSL[5]
Heptachlor Epoxide[2]	0.0039	SSL[5]
Dieldrin [2]	0.00446	SSL[5]
2,3,7,8-TCDD (TEQ) [1]	6.57E-06	SSL[5]

Notes:
AL = Action Level
TNT = Trinitrotoluene
DNT = Dinitrotoluene
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazacyclohexane
TCDD = Tetrachlorodibenzodioxin
mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter
RG = Remedial Goals
T-RBC = Tap Water RBC (USEPA, October 2007)
(1) =Not identified as COPC in GW
(2) =Not detected in groundwater
(3) = Lead criteria are Action Levels; see USEPA Region III guidance
(4) = SSL RG values for soil-to-groundwater migration pathway calculated with SSL equation using calculated GW RGs for 2,4,6-TNT, DNT Mixture, and RDX from Area A as target groundwater concentrations (See Tables G.2-2a - G.2-2i)
(5) = Soil SSL RG values for soil-to-groundwater migration pathway calculated with SSL equation using T-RBCs as target groundwater concentrations (See Tables G.2-2a - G.2-2i)

Table G.2-1a
Remedial Goal Calculation Equations - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Remedial Goal Equations used for Soil

Ingestion
Noncarcinogens

$$RG_o = \frac{THQ*BW*AT\text{-}N*RfD_o}{EF*ED*IR\text{-}S*FI*CF_1}$$

Dermal
Noncarcinogens

$$RG_d = \frac{THQ*BW*AT\text{-}N*RfD_d}{SA*AF*ABS_d*EF*ED*CF_1}$$

Inhalation
Noncarcinogens

$$RG_i = \frac{THQ*BW*AT\text{-}N*RfD_i}{EF*ED*IR\text{-}A*ET*(1/VF+1/PEF)}$$

Overall Remedial Goal Equation

$$RG = \frac{1}{(1/RG_o + 1/RG_d + 1/RG_i)}$$

NOTES:

RG =	remedial goal soil	mg/kg
THQ =	target hazard quotient	unitless

Receptor specific parameters provided in Appendix E.2, Table E.2-4.1c (oral and dermal) and Table E.2-4.1d (inhalation)

BW =	body weight (receptor specific - kg)	kg
AT-N =	averaging time (receptor specific)	days
EF =	exposure frequency (receptor specific)	days/year
ED =	exposure duration (receptor specific)	years
ET =	exposure time (receptor specific)	hours/day
EV =	event frequency (receptor specific)	events/day
IR-S =	ingestion rate -soil (receptor specific)	mg/day
IR-A =	inhalation rate (receptor specific)	m^3/hour
SA =	skin surface contact area (receptor specific)	cm^2
AF =	adherence factor (receptor specific)	mg/cm^2

Table G.2-1a
Remedial Goal Calculation Equations - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

NOTES CONTINUED:

Toxicity Data provided in Appendix E.2, Tables E.2-5.1 and E.2-5.2

RfD_o =	oral reference dose (see Table E.2-5.1)	mg/kg-day
RfD_d =	dermal reference dose (see Table E.2-5.1)	mg/kg-day
RfD_i =	inhalation reference dose (see Table E.2-5.2)	mg/kg-day

Additional parameters used for soil calculations provided in Appendix E.2

FI =	fraction ingested (1.0)	unitless
ABS_d =	absorption factor (see Table E.2-4.3)	unitless
VF =	volatilization factor (see Table E.2-4.3)	m^3/kg
PEF =	particulate emission factor (see Table E.2-4.4)	m^3/kg
CF_1 =	conversion factor (1E-06)	kg/mg
CF_2 =	conversion factor (1E-03)	cm^3/L
CF_3 =	conversion factor (1E-03)	mg/ug

Table G.2-1b
Noncarcinogenic Remedial Goal Calculation - Soil - Child Resident - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammuntion Plant, Radford, Virginia

Scenario Timeframe:	Future
Medium:	Soil
Receptor:	Child Resident

	INGESTION		DERMAL		INGESTION/DERMAL	INHALATION		Noncarcinogenic Remedial Goal Calculation							
												Noncancer RG (mg/kg)			
Chemical	CAS Number	RfDo (mg/kg-day)	RfDd (mg/kg-day)	ABSd	Ingestion/Dermal Target Organ	RfD (mg/kg-day)	Inhalation Target Organ	VF	PEF	(1/VF+1/PEF)	THQ	RGo	RGd	RGi	RG
2,4,6-TNT	118-96-7	5.00E-04	5.00E-04	3.00E-02	liver	--	--	--	6.70E+08	1.49E-09	1.E+00	3.91E+01	4.66E+02	--	3.61E+01
Nitroglycerin	55-63-0	1.00E-04	1.00E-04	1.00E-02	vascular	--	--	--	6.70E+08	1.49E-09	1.E+00	7.82E+00	2.79E+02	--	7.61E+00

Notes:
See Table G.2-1a for Remedial Goal Equations and acronyms

Table G.2-2a
Soil-to-Groundwater RG for 2,4,6-Trinitrotoluene using RG_{gw} from Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	10	--
RG_{gw}	GW Concentration Source=	0.00782	mg/L
C_w =	Target Leachate Conc =	0.07820	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	1.870E-05	--
P_b =	Dry Soil Bulk Density =	1.35	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	1834	L/kg

$RG_{soil\text{-}to\text{-}gw}$ (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/P_b]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	18.34	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**1.45**	**mg/kg**

Table G.2-2b
Soil-to-Groundwater RG for DNT Mixture (50% 2,4-DNT , 50% 2,6-DNT) using RG_{gw} from Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	10	--
RG_{gw}	GW Concentration Source=	0.00094	mg/L
C_w =	Target Leachate Conc =	0.00938	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	1.620E-05	--
P_b =	Dry Soil Bulk Density =	1.35	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	371	L/kg

$RG_{soil\text{-}to\text{-}gw}$ (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/Pb]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	3.714	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**0.037**	**mg/kg**

Table G.2-2c
Soil-to-Groundwater RG for RDX using RG_{gw} from Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	10	--
RG_{gw}/T-RBC	GW Concentration Source=	0.00610	mg/L
C_w =	Target Leachate Conc =	0.06100	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	2.580E-06	--
P_b =	Dry Soil Bulk Density =	1.35	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	195.4	L/kg

$RG_{soil\text{-}to\text{-}gw}$ (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/Pb]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	1.954	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**0.134**	**mg/kg**

Table G.2-2d
Soil-to-Groundwater RG for Aminodinitrotoluenes using RG_{gw} (T-RBC)
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	10	--
RG_{gw}/T-RBC	GW Concentration Source=	0.073	mg/L
C_w =	Target Leachate Conc =	0.73000	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	1.610E-10	--
P_b =	Dry Soil Bulk Density =	1.35	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	101	L/kg

$SSL_{soil\text{-}to\text{-}gw}$ (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/Pb]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	1.005	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**0.912**	**mg/kg**

Table G.2-2e
Soil-to-Groundwater RG for Nitroglycerin using RG_{gw} (T-RBC)
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	10	--
RG_{gw}/T-RBC	GW Concentration Source=	0.0037	mg/L
C_w =	Target Leachate Conc =	0.03700	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	1.040E-07	--
P_b =	Dry Soil Bulk Density =	1.35	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	130.8	L/kg

$$RG_{soil\text{-}to\text{-}gw}\ (mg/kg) = C_w\ [K_d + (\theta_w + \theta_a H')/Pb]$$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	1.308	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**0.057**	**mg/kg**

Table G.2-2f
Soil-to-Groundwater RG for Aroclor 1254 using RG_{gw} (T-RBC)
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	10	--
RG_{gw}/T-RBC	GW Concentration Source=	3.35E-05	mg/L
C_w =	Target Leachate Conc =	3.35E-04	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	1.160E-02	--
P_b =	Dry Soil Bulk Density =	1.5	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	7.56E+04	L/kg

$RG_{soil\text{-}to\text{-}gw}$ (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/Pb]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	756	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**0.25**	**mg/kg**

Table G.2-2g
Soil-to-Groundwater RG for Heptachlor Epoxide using RG_{gw} (T-RBC)
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	10	--
RG_{gw}/T-RBC	GW Concentration Source=	7.40E-06	mg/L
C_w =	Target Leachate Conc =	7.40E-05	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	8.590E-04	--
P_b =	Dry Soil Bulk Density =	1.5	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	5.26E+03	L/kg

$RG_{soil\text{-}to\text{-}gw}$ (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/Pb]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	52.6	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**0.0039**	**mg/kg**

Table G.2-2h
Soil-to-Groundwater RG for Dieldrin using RG_{gw} (T-RBC)
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	10	--
RG_{gw}/T-RBC	GW Concentration Source=	4.20E-06	mg/L
C_w =	Target Leachate Conc =	4.20E-05	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	4.09E-04	--
P_b =	Dry Soil Bulk Density =	1.5	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	1.06E+04	L/kg

$RG_{soil\text{-}to\text{-}gw}$ (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/Pb]$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	106	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**0.00446**	**mg/kg**

Table G.2-2i
Soil-to-Groundwater RG for 2,3,7,8-TCDD TEQ using RG_{gw} (T-RBC)
SWMU 54 RFI/CMS Report
Radford Army Ammunition Report, Radford, Virginia

Input Parameters Averaged from All Soil-Sample Physical Test Results

			units
	Dilution Factor =	10	--
RG_{gw}/T-RBC	GW Concentration Source=	4.50E-10	mg/L
C_w =	Target Leachate Conc =	4.50E-09	mg/L
θ_w =	Water-Filled Soil Porosity =	0.33	--
θ_a=	Air-Filled Soil Porosity =	0.03	--
H' =	Henry's Law Constant =	2.040E-03	--
P_b =	Dry Soil Bulk Density =	1.5	kg/L
Koc=	Soil Organic Carbon/Water Partition Coefficient =	1.46E+05	L/kg

$$RG_{soil\text{-}to\text{-}gw}\ (mg/kg) = C_w\ [K_d + (\theta_w + \theta_a H')/Pb]$$

foc =	Fraction Organic Carbon =	0.01	unitless
K_d =	Soil-Water Partition Coeff (K_{oc}*foc) =	1460	L/kg
$RG_{soil\text{-}to\text{-}gw}$ =		**6.57E-06**	**mg/kg**

Response to Comments (7/8/2008)

Radford AAP, SWMU 54 Ecological Risk Assessment Comments

To: William Geiger, Project Manager

From: Ruth Prince, Toxicologist

Date: June 17, 2008

General Comment
A number of explosives were detected in the SWMU 54 surface soil, some at fairly high concentrations, which are characteristic of the waste that was disposed of in SWMU 54. However, they were not evaluated in this ecological risk assessment because there were no identified wildlife Toxicity Reference Values (TRVs) or readily available screening values for direct toxicity to soil organisms or plants. However, despite the apparent lack of screening values, these chemicals which are truly SWMU-specific must still be evaluated for direct and wildlife toxicity. Besides literature searches and/or the use of surrogates, the U.S. Army Center for Health Promotion and Prevention Medicine has developed wildlife TRVs for numerous contaminants including the explosives and nitroglycerin. Please revise accordingly; the TRVs may be accessed at http://chppm-www.apgea.army.mil/erawg/tox/.

RFAAP Response: Data will be screened against available TRVs (see attached TRV table).

Appendix F
Table F.2-2, Area A Dioxin/Furan Equivalents
Please explain why 2,3,7.8-TCDF is not included in this table and revise as necessary.

RFAAP Response: Although the row was inadvertently hidden in Table F.2-2, 2,3,7,8-TCDF was included in the TEQ calculations. The table has been corrected to show the previously hidden row.

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Draft TRVs for Explosives
Screening Level Ecological Risk Assessment
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

					Avian				Mammalian			
	Plant SL (mg/kg)	Source	Inv SL (mg/kg)	Source	Chronic NOAEL Dose (mg/kg/day)	Chronic LOAEL Dose (mg/kg/day)	Test Animal/ Weight (kg)	Reference	Chronic NOAEL Dose (mg/kg/day)	Chronic LOAEL Dose (mg/kg/day)	Test Animal/ Weight (kg)	Reference
2,4-DNT[1]	5.3	Kuperman 2003	19.8	Kuperman 2003	0.1	1.25	Northern Bobwhite/0.203 kg	Johnson et al. 2005a	NA	NA	NA	NA
2,6-DNT[2]	4.5	Kuperman 2003	6.9	Kuperman 2003	0.1	1.25	Northern Bobwhite/0.203 kg	Johnson et al. 2005a	NA	NA	NA	NA
1,3,5-TNB	8.6	Kuperman 2003	18.1	Kuperman 2003	NA	NA	NA	NA	2.68	13.31	Rat/0.325[4]	USCHPPM 2001a
2,4,6-TNT	2.4	Best et al. 2004	1.2	Best et al. 2004	0.07	1.8	Northern Bobwhite/0.191 kg[5]	USCHPPM 2001b	2	8	Dog (beagle)/14[7]	USCHPPM 2001b (Levine et al. 1990)
2-Amino-4,6-DNT	80	Pennington. 1988	NA	NA	NA	NA	NA	NA	9	48	Rat/0.325[4]	USCHPPM 2005
4-Amino-2,6-DNT	80	Pennington. 1988	NA	NA	NA	NA	NA	NA	9	48	Rat/0.325[4]	USCHPPM 2005
HMX	NA	NA	6.3	Kuperman 2003	NA	NA	NA	NA	9	62.5	Mouse/0.035[6]	USCHPPM 2001c
RDX[3]	100	Simini, et al. 1995	98.6	Kuperman 2003	2.6	26	Northern Bobwhite/0.191 kg[5]	USCHPPM 2002 (Gogal et al. 2001)	8	39.8	Rat/0.325[4]	USCHPPM 2002 (Levine et al. 1983)
Nitroglycerin	NA	NA	NA	NA	NA	NA	NA	NA	3	32	Rat0.325[4]	USCHPPM 2007

NA = Not Available
kg = kilogram
mg/kg = milligram per kilogram
mg/kg/day = milligram per kilogram per day
TNT = Trinitrotoluene
DNT = Dinitrotoluene
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazacyclohexane
TNB = Trinitrobenzene

Best, E.P.H., H.E. Tatem, K.N. Geter, M.L. Wells and B.K. Lane. 2004. Toxicity and Metabolites of 2,4,6 Trinitrotoluene (TNT) in Plants and Worms from Exposure to Aged Soil. U.S. Army Corps of Engineers, Engineer Research and Development Center. ERDC/EL TR-04-18.

Gogal, R.M. Jr., M.S. Johnson, C.T Larsen, M.R. Prater, R.B. Duncan, D.L.Ward, and S.D. Holladay. 2002. Influence of dietary 2,4,6-trinitrotoluene exposure in the northern bobwhite (Colinus virginianus). Envir. Tox. And Chem., Vol. 21, No. 1, pp. 81-86.

Levine, B.S., J.S. rust, J.j. Barkley, E.M. Furedi, and P.M. Lish. 1990. Six-month oral toxicity study of trinitrotoluene in beagle dogs. Toxicology 63:233-244.

Levine, B.S., E.M. Furedi, V.S Rac, D.E. Gordon, and P.M. Lish. 1983. Determination of the chronic mammalian toxicological effects of RDX: Twenty-four month chronic toxicity/carcinogenicity study of hexahydro-1,3,5-trinitro-1,3,5-trazine (RDX) in the Fischer 344 rat. AD A160774. Prepared by ITT Research Institute, Chicago, IL. for the U.S. Army Medical Research and Development Command, Fredrick, MD.

Johnson, M.S., M.W. Michie, M.A. Bazar, and R.M. Gogal Jr. 2005a. Influence of Oral 2,4-Dinitrotoluene Exposure to the Northern Bobwhite (Colinus virginianus). Intern. J. of Tox. 24:265-274.

Kuperman. R. 2003. Development of Ecological Toxicity and Biomagnification Data for Explosives Contaminants in Soil. U.S. Army Edgewood Chemical Biological Center. Final Techinical Report. Project CU-1221.

Pennington, Judith C. 1988. Plant Uptake of 2,4,6-Trinitrotoluene, 4-Amino-2,6-Dinitrotoluene, and 2-Amino-4,6-Dinitrotoluene Using 14C-Labeled and Unlabeled Compounds. ADA203690.

Simini, M., R.S. Wentsel, R.T. Checkai, C.T. Phillips, N.A. Chester, M.A. Major, and J.C. Amos. 1995. Evaluation of Soil Toxicity at Joliet Army Ammunition Plant. Environ. Toxicol. Chem. 14:623-630.

U.S. Army Center for Health Promotion and Preventive Medicine (USCHPPM) 2007. Wildlife Toxicity Assessment for Nitroglycerine (NG). USACHPPM Document No: 37-EJ-1138-01F. November.

U.S. Army Center for Health Promotion and Preventive Medicine (USCHPPM) 2005. Wildlife Toxicity Assessment for 2-Amino-4,6-Dinitrotoluene and 4-Amino-2,6-Dinitrotoluene. USACHPPM Document No: 39-EJ-1138-01D. December.

U.S. Army Center for Health Promotion and Preventive Medicine (USCHPPM) 2002. Wildlife Toxicity Assessment for 1,3,5-Trinitrohexahydro-1,3,5-Triazine (RDX). USACHPPM Document No: 39-EJ-1138-01H. July.

U.S. Army Center for Health Promotion and Preventive Medicine (USCHPPM) 2001a. Wildlife Toxicity Assessment for 1,3,5-Trinitrobenzene (1,3,5-TNB). USACHPPM Document No: 39-EJ-1138-01B. November.

U.S. Army Center for Health Promotion and Preventive Medicine (USCHPPM) 2001b. Wildlife Toxicity Assessment for 2,4,6-Trinitrotoluene (TNT). USACHPPM Document No: 39-EJ-1138-00. November.

U.S. Army Center for Health Promotion and Preventive Medicine (USCHPPM) 2001c. Wildlife Toxicity Assessment for High Melting Explosive (HMX). USACHPPM Document No: 39-EJ-1138-01E. November.

U.S. EPA 1993. Wildlife Exposure Factors Handbook. EPA/600/P-93/187a.

1- Avian TRVs derived from subchronic NOAEL value of 1 and subchronic LOAEL value of 5 from a northern bobwhite and applying an uncertainty factor of 10 and 4 to derive NOAEL-based and LOAEL-based TRVs.

2 - Used 2,4-dinitrotoluene avian TRVs as surrogate.

3- Avian chronic NOAEL TRV derived from subchronic NOAEL value of 26 from a northern bobwhite and applying an uncertainty factor of 10. Mammalian chronic NOAEL TRV derived from Chronic LOAEL value of 40 from a rat and applying an uncertainty factor of 5.

4- Mature rat body weight (average male & female) = 0.325 kg (U.S. EPA, 1988).

5- Mature Bobwhite Body Weight (seasonal average) = 0.191 kg (U.S. EPA, 1993).

6- Mature mouse body weight (female) = 0.035 kg (U.S.EPA, 1988).

7- Mature dog body weight (average male & female) = 14 kg (U.S. EPA, 1988).

Response to Comments (7/8/2008)

Radford AAP, SWMU 54 Comments

To: William Geiger, Project Manager

From: Betty Ann Quinn, Toxicologist

Date: June 24, 2008

1. Executive Summary (Human Health Risk Assessment Summary), Section 6.6.1 (Area A Summary), and Section 8.1.1 Area A: All three of these sections state that site-related Hazard Indices are less than 1 for Area A (after target organ segregation). However, the presence of 2,4,6-TNT in groundwater at Area A predicts an individual Hazard Quotient of 2.2, which exceeds EPA's acceptable Hazard Quotient of 1. These sections should be corrected.

   RFAAP Response: The HI exceedance of 2 for the liver noted due to 2,4,6-TNT in groundwater for the child resident will be noted in Sections 6.6.1, 8.1.1, and the executive summary.

2. Executive Summary, Corrective Measures Study: What measures will be taken to control potential exposures to soil at Area B, where concentrations of 2,4,6-TNT and lead, which present significant risks to future construction workers and residential children, were reported? Some discussion in this section is warranted.

   RFAAP Response: The following text will be added to the corrective measures portion of the executive summary: "Note that under Alternative Two, the soil at Area B where concentrations of 2,3,6-TNT and lead which pose significant risk to receptors located in the area of borings 54SB42, 54SB46, and 54SB49 (Figure 8-3) will be removed as part of the proposed corrective measures."

3. Appendix C.9, Soil Background Evaluations: This evaluation appears to be different from the evaluation that resulted in the Facility Wide Background Point Estimates listed on data summary tables. Explain. In addition, provide documentation that the background soil sample locations have not been impacted by industrial activity. If possible, a map should also be provided.

   RFAAP Response: As indicated in Section 6.4.3 of the report, further statistical evaluations with respect to background were conducted for aluminum and manganese at Area A beyond the initial comparisons of site data to facility background for these chemicals. The additional statistical evaluations were conducted given the apparent lower concentrations of aluminum and manganese

detected within the disposal unit area of Area A, when compared to an area of the site between the site fence and the New River, where disposal/industrial activities were not apparent from boring data and sample results. Figure 1 attached to this comment response shows the sample locations used as site background samples in the evaluation. The sample assemblages used for the evaluations are summarized in the following table.

Samples Used for Site-Specific Background Evaluation

Disposal Area	Background Samples from Outside Disposal Area - Between Site Fence and New River
54SB3A, 54SB10A, 54SB17A, 54SB18A, 54SB19A, 54SB20A, 54SB21A, 54SB22A, 54SB23A, 54SB23A, 54SB24A, 54SB25A, 54SB26A, 54SB27A, 54SB28A, 54SB29A, 54SB30A, 54SB31A, 54SB32A, 54SB33A, 54SB33A, 54SB34A, 54SB35A, 54SB36A, 54SB37A, 54SB38A, 54SB57A, 54SB58A, 54SB61A, 54SB81A, 54SB82A, 54SB83A, 54SB84A	54SB56, 54SB59, 54SB60, 54SB62, 54SB63, 54SB64, 54SB65, 54SB66, 54SB67, 54SB68, 54SB69, 54SB70

The area between the site fence and the New River at Area A was considered an appropriate background reference area for the evaluation given the following:

- Historical review and aerial photographs did not indicate disposal activity or significant disturbance in this area;
- Borings completed in this area did not indicate evidence of waste disposal activities or disturbance;
- Explosives (indicator chemicals for propellant-ash disposal activity) were not detected in samples collected from this area;
- Lead concentrations (indicator chemical for propellant-ash disposal activity) were not indicative of disposal activities in the area, as discussed on page 4-4 and 4-5 of the RFI/CMS Report;
- Pesticides were not detected in samples collected from this area;
- PCBs were not detected in soil samples at concentrations above the laboratory's reporting limit; and
- Both the disposal area and the background reference area were located within the alluvial flood plain.

As indicated on page 6-10 of the RFI/CMS Report, non-parametric Mann Whitney Wilcox Tests were conducted for the data sets given the non normal distribution of aluminum and manganese from inside and outside the disposal area, respectively.

4. Table E.1-7.1.RME: The cancer risk column for the soil ingestion risk for 2,3,7,8-TCDD equivalents is blank. Risk values should be provided.

   RFAAP Response: The risk value (1E-08) will provided in Table E.1-7.1 for soil ingestion risk for 2,3,7,8-TCDD.

5. Table E.2-7.5 RME: Total Hazards at the end of this table do not appear. Correct.

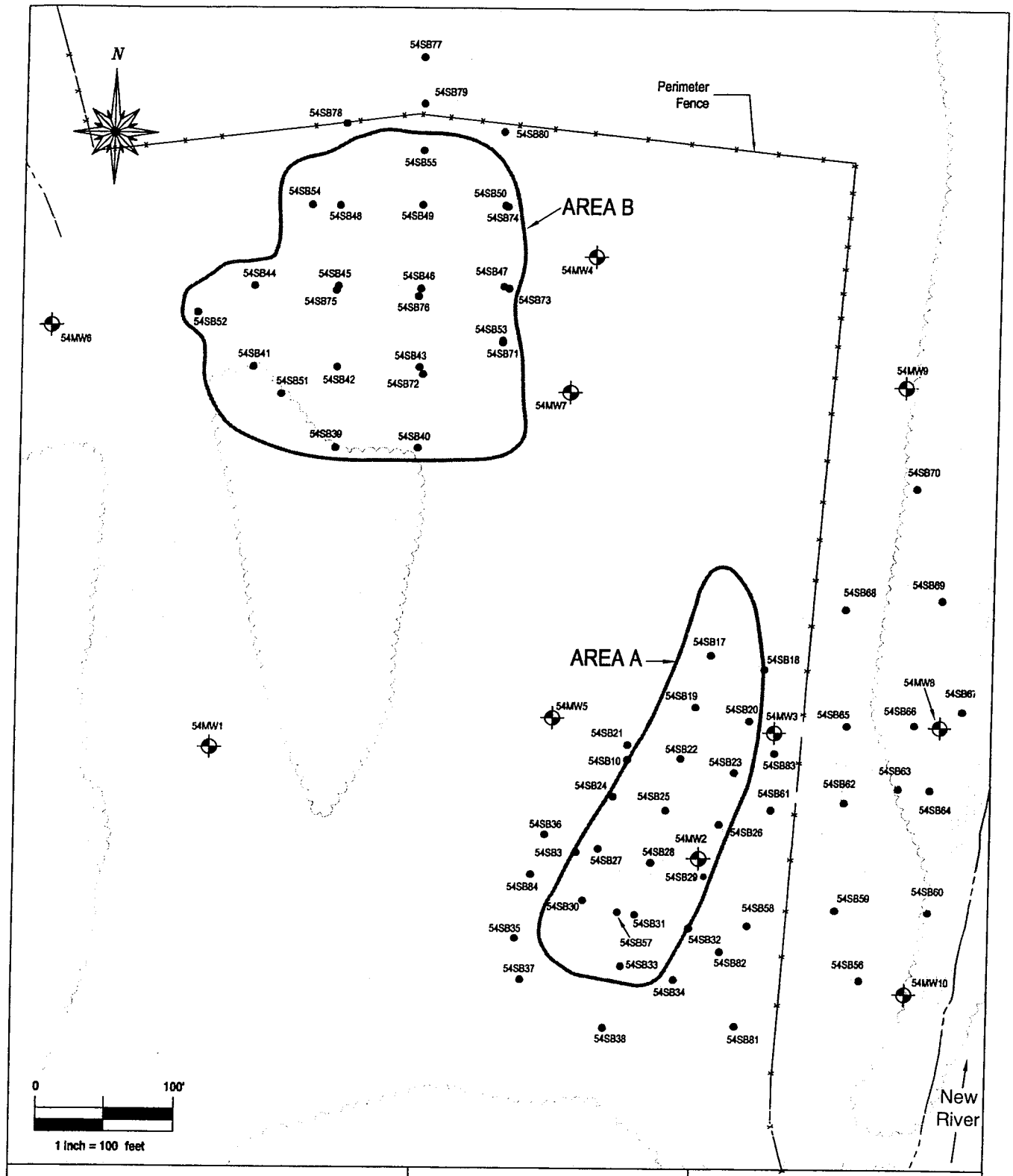
   RFAAP Reponse: The total hazards at the end of Table E.2-7.5 will be corrected to reflect a total hazard for groundwater of 3E-01 and total hazard across site media of 9E+00.

6. Appendix E, Lead IEUBK Model Results, Area A: The source of the lead soil concentration used in the model, 129 mg/kg, is not clear. This value does not agree with either the mean or UCL values for lead listed on Table E.2-3.2. Clarify.

   RFAAP Response: The value used in the IEUBK model will be changed from 129 mg/kg to 46.5 mg/kg which is the mean concentration of lead in total soil for Area A.

7. Appendix E, Lead IEUBK Model Results, Areas A and B: Note that updated dietary lead intake values are available on the EPA Lead website. These lower dietary values will reduce risks predicted by the IEUBK model, and should be used in future risk assessments.

   RFAAP Response: Noted for future risk assessments.



Legend

- SWMU Boundary
- Monitoring Well Location
- Soil Boring Location

FIGURE 1

RFI Sample Locations
Soil and Groundwater

Date: July 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 100 feet	File Name: Fig.3-1 RFILocs

SWMU 54

RCRA Facility Investigation
Radford Army Ammunition Plant
Radford, Virginia

URS

URS Group, Inc.
5540 Falmouth Street
Suite 201
Richmond, Virginia 23230



Geiger.William@epamail.epa.gov
08/19/2008 10:05 AM

To "McKenna, Jim J Mr CIV USA AMC" <jim.mckenna@us.army.mil>
cc anne.greene@atk.com, dennis.druck@us.army.mil, "durwood willis2" <dhwillis@deq.virginia.gov>, diane.wisbeck@arcadis-us.com, "beth lohman"
bcc
Subject Re: FW: RFAAP - Final RTC for SWMU 54 RFI/CMS (UNCLASSIFIED)

History: This message has been forwarded.

EPA/VDEQ approve of the SWMU 54 RFI/CMS with the changes noted below.

We're working on our SMWU 40/71 comments now. I think we said we'd have something out by the 20th, but that may get delayed until sometime early next week. Thanks

William A. Geiger
USEPA Region III
1650 Arch Street
Philadelphia, PA 19103
(215)814-3413

"McKenna, Jim J Mr CIV USA AMC" <jim.mckenna@us.army.mil>

08/13/2008 02:43 PM

To <anne.greene@atk.com>, "beth lohman" <ealohman@deq.state.va.us>, <dennis.druck@us.army.mil>, <diane.wisbeck@arcadis-us.com>, "durwood willis2" <dhwillis@deq.virginia.gov>, William Geiger/R3/USEPA/US@EPA, <jerome.redder@atk.com>, "jim spencer" <james_o_spencer@urscorp.com>, <jlcutler@deq.virginia.gov>, "Llewellyn, Tim" <Tim.Llewellyn@arcadis-us.com>, "Mendoza, Richard R Mr CIV USA IMCOM" <richard.r.mendoza@us.army.mil>, "Parks, Jeffrey N" <Jeffrey.Parks@shawgrp.com>, <Timothy.Leahy@shawgrp.com>, <Tina_Devine@URSCorp.com>, <Tom.Meyer@nab02.usace.army.mil>
cc
Subject FW: RFAAP - Final RTC for SWMU 54 RFI/CMS (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

All,

See Tina's email below. I'm resending these SWMU 54 responses to comments so that they are all in one file and one email. My understanding is that they are acceptable so I anticipate approval from EPA and DEQ.

Thanks,
Jim

-----Original Message-----
From: Tina_Devine@URSCorp.com [mailto:Tina_Devine@URSCorp.com]
Sent: Wednesday, August 13, 2008 2:36 PM
To: McKenna, Jim J Mr CIV USA AMC
Subject: RFAAP - Final RTC for SWMU 54 RFI/CMS

Good afternoon. Attached is a final RTC for SWMU 54 RFI/CMS including the revision (per verbal discussion with VDEQ)to comment #14 and revised Tables 8-1 and 8-2 (as previously submitted) for final approval. Thanks and have a great day.

(See attached file: Final SWMU 54 RFI-CMS RTC 7_13_2008.pdf)

Tina DeVine, P.E.
Project Engineer
URS Corporation
(804)474-5448

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Classification: UNCLASSIFIED
Caveats: NONE (See attached file: Final SWMU 54 RFI-CMS RTC 7_13_2008.pdf)



Final SWMU 54 RFI-CMS RTC 7_13_2008.pdf

"Druck, Dennis E Mr USACHPPM"
<dennis.druck@us.army.mil>
07/09/2008 08:38 AM

To <Tina_Devine@URSCorp.com>, "Meyer, Tom NAB02" <Tom.Meyer@usace.army.mil>, "Mendoza, Richard R Mr CIV USA IMCOM" <richard.r.mendoza@us.army.mil>,
cc
bcc
Subject RE: Draft RTC - SWMU 54 RFI/CMS Report (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Tina,
I have no comments and the wildlife values in the TRV table were developed by the CHPPM toxicology directorate.

Dennis

Dennis E. Druck
Supervisory Environmental Scientist
Environmental Health Risk Assessment Program.
U.S. Army Center for Health Promotion and Preventive Medicine.
ATTN: MCHB-TS-REH/Bldg E1675
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-----Original Message-----
From: Tina_Devine@URSCorp.com [mailto:Tina_Devine@URSCorp.com]
Sent: Tuesday, July 08, 2008 4:16 PM
To: Druck, Dennis E Mr USACHPPM; Meyer, Tom NAB02; Mendoza, Richard R Mr CIV USA IMCOM; McKenna, Jim J Mr CIV USA AMC
Subject: Draft RTC - SWMU 54 RFI/CMS Report

Attached are the RTCs for the SWMU 54 RFI/CMS Report. You have all reviewed the first set of comments provided (the sans risk assessment comments), but some changes have been made to address previous army comments (these changes are shown in blue underlined font). This is the complete RTC including responses to the human health and ecological risk assessment comments. I have included a draft ecological TRV table for explosives per Ruth Prince's comment. This is probably of particular interest to CHPPM. Let me know if you have any comments or questions.
Have a great day,

(See attached file: Complete RTC SWMU 54 RFI_CMS Report.pdf)

Tina DeVine, P.E.
Project Engineer
URS Corporation
(804)474-5448

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retain, distribute, disclose or use any of this information and you should destroy the e-mail and any attachments or copies.

Classification: UNCLASSIFIED
Caveats: NONE

Radford AAP, SWMU 54 Comments

To: William Geiger, Project Manager

From: Betty Ann Quinn, Toxicologist

Date: June 24, 2008

1. Executive Summary (Human Health Risk Assessment Summary), Section 6.6.1 (Area A Summary), and Section 8.1.1 Area A: All three of these sections state that site-related Hazard Indices are less than 1 for Area A (after target organ segregation). However, the presence of 2,4,6-TNT in groundwater at Area A predicts an individual Hazard Quotient of 2.2, which exceeds EPA's acceptable Hazard Quotient of 1. These sections should be corrected.

2. Executive Summary, Corrective Measures Study: What measures will be taken to control potential exposures to soil at Area B, where concentrations of 2,4,6-TNT and lead, which present significant risks to future construction workers and residential children, were reported? Some discussion in this section is warranted.

3. Appendix C.9, Soil Background Evaluations: This evaluation appears to be different from the evaluation that resulted in the Facility Wide Background Point Estimates listed on data summary tables. Explain. In addition, provide documentation that the background soil sample locations have not been impacted by industrial activity. If possible, a map should also be provided.

4. Table E.1-7.1.RME: The cancer risk column for the soil ingestion risk for 2,3,7,8-TCDD equivalents is blank. Risk values should be provided.

5. Table E.2-7.5 RME: Total Hazards at the end of this table do not appear. Correct.

6. Appendix E, Lead IEUBK Model Results, Area A: The source of the lead soil concentration used in the model, 129 mg/kg, is not clear. This value does not agree with either the mean or UCL values for lead listed on Table E.2-3.2. Clarify.

7. Appendix E, Lead IEUBK Model Results, Areas A and B: Note that updated dietary lead intake values are available on the EPA Lead website. These lower dietary values will reduce risks predicted by the IEUBK model, and should be used in future risk assessments.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

SUBJECT: Radford Army Plant SWMU 54 RFI/CMS Ecological Risk Assessment — June 17, 2008

FROM: Ruth Prince, Toxicologist
Technical Support Branch

TO: Will Geiger, RPM
General Operations Branch

General Comment
A number of explosives were detected in the SWMU 54 surface soil, some at fairly high concentrations, which are characteristic of the waste that was disposed of in SWMU 54. However, they were not evaluated in this ecological risk assessment because there were no identified wildlife Toxicity Reference Values (TRVs) or readily available screening values for direct toxicity to soil organisms or plants. However, despite the apparent lack of screening values, these chemicals which are truly SWMU-specific must still be evaluated for direct and wildlife toxicity. Besides literature searches and/or the use of surrogates, the U.S. Army Center for Health Promotion and Prevention Medicine has developed wildlife TRVs for numerous contaminants including the explosives and nitroglycerin. Please revise accordingly; the TRVs may be accessed at http://chppm-www.apgea.army.mil/erawg/tox/.

Appendix F
Table F.2-2, Area A Dioxin/Furan Equivalents
Please explain why 2,3,7.8-TCDF is not included in this table and revise as necessary.

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EPA/VDEQ Comments Minus Risk Assessment
Comments for Radford Army Ammunition Plant's Solid Waste Management Unit 54
RCRA Facility Investigation/ Corrective Measures Study (January 2008)
Received via E-mail 4/2/2008

GENERAL COMMENTS

1. The figures in Section 4.0 provide visual representations of the extent of soil and groundwater contamination at both Areas A and B. The extent of contamination of the following areas of interest does not appear to have been fully delineated. The RFI/CMS Report does not identify any data gaps or areas which would require the collection of additional data to fully define an area of concern during the CMS. For each bullet listed, the RFI/CMS Report needs to be revised to address the perceived data gap, or lack of data for complete delineation of the extent of contamination.

    - Figure 4-2, Area A – Extent of Pesticides and PCBs in Soil: The extent of heptachlor epoxide contamination in the immediate vicinity of sample 54SB25B is not immediately evident as the sample location just south of 54SB25B (54SB28) was not analyzed for heptachlor epoxide. According to the proposed remedial boundaries for Area A (Figure 8-1), sample 54SB28 is specifically excluded from the area requiring remediation. However, without adequate data for this sample and others shown on Figure 4-2, it is not clear that the extent of heptachlor epoxide has been adequately characterized. Since sidewall and bottom of excavation sampling is proposed during remedy implementation, it may be acceptable to address this concern at that time. However, the CMS should identify this potential data gap and discuss how it will be addressed during remedy implementation.

    - Figure 4-3, Area A – Extent of Dioxin/Furans in Soil: The extent of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) toxicity equivalent concentration (TEQ) contamination north and west of samples 54SB25, 54SB23, and 54SB83 does not appear to have been adequately defined. Samples were not collected for dioxin/furan analysis in the above-noted areas, which includes the northern one-third area of this solid waste management unit (SWMU). Additionally, the extent of contamination does not appear to be defined west of sample 54SB33, which reported a 2,3,7,8-TCDD TEQ concentration above the Region 3 industrial risk-based screening concentration (RBC). Please revise Figure 4-3 to clearly indicate those samples which are contributing to the presented extent of contamination and revise the RFI/CMS Report to address these data gaps.

    - Figure 4-5, 2,4,6-TNT in Groundwater Isoconcentration Map, and Figure 4-6, RDX in Groundwater Isoconcentration Map: The extent of groundwater contamination south of existing wells existing wells 54MW-2 and 54MW-10 is not adequately characterized (as evidenced by the dashed isoconcentration contours). Monitoring well 54MW-10 reported some of the highest levels of groundwater contamination at the site during the September 2007 sampling round (Table 4-6). Given the east/southeastern groundwater flow direction at the site, it

will be important to complete delineation of the groundwater plume in the vicinity of monitoring well 54MW-10 at the site (specifically with respect to 2,4,6-TNT and RDX). It is noted that a groundwater monitoring well (54MW13) is proposed in this area in Section 10.0 of the RFI/CMS Report. However, if concentrations exceed remedial goals (RGs) in this new well, further plume definition to the south will be warranted. The RFI/CMS Report should also document this area as a data gap when discussing the current nature and extent of contamination in Section 4.0.

- Figure 4-11, Area B – Extent of Dioxin/Furans in Soil: The extent of dioxin contamination east of sample 54SB53 and southeast of sample 54SB43 does not appear to be defined as no samples were collected in this area. Since sidewall and bottom of excavation sampling is proposed during remedy implementation, it may be acceptable to address this concern at that time. However, the CMS should identify this potential data gap and discuss how it will be addressed during remedy implementation.

2. Appendix G.6 (Corrective Measures Alternative Four: Excavation of Soil to Industrial RGs) is included as an attachment, yet this appendix apparently has not been discussed in the main text of the RFI/CMS Report, and excavation of soil to industrial RGs is not evaluated as one of the three alternatives in the CMS. This alternative is, however, mentioned in the Executive Summary, as follows: "As part of the development of these alternatives, initial evaluations were conducted to compare implementation of an additional corrective measure alternative that addressed identified risks associated with current and future industrial land use scenarios at the site to Alternative Nos. Two and Three, which in addition to the identified industrial risks also address identified risks associated with the soil-to-groundwater pathway and groundwater (Appendix G.6). These evaluations indicated that the estimated total cost of implementing an industrial based alternative ($5,941,375) was approximately 54% higher than implementing Alternative No. Two ($3,585,547) and 46% higher than implementing Alternative No. Three ($4,081,562). The difference in cost between the industrial based alternative and the other alternatives was related to leaving waste in place at concentrations that would require long-term monitoring and maintenance beyond the period of remedy implementation for Alternative Nos. Two and Three. Based on this initial evaluation, the alternative based only on addressing industrial risk in soil was not carried forward as a corrective measures alternative for further evaluation in the CMS." Although this information is presented in the Executive Summary, it also needs to be presented in the CMS portion of the RFI/CMS Report. The explanation presented above needs to be included in the CMS to justify why a potentially more protective approach was selected. Please revise the RFI/CMS Report to discuss Alternative Four within the CMS portion of the Report.

3. Figures 2-9, 2-10, 2-11, and 2-12 appear to show that monitoring well MW-9 is located downgradient of Area B, yet data from this well was not included in the nature and extent evaluation at Area B or in the risk assessment for Area B. The RFI/CMS Report does address the possibility that monitoring well MW-9 may have been impacted by Area A contaminants due to the variable groundwater flow directions at the site under

high flow conditions of the New River; however, under normal base flow conditions, groundwater flow direction at the site is towards the New River. Please revise the RFI/CMS Report to clarify why monitoring well MW-9 was not considered a dual-purpose well, used to monitor both areas, and why MW-9 was not selected as a point of compliance well for long-term monitoring for Area B. If adequate justification cannot be provided for limiting the data set for Area B, the nature and extent evaluation and risk assessment should be revised to include data from MW-9.

SPECIFIC COMMENTS

4. **Table 2-4, Groundwater Elevation Data:** The last two columns of this table appear to present data for the September 28, 2005, groundwater monitoring event, but groundwater elevations from this date were already presented in the third and fourth columns of the table, and do not match the values presented in the last two columns. Although the data presented in the last two columns is titled September 28, 2005, it appears that they may actually represent another monitoring event, possibly the September 2007 event. Please revise Table 2-4 to correct this discrepancy, and assure that groundwater elevations for the September 2007 monitoring event are also included on the table.

5. **Section 4.1.1, Analytical Results, Page 4-2:** The first paragraph indicates that an "A" sample represents a surface soil sample. However, Table 3-1, Field Sample Identifiers, Depths, and Analytical Methods, included in Section 3.0, identifies a few exceptions to this statement. For example, Table 3-1 indicates that sample 54SB18A was collected at a depth of 9-10 feet (ft) below ground surface (bgs). Sample 54SB19A was also collected 9-10 ft bgs. Please revise the RI/CMS Report to address this discrepancy, and assure that the nature and extent evaluation, as well as the risk assessments take these sample depths into account during site characterization. It is recommended that the sample designation be noted in some way to document this exception to ensure that all users of the data are aware of it.

6. **Table 4-1, Summary of Detected Chemicals in Soil Analytical Samples at Area A:** A note included at the end of this table states that bold italic type is used to identify concentrations that exceed soil screening levels (SSLs) based on a dilution attenuation factor (DAF) of 20. The table actually screens contaminants against a DAF based on a conservative DAF of 1. Please revise the notes section of Table 4-1 to accurately state what the bold italic type identifies within the table.

7. **Section 5.1.4.6, Dioxins, Page 5-11:** This section is supposed to address dioxin soil data in comparison to site specific soil-to-groundwater SSLs, but the third and fourth paragraphs in this section appear to describe polychlorinated biphenyls (PCBs) at Area B instead, although some text does appear to discuss dioxins. Dioxins at Area B need to be described consistently. Please revise this section to include a discussion of the potential for dioxins detected in soil at Area B to leach to groundwater.

8. **Section 5.1.4.7, Explosives, Page 5-11:** The site-specific SSL for 2,4,6-DNT at Area A is identified as 0.498 milligram per kilogram (mg/kg) on this page. However, Appendix C.8 notes that the SSL for 2,4,6-DNT at Area A is 0.408 mg/kg. Please address this discrepancy and assure that the total number of samples exceeding the calculated SSL is accurate.

9. **Section 5.1.4.7, Explosives, Page 5-12:** The third paragraph on this page indicates that 2,4,6-TNT, DNT mixture, amino DNTs, and nitroglycerin have the potential to leach to groundwater. According to the table directly above this paragraph (Area B-Comparison of Explosives Soil Data to Site Specific Soil-to-Groundwater SSLs), RDX was also detected above the site-specific SSL, and therefore, has the potential to leach to groundwater. Please revise the RFI/CMS Report to address the potential for RDX to leach to groundwater at Area B.

10. **Section 5.2.1, Volatilization, Page 5-13**: This section references Table 5-1 for the chemical-specific Henry's Law constants. It appears that the appropriate reference for this information is actually Table 5-2 (Chemical Properties Affecting Fate and Transport) since Table 5-1 describes the fate processes affecting organisms. Please revise the RFI/CMS Report to make the necessary change.

11. **Section 8.1.2, Area B, Page 8-2:** The table for Area B – Chemicals and Media of Interest, does not appear to include dieldrin or nitroglycerin for soil to groundwater migration potential at Area B. Page 5-10 notes that dieldrin was detected above its site-specific SSL in one sample. Additionally, nitroglycerin was detected above its site-specific SSL in two samples. Both of these constituents have the potential to leach to groundwater, and should therefore, be identified as Chemicals of Interest in the table on Page 8-2 for Soil-to-Groundwater Migration. Please revise the RFI/CMS Report to include these constituents, or provide additional justification for excluding them. Identification of dieldrin in only one sample is not necessarily adequate justification as several other constituents were only detected in one sample above their respective SSLs, but they were included as Chemicals of Interest in Section 8.0 (i.e., 2,3,7,8-TCDD TEQ and nitroglycerin at Area A).

12. **Section 8.2.2, Area B, Page 8-3:** Only one corrective measure objective (CMO) has been stated for Area B, and it does not appear to take into account the results of the human health or ecological risk assessments. The table on Page 8-2 noted that lead, 2,4,6-TNT and nitroglycerin were identified as chemicals of interest in the HHRAs (and in particular, lead for the future construction worker since this is the most likely receptor scenario). A CMO that addresses protection of human health associated with soil impacts must also be developed. Upon further review, it appears that Section 13.0 includes a more thorough list of CMOs for Area B. These CMOs appear adequate provided that they are included in the initial discussion of CMOs in Section 8.0. Please revise the RFI/CMS Report to make the necessary changes to Section 8.0.

13. **Section 8.2, Corrective Measures Objectives:** Please clarify why Initial CMOs make no mention of goals for soil remediation.

14. **Section 8.3, Remedial Goals:** It is not clear how remedial goals (RGs) are being addressed. It appears that all possible RGs are presented rather than the RGs that relate to specific remediation objectives. Note that if risk is present for GW then ARARs are triggered (VA MCLs) to establish RGs. However there are no MCLs that apply to the GW COCs for this site.

15. **Table 8-1, Remedial Goals:** This table documents the proposed RGs for soil and groundwater at the site. Some of the groundwater RGs are the Region 3 tapwater RBC values (T-RBCs). However, there are several discrepancies that need to be corrected. First, the T-RBC for 2,3,7,8-TCDD (TEQ) is identified as 4.50E-07 mg/l. The T-RBC listed in the October 2007 RBC table is 4.50E-07 *micrograms per liter (ug/l)* or 4.50E-10 mg/l. The T-RBC for heptachlor epoxide is listed in Table 8-1 as 0.0074 mg/l, but the actual T-RBC is 7.4E-03 ug/l or 7.4E-6 mg/l. Please make careful notice of the units of measure when establishing RGs based on the T-RBCs. It appears that the correct T-RBC values were used when calculating the site-specific soil RGs for the soil to groundwater migration pathway. Please revise the RFI/CMS Report to document the correct T-RBC values as RGs for 2,3,7,8-TCDD (TEQ) and heptachlor epoxide.

16. **Table 8-1, Remedial Goals:** Some of the groundwater RGs were calculated using total groundwater risk for a lifetime resident of equal to or less than 1E-05, according to the note presented on Table 8-1. Although calculations are provided in Appendix G, there still appears to be a disconnect between how the RGs were originally selected in the risk calculations. Often, RGs are back-calculated from the estimated risk level, but the calculations in Appendix G do not show this. Additionally, neither Appendix G nor Section 8.0 of the RFI/CMS Report describes the equations used to calculate the RGs and the exposure assumptions that are inherent in these calculations. Please revise Section 8.0 to include the equations used to calculate the groundwater RGs for the site. Additionally, please discuss the exposure assumptions that are inherent in these calculations. Review of the proposed groundwater RGs will be reserved until this information is provided.

17. **Section 8.4, Area and Volume of Impacted Area:** Again, it is not clear how the impacted area is being delineated. Is the soil-to-GW pathway the primary driver or just the most conservative?

18. **Section 8.4.1, Area A, and Section 8.4.2, Area B, Pages 8-4 and 8-5:** Residual risk and hazard were calculated to address any remaining contamination at the site after remedy implementation. However, the samples that were used in these calculations have not been documented. To assure the samples that remain in place after remedy implementation have been included in the risk/hazard calculations, please provide a list of the sample IDs that were used in the residual risk assessment.

19. **Figure 10-1, Monitored Natural Attenuation Performance Monitoring Network:** The approximate lateral extent of impacted groundwater above RGs (2007) is delineated on this figure, but monitoring well 54MW10 is not located within this area. Since monitoring well 54MW10 reported 2,4,6-TNT, DNT mixture, and RDX above the proposed RGs in September 2007, the approximate extent of groundwater

contamination should encompass this well. Please revise Figure 10-1 and any other figures which include this approximate lateral extent so that it encompasses monitoring well 54MW10.

20. **Section 11.2.2, Compliance with Media Standards and Criteria:** The use of the word "after" suggests that more restoration will be performed in addition to meeting RGs?

21. **Section 11.3.1, Technical, Page 11-6:** The second paragraph on Page 11-6 states that it is anticipated that CMOs and RGs for groundwater will be achieved by Alternative Two (Monitored Natural Attenuation) within 5 years after completion of soil excavation activities. This estimated timeframe for compliance is not substantiated by any calculations or modeling efforts. It should be noted that this time frame is key to remedy selection, as currently the remedial time frames projected for Alternatives Two and Three are similar. Also, any MNA remedy needs to achieve RGs within a reasonable time frame. The RFI/CMS Report has not described estimated rates of attenuation, or other means used to calculate this 5-year timeframe to achieve CMOs and RGs for groundwater. Please revise the RFI/CMS Report to include the estimated rates of attenuation at the site, and describe how the estimated compliance date of 5 years was determined.

22. **Table 11-1: Cost Estimate: Corrective Measures Alternative Two:** It does not appear that this cost estimate includes costs for several items that are described in Section 10.2 of the RFI/CMS Report. For example, the cost estimate does not appear to include labor costs for onsite geologists or other site personnel, who may be sampling or providing oversight. It is noted in Task 1.2, Soil Excavation and Backfill, that per diem costs for three onsite personnel have been included in the cost estimate, but hourly or daily costs for the personnel have not been included. Additional discrepancies which require clarification are identified below:

    - Task 1.2 of the cost estimate does not include costs associated with the decontamination station (which are to include a high density polyethylene liner and a tank to contain water, as noted on Page 10-2).
    - Page 10-2 notes that a water truck will be required for dust suppression during excavation activities. Costs associated with the water truck do not appear to have been included in the cost estimate.
    - Task 1.2 of the cost estimate notes that Area A confirmatory samples will be analyzed for explosives, lead, dioxins, perchlorate, and pesticides. Table 10-1 includes all of those analyte classes with the exception of pesticides.
    - Task 2.1 only includes 21 55-gallon drums whereas Page 10-4 indicates that at least 23 55-gallon drums will likely be generated during monitoring well installation and development (including 14 drums for soil, 7 drums for decontamination and well development water, and 2 drums for personal protection equipment (PPE)).
    - Page 10-4 also indicates that approximately one 55-gallon drum will be generated during each groundwater sampling event. The costs associated with this drum

generation are not specifically included in the Annual O&M costs associated with quarterly sampling.

Please revise the cost estimate for Alternative Two to address the above-noted concerns. It should be noted that many of these concerns also apply to the cost estimate for Alternative Three in Table 11-2, specifically with regard to the soil excavation. Corrections to this table should also be made to reflect any necessary changes.

23. **Section 13, Substantiation/Justification of Final Remedy:** This section should include some contingency wording if RGs aren't met in some specified timeframe to include the potential for implementing Alternative 3, which appears to be "practicable".

DEPARTMENT OF THE ARMY
US ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND MD 21010-5403

MCHB-TS-REH

14 FEB 2008

MEMORANDUM FOR Office of Environmental Quality, Radford Army Ammunition Plant (SJMRF-OP-EQ/Mr. Jim McKenna), P.O. Box 2, Radford, VA 24143-0002

SUBJECT: Review of Document Titled: "Revised Draft RCRA Facility Investigation/ Corrective Measures Study Report for Solid Waste Management Unit 54, Radford Army Ammunition Plant, Virginia, January 2008"

1. The U.S. Army Center for Health Promotion and Preventive Medicine reviewed the subject document on behalf of the Office of The Surgeon General pursuant to Army Regulation 200-1 (Environmental Protection and Enhancement). We appreciate the opportunity to review this report.

2. The previous comments have been adequately addressed and we concur with the selected corrective measures alternative as being protective of human health and the environment.

3. The document was reviewed by Mr. Dennis Druck, Environmental Health Risk Assessment Program. He can be reached at DSN 584-2953, commercial (410) 436-2953 or electronic mail "dennis.druck@us.army.mil".

FOR THE COMMANDER:

JEFFREY S. KIRKPATRICK
Director, Health Risk Management

CF:
HQDA (DASG-PPM-NC)
IMCOM, NERO (IMNE-PWD-E)
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USAEC (IMAE-CD/Mr. Rich Mendoza)

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February 4, 2008

Mr. William Geiger
RCRA General Operations Branch, Mail Code: 3WC23
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1650 Arch Street
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Mr. James L. Cutler, Jr.
Virginia Department of Environmental Quality
629 East Main Street
Richmond, VA 24143-0100

Subject: With Certification, Radford Army Ammunition Plant,
Solid Waste Management Unit 54 RCRA Facility Investigation/Corrective Measures Study Report, Draft Document January 2008
EPA ID# VA1 210020730

Dear Mr. Geiger and Mr Cutler:

Enclosed is the certification for the subject document that was sent to you on January 31, 2008. Also enclosed is a copy of the transmittal email message.

Please coordinate with and provide any questions or comments to myself at (540) 639-8658, Jerry Redder of my staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 639-8641.

Sincerely,

P.W. Holt, Environmental Manager
Alliant Techsystems Inc.

c: Durwood Willis
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P. O. Box 10009
Richmond, VA 23240-0009

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Virginia Department of Environmental Quality
West Central Regional Office
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08-815-17
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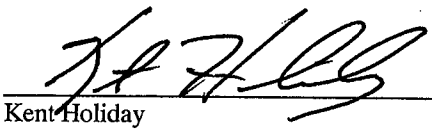
08-815-17
JMcKenna

Concerning the following:

Radford Army Ammunition Plant
Solid Waste Management Unit 54
RCRA Facility Investigation/Corrective Measures Study Report
Draft Document January 2008

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

SIGNATURE: 
PRINTED NAME: for Jon R. Drushal
TITLE: Lieutenant Colonel, US Army
Commanding

SIGNATURE: 
PRINTED NAME: Kent Holiday
TITLE: Vice President and General Manager
ATK Energetics Systems

08-815-17
JMcKenna

Greene, Anne

From: McKenna, Jim
Sent: Thursday, January 31, 2008 11:02 AM
To: Greene, Anne; beth lohman; dennis.druck@us.army.mil; durwood willis2; Geiger.William@epamail.epa.gov; Redder, Jerome; jim spencer; jlcutler@deq.virginia.gov; Mendoza, Richard R Mr CIV USA SA; Parks, Jeffrey N; Timothy.Leahy@shawgrp.com; Tina_Devine@URSCorp.com; Tom.Meyer@nab02.usace.army.mil
Subject: SWMU 54 RFI/CMS report & Fed Ex Tracking numbers (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

All:

Note the contractor will ship the subject document with a copy of this email to the POCs and tracking numbers below.

The certification letter will follow from Radford AAP under separate cover.

William Geiger 7924 9741 3634 3 Paper copies and 3 CDs
7926 4066 4501
James McKenna 7914 8912 9983 2 Paper copies and CD
7988 6379 4935
Jim Cutler 7983 6332 8355 1 Paper copy and CD Durwood Willis 7992 6392 6959 1 Paper copy and CD Tom Meyer 7926 4010 3929 1 Paper copy and CD Richard Mendoza 7992 6391 6650 1 Paper copy and CD Dennis Druck 7926 4012 0965 CD Elizabeth Lohman 7918 4111 2837 CD

Thank you for your support of the Radford AAP Installation Restoration Program.
Jim McKenna
Classification: UNCLASSIFIED
Caveats: NONE

EXECUTIVE SUMMARY

URS Group, Inc. (URS) conducted a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) and Corrective Measures Study (CMS) at Radford Army Ammunition Plant (RFAAP) solid waste management unit (SWMU) 54, the Propellant Burning Ash Disposal Area (the site). The site consists of two non-contiguous disposal areas, Area A and Area B. The work was conducted to fulfill the requirements set forth in the 2000 RCRA Corrective Action permit as tasked by the United States Army Corps of Engineers, Baltimore District. URS performed the RFI/CMS in accordance with the Master Work Plan (URS 2003), Work Plan Addendum 013 (URS 2003), Additional Characterization – Work Instructions (URS 2004), and Additional Proposed Investigations (URS 2006) approved by the U.S. Environmental Protection Agency (USEPA) Region III and the Virginia Department of Environmental Quality.

Between 1992 and 1998, several investigations were conducted at the site to characterize concentrations of chemicals in soil and groundwater. These investigations resulted in the performance of remedial interim measures at both Areas A and B in 1999, which consisted of the excavation and removal of 1,827 tons of soil. This RFI/CMS was completed in multiple phases of investigation to fill identified data gaps and included: completion of direct push soil borings, installation of additional monitoring wells, geotechnical characterization, physical soil testing, chemical sampling of soil and groundwater, investigation of the New River (including sediment, surface water, and pore water sampling), and aquifer characterization.

Nature and Extent Assessment

The primary site related chemicals of concern in soil at the site are those associated with propellant ash including lead, explosives, and dioxins. At Area A, the area of impacted soil is within an approximate 16,300 square foot (ft^2) area (Figure 4-14), which includes two areas where explosive concentrations are above industrial risk-based screening standards (Figure 4-15). The vertical extent of impact in soil at Area A is less than 16 feet (ft) below ground surface (bgs). As shown on Figure 4-16, at Area B a contiguous area of impact of approximately 21,800 ft^2 within the disposal area has been identified including a "hot spot" primarily centered around borings 54SB42, 54SB46, and 54SB49 where, the concentrations of lead, explosives, and/or dioxins are above their industrial risk-based screening criteria as shown on Figures 4-9, 4-11, and 4-12, respectively. The vertical extent of impact is greater than 12 feet in the center of the hot spot area.

Explosives and perchlorate have been detected in site groundwater at levels of concern, with the release occurring from Area A. Groundwater impacts have not been detected at disposal unit wells at Area B at levels of concern. Concentrations of explosives and perchlorate in groundwater have decreased since RFI monitoring began in 2003 and 2004. The lateral extent of explosives and perchlorate in groundwater at concentrations above USEPA adjusted tap water, risk-based screening concentrations (T-RBCs), extends from the Area A disposal unit eastward to the area of the New River. For the September 2007 quarterly sampling event, perchlorate, 2,4,6-trinitrotoluene (2,4,6-TNT), dinitrotoluene (DNT) mixture, and RDX were detected at concentrations above their adjusted T-RBCs. Sampling of the groundwater/surface water interface (sediment pore water) and surface water of the New River did not indicate detectable impacts to sediment pore water or surface water from chemicals of potential concern (COPCs) in groundwater.

Fate and Transport Assessment

At Area A, explosives and perchlorate have leached from soil to groundwater. Fate and transport analysis of soil data at Area A indicates potential continued leaching of explosives from soil to groundwater at levels of concern. At Area B, potential leaching of explosives, dioxins, Aroclor 1254, and heptachlor epoxide from soil to groundwater has been identified as a potential concern based on the levels detected in the soil hot spot area, although groundwater impacts at levels of concern have not been identified at Area B.

Degradation of 2,4,6-TNT in soil to transformation byproducts 2-amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene is apparent at both disposal units. The same degradation byproducts of 2,4,6-TNT have also been detected in groundwater at Area A. Dispersion processes have influenced the configuration of the dissolved phase constituent plume in groundwater at the site, which along with previous source removal activities and degradation of chemicals in groundwater have likely contributed to observed decreases in groundwater concentrations. The mixing zone between Area A and the New River, where water from the New River can flow into the aquifer when river stage is above base flow, has likely caused dispersion of the dissolved phase plume and corresponding reductions in dissolved phase constituent concentrations, particularly during high flow events. Some enhanced transverse dispersion of the plume is apparent toward the north within 100 ft of the New River. It is believed that the fringes of the plume have been stretched approximately 100 ft to the north in the direction of river flow due to these mixing processes. Further dispersion of the dissolved phase plume will occur as groundwater discharges to the New River; based on site-specific discharge calculations, potentially three orders of magnitude or greater reduction of chemical concentrations is possible depending on the specific discharge rates.

Human Health Risk Assessment (HHRA)

A HHRA was performed to evaluate the potential human health effects associated with previous activities at the site. Soil and groundwater for each non-contiguous disposal area was evaluated separately in the HHRA. Receptors evaluated for both areas included: current/future maintenance worker, future hypothetical construction worker, future commercial worker, future adult resident, future child resident, and lifetime resident. The HHRA included the calculated estimates of upper bound excess lifetime cancer risks for carcinogenic chemicals, and calculated estimates of hazard quotients (HQs) and hazard indices (HI) for non-carcinogenic chemicals. HHRA methodology was consistent with guidance included in EPA's *Interim Final Risk Assessment Guidance for Superfund* (RAGS) and other current USEPA/USEPA Region III resources and guidance documents as noted in the report.

For both Area A and Area B, the total risk calculated for each receptor was below or within USEPA's target risk range for Superfund sites of 1E-06 to 1E-04 (USEPA 1989b). Total HIs after target organ segregation were below the USEPA reference HI of 1E+00 except for hypothetical future construction worker and hypothetical future child resident at both disposal areas. When considering the results of background evaluations for metals and target organ segregation, the site-related HIs were less than 1E+00 for Area A with the exception of the child resident due to 2,4,6-TNT in groundwater. At Area B, the site-related HIs when considering background evaluations and target organ segregation were greater than 1E+00 for hypothetical future child resident due to 2,4,6-TNT and nitroglycerin concentrations in soil. The iron exposure assessment results for the hypothetical future child resident were below the applicable iron margin of exposure screening criteria for both Area A and Area B. The results of the lead modeling predicted that the probability of the receptors for Area A and Area B expected to have blood levels of 10 microgram per deciliter or greater were below the established threshold of 5% with the exception of the hypothetical future construction worker and hypothetical future child resident at Area B.

Screening Level Ecological Risk Assessment (SLERA)

A SLERA was performed to evaluate potential ecological risks associated with previous activities at the site. Each disposal area was evaluated separately in the SLERA. Direct contact and wildlife ingestion pathways were evaluated for soil. Terrestrial receptors that were evaluated included: plant communities, soil invertebrate/ microbial communities, American Robin, Red-tailed Hawk, Meadow Vole, Red Fox, and Short-tailed Shrew. The SLERA assessed risk by comparing various exposure estimates for chemicals to available toxicity reference values (TRVs) for each receptor. The relative risk was expressed as an HQ. An HQ of less than 1 indicates no or negligible risk. The potential for risk increases as the HQ increases above unity. HQs were calculated for no effects range observable adverse effect levels (NOAELs) and lowest observable adverse effect levels (LOAELs). Preliminary and refined risk characterizations were conducted, with refined characterizations considering mean concentrations, background evaluations, and other more environmentally realistic assumptions than conservative

preliminary estimates. Identification of an appropriate scientific management decision point (SMDP) for each site area was made based on the ecological risk screening results. The SLERA presented the following SMDPs for Area A and Area B:

Area A*: There is adequate information to conclude that the potential exists for an adverse ecological impact to plants, invertebrates, and the American robin due to 2,4,6-TNT concentrations in soil. Screening level exceedances were identified in the immediate area of soil borings 54SB27, 54SB30, and 54SB32 in the same area identified for human health RBC exceedances and/or SSL exceedances for explosives as shown on Figure 4-4 and Figure 5-1, respectively. No other significant potential impacts to ecological receptors due to site-related activities were identified. Significant uncertainty is associated with the potential impact to the American robin. It is recommended that the need for remedial action to address this potential impact be evaluated along with the uncertainty associated with the derivation of the HQs, the location of HHRA COCs, the fate and transport evaluation, and other relevant factors, which would influence any decision to implement action.*

Area B*: There is adequate information to conclude that the potential exists for an adverse ecological impact to plants due to lead, 2,4-DNT, and 2,4,6-TNT concentrations in soil, invertebrates due to the lead and 2,4,6-TNT concentration in soil, the meadow vole due to exposure to nitroglycerin in soil, the short-tailed shrew due to exposure to 2,3,7,8-TCDD TEQ (dioxin/furans), and the American robin due to exposure to 2,3,7,8-TCDD TEQ, lead, 2,4,6-TNT, and 2,4-DNT in soil at the site. Hot spots for lead, explosives, and dioxins were identified in the immediate area of soil borings 54SB42, 54SB46, and 54SB49 in the same area identified for human health I-RBC exceedances for lead, explosives, and/or dioxins as presented on Figures 4-9, 4-11, and 4-12, respectively. No other significant potential impacts to ecological receptors due to site-related activities were identified. Significant uncertainty is associated with the potential impact to the meadow vole, short-tailed shrew and American robin. It is recommended that the need for remedial action to address this potential impact be evaluated along with the uncertainty associated with the derivation of the HQs, the location of HHRA COCs, the fate and transport evaluation, the "hot spot" locations, and other relevant factors, which would influence any decision to implement action.*

Corrective Measures Study (CMS)

The RFI fate and transport assessment and risk assessments identified a requirement to evaluate corrective measures options to address: 1) potential continued leaching of explosives from soil to groundwater at Area A, 2) potential future leaching of explosives, dioxins, Aroclor 1254, and heptachlor epoxide from soil to groundwater at Area B, and 3) address explosives and perchlorate detected in groundwater. Based on these results, the following corrective measures objectives (CMOs) were identified for each disposal area:

Area A

- CMO No. 1 – Mitigate further leaching of explosives constituents from soil to groundwater at levels that would potentially increase observed concentrations and adversely impact future beneficial use of groundwater; and
- CMO No. 2 – To extent practicable, a goal of restoring site groundwater to the most beneficial use.

Area B

- CMO No. 1 – Mitigate the potential hypothetical future risks that have been identified for exposure to soil under a future construction worker scenario; and
- CMO No. 2 – Prevent leaching of COCs from soil-to-groundwater at levels that would potentially adversely impact future beneficial use of groundwater.

Three corrective measures technologies were selected in the CMS for development of two corrective measures alternatives in addition to a baseline no further action alternative including:

- Alternative No. 1: No Further Action;
- Alternative No. 2: Excavation of Soil at Area A and Area B, Offsite Disposal, and Monitored Natural Attenuation (MNA) of Groundwater; and
- Alternative No. 3: Excavation of Soil at Area A and Area B, Offsite Disposal, and Enhanced *In Situ* Bioremediation of Groundwater.

As part of the development of these alternatives, initial evaluations were conducted to compare implementation of an additional corrective measure alternative that addressed identified risks associated with current and future industrial land use scenarios at the site to Alternative Nos. Two and Three, which in addition to the identified industrial risks also address identified risks associated with the soil-to-groundwater pathway and groundwater (Appendix G.3). These evaluations indicated that the estimated cost expressed as net present value (NPV) of implementing an industrial-based alternative ($4,283,921) was approximately 11% higher than the implementing Alternative No. Two ($3,800,027) and less than 1% percent higher than implementing Alternative No. Three ($4,269,622). The difference in cost between the industrial-based alternative and the other alternatives was related to leaving waste in place at concentrations that would require long-term monitoring and maintenance beyond the period of remedy implementation for Alternative Nos. Two and Three. Based on this initial evaluation, the alternative based only on addressing industrial risk in soil was not carried forward as a corrective measures alternative for further evaluation in the CMS.

Evaluation of Alternatives Two and Three indicated that they both achieved the CMOs and RGs, with both alternatives achieving unrestricted future use of the site after remedy completion. Alternative Two was selected as the recommended alternative for SWMU 54 because it will effectively achieve the CMOs and RGs while also providing for future unrestricted use of the site. Note that under Alternative Two, the soil at Area B where concentrations of 2,3,6-TNT and lead which pose significant risk to receptors located in the area of borings 54SB42, 54SB46, and 54SB49 (Figure 8-3) will be removed as part of the proposed corrective measures. Removal of the soil source areas will prevent future leaching of COCs to groundwater and allow for continued attenuation of COCs in groundwater to levels at or below RGs; thereby restoring groundwater. In addition, implementation of Alternative Two will not result in potential adverse effects to groundwater (i.e., degradation of secondary water quality parameters) from remedial implementation activities, which would occur with implementation of Alternative Three. These potential effects along with groundwater injection proximate to surface water would make implementation of Alternative 3 more difficult compared with Alternative Two. Alternative Three would likely require a longer duration to implement than Alternative Two due to potential permitting requirements for groundwater injection, and/or studies and monitoring that would be required to demonstrate that adverse impacts to surface water would not occur from groundwater injection. In combination with source removal, the low-levels of dissolved phase constituents detected in groundwater and observed attenuation of COC concentrations in groundwater since 2003 also support implementation of Alternative Two. Alternative Two is also more cost-effective in achieving the CMOs and RGs, with 17% lower capital cost, 9% lower total cost, and 11% lower present value cost.

The soil component of Alternative Two is expected to be completed in less than one year. MNA is expected to require five years or less of performance groundwater monitoring to demonstrate achievement of CMOs and RGs based on observed attenuation rates of COCs in groundwater relative to established RGs and source area removal. For purposes of the CMS, an additional three years of monitoring has been assumed to demonstrate continued achievement of CMOs and RGs before site closeout. This time frame is considered an estimate and the actual time to complete the corrective measures will be subject to site-specific conditions. In the event that the proposed MNA remedy does not perform as expected within timeframes specified in the remedy implementation plan, potential contingencies will be identified in the plan, which would include as one option, implementation of elements contained in Alternative Three to

provide for enhanced bioremediation of groundwater in area or areas where the remedy is not performing as expected.

Implementation of Alternative Two will include the following:

- Pre-characterization of waste;
- Excavation of soil from Area A and Area B so that remaining soil is at or below the RGs;
- Transportation and offsite disposal of soil;
- Site restoration of excavation areas including backfilling, grading, seeding, etc.;
- Installation of supplemental monitoring network for MNA of groundwater;
- Quarterly performance groundwater monitoring and annual monitoring of surface water/sediment pore water of the New River until achievement and maintenance of RGs; and
- Closeout/abandonment of site monitoring wells.

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LIST OF ABBREVIATIONS AND ACRONYMS

2ADNT 2-amino-4,6-dinitrotoluene
4ADNT 4-amino-2,6-dinitrotoluene
°C .....Degrees Celsius
% .....Percent
AL .....Action Level
ALM.....Adult Lead Model
ATSDR .....Agency for Toxic Substance Disease Registry
AF .....Area Use Factor
bgs.....Below Ground Surface
BOD .....Biochemical Oxygen Demand
BTAG.....Biological Technical Assistance Group
CDCP .....Center for Disease Control and Prevention
CDD .....Chlorinated Dibenzo-p-dioxin
CDF.....Chlorinated Dibenzofuran
CDI.....Chronic Daily Intake
cfs.....Cubic Feet Per Second
cm/sec .....Centimeters Per Second
CMO .....Corrective Measure Objective
CMS .....Corrective Measures Study
CNS.....Central Nervous System
COD .....Chemical Oxygen Demand
COC .....Chemical of Concern
COPC .....Chemical of Potential Concern
COPEC.....Chemical of Potential Ecological Concern
CSM .....Conceptual Site Model
CSD.....Conceptual Site Diagram
DAF .....Dilution Attenuation Factor
DQO.....Data Quality Objective
DNT .....Dinitrotoluene
ECSM.....Ecological Conceptual Site Model
EM .....Electromagnetic
EPC .....Exposure Point Concentration
EPIC.....Environmental Photographic Interpretation Center
ERAGS .....Ecological Risk Assessment Guidance for Superfund
ft.....Feet
ft^3/day.....Cubic Feet per Day
ft/ft .....Feet per Foot
g/dL.....Grams Per Deciliter
GI .....Gastrointestinal
GPR.....Ground Penetrating Radar
GPS .....Global Positioning System
HHRA .....Human Health Risk Assessment
HI .....Hazard Index
HMX .....Cyclo-1,3,5,7-tetramethylene 2,4,6,8-tetranitramine; Octogen
HSA .....Horseshoe Area
HQ.....Hazard Quotient
I-RBC.....Industrial Risk-Based Concentration

LIST OF ABBREVIATIONS AND ACRONYMS (CONTINUED)

IDM.....Investigation-Derived Material
IEUBK .....Integrated Exposure Uptake Biokinetic
IRIS.....Integrated Risk Information System
LOAEL .....Lowest Observable Adverse Effect Level
MCL.....Maximum Contaminant Level
MDC .....Maximum Detected Concentration
MNA .....Monitored Natural Attenuation
µg/L.....Micrograms per Liter
µm .....Micrometer
mg/kg .....Milligrams per Kilogram
mg/L.....Milligrams per Liter
MHSP.....Master Health and Safety Plan
ML .....Sandy Silt
MQAP.....Master Quality Assurance Plan
mS/cm .....Millisiemens per Centimeter
MSE .....Millennium Science and Engineering
msl.....Mean Sea Level
mV .....millivolt
MWP.....Master Work Plan
NOAEL.....No Observable Adverse Effect Level
NPV .....Net Present Value
O&M.....Operation and Maintenance
ORP.....Oxidation-Reduction Potential
PAH .....Polynuclear Aromatic Hydrocarbon
PCB.....Polychlorinated Biphenyl
PEF.....Particulate Emission Factor
PETN .....Pentaerythritoltetranitrate
PPE.....Personal Protective Equipment
PSI.....Pounds per Square Inch
PVC.....Polyvinyl Chloride
QA.....Quality Assurance
QC.....Quality Control
R-RBC .....Residential Risk-Based Concentration
RAGS.....Risk Assessment Guidance for Superfund
RBC .....Risk-Based Concentration
RCRA.....Resource Conservation and Recovery Act
RDA.....Recommended Daily Allowance
RDX.....Hexahydro-1,3,5-trinitro-1,3,5-triazine
RFA.....RCRA Facility Assessment
RfD.....Risk Reference Dose
RFAAP.....Radford Army Ammunition Plant
RFI .....RCRA Facility Investigation
RG.....Remedial Goal
SC.....Clayey Sand
SLERA.....Screening Level Ecological Risk Assessment
SM.....Silty Sand

LIST OF ABBREVIATIONS AND ACRONYMS (CONTINUED)

SMDP.....Scientific Management Decision Point
SOP .....Standard Operating Procedure
SP .....Sand
SSL.....Soil Screening Level
SU .....Standard Units
SVOC.....Semi-volatile Organic Compound
SWMU .....Solid Waste Management Unit
T-RBC.....Tap Water Risk-Based Concentration
TAL.....Target Analyte List
TCDD.....Tetrachlorodibenzo-p-dioxin
TCL.....Target Compound List
TCLP.....Toxicity Characteristic Leaching Procedure
TEF .....Toxicity Equivalent Factor
TEQ.....Toxicity Equivalent Concentration
TIC .....Tentatively Identified Compound
TOC .....Total Organic Carbon
TOX .....Total Organic Halogen
TNT.....Trinitrotoluene
TRV .....Toxicity Reference Value
UCL .....Upper Confidence Limit
URS.....URS Group, Inc.
USACE .....United States Army Corps of Engineers
USEPA.....United States Environmental Protection Agency
VDEQ .....Virginia Department of Environmental Quality
VI .....Verification Investigation
VOC .....Volatile Organic Compound
WPA.....Work Plan Addendum
XRF.....X-ray Fluorescence

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1.0 INTRODUCTION

This Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Corrective Measures Study (CMS) report presents the results and findings of the investigations conducted at the Radford Army Ammunition Plant (RFAAP) Solid Waste Management Unit (SWMU) 54, the Propellant Burning Ash Disposal Area (the site). The site consists of two non-contiguous disposal areas; Area A is an approximate 0.58 acre area in the southern portion of SWMU 54 and Area B is an approximate 1.09 acre area in the northern portion of SWMU 54.

The work was conducted by URS Group, Inc. (URS) to fulfill the requirements set forth in the 2000 RCRA Corrective Action permit as tasked by the United States Army Corps of Engineers (USACE), Baltimore District. URS performed the RFI in accordance with the Master Work Plan (MWP) developed for RFAAP, Work Plan Addendum (WPA) 013 to the MWP (URS 2002), Additional Characterization – Work Instructions (URS 2004), and Additional Investigations (URS 2006). These documents, approved by the United States Environmental Protection Agency (USEPA) Region III and the Virginia Department of Environmental Quality (VDEQ), contain the Master Quality Assurance Plan (MQAP), the Master Health and Safety Plan (MHSP), and associated project-specific addenda.

Between 1992 and 1998, several investigations were conducted at the site to characterize concentrations of chemicals in soil and groundwater. These investigations resulted in the performance of remedial interim measures at both Areas A and B in 1999, which consisted of the excavation and removal of 1,827 tons of soil. This RFI was completed in multiple phases of investigation and included: completion of direct push soil borings, installation of additional monitoring wells, geotechnical characterization, physical soil testing, chemical sampling of soil and groundwater, investigation of the New River (including sediment, surface water, and pore water sampling), and aquifer characterization. The RFI was designed to:

- Fill data gaps from previous investigations;
- Further evaluate and characterize the nature and extent of chemicals remaining in soil at both disposal areas after completion of interim measures;
- Further evaluate the nature and extent of the dissolved chemicals detected in groundwater at Area A;
- Further evaluate potential releases to groundwater at Area B;
- Evaluate potential releases to the New River;
- Evaluate potential risks to human health and the environment using the physical and chemical data collected at the site; and
- Collect data to support completion of a CMS.

Section 2.0 of this report presents site background information including: site history, physical setting, and previous investigation results. The RFI field investigation program is described in Section 3.0. Sufficient data was collected for the RFI to complete a Nature and Extent of Chemicals Assessment (Section 4.0), Fate and Transport Evaluation (Section 5.0), Human Health Risk Assessment (HHRA) (Section 6.0), and a Screening Level Ecological Risk Assessment (SLERA) (Section 7.0).

The results of the risk assessments and fate and transport assessment indicated a requirement to complete a CMS for soil and groundwater at Area A and for soil at Area B. The purpose of the CMS is to develop and evaluate remedial alternatives and to recommend the remedy to be implemented. The CMS portion of this report includes the following sections: Establishment of Corrective Measures Objectives (Section 8.0), Identification and Screening of Corrective Measure Technologies (Section 9.0), Development of

Corrective Measure Alternatives (Section 10.0), Evaluation of Corrective Measure Alternatives (Section 11.0), Ranking of Corrective Measure Alternatives (Section 12.0), and Substantiation/Justification of Final Remedy (Section 13.0).

2.0 SITE BACKGROUND

A comprehensive discussion of the regional physiography, soil, geology, and groundwater at RFAAP is included in the RFAAP MWP (URS 2002) and therefore is not discussed in this report.

2.1 SITE DESCRIPTION

SWMU 54 is located within the easternmost portion of the Horseshoe Area (HSA) at RFAAP (Figure 2-1). Figure 2-2 shows the site layout, which consists of two non-contiguous areas for propellant burning ash disposal. Area A is an approximate 0.58-acre (approximately 100 by 320 feet (ft)), triangular shaped disposal area in the southeastern portion of the site. Area B is an approximate 1.09-acre area (approximately 240 by 240 ft) in the northwestern portion of the site. SWMU 54 was reportedly used as a disposal area in the late 1970s for ash from propellant burning operations located at the Waste Propellant Burning Grounds (SWMU 13).

The site is currently undeveloped with no structures located within the sites' boundaries. The RFAAP installation security fence is located adjacent to the site along the eastern and northern boundaries and a paved road is located adjacent to the site along the western and southern boundaries.



SWMU 54 Area A

2.2 SITE HISTORY

The RCRA Facility Assessment (RFA) conducted by the USEPA in 1987 identified the site as having the potential to release contaminants into the environment. The site is included in the RFAAP RCRA Permit for Corrective Action (USEPA 2000b).



SWMU 54 Area B

In the late 1970s, ash from propellant burning operations at SWMU 13 was reportedly disposed of at the site. Propellant ash is a residue resulting from the burning of waste explosives, propellants, and laboratory wastes. There has been conflicting information describing routine ash disposal practices at the site. The RFA indicated that, according to plant personnel, disposal occurred on the surface, with no routine disposal in pits or trenches. In 1998, Millennium Science and Engineering (MSE) reported that ash was buried up to 17 ft below ground surface (bgs) in Area A and up to 7 ft bgs in Area B (MSE 1998b). The quantity of ash disposed of at the site has been estimated at 10 tons

(USEPA 1987; USATHAMA 1976). A sample of ash was collected for laboratory analysis from the site during an investigation conducted by Parsons in 1996 (Parsons 1996). Laboratory analytical results of this sample indicated a concentration of lead above the Toxicity Characteristic Leaching Potential (TCLP) limit of 5 milligrams per liter (mg/L).

2.3 PHYSIOGRAPHY

SWMU 54 ground surface topography slopes west to east across the site area towards the New River located approximately 170 to 360 ft east of the site. Elevations across the site range from approximately 1,716 ft mean sea level (msl) immediately west of the site to 1,696 ft msl immediately east of the site (Figure 2-2). SWMU 54 is positioned within the 100-year floodplain on a terrace feature of the New River. West of the site, ground surface slopes toward the site steeply with ground surface elevations descending from approximately 1,732 to 1,716 ft msl. East of the site and adjacent to the New River, ground surface slopes steeply toward the New River with elevations ranging from approximately 1,688 to 1,678 ft msl.

2.4 SURFACE WATER

Figure 2-3 shows surface water features and drainage patterns in the site area. Surface water runoff flows into the site area from topographically higher areas to the west. As shown on Figure 2-3, there is a surface water drainage divide between the disposal units and the New River to the east. East of this divide, any surface water runoff in this area would flow east down moderate to steeply sloping ground surface to the New River. West of the drainage area, any surface water runoff would flow to the north parallel to the New River where it eventually would flow eastward toward the New River. Surface water runoff will tend to infiltrate at the site rather than runoff due to the site being completely covered with thick tall field grasses.

The primary surface water feature in the site area is the New River, which is located approximately 170 ft east of Area A and 360 ft east of Area B (Figure 2-1 and Figure 2-2). In the site area, the New River is approximately 500 ft wide and flows toward the north around the HSA at RFAAP.

Flow of the New River is controlled by the American Electric Power hydroelectric power dam at Claytor Lake located approximately eight miles upstream of the site. Figure 2-4 shows river discharge data for April 2005 through July 2007 from the United States Geological Survey river gauge located upstream of the site at the Route 11 bridge at Radford, Virginia. This graph shows both the 67 year mean daily discharge (from 1940 through 2006) and the daily mean discharges for the period. River discharges typically have a cyclical (seasonal) pattern of variation with the highest average flow of 5,000 cubic feet per second (cfs) occurring in the spring (April) and the lowest average flows of 1,750 cfs occurring in the fall (October). The annual average river discharge from 1940 through 2006 was 3,841 cfs.

A small unnamed tributary of the New River is located approximately 150 ft south of the disposal area at Area A (Figure 2-3). The banks of the tributary are heavily wooded and vegetated in the site area. This tributary flows into the New River approximately 250 ft southeast of disposal area at Area A upstream of the site. The tributary originates in the HSA of RFAAP west of the site. Based on topography and identified surface water drainage patterns, surface water runoff from the site does not drain into the tributary (Figure 2-3).

2.5 SITE SOIL

SWMU 54 soil is mapped locally as Wheeling Sandy Loam (URS 2003). This soil is described as having 0 to 2 percent (%) slopes and generally consists of a 10-inch thick, dark brown sand loam underlain by a 42-inch thick subsoil of dark brown gravelly sandy loam. Permeability and available water capacity of the Wheeling soil is moderate and surface water runoff is slow with a slight erosion potential. Natural fertility of the Wheeling soil is moderate, organic matter content is moderately low, and the soil is moderately to significantly acidic.

Specific physical properties of site soil have been evaluated through laboratory testing. Testing conducted for previous investigations (Dames & Moore 1992 and Parsons 1996) included grain size analysis, Atterberg Limit testing, and soil classification for 18 samples collected from various discrete depths from 5 to 20 ft bgs. Table 2-1 summarizes these physical test results. Seven samples collected for the RFI in 2005 were submitted to URS' laboratory in Totowa New Jersey for more extensive physical testing as summarized in Table 2-1. The RFI physical soil test results presented in Table 2-1 are summarized below.

Summary of Physical Soil Test Data for RFI (2005)

Test Parameter	Range of Parameter Values
Sample Depths (ft bgs)	1.5 to 20
Unified Soil Classification Symbol	SM (Silty Sand) - 5 samples SC (Clayey Sand) – 2 sample
Sieve Analysis - % fines (minus 200 Sieve)=	9.4 to 49.9%
Sieve Analysis - hydrometer percent minus 2 µm	3 to 22%
Organic Content	1.4 to 3.5%
pH – distilled water	5.6 to 8.1
pH – 0.01 M CaCl Solution	5.0 to 7.4
Soil particle density (pounds per cubic foot)	2.706 to 2.746
Soil bulk density (pounds per cubic foot)	106.3 to 125.3
Soil dry density (pounds per cubic foot)	90.5 to 107.6
Coefficient of permeability (centimeters per second)	3.5E-07 to 3.6E-03
Total Porosity	0.36 to 0.47
Air Filled Porosity	0.01 to 0.18
Water Filled Porosity	0.24 to 0.41
Water Content (%)	11.5 to 25.8%

Soil physical test results indicate that the primary soil type at the site is silty sand (SM) with lesser amounts of clayey sand (SC), sand (SP), and sandy silt (ML). A complete report of the RFI physical test results is included in Appendix C.1

2.6 SITE GEOLOGY

Geologic conditions at SWMU 54 were characterized for the RFI by drilling 70 soil borings to depths of 10 to 26 ft bgs and by the installation of 10 groundwater monitoring wells to depths ranging from 23 to 60 ft bgs. Monitoring well and soil boring locations are shown on Figure 2-5. Table 2-2 summarizes soil boring data collected during the RFI investigation. Monitoring well construction data are summarized in Table 2-3. Complete lithologic logs of monitoring wells and soil borings are included in Appendices C.2 (Verification Investigation [VI]) and C.3 (RFI).

Two geologic cross sections have been prepared from monitoring well boring and soil boring lithologic data. Cross-section A-A' is orientated west to east across Area A (Figure 2-6) and cross-section B-B' is orientated west to east across Area B (Figure 2-7).

The geology of the site generally consists of unconsolidated alluvial sediments that overlie limestone of the Elbrook Formation (DMR 2000). As shown on the geologic cross sections, the alluvial sediments consist primarily of brown silty sand (SM) with interspersed sand and gravel from 0 to 4 ft above bedrock. The observed thickness of sediments ranged from 17 ft at well 54MW5 to 24 ft at well 54MW3. Portions of the disposal areas contain fill material to depths of 9 to 10 ft bgs.

Bedrock underlying the site generally consists of gray to greenish-gray limestone with interbedded siltstone and shale. At well locations 54MW7 and 54MW8, in-place weathering of the bedrock has occurred with a 1 to 2.5 ft thick layer of saprolite observed above bedrock. Bedrock cores obtained at well borings 54MW2 and 54MW3 indicated weathered and highly fractured bedrock within the uppermost 10 ft of bedrock screened by these wells. Air drilling at well borings 54MW4, 54MW8, 54MW9, and 54MW10 also identified weathered zones of bedrock within the well screened intervals. The bedrock surface slopes from west to east across the site toward the New River as shown on Figure 2-8 and generally reflects topography in the area. The observed elevations of bedrock ranged from approximately 1,716 ft msl at well 54MW6 to 1,670 ft msl at well 54MW8.

2.7 SITE GROUNDWATER

Groundwater conditions at the site were investigated by installing 10 monitoring wells (54MW1 through 54MW10) and one piezometer (54MW1A). During the RFI, various measurements and data were obtained from the monitoring wells to characterize groundwater conditions, as discussed in the following sections.

2.7.1 Occurrence of Groundwater and Groundwater Flow Direction

The uppermost zone of groundwater at the site occurs within alluvium and underlying weathered bedrock as illustrated on the geologic cross sections on Figures 2-6 and 2-7. Groundwater is present entirely within the bedrock west of the disposal units where elevations increase sharply to a higher alluvial terrace.

Groundwater elevation data collected during site-wide groundwater sampling events conducted for the RFI are summarized in Table 2-4. At the time of these measurements, groundwater levels were approximately 2 ft above the bedrock surface, except in the area of well 54MW8, where measured groundwater levels were 2 to 6 ft above bedrock. The data provided in Table 2-4 have been used to prepare the groundwater potentiometric maps for September 2005 (Figure 2-9), November 2006 (Figure 2-10), March 2007 (Figure 2-11), and June 2007 (Figure 2-12).

The overall groundwater flow direction shown on Figures 2-9 through 2-12 is east and southeast toward the New River. Average hydraulic gradients have been calculated for groundwater flow paths across Area A and Area B using the potentiometric contour data on Figures 2-9 through 2-12. The following tables present the results of the calculations.

Hydraulic Gradient for Lateral Groundwater Flow at Area A

Date	Flow Path Contour Lines	Elevation Difference (ft)	Flow Path Distance (ft)	Calculated Hydraulic Gradient (ft/ft)
09/28/2005	1680 ft to 1676 ft	4	190	0.0210
11/29/2006	1682 ft to 1676 ft	6	340	0.0176
03/27/2007	1682 ft to 1674 ft	8	290	0.0275
06/05/2007	1682 ft to 1676 ft	6	310	0.0192
Average Hydraulic Gradient (ft/ft)				0.0213

Hydraulic Gradient for Lateral Groundwater Flow at Area B

Date	Flow Path Contour Lines	Elevation Difference (ft)	Flow Path Distance (ft)	Calculated Hydraulic Gradient (ft/ft)
09/28/2005	1696 ft to 1676 ft	20	476	0.0420
11/29/2006	1696 ft to 1678 ft	18	470	0.0383
03/27/2007	1696 ft to 1680 ft	16	380	0.0421
06/05/2007	1696 ft to 1678 ft	18	484	0.0372
Average Hydraulic Gradient (ft/ft)				0.0399

An average hydraulic gradient of 0.0213 feet per foot (ft/ft) was calculated for Area A for the four groundwater monitoring events. A slightly steeper average hydraulic gradient of 0.0399 ft/ft was calculated for Area B for the same monitoring events. The hydraulic gradient gradually decreases downgradient of both disposal units as groundwater flows east toward the New River.

2.7.2 Hydraulic Conductivity and Groundwater Flow Velocity

Rising and falling head slug tests were conducted at monitoring wells 54MW4 through 54MW10 to provide estimates of the hydraulic conductivity of well screened intervals. Slug testing methods are described in Section 3.3.5 and slug test results are summarized in the following table. Detailed analysis and calculations for the slug tests are included in Appendix C.4.

Summary of Slug Test Results for Area A

Well ID	Falling Head Test (cm/sec)	Rising Head Test (cm/sec)	Appropriate Test for Well Construction	Final Hydraulic Conductivity (cm/sec)
54MW5	3.730E-03	3.322E-03	Rising Head	3.322E-03
54MW8	1.587E-03	1.957E-03	Falling Head	1.587E-03
54MW10	2.929E-04	2.355E-04	Rising Head	2.355E-04
Average Hydraulic Conductivity Value				1.715E-03

Summary of Slug Test Results for Area B

Well ID	Falling Head Test (cm/sec)	Rising Head Test (cm/sec)	Appropriate Test for Well Construction	Final Hydraulic Conductivity (cm/sec)
54MW4	5.832E-04	5.269E-04	Falling Head	5.832E-04
54MW6	4.998E-03	4.760E-03	Rising Head	4.760E-03
54MW7	9.840E-04	8.645E-04	Rising Head	8.645E-04
54MW9	2.182E-04	3.089E-04	Falling Head	2.182E-04
Average Hydraulic Conductivity Value				1.606E-03

Slug test analysis indicated an average hydraulic conductivity of 1.715E-03 centimeters per second (cm/sec) (4.86 ft/day) at Area A and 1.606E-03 cm/sec (4.55 ft/day) at Area B.

Equation 1 below was used to calculate average groundwater flow velocity of the uppermost aquifer at both Area A and Area B separately.

(1) $V_s = Ki/n_e$

Where:

V_s = average groundwater flow (seepage) velocity (ft/day)

K = hydraulic conductivity (ft/day)

i = hydraulic gradient (ft/ft)

n_e = effective porosity (%)

The following values were substituted into Equation 1:

K =	4.86 ft/day (Area A) 4.55 ft/day (Area B)	Average value calculated from slug tests at Area A Average value calculated from slug tests at Area B
i =	0.0213 ft/ft (Area A) 0.0399 ft/ft (Area B)	Average value calculated at Area A (Section 2.7.1) Average value calculated at Area B (Section 2.7.1)
n_e =	0.20	Estimated effective porosity for limestone from Freeze and Cherry 1979 page 37

The following average groundwater-flow velocities were calculated using the above values in Equation 1:

- Area A: groundwater flow velocity of 0.52 ft/day (189.8 ft/year); and
- Area B: groundwater flow velocity of 0.91 ft/day (332.2 ft/year).

2.7.3 *In Situ* Groundwater Quality Measurements

Downhole measurements of water quality parameters were obtained from monitoring wells (54MW2 through 54MW7) during a groundwater sampling event conducted for the RFI in March 2003. Measurements were collected starting at the top of the water column in the screened interval moving downward to the bottom of the well. A Horiba Model U-22 water quality meter and probe was used to obtain the measurements. The water quality data are presented in Tables 2-5a through 2-5f.

Measurements conducted for wells located at Area A (54MW2, 54MW3, and 54MW5) showed aerobic conditions for groundwater. Levels of dissolved oxygen in the wells ranged of 2.88 to 7.87 milligrams per liter (mg/L). Oxidation reduction potential (ORP) measurements in the wells ranged from 88 to 168 millivolts (mV). Levels of pH were generally in the neutral range with measurements ranging from 6.29 to 7.45 standard units (SU). Specific conductance measurements in the Area A wells ranged from 0.191 to 0.388 millisiemens per centimeter (mS/cm).

Measurements conducted for wells located at Area B (54MW4, 54MW6, and 54MW7) also showed aerobic conditions for groundwater. Levels of dissolved oxygen in wells ranged from 1.78 to 8.09 mg/L. ORP measurements in the wells ranged from 1 to 126 mV. Levels of pH were slightly higher than at Area A but still in the neutral range of 6.93 to 7.60 SU. Specific conductance measurements in the Area B wells ranged from 0.156 to 0.379 mS/cm.

2.7.4 Groundwater and Surface Water Interaction

Groundwater and surface water interaction was investigated at the site by conducting long-term monitoring of water levels in selected monitoring wells and at a station in the New River. The

groundwater/surface water interface was also investigated at the site by collecting samples of sediment pore water and surface water along the shoreline of the river.

2.7.4.1 Water Level Monitoring

Data logging transducers (In-Situ miniTroll) were installed in monitoring wells 54MW2, 54MW3, 54MW9, and 54MW10 and at a location within the New River east of 54MW9 to investigate the interaction of groundwater and surface water of the New River at the site. Groundwater levels and surface water levels within the river were recorded at half hour increments from March 2005 to March 2006. Recorded data are graphed on Figure 2-13 to show the relative changes in water levels over time.

Review of Figure 2-13 shows a strong positive correlation with river levels and water levels in well 54MW10 located closest to the New River. Both the river level and water level in 54MW10 exhibited almost continuous synchronized, short-term cyclical fluctuations with an average peak to peak amplitude of approximately 2 ft. Four significant spikes in river and water levels in well 54MW10 were observed during the monitoring period. These spikes correlated with peak river flows of 10,000 to 20,000 cfs as shown in the following table. Peak flows of the New River during these periods were approximately 2.5 to 6 times higher than the average river flow of 3,841 cfs measured from 1940 through 2006 (USGS 2007).

High Flow Water Level Changes

		Maximum Change in Water Level (ft)				
Date(s)	**Peak River Flow (cfs)**	**River Station**	**54MW2**	**54MW3**	**54MW9**	**54MW10**
03/28/2005 to 3/31/2005	22,400	7.6	2.1	2.3	2.4	6.8
10/08/2005	11,400	6.3	Down	0.8	1.1	5.6
11/30/2005 to 12/1/2005	15,300	7.8	Down	1.4	1.6	6.7
1/19/2006	9,850	5.2	0.7	1.4	1.3	4.7

As indicated in the above table, water level changes in the river ranged from 5.2 to 7.8 ft while corresponding changes at 54MW10 were slightly lower ranging from 4.7 to 6.8 ft. Short-term spikes in water levels were also observed in wells 54MW2, 54MW3, and 54MW9 during the high river flow events, with the magnitude of change decreasing away with distance from the river. Spikes in these wells slightly lagged the observed peaks of 54MW10 and the New River due to their increased distance from the river. Several other lower magnitude spikes (0.1 to 0.3 ft) in water levels were observed at 54MW2, 54MW3, and 54MW9 on Figure 2-13; these spikes were also slightly lagging short-term peaks in 54MW10 and in river levels.

Comparison of the graph on Figure 2-13 with daily mean discharge data for the New River for the same period shown on Figure 2-4 shows that longer-term water level trends in monitored wells have a similar cyclical pattern to that of mean river discharges. The highest levels are observed in April and the lowest levels are observed in October.

Local groundwater flow patterns adjacent to the New River are influenced by changes in river stage and discharge. Under low flow or normal base flow conditions, the New River will gain some water from inflow of groundwater. Figure 2-9, shows the groundwater flow pattern at the site when the New River is at lower discharge level of 1,000 to 1,500 cfs (more typical of base flow) and apparent flow is eastward toward the New River. In this case, the groundwater level at well 54MW8 is lower than at wells 54MW2 and 54MW3 located 120 to 150 ft west of 54MW8 at the disposal unit.

When the river is at discharge levels closer to the annual average discharge level of 3,841 cfs, local groundwater-flow patterns will be altered near the river when compared to low-flow conditions. For example, Figures 2-10, 2-11, and 2-12 show groundwater-flow patterns at the site when river discharge levels are at 2,600 to 3,860 ft cfs. For these three measurement events, groundwater levels at well 54MW8 are higher than at wells 54MW2 and 54MW3; thereby altering the apparent flow patterns to be locally away from the river toward the disposal area and/or causing the groundwater flow path across Area A to curve more toward the southeast as it approaches the New River. Under higher than average discharge levels, inflow of surface water from the New River into the aquifer will be even more pronounced, as illustrated by the water logging data that showed short term spikes in water levels with peak discharges.

It is apparent from the groundwater data and surface data collected for the RFI that the groundwater zone located adjacent to the New River monitored by wells 54MW8 and 54MW10 is a dynamic zone subjected to inflow and extensive mixing of surface water from the river. The degree of groundwater and surface water mixing and inflow into the aquifer has likely been increased by the more consistent river discharges maintained by the upstream dam than if the river flowed unaltered at its natural base flow.

2.7.4.2 Groundwater Discharge Rate

Estimates of groundwater discharge rate (Q) to the New River can be calculated as the product of the groundwater flow rate for the site (V_s), the average thickness of the alluvial/weathered bedrock aquifer (b), and the width of the interface between groundwater and the New River at the site (w).

The following values were used to calculate the estimated groundwater discharge rate (Q):

V_x =	0.71 ft/day	Average value calculated for Area A (0.52 ft/day) and Area B (0.91 ft/day) as presented in Section 2.7.2.
b =	20 ft	Estimated thickness of alluvial/weathered bedrock aquifer
w =	850 ft	Width of interface at New River for site area

The groundwater discharge rate (Q) calculated using the above values was 12,070 ft^3/day (cfd) or 0.14 cfs, which is approximately three orders of magnitude less than flow in the New River under lower flow conditions (1,000 to 1,500 cfs). These data indicate that the New River has the capacity to dilute discharge of groundwater potentially containing chemicals of potential concern (COPC) concentrations by several orders of magnitude.

2.7.4.3 Groundwater/Surface Water Interface Investigation

The groundwater/surface water interface was investigated at the site by installing 10 temporary push point piezometers along the shoreline of the New River adjacent to the site (Figure 2-14). Surface water samples were also collected at the piezometer stations. Piezometers were installed into sediment to obtain water quality measurements and samples for chemical analysis. A more detailed discussion of the field sampling program completed in November 2006 is provided in Section 3.1.4 and investigation methods are discussed in Section 3.3.7. Field water quality measurements obtained during the investigation are summarized in Tables 2-6 and 2-7. Table 2-6 presents water quality data for the groundwater sampling event that was conducted concurrent with the river sampling. Table 2-7 presents water quality data for the surface water/sediment pore water sampling.

The water quality data in Table 2-6 generally indicate aerobic conditions for groundwater at the site. Dissolved oxygen levels ranged from 8.13 to 11.95 mg/L, while ORP measurements were positive (32 to 231 mV), with the exception of well 54MW3, which was -92 mV. Specific conductance levels ranged from 297 micro Siemens per centimeter (µS/cm) at 54MW6 to 1130 µS/cm at 54MW4. Levels of pH were generally in the neutral range of 7.15 to 8.00 SU.

The water quality data in Table 2-7 indicate that sediment pore water and surface water differ with respect to water quality parameters. As expected, the levels of dissolved oxygen in sediment pore water (9.25 to 12.20 mg/L) are lower than for surface water (12.93 to 17.05 mg/L). ORP measurements for surface water are positive (10 to 219 mV), while the ORP measurements for sediment pore water are generally negative (-194 to 20 mV). Levels of pH were in the neutral range for sediment pore water (7.20 to 7.57 mg/L) and lower than surface water (7.62 to 8.9 SU). Specific conductance levels were higher in sediment pore water (248 to 660 μS/cm) than in surface water (113 to 174 μS/cm).

Comparison of the conductivity data from monitoring wells 54MW8 and 54MW9 with the closest associated sediment pore-water data in Table 2-7 indicated that conductivity levels in the wells were approximately 1.6 to 2.6 times higher than in sediment pore water. For well 54MW10, the conductivity levels were closer to levels in sediment pore water (1.1 to 1.4 times higher) at the closest stations NR-PW-7 and NR-PW-8.

2.8 PREVIOUS INVESTIGATIONS

This section and Table 2-8 provide an overview of previous investigations conducted at the site between 1992 and 1999, which are discussed in more detail in MWP Addendum 013. Three site investigations were conducted at the site prior to completion of an interim removal measures in 1999 by Parallax, Inc. Investigation data obtained from previous site investigations conducted prior to the interim measure were used to identify disposal area boundaries and characteristics, and identify COPCs, as presented in MWP Addendum 013. Data gaps identified in MWP Addendum 013 and subsequent follow-up work plans included:

- Incomplete chemical data to characterize the nature and extent of impacted soil at Area A both before and after completion of the interim removal measures;
- A lack of definitive data to characterize the nature and extent of impacted soil at Area B both before and after completion of the interim removal measures;
- Limited data or lack of data for Target Compound List (TCL) semi-volatile organic compounds (SVOCs including polynuclear aromatic hydrocarbons (PAHs)), TCL polychlorinated biphenyls (PCBs), TCL pesticides, TCL dioxin/furans, and target analyte list (TAL) metals for soil and groundwater;
- The lack of an upgradient groundwater monitoring well and second downgradient groundwater monitoring well at Area B; and
- Characterization of the nature and extent of impacts to groundwater at Area A and potential impacts to the New River located adjacent to the site for explosives and perchlorate.

Given the disturbance of both sites and identified data gaps, historical soil data are not considered definitive for use in the current RFI (nature and extent assessment and risk assessment). Additional groundwater data collected for the current RFI are used as the definitive data set for the nature and extent, fate and transport, and risk assessments.

2.8.1 Installation Assessment (Air Photo Interpretation) – 1992

The Environmental Photographic Interpretation Center (EPIC), under the direction of USEPA, performed an assessment of multiple SWMUs at RFAAP using selected aerial photographs from 1937 to 1986. The objective was to "concentrate upon tracking 42 known SWMUs located in the [RFAAP], and to identify other features which may represent potential groundwater or surface water contamination sources" (USEPA 1992).

Activity within the SWMU 54 area was first noted on a 1971 aerial photograph as shown on Figure 2-15. The 1971 photograph was interpreted by EPIC to show "a pit, disturbed ground, and probable liquid" as

present in SWMU 54. Based on the current review of the 1971 photograph, the area described by USEPA (1992) is Area B, located in the northern portion of SWMU 54.

A 1975 photograph of the site was interpreted by EPIC to indicate the presence of a "probable excavation" (USEPA 1992). The Installation Assessment does not include the 1975 photograph, but provides an interpretation of the 1975 photograph with the 1981 photograph. Based on the current review of the data, the area described by USEPA (1992) is Area A, located in the southern portion of SWMU 54. As shown on Figure 2-15, a 1981 photograph shows Area B as re-vegetating, and a 1986 photograph shows both areas re-vegetated.

2.8.2 RCRA Verification Investigation – Dames & Moore 1992

A RCRA VI was conducted at Area A in 1992 by Dames & Moore (Dames & Moore 1992). An electromagnetic (EM) and magnetic geophysical survey was conducted as part of the VI to identify the propellant ash disposal at Area A. EM and magnetic readings were measured at intervals of 15 ft along north-south transects made at a spacing of 15 ft. Figure 2-16 shows the approximate 135 ft by 300 ft geophysical survey area and interpreted results. During the site reconnaissance, two "mounds" of soil and ash (2 to 4 ft high) and two "pits" (3 to 5 ft deep) were identified within Area A as shown on Figure 2-16. EM and magnetic anomalies were identified in the southern portion of Area A surrounding the soil and ash mound as shown on Figure 2-16.

Three groundwater monitoring wells, 54MW1, 54MW2, and 54MW3 were installed for the VI at the locations shown on Figure 2-5. 54MW1 was installed as an upgradient well and wells 54MW2 and 54MW3 were installed in the area of the disposal unit at Area A. Groundwater samples were collected from these wells in February 2002 for analysis of TCL volatile organic compounds (VOCs), TCL SVOCs, explosives, TAL metals, total organic carbon (TOC), and total organic halogens (TOX). Explosives were identified as a potential concern at the site based on detections of 2,4,6-trinitrotoluene (2,4,6-TNT) in sample 54MW2 (2.81 micrograms per liter (µg/L) and Cyclo-1,3,5,7-tetramethylene (HMX) in sample 54MW3 (3.07 µg/L).

2.8.3 RCRA Facility Investigation – Parsons 1996

As a follow-up to the 1992 VI, Parsons Engineering Science, Inc. (Parsons) completed an RFI at SWMU 54 in 1996 as part of a multiple site investigation. The objective of this RFI was to "define the extent of ash and the limits of soil contamination" (Parsons 1996). The RFI addressed the Area A disposal unit and included the collection of groundwater samples from existing wells 54MW1, 54MW2, and 54MW3, completion of 16 soil borings, and the collection of 30 soil samples. Groundwater samples were analyzed for explosives, TAL metals, TOC, and TOX. Soil samples were analyzed for explosives and TAL metals.

Explosives were identified as a potential concern in groundwater due to detections of HMX in samples 54MW2 and 54MW3. 2,4,6-TNT was not detected in sample 54MW2; however, the detection limit was elevated at a level of 17.5 µg/L or approximately 27 times higher than the VI detection limit. Lead and explosives were the primary COPCs identified in soil within the southern portion of Area A. Both lead and explosives were detected at concentrations above their industrial risk-based screening criteria. 2,4,6-TNT and dinitrotoluene (DNT) compounds were the primary explosives of concern in soil.

Parsons collected two samples of ash from Area A including one sample from the northern mound and one sample from the southern mound for analysis of waste characteristics. Each sample was submitted for analysis of TCLP metals, corrosivity, reactivity, ignitability, and paint filter liquids. The text of the Parsons RFI Report indicated that the TCLP lead concentration in the sample collected from the southern mound of Area A exceeded the regulatory limit of 5 mg/L. No additional data were available regarding the test results for these samples.

2.8.4 Supplemental RCRA Facility Investigation and Corrective Measures Study – MSE 1998

In 1998, a Supplemental RFI Report was prepared by MSE (MSE 1998b). During analysis of aerial photographs of SWMU 54 by the USEPA, and coincident with field observations, a flat grassy area ringed by mature pine trees was identified northwest of Area A. This area was defined as Area B within SWMU 54. The purpose of the supplemental RFI was "to characterize the nature and extent of contamination within SWMU 54 and to summarize potential risks to human health."

A geophysical investigation, which consisted of a ground-penetrating radar (GPR) survey, was completed by MSE as part of the RFI to identify potential disposal areas at Area B. Figure 2-17 shows the location of potential disturbed areas identified by the GPR survey.

Twelve soil borings were completed in the identified potential disturbed areas including five hand auger borings and six borings completed with a hollow-stem auger drill rig. Eleven soil samples (one from each hand auger boring and one each from 5 of 6 soil borings) were collected for chemical analysis of TCL VOCs, TCL SVOCs, explosives, TAL metals, TOC, and TOX. Selected samples were also analyzed for pH. Specific sample depths were not identified in the report. One composite soil sample from the six hand auger borings was analyzed for full TCLP parameters, ignitability, and reactivity (cyanide and sulfide). Site-related TCLP detections were limited to barium (1.08 mg/L) and lead (0.541 mg/L) at levels below regulatory criteria. Reactive sulfide was detected at a concentration of 7.88 milligrams per kilogram (mg/kg).

Lead and 2,4,6-TNT were the primary chemicals of potential concern identified in soil at Area B based on detections above industrial risk-screening criteria. These constituents were not detected in the groundwater sample collected from well 54MW4 and other chemical classes sampled for at 54MW4 were not identified as a potential concern in groundwater. The results of the RFI indicated waste burial depths of up to 7 ft bgs.

MSE prepared a Draft CMS Report for SWMU 54 and based on the findings of their RFI and previous investigation results (MSE 1998). The CMS recommended final corrective measures alternative that consisted of excavation of lead and explosives "hot spots" in soil with offsite treatment disposal in a hazardous waste landfill followed by phytoremediation of remaining "residues in soil."

2.8.5 SWMU 54 Interim Measures – Parallax, Inc. 1999

In 1999, Parallax, Inc. completed interim measures at Area A and Area B of SWMU 54 consisting of the excavation of selected "hot spot" areas of lead and explosives in soil. Three grid cells were excavated from Area A (Figure 2-18) and ten grid cells were excavated from Area B (Figure 2-19). Approximately 1,827 tons of soil were excavated and disposed offsite at the Pinewood South Carolina Landfill.

Hot spot areas were identified by establishing a systematic grid within each area and conducting field screening of soil samples using D-Tech immunoassay test kits (D-Tech kits) for explosives and portable x-ray fluorescence (XRF) for metals. Approximately 1,600 samples were screened in the field from 231 grid cells. Site screening in Area A extended to depths of 15.0 to 22.0 ft bgs and site screening in Area B extended to depths of 7.0 to 12.0 ft bgs. In some cases, Parallax considered lateral and vertical characterization to be complete in an area and a series of grid cells were skipped. Aliquots of each discrete sample from various elevations within each grid were then composited into a single sample that was submitted for laboratory analysis. Laboratory analysis on each of over 200 composite samples included VOCs, explosives, TAL Metals, and TCLP Metals.

Parallax also collected groundwater samples from existing monitoring wells 54MW1, 54MW2, 54MW3, and 54MW4. Samples were analyzed for VOCs, SVOCs, explosives, perchlorate, pesticides, and TAL metals. Consistent with previous sample results, explosives were identified as a potential concern for groundwater at Area A due to detections of 2,4,6-TNT and 2-Amino-4,6-dinitrotoluene (2ADNT) in well 54MW3. Explosives were not detected in the sample collected from well 54MW4.

Based on the results of the interim measures, additional investigation of both Area A and Area B was planned to confirm the effectiveness of the interim measure, as well as, evaluate and assess current conditions at the sites and provide recommendations regarding potential corrective measure requirements at the sites.

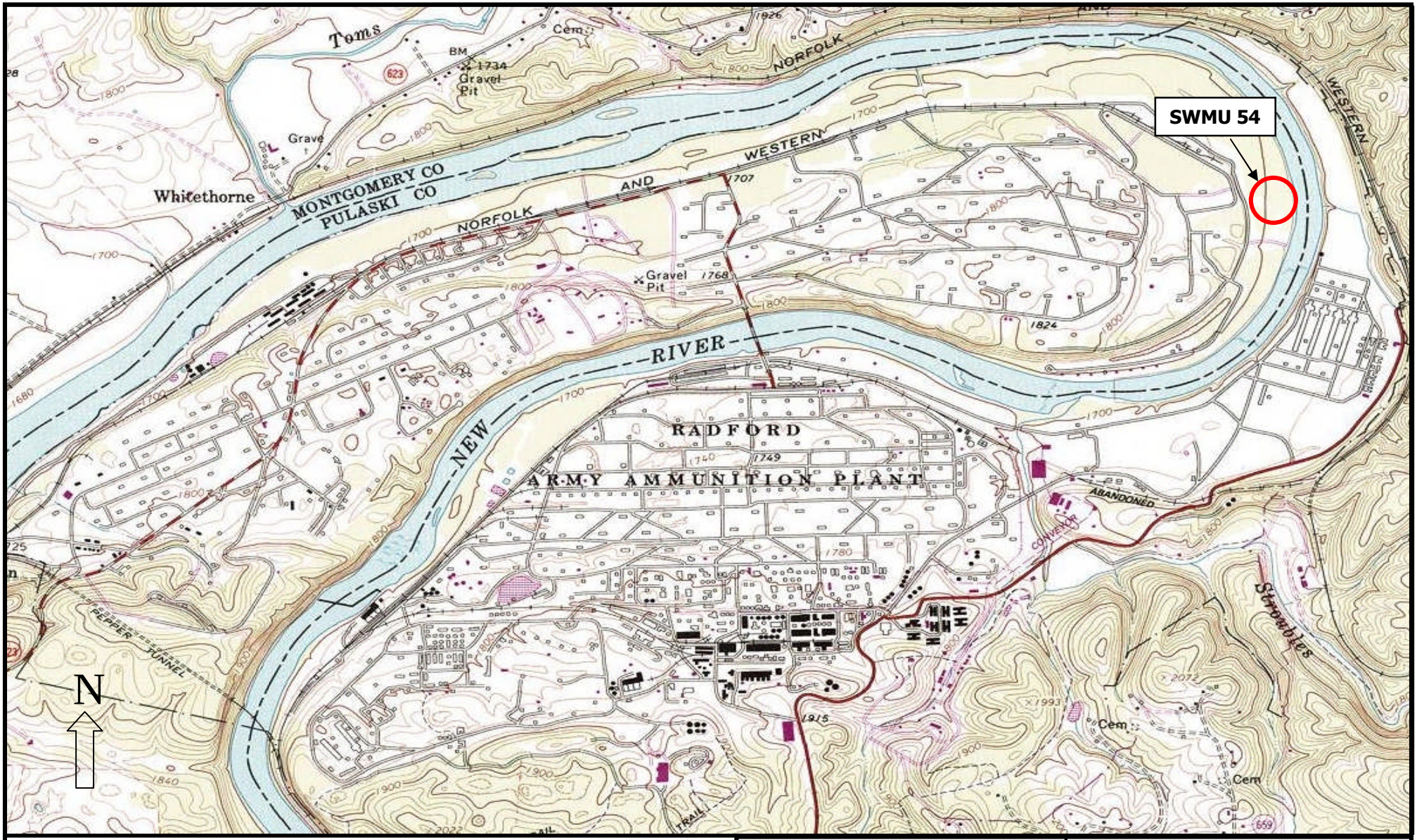
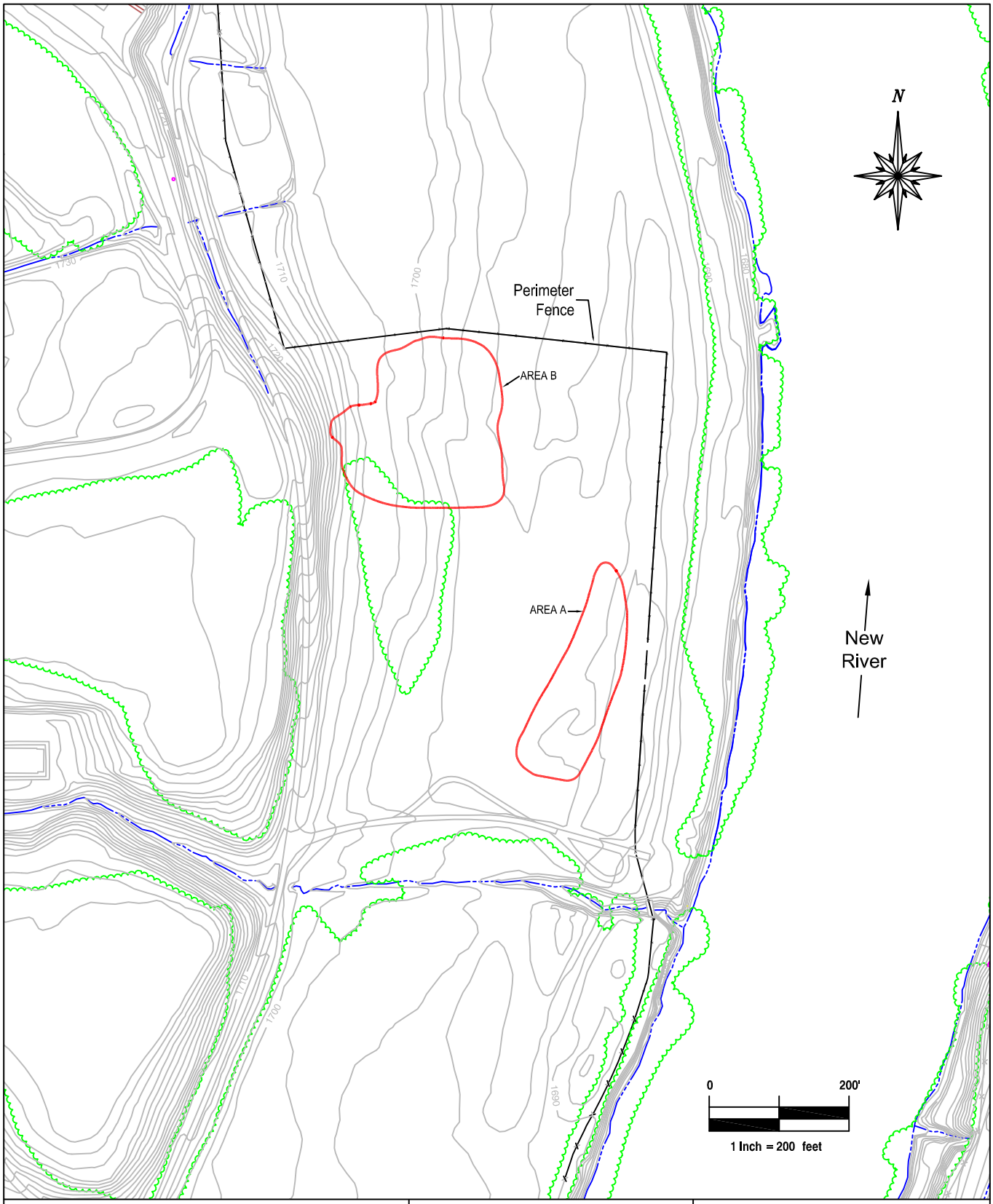


FIGURE 2-1	
SITE LOCATION MAP	
Date: *January 2006*	**Prepared by:** *CLD*
Scale: *1" = 2000'*	**Job Number:** *21354893*

SWMU 54
RCRA Facility Investigation
Radford Army Ammunition Plant
Radford, Virginia

URS
URS Group, Inc.
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Suite 201
Richmond, VA 23230



Legend

- Approximate SWMU Boundary
- Topographic Contour
- Vegetation

FIGURE 2-2

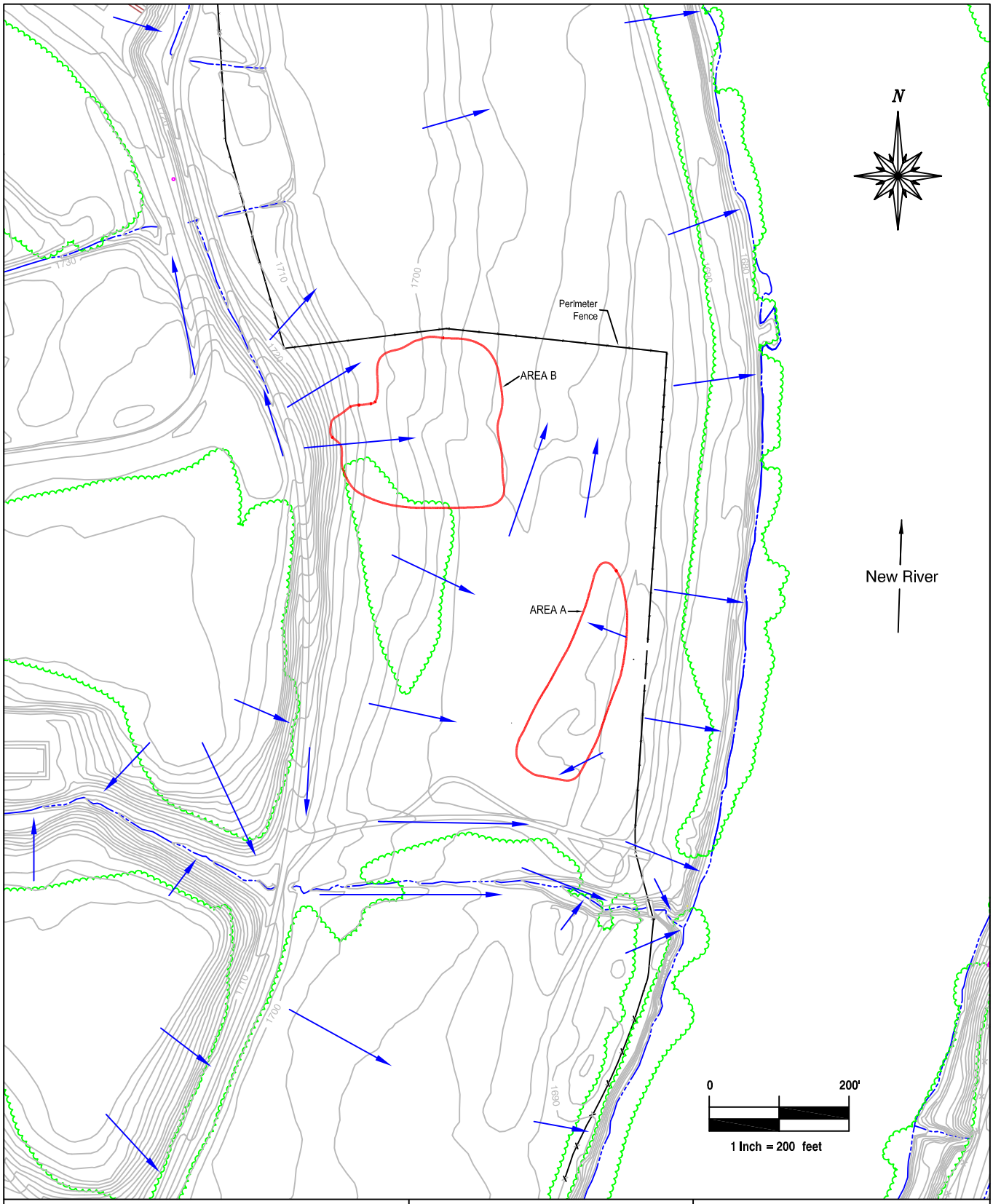
Site Layout

Date: September 2005	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 200 feet	File Name: Fig.2-2 SiteLayout

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Legend

- Approximate SWMU Boundary
- Topographic Contour
- Vegetation
- Surface Water Flow Direction

FIGURE 2-3
Surface Water Drainage

Date: September 2005	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 200 feet	File Name: Fig.2-3 SWDrainage

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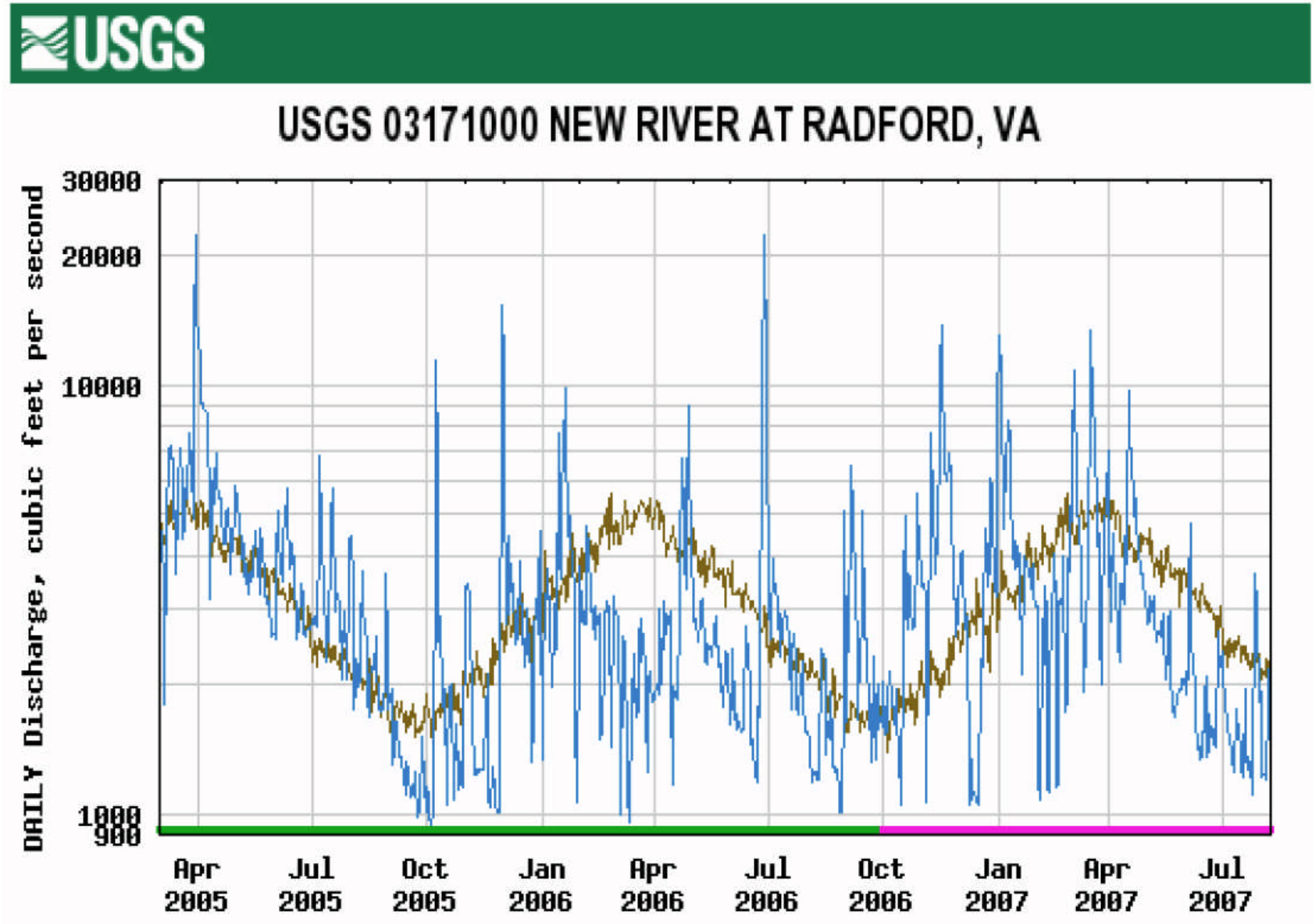
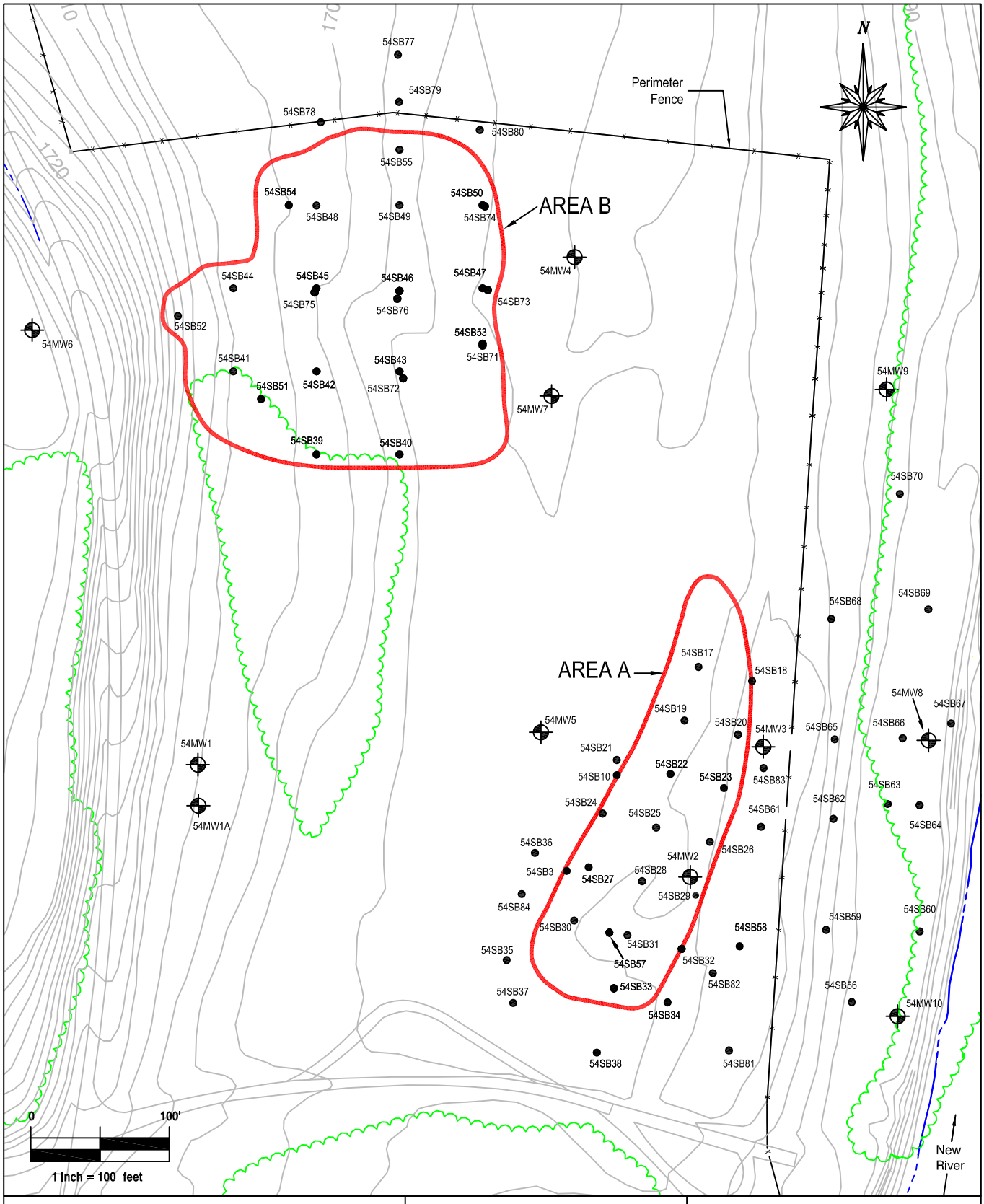


FIGURE 2-4
New River Daily Discharge Chart

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Radford, Virginia

Date: August 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: *N.T.S.*	File Name: Fig.2-4 RiverDis.

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Legend

- SWMU Boundary
- Monitoring Well Location
- Soil Boring Location

FIGURE 2-5

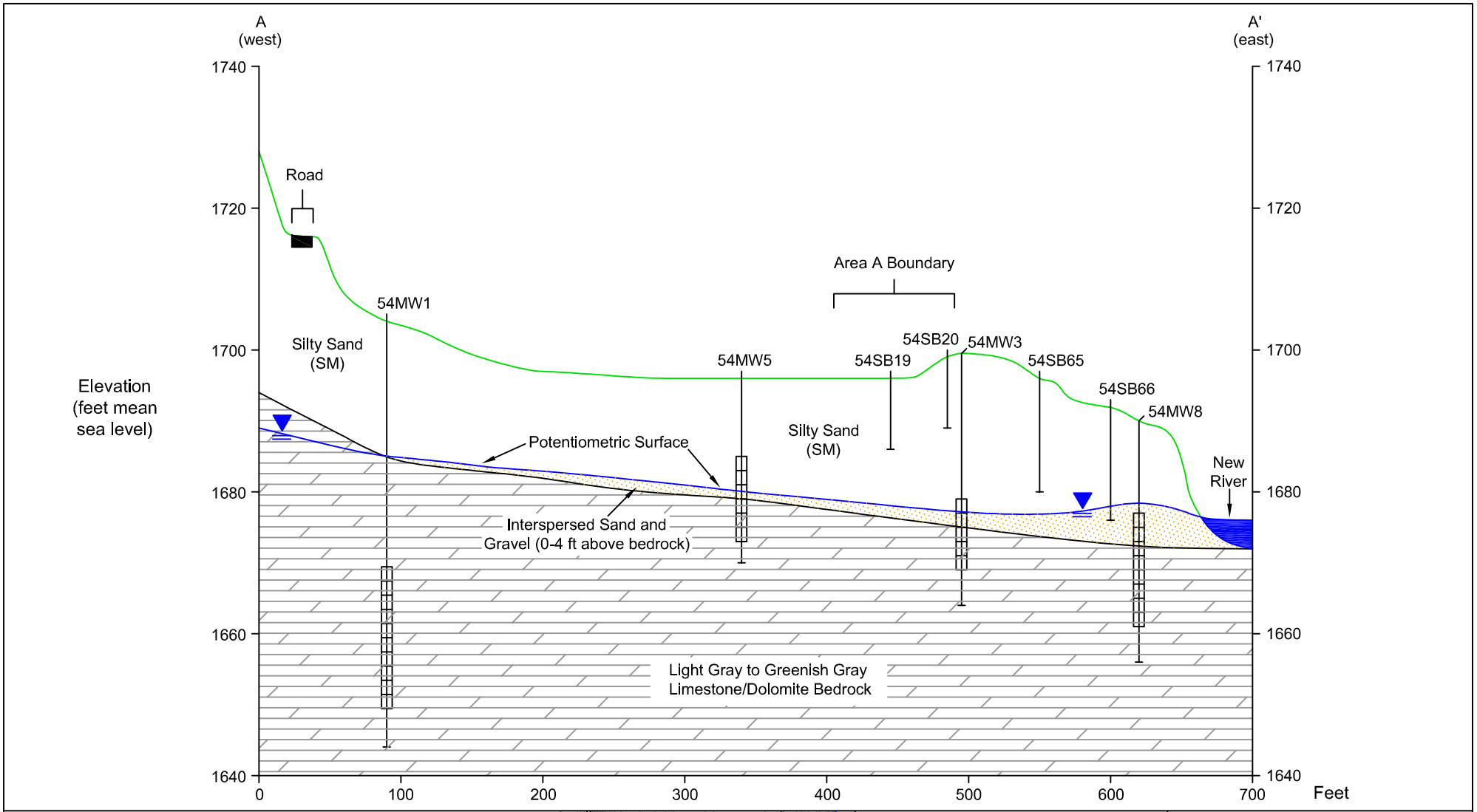
RFI Soil Boring and Monitoring Well Locations

Date: July 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 100 feet	File Name: Fig.2-5 RFILocs

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1" = 20'

1" = 100'

Vertical
Exaggeration = 5

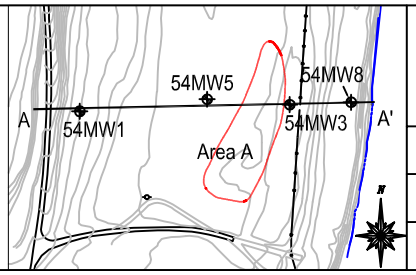
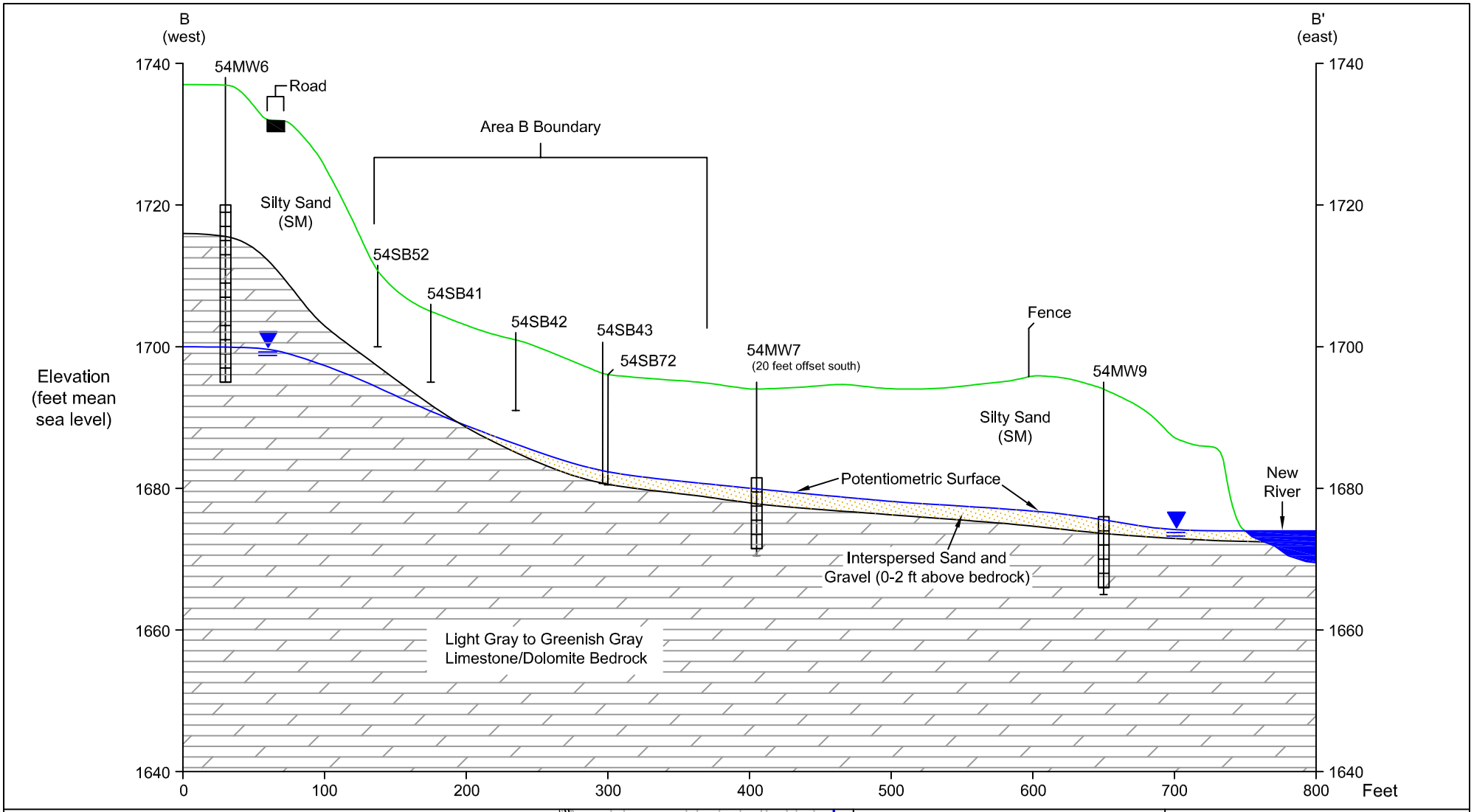


Figure 2-6
Geologic Cross Section
A-A'

Date: July 2007	Job Number: 21355035
Prepared By: DBC	Reviewed By: JOS
Scale: As Shown	File Name: Fig.2-6 A-A'CrssSec

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1" = 20'

1" = 100'

Vertical
Exaggeration = 5

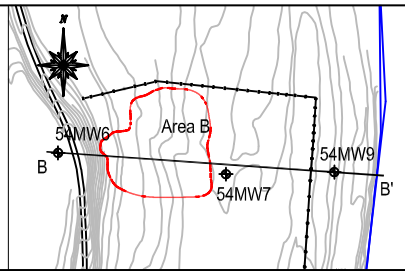


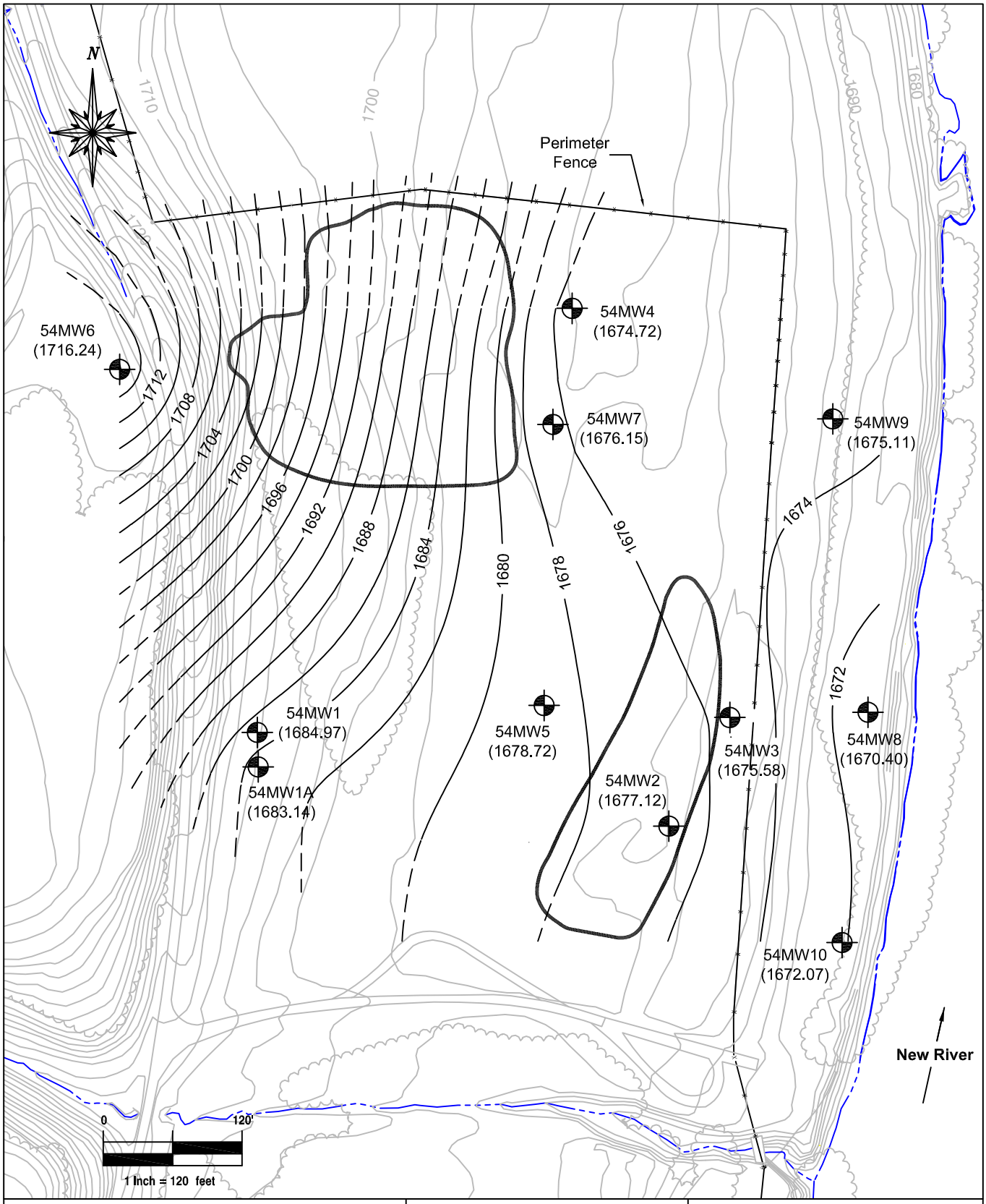
Figure 2-7
Geologic Cross Section
B-B'

Date: July 2007	Job Number: 21355035
Prepared By: DBC	Reviewed By: JOS
Scale: As Shown	File Name: Fig.2-7 B-B'CrssSec

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Legend

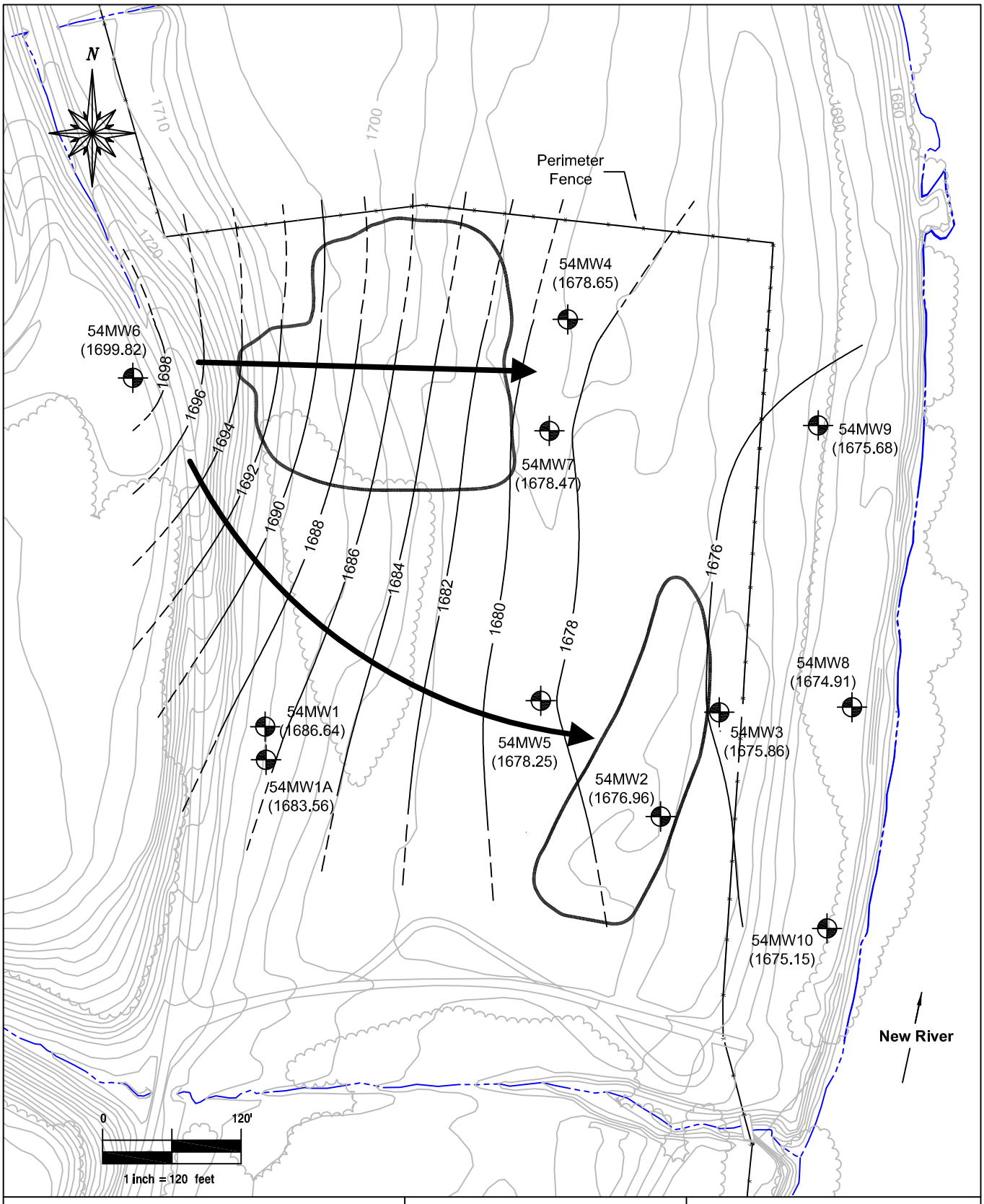
- Approximate SWMU Boundaries
- Monitoring Well Location
- Top of Bedrock Contour
- Inferred Top of Bedrock Contour
- (1699.92) Top of Bedrock Elevation

FIGURE 2-8
Top of Bedrock

Date: July 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 120 feet	File Name: Fig.2-8 TopofBed

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Legend

- Approximate SWMU Boundaries
- Monitoring Well Location
- Potentiometric Contour
- Inferred Potentiometric Contour
- (1699.82) Groundwater Elevation
- Groundwater Flow Direction

FIGURE 2-9

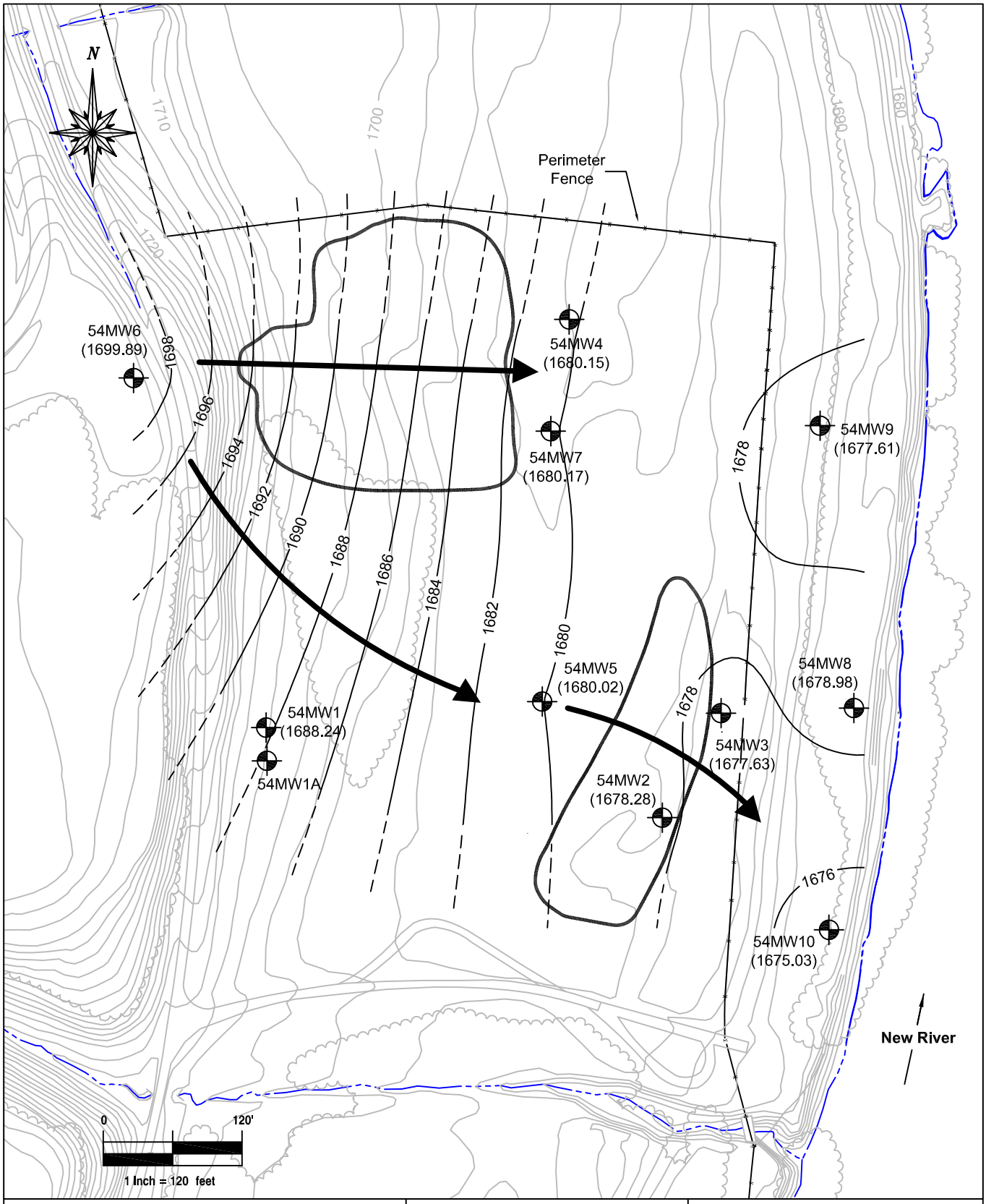
Groundwater Potentiometric Map - September 28, 2005

Date: July 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 120 feet	File Name: Fig.2-9 PotMap 9/05

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Legend

- Approximate SWMU Boundaries
- Monitoring Well Location
- Potentiometric Contour
- Inferred Potentiometric Contour
- (1699.89) Groundwater Elevation
- Groundwater Flow Direction

FIGURE 2-10

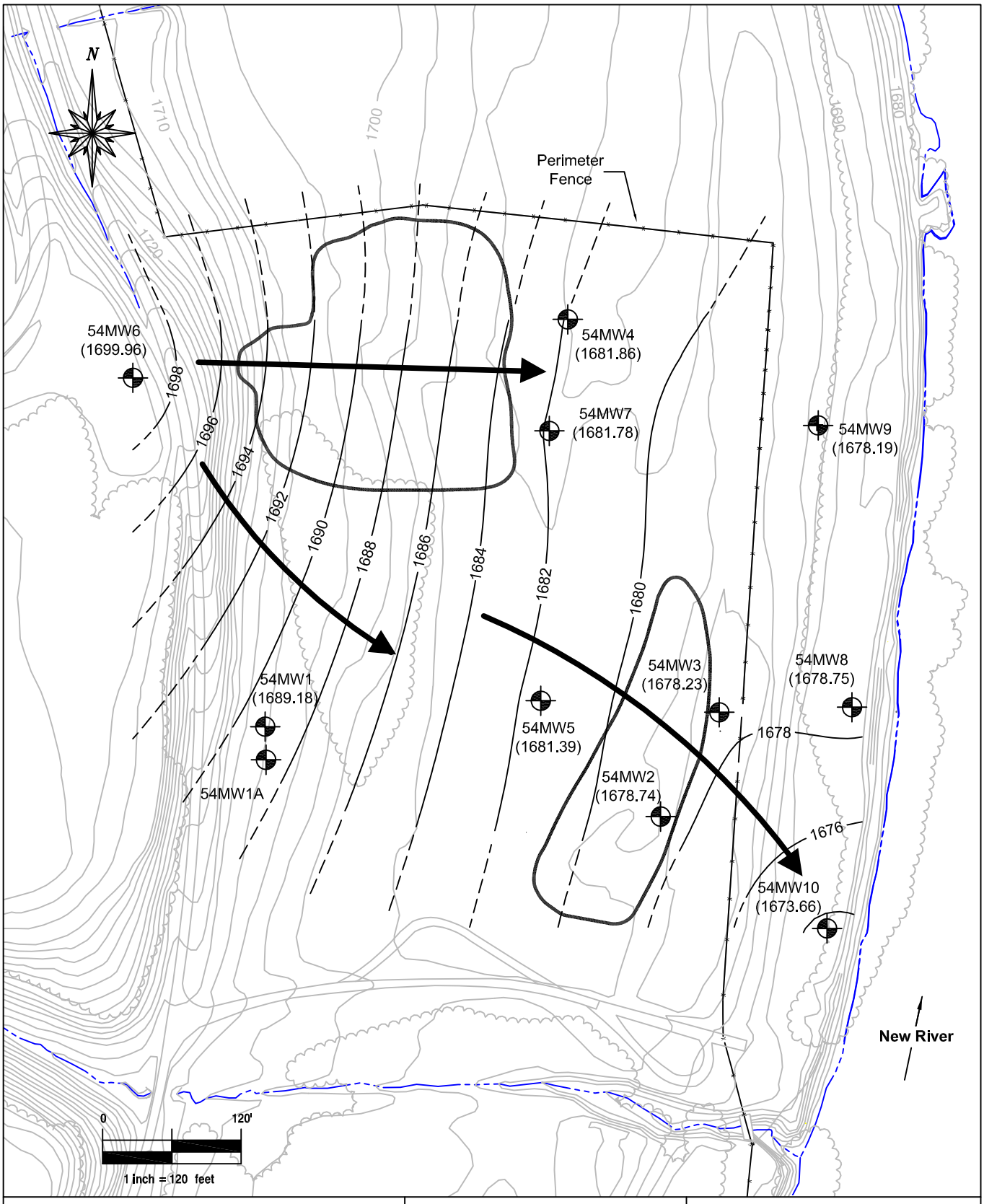
Groundwater Potentiometric Map - November 29, 2006

Date: July 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 120 feet	File Name: Fig.2-10 PotMap 11/06

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Legend

- Approximate SWMU Boundaries
- Monitoring Well Location
- Potentiometric Contour
- Inferred Potentiometric Contour
- (1699.96) Groundwater Elevation
- Groundwater Flow Direction

FIGURE 2-11

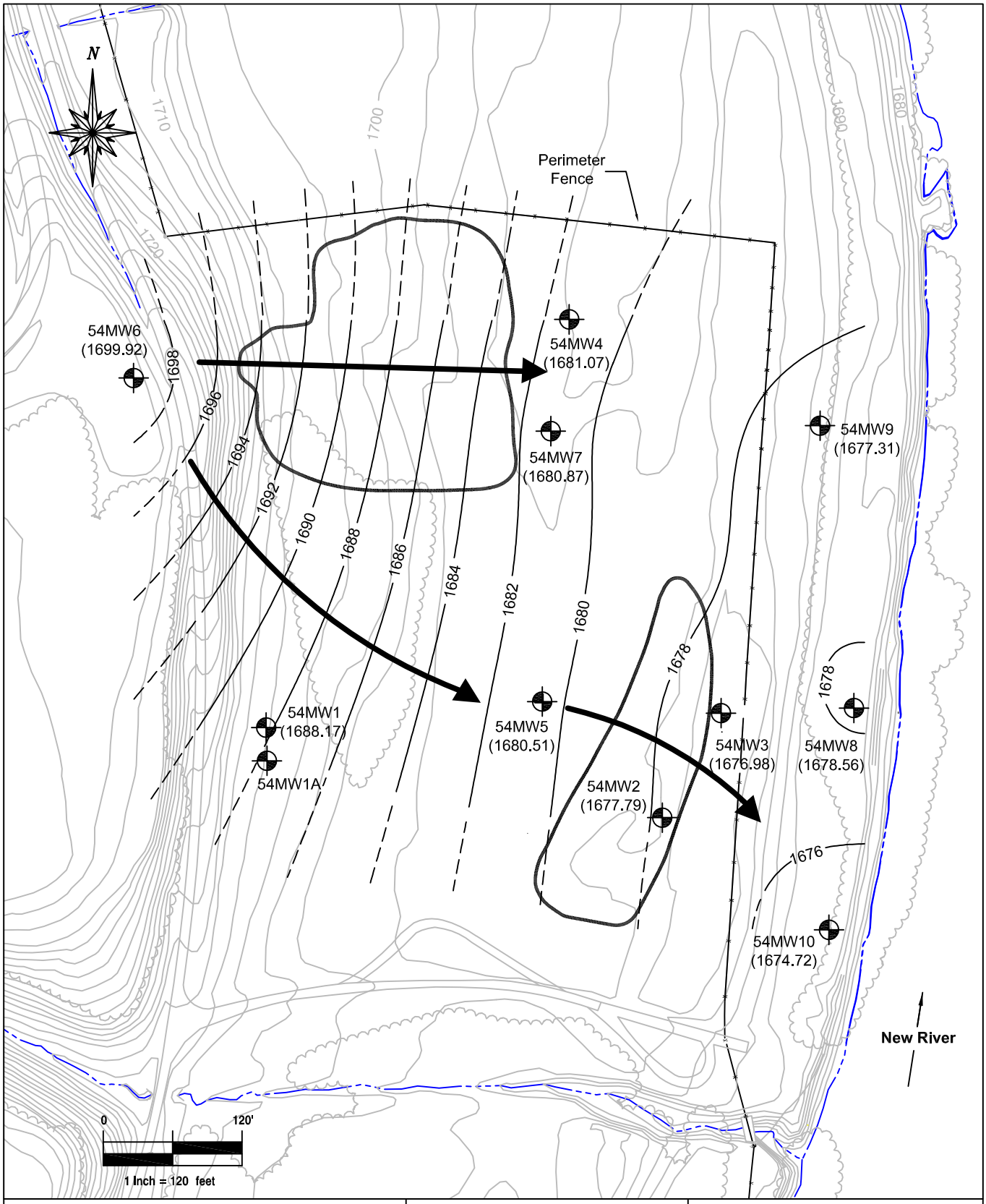
Groundwater Potentiometric Map - March 27, 2007

Date: July 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 120 feet	File Name: Fig.2-11 PotMap 3/07

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Legend

- Approximate SWMU Boundaries
- Monitoring Well Location
- Potentiometric Contour
- Inferred Potentiometric Contour
- (1699.92) Groundwater Elevation
- Groundwater Flow Direction

FIGURE 2-12

Groundwater Potentiometric Map - June 5, 2007

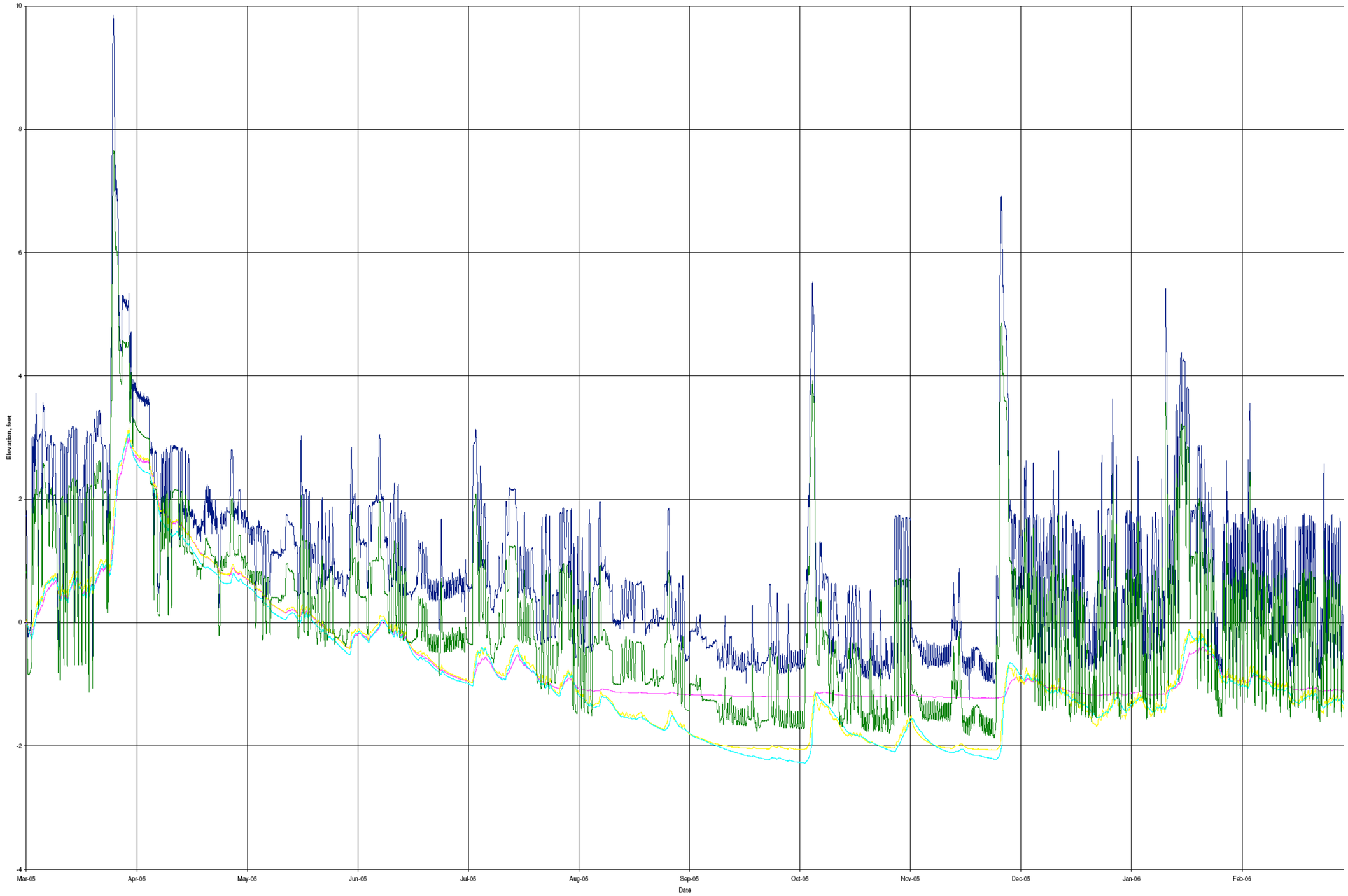
Date: July 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 120 feet	File Name: Fig.2-12 PotMap 6/07

SWMU 54

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SWMU 54 Well and River Probes



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River
54MW10
54MW2
54MW9
54MW3

Revisions:

Groundwater and New River Water Level Data
March 2005 - March 2006

Figure:

2-13

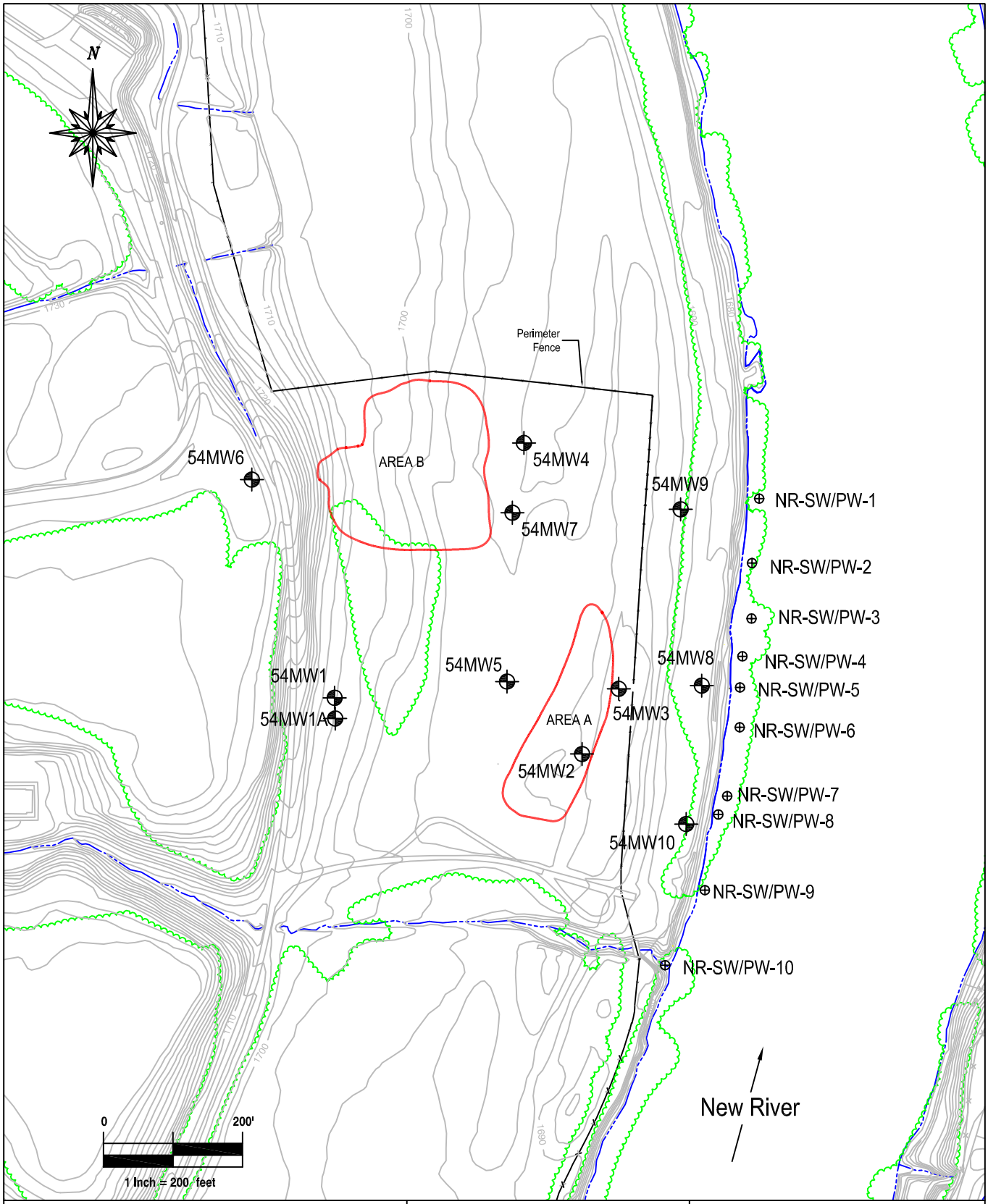
Date: August 2007

Project #: 21354893

Drawn/Approved by: DBC/CLD

Approved by: JOS

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Legend

- Approximate SWMU Boundaries
- Monitoring Well Location
- Surface Water / Pore Water Sample Location

FIGURE 2-14

Push Point Piezometer and Surface Water Station Locations

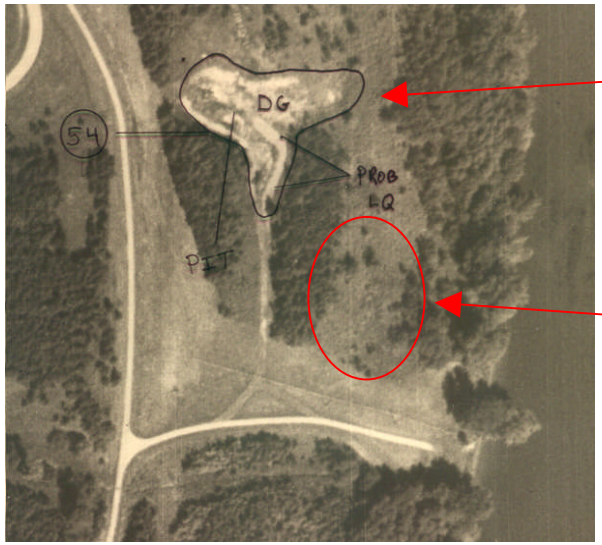
Date: June 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 200 feet	File Name: Fig.2-14 PushPnt Locs

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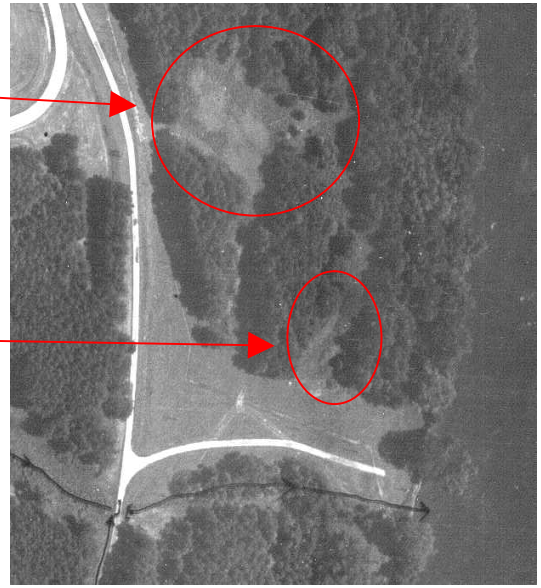
1971



AREA B

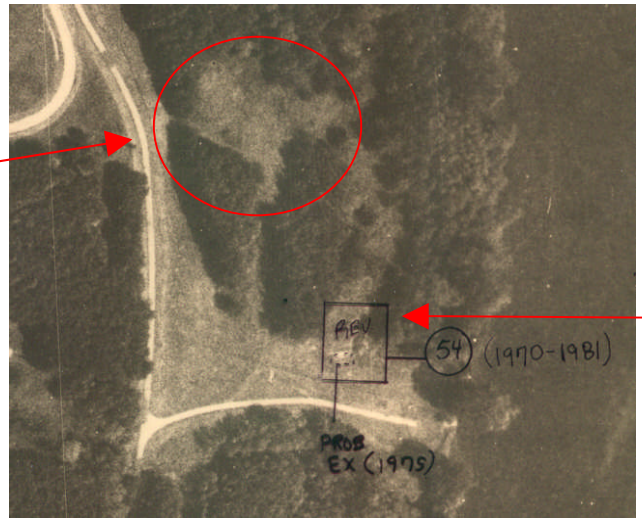
AREA A

1986



1981

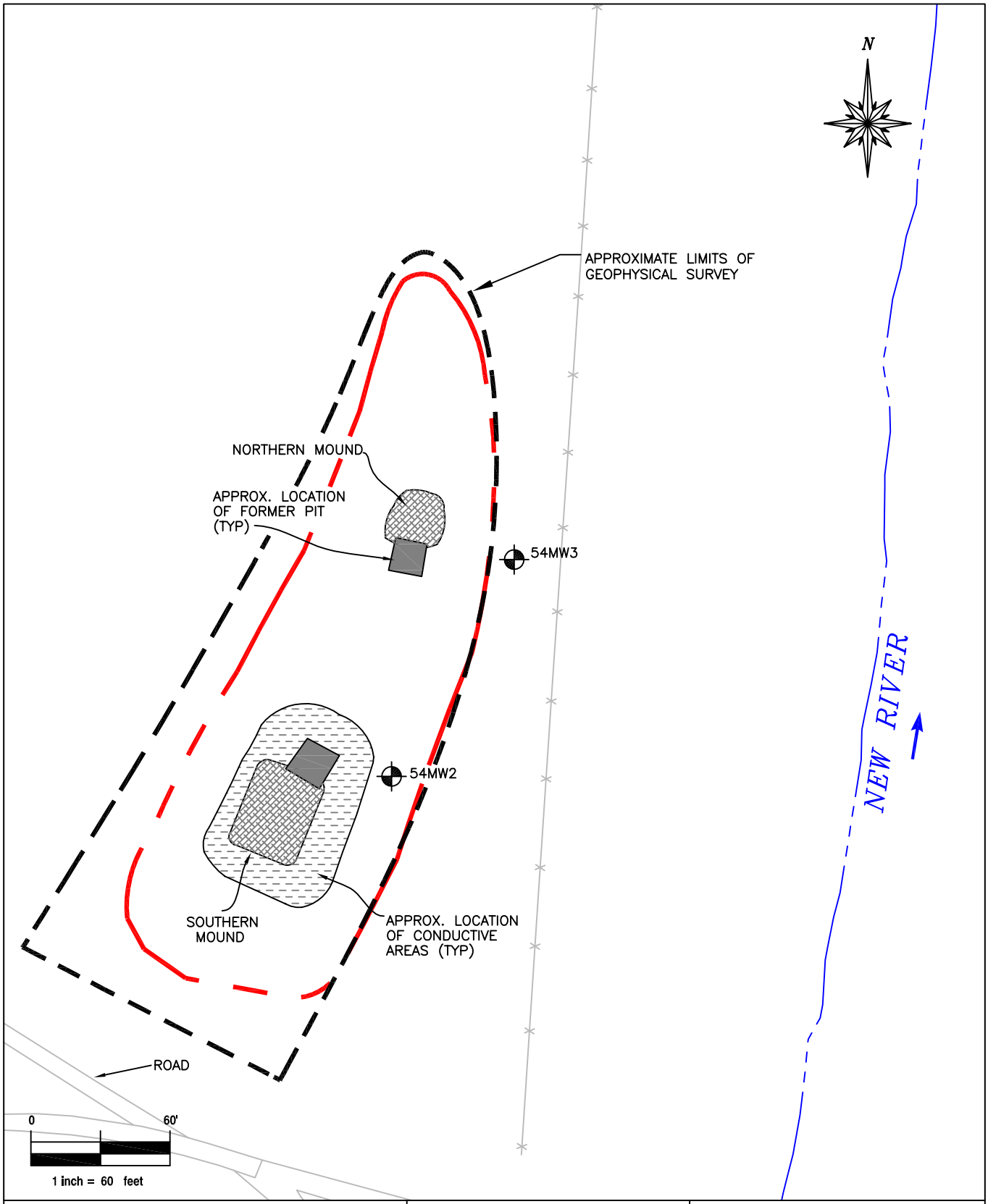
AREA B



AREA A

Aerial Photographs from Installation Assessment, (1992), showing interpretation of SWMU areas.

FIGURE 2-15		SWMU 54 RCRA Facility Investigation Radford Army Ammunition Plant Radford, Virginia
AERIAL PHOTOGRAPHS		
Date: *August 2007*	**Prepared by:** *CLD*	
Scale: *1" = 2000'*	**Job Number:** *21355035*	URS Group, Inc. 5540 Falmouth Street, Suite 201 Richmond, VA 23230



Legend

- SWMU Boundary
- Monitoring Well Location
- Approximate Location of Former Pit
- Approximate Location of Former Soil Mound
- Approximate Location of Conductive Areas (D & M, 1992)

FIGURE 2-16

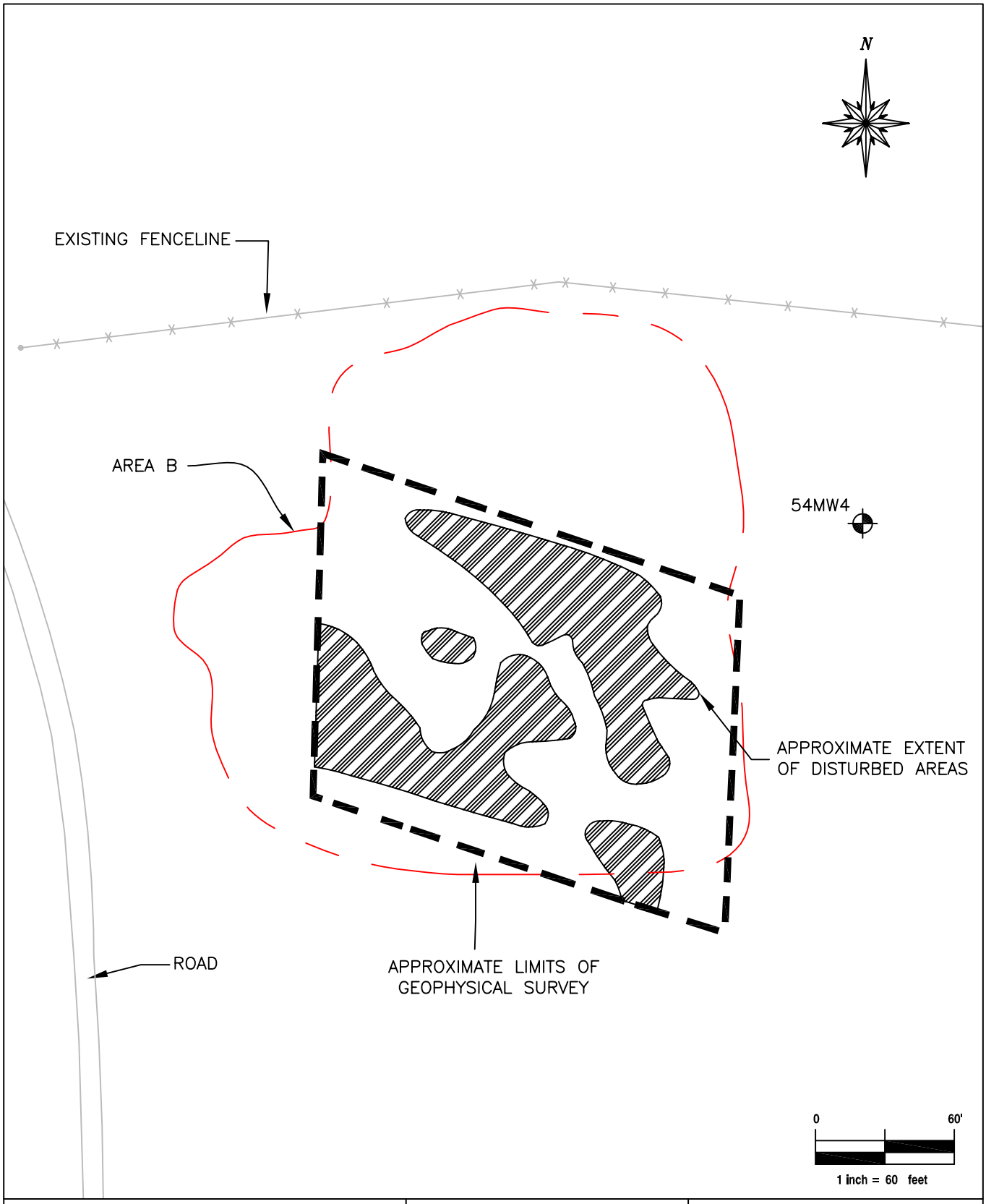
Geophysical Interpretation of Area A, Dames & Moore, 1992

Date: August 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 60 feet	File Name: Fig.2-16 1992 'A' Geo

SWMU 54

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Richmond, Virginia 23230



Legend

- SWMU Boundary
- Monitoring Well Location

FIGURE 2-17

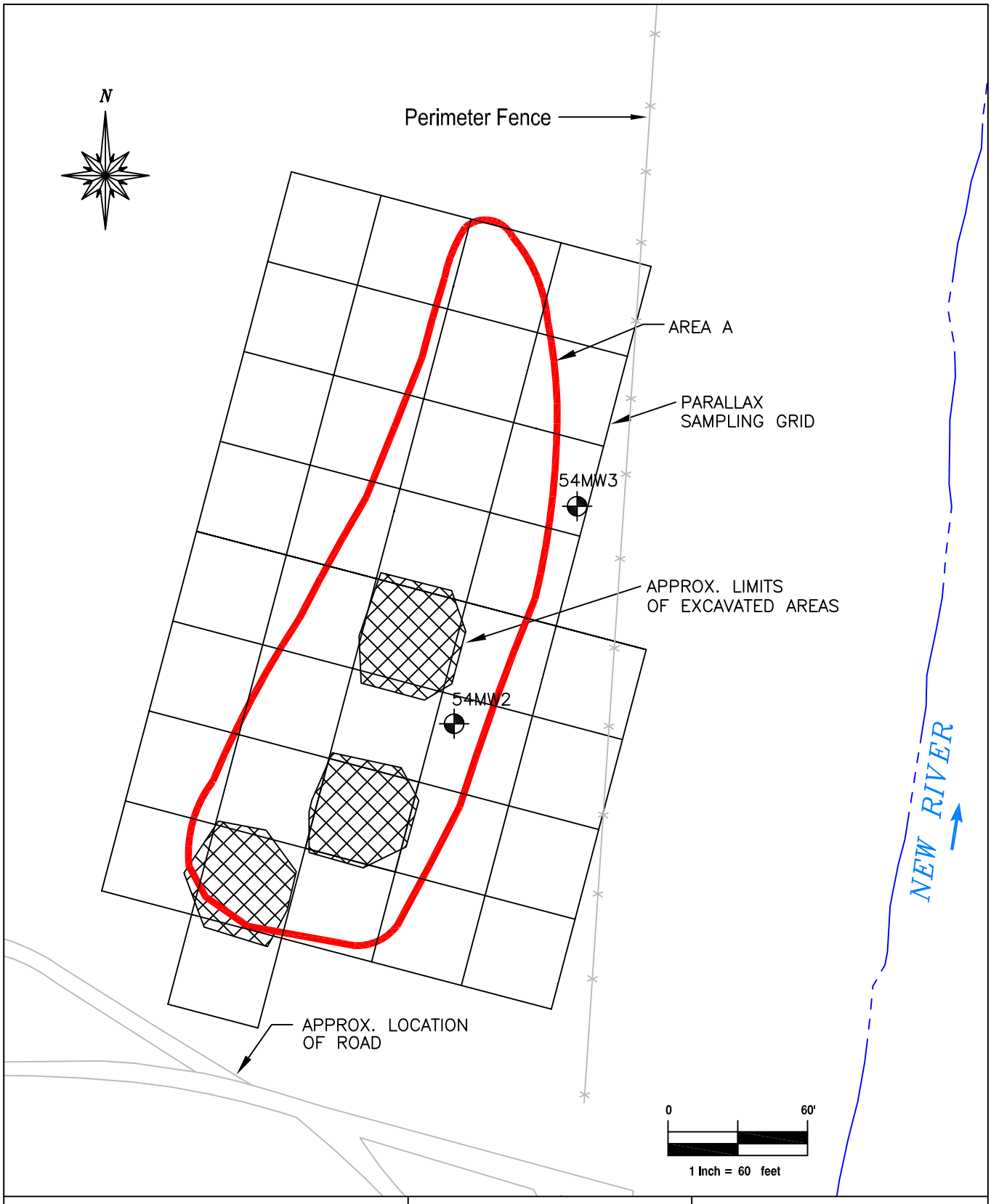
Geophysical Interpretation of Area B, MSE, 1998

Date: August 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 60 feet	File Name: Fig.2-17 1998 'B' Geo

SWMU 54

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Legend

- 54MW99 — EXISTING GROUNDWATER MONITORING WELL
- APPROX. LIMITS OF SWMU
- APPROX. WESTERN BOUNDARY OF NEW RIVER
- APPROX. LIMITS OF EXCAVATED AREAS
- EXISTING FENCELINE

FIGURE 2-18

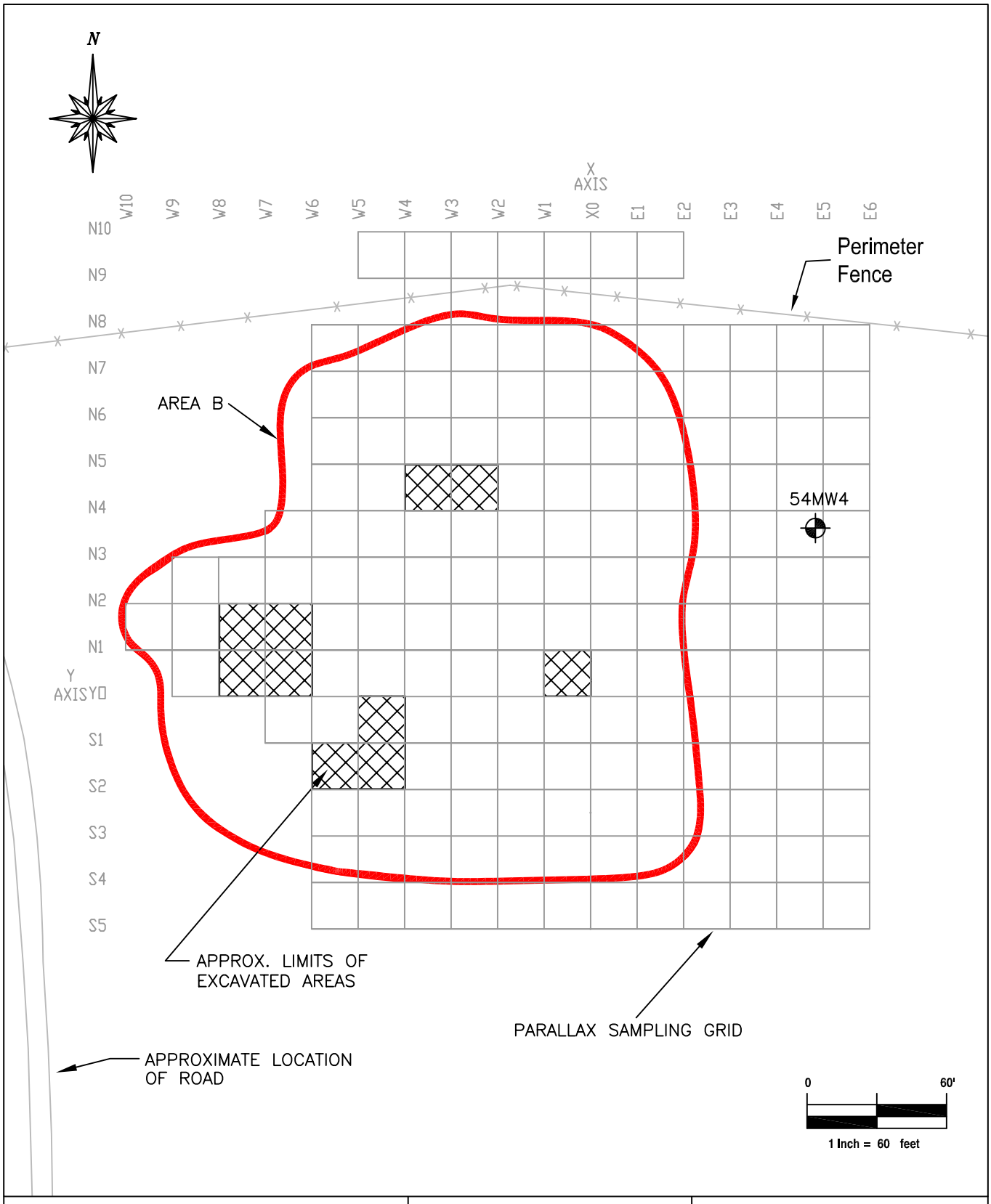
Excavated Cells for Interim Measure Area A

Date: September 2005	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 60 feet	File Name: Fig.2-18 Exc.CellsA

SWMU 54

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Legend

- 54MW99 — EXISTING GROUNDWATER MONITORING WELL
- APPROX. LIMITS OF SWMU
- APPROX. LIMITS OF EXCAVATED AREAS
- EXISTING FENCELINE

FIGURE 2-19

Excavated Cells for Interim Measure Area B

Date: September 2005	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 60 feet	File Name: Fig.2-19 Exc.CellsB

SWMU 54

RCRA Facility Investigation
Radford Army Ammunition Plant
Radford, Virginia

URS Group, Inc.
5540 Falmouth Street
Suite 201
Richmond, Virginia 23230

Table 2-1
Laboratory Physical Testing Data Summary
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

SAMPLE AREA	SAMPLE NAME	SAMPLE COMPOSITION	DEPTH (ft)	D2216	D4318			USCS SYMB. (1)	D422			D4972		D2974	D854	D2937 (2)		D5084	CALCULATED SOIL POROSITIES			REMARKS
									GRAIN SIZE			pH										
				WATER CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTIC INDEX (PI)		(%) GRAVEL	% SAND	% FINES	Distilled Water	0.01 M CaCl Solution	ORGANIC CONTENT (burnoff) (%)	SOIL PARTICLE DENSITY (-)	SOIL BULK DENSITY (pcf)	DRY DENSITY (pcf)	HYDRAULIC CONDUCTIVITY (cm/sec)	TOTAL (-)	AIR FILLED (-)	WATER FILLED (-)	
Verification Investigation, Dames & Moore, 1992																						
Area A	54MW1	--	5-7	19.6	30	23	7	SC-SM	0.8	54.3	44.9	--	--	--	--	--	--	--	--	--	--	
	54MW2	--	5-7	18.4	22	21	1	SM	0	71.8	28.2	--	--	--	--	--	--	--	--	--	--	
	54MW3	--	15-17	22.6	--	--	--	SM	0	66	34	--	--	--	--	--	--	--	--	--	--	
Parsons, 1996																						
Area A	54SB1	--	15-17	--	NP	NP	NP	SM	0	68	32	--	--	--	--	--	--	--	--	--	--	
	54SB2	--	10-12	--	NP	NP	NP	ML	0	47	53	--	--	--	--	--	--	--	--	--	--	
	54SB3	--	10-12	--	NP	NP	NP	SM	0	68	32	--	--	--	--	--	--	--	--	--	--	
	54SB4	--	5-7	--	26	21	5	CL-ML	0	40	60	--	--	--	--	--	--	--	--	--	--	
	54SB5	--	15-17	--	NP	NP	NP	SM	0	52	48	--	--	--	--	--	--	--	--	--	--	
	54SB6	--	15-20	--	NP	NP	NP	SM	0	52	48	--	--	--	--	--	--	--	--	--	--	
	54SB7	--	10-12	--	NP	NP	NP	SM	0	82	18	--	--	--	--	--	--	--	--	--	--	
	54SB8	--	15-17	--	NP	NP	NP	SM	0	59	41	--	--	--	--	--	--	--	--	--	--	
	54SB9	--	10-12	--	24.1	21.2	2.9	ML	0	46	54	--	--	--	--	--	--	--	--	--	--	
	54SB10	--	10-12	--	NP	NP	NP	SM	0	63	37	--	--	--	--	--	--	--	--	--	--	
	54SB11	--	15-17	--	NP	NP	NP	SM	0	63	37	--	--	--	--	--	--	--	--	--	--	
	54SB12	--	5-7	--	23.2	18	5.2	CL-ML	0	42	58	--	--	--	--	--	--	--	--	--	--	
	54SB13	--	5-7	--	NP	NP	NP	SM	0	48	52	--	--	--	--	--	--	--	--	--	--	
	54SB14	--	7-9	--	NP	NP	NP	SM	0	75	25	--	--	--	--	--	--	--	--	--	--	
	54SB16	--	10-12	--	NP	NP	NP	SM	0	71	29	--	--	--	--	--	--	--	--	--	--	
RCRA Facility Investigation, 2005																						
Area A	54A-SM	54SB32	7-7.5	21.2	21	19	2	SM	0.4	55.9	43.7	7.3	7.0	1.7	2.706	119.2*	98.3*	3.5E-07	0.42*	0.06*	0.36*	
		54SB32	8-8.5																			
Area B	54 B-CL	54SB52	1.5-2	25.8	26	17	9	SC	--	41.9	22.0	6.2	5.9	3.5	2.708	124.0	98.6	1.7E-06	0.42	0.01	0.41	
		54SB53	3.5-4																			
	54 B-GM	54SB43	13.5-14	11.5	NP	NP	NP	SP-SM	39.2	51.4	9.4	8.1	7.1	1.5	2.713	119.9*	107.6*	3.6E-03	0.36*	0.12*	0.24	
		54SB49	15.5-16																			
	54 B-ML	54SB39	3	18.8	26	18	8	SC	--	50.1	49.9	5.6	5	1.5	2.722	125.3	105.5	3.7E-06	0.38	0.04	0.34	
		54SB51	3.5-4																			
	54 B-SM	54SB32	7-7.5	23.7	26	23	3	SM	2.2	56.9	40.9	7.5	7.4	3.4	2.712	115.9*	93.7*	3.0E-05	0.45*	0.06*	0.39*	
		54SB32	8-8.5																			
	54 B-SP 1	54SB51	11.5-12	17.6	NP	NP	NP	SM	--	74.0	26.0	7.8	*(3)	1.4	2.746	106.5*	90.5*	8.6E-04	0.47*	0.14*	0.33*	
		54SB51	13.5-14																			
		54SB51	19.5-20																			
	54 B-SP 2	54SB49	7-7.5	13.3	NP	NP	NP	SM	--	80.7	19.3	*(3)	*(3)	1.5	2.735	106.3*	93.8*	1.4E-03	0.45*	0.18*	0.27*	
		54SB49	9-10																			

Notes:

(1) = USCS symbol based on grain size results and Atterberg Limits reported
- SM = Silty sand
- SC = Clayey sand
- SP = Poorly-sorted sand

(2) = Density determined in general accordance with method D2937
(3) = Not Enough Sample to Perform Testing
* Density and porosity after lab specimen compaction

Atterberg Limits:
- LL: Liquid Limit
- PL: Plasticity Limit
- PI: Plasticity Index (PI = LL - PL)
- NP: Nonplastic

Grain Size Distribution:
- Gravel: Particles of rock that are retained on a 4.75 millimeter (No. 4) sieve
- Sand: Particles that will pass a 4.75 millimeter sieve, but are retained on a 0.075 millimeter (No. 200) sieve
- Fines: Includes silt and sand. Particles that will pass a 0.075 millimeter (No. 200) sieve

Table 2-2
Boring Data Summary Table
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

	Depth Below Ground Surface			Elevation - Mean Sea Level					Coordinates	
Boring	Top of Bedrock (bgs)	Borehole Termination (bgs)	DTW During Drilling (bgs)	Ground Surface (msl)	Top of Well Casing (msl)	Top of Bedrock (msl)	Borehole Termination (msl)	Groundwater During Drilling (msl)	Northing	Easting
Area A										
54SB3	--	16.0	14.5	--	--	--	--	--	3602114.26	10895619.24
54SB10	--	16.0	14.4	--	--	--	--	--	3602183.40	10895655.46
54SB17	--	10.0	--	1696.35	--	--	1686.35	--	3602262.25	10895715.18
54SB18	--	10.0	--	1698.98	--	--	1688.98	--	3602252.05	10895753.85
54SB19	--	10.0	--	1696.15	--	--	1686.15	--	3602223.57	10895704.98
54SB20	--	10.0	--	1698.88	--	--	1688.88	--	3602213.38	10895743.66
54SB21	--	10.0	--	1696.04	--	--	1686.04	--	3602195.09	10895656.12
54SB22	--	10.0	--	1696.98	--	--	1686.98	--	3602184.90	10895694.79
54SB23	--	10.0	--	1699.31	--	--	1689.31	--	3602174.71	10895733.46
54SB24	--	10.0	--	1696.17	--	--	1686.17	--	3602156.42	10895645.92
54SB25	--	10.0	--	1696.66	--	--	1686.66	--	3602146.22	10895684.60
54SB26	--	10.0	--	1698.88	--	--	1688.88	--	3602136.03	10895723.27
54SB27	--	10.0	--	1696.56	--	--	1686.56	--	3602117.74	10895635.73
54SB28	--	10.0	--	1697.68	--	--	1687.68	--	3602107.55	10895674.40
54SB29	--	10.0	--	1698.88	--	--	1688.88	--	3062565.62	10897129.49
54SB30	--	10.0	--	1696.76	--	--	1686.76	--	3602079.17	10895625.34
54SB31	--	10.0	--	1697.87	--	--	1687.87	--	3602068.88	10895664.21
54SB32	--	10.0	--	1699.07	--	--	1689.07	--	3602058.68	10895702.89
54SB33	--	10.0	--	1696.44	--	--	1686.44	--	3602030.20	10895654.02
54SB34	--	10.0	--	1698.03	--	--	1688.03	--	3602020.01	10895692.69
54SB35	--	10.0	--	1696.63	--	--	1686.63	--	3602050.59	10895576.67
54SB36	--	10.0	--	1696.31	--	--	1686.31	--	3602127.94	10895597.06
54SB37	--	10.0	--	1696.09	--	--	1686.09	--	3602019.71	10895581.27
54SB38	--	10.0	--	1696.31	--	--	1686.31	--	3601983.79	10895641.79
54SB56	17.8	17.8	13.9	1685.05	--	1667.25	1667.25	1671.15	3602022.42	10895828.59
54SB57	23.0	23.0	--	1697.03	--	1674.03	1674.03	--	3602072.61	10895653.59
54SB58	26.6	26.6	24.0	1700.43	--	1673.83	1673.83	1676.43	3602062.75	10895747.59
54SB59	20.6	20.6	14.7	1688.97	--	1668.37	1668.37	1674.27	3602074.60	10895810.03
54SB60	19.0	19.0	13.5	1693.89	--	1674.89	1674.89	1680.39	3602073.47	10895877.59
54SB61	25.6	25.6	--	1702.06	--	1676.46	1676.46	--	3602149.04	10895763.02
54SB62	18.0	18.0	17.0	1700.91	--	1682.91	1682.91	1683.91	3602154.77	10895815.33
54SB63	13.0	13.0	12.2	1692.13	--	1679.13	1679.13	1679.93	3602165.50	10895854.51
54SB64	16.5	16.5	13.6	1694.40	--	1677.90	1677.90	1680.80	3602164.58	10895877.48
54SB65	18.0	18.0	--	1701.31	--	1683.31	1683.31	--	3602212.06	10895816.21
54SB66	15.6	15.6	12.5	1692.12	--	1676.52	1676.52	1679.62	3602212.95	10895865.34
54SB67	16.0	16.0	13.1	1711.14	--	1695.14	1695.14	1698.04	3602223.63	10895900.26
54SB68	21.0	21.0	20.0	1701.11	--	1680.11	1680.11	1681.11	3602299.07	10895813.73
54SB69	15.2	15.2	14.0	1690.61	--	1675.41	1675.41	1676.61	3602306.03	10895883.85
54SB70	15.4	15.4	14.0	1711.68	--	1696.28	1696.28	1697.68	3602389.35	10895863.26
54SB81	24.0	24.0	20.5	--	--	--	--	--	3601984.68	10895736.45
54SB82	24.0	24.0	20.0	--	--	--	--	--	3602040.49	10895724.76
54SB83	24.0	24.0	22.5	--	--	--	--	--	3602188.53	10895761.41
54SB84	17.6	17.6	16.2	--	--	--	--	--	3602097.59	10895586.79
54MW5	17.0	25.0	15.0	1695.72	1698.11	1678.72	1670.72	1680.72	3602215.01	10895601.44
54MW-8	18.0	34.0	8.0	1688.90	1692.64	1670.90	1654.90	1680.90	3602211.14	10895601.34
54MW-9	19.0	28.5	20.0	1694.11	1696.04	1675.11	1665.61	1674.11	3602464.31	10895849.83
54MW-10	18.5	35.0	12.0	1690.07	1691.10	1671.57	1655.07	1678.07	3602012.49	10895859.27
Area B										
54SB39	--	10.0	--	1700.91	--	--	1690.91	--	3602415.70	10895439.24
54SB40	--	10.0	--	1697.44	--	--	1687.44	--	3602415.70	10895499.23
54SB41	--	10.0	--	1704.70	--	--	1694.70	--	3602475.69	10895379.25
54SB42	--	10.0	--	1700.79	--	--	1690.79	--	3602475.69	10895439.36
54SB43	15.0	15.0	--	1696.54	--	1681.54	1681.54	--	3602475.69	10895499.23
54SB44	20.7	20.7	18.0	1704.00	--	1683.30	1683.30	1686.00	3602535.69	10895379.25
54SB45	--	10.0	--	1700.94	--	--	1690.94	--	3602535.69	10895439.24
54SB46	16.2	16.2	12.0	1698.14	--	1681.94	1681.94	1686.14	3602533.75	10895499.23
54SB47	--	10.0	--	1694.02	--	--	1684.02	--	3602535.69	10895559.22
54SB48	--	10.0	--	1701.60	--	--	1691.60	--	3602595.37	10895439.24
54SB49	16.2	16.2	15.0	1697.67	--	1681.47	1681.47	1682.67	3602595.68	10895499.23
54SB50	--	10.0	--	1694.08	--	--	1684.08	--	3602595.68	10895559.22
54SB51	21.5	21.5	17.0	1702.91	--	1681.41	1681.41	1685.91	3602455.70	10895399.24
54SB52	--	10.0	--	1711.06	--	--	1701.06	--	3602515.69	10895339.25
54SB53	--	10.0	--	1695.28	--	--	1685.28	--	3602495.69	10895559.22
54SB54	--	10.0	--	1701.88	--	--	1691.88	--	3602595.68	10895419.24
54SB55	--	10.0	--	1697.57	--	--	1687.57	--	3602635.67	10895499.23
54SB71	--	16.0	13.0	1695.82	--	--	1679.82	1682.82	3602496.44	10895561.97
54SB72	15.2	15.2	10.8	1696.53	--	1681.33	1681.33	1685.73	3602472.76	10895504.67
54SB73	14.7	14.7	11.0	1694.47	--	1679.77	1679.77	1683.47	3602536.52	10895565.75
54SB74	--	16.0	12.8	1694.41	--	--	1678.41	1681.61	3602597.01	10895563.67
54SB75	--	20.0	14.8	1701.65	--	--	1681.65	1686.85	3602534.78	10895440.71
54SB76	--	16.0	11.5	1697.45	--	--	1681.45	1685.95	3602530.31	10895500.44
54SB77	12.0	12.0	10.8	--	--	--	--	--	3602703.53	10895497.43
54SB78	16.0	16.0	14.6	--	--	--	--	--	3602654.83	10895441.72
54SB79	12.0	12.0	10.6	--	--	--	--	--	3602669.51	10895498.19
54SB80	12.0	12.0	10.5	--	--	--	--	--	3602649.19	10895556.55
54MW4	19.0	45.0	16.0	1693.72	1696.14	1674.72	1648.72	1677.72	3602558.11	10895625.67
54MW6	20.5	42.0	38.0	1736.74	1739.19	1716.24	1694.74	1698.74	3602505.43	10895234.04
54MW7	18.0	23.0	19.0	1694.15	1696.58	1676.15	1671.15	1675.15	3602457.87	10895608.99
VI Borings										
54MW1	19.5	60.0	--	1704.47	1706.39	1684.97	1644.47	--	3602191.70	10895353.65
54MW1A	20.9	52.0	--	1704.04	1704.70	1683.14	1652.04	--	3602162.05	10895354.01
54MW2	20.7	30.0	--	1697.82	1700.01	1677.12	1667.82	--	3602110.65	10895709.15
54MW3	24.0	35.0	--	1699.58	1700.77	1675.58	1664.58	--	3602204.62	10895761.92

Notes:
bgs = Below ground surface
msl = Mean sea level
DTW = Depth to water
VI = Verification Investigation

Table 2-3
Monitoring Well Construction Data
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Well Identification	Date Installed	Screened Zone	Total Well Depth (ft bgs)	Elevation Ground Surface (ft msl)	Elevation TOC (ft msl)	Screened Interval (ft bgs)	Depth to Bedrock (ft bgs)	Bedrock Elevation (ft msl)
54MW1	11/6/1991	Bedrock	60.0	1704.47	1706.39	34.8-54.8	19.5	1684.97
54MW1A	9/17/1991	Bedrock	52.0	1704.04	1704.40	36.0-51.0	20.9	1683.14
54MW2	9/17/1991	Alluvium/Bedrock	30.0	1697.82	1700.01	18.0-28.0	20.7	1677.12
54MW3	9/18/1991	Alluvium/Bedrock	35.0	1699.58	1700.77	20.0-30.0	24.0	1675.58
54MW4	12/3/1997	Bedrock	45.0	1693.72	1696.14	30.0-45.0	19.0	1674.72
54MW5	1/30/2003	Alluvium/Bedrock	25.0	1695.72	1698.11	12.5-22.5	17.0	1678.72
54MW6	1/28/2003	Alluvium/Bedrock	42.0	1736.74	1739.19	16.5-41.5	20.5	1716.24
54MW7	1/29/2003	Alluvium/Bedrock	23.0	1694.15	1696.58	12.5-22.5	18.0	1676.15
54MW8	12/9/2004	Alluvium/Bedrock	34.0	1690.07	1692.64	14.0-29.0	18.0	1672.07
54MW9	12/8/2004	Alluvium/Bedrock	28.5	1694.11	1696.04	17.0-27.0	19.0	1675.11
54MW10	12/13/2004	Alluvium/Bedrock	35.0	1688.90	1691.10	12.0-27.0	18.5	1670.40

Notes:
TOC = Top of Casing
BTOC = Below Top of Casing
DTW = Depth to Water
ft = feet
msl = mean sea level
bgs = below ground surface

Table 2-4
Groundwater Elevation Data
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Well Identification	Elevation TOC (ft msl)	DTW (ft BTOC) 9/28/05	Groundwater Elevation 9/28/05 (ft msl)	DTW (ft BTOC) 11/29/06	Groundwater Elevation 11/29/06 (ft msl)	DTW (ft BTOC) 3/28/07	Groundwater Elevation 3/28/07 (ft msl)	DTW (ft BTOC) 6/5/07	Groundwater Elevation 6/5/07 (ft msl)	DTW (ft BTOC) 9/18/07	Groundwater Elevation (ft msl)
54MW1	1706.39	19.75	1686.64	18.15	1688.24	17.21	1689.18	18.22	1688.17	19.68	1686.71
54MW1A	1704.40	20.84	1683.56	--	--	--	--	--	--	--	--
54MW2	1700.01	23.05	1676.96	21.73	1678.28	21.27	1678.74	23.79	1676.22	22.94	1677.07
54MW3	1700.77	24.91	1675.86	23.14	1677.63	22.54	1678.23	22.22	1678.55	24.84	1675.93
54MW4	1696.14	17.49	1678.65	15.99	1680.15	14.28	1681.86	15.07	1681.07	17.21	1678.93
54MW5	1698.11	19.86	1678.25	18.09	1680.02	16.72	1681.39	17.6	1680.51	19.49	1678.62
54MW6	1739.19	39.37	1699.82	39.30	1699.89	39.23	1699.96	39.27	1699.92	39.33	1699.86
54MW7	1696.58	18.11	1678.47	16.41	1680.17	14.8	1681.78	15.71	1680.87	17.77	1678.81
54MW8	1692.64	17.73	1674.91	13.66	1678.98	13.89	1678.75	14.08	1678.56	15.7	1676.94
54MW9	1696.04	20.36	1675.68	18.43	1677.61	17.85	1678.19	18.73	1677.31	20.32	1675.72
54MW10	1691.10	15.95	1675.15	16.07	1675.03	17.44	1673.66	16.38	1674.72	17.48	1673.62

Notes:
TOC = Top of Casing
BTOC = Below Top of Casing
DTW = Depth to Water
ft = feet
msl = mean sea level
bgs = below ground surface

Table 2-5a
Water Quality Data - 54MW2
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Date m/d/y	Time h/m/s	Temp ºC	Sp Cond mS/cm	DO %	DO mg/L	pH su	ORP mV	Depth toc
3/7/2003	10:54:13	12.80	0.307	65.1	6.89	6.40	220	19.50
3/7/2003	10:53:43	12.81	0.309	64.7	6.84	6.40	220	20.00
3/7/2003	10:53:13	12.83	0.311	64.1	6.77	6.42	218	20.50
3/7/2003	10:52:43	12.85	0.317	62.9	6.64	6.43	218	21.00
3/7/2003	10:52:13	12.88	0.319	60.7	6.41	6.47	216	21.50
3/7/2003	10:51:43	12.91	0.336	56.2	5.93	6.53	215	22.00
3/7/2003	10:51:13	12.96	0.361	49.7	5.24	6.62	213	22.50
3/7/2003	10:50:43	13.07	0.436	38.6	4.05	6.72	211	23.00
3/7/2003	10:50:13	13.14	0.509	31.0	3.25	6.84	209	23.50
3/7/2003	10:49:43	13.20	0.555	22.3	2.34	6.95	207	24.00
3/7/2003	10:49:13	13.26	0.581	18.1	1.89	7.02	206	24.50
3/7/2003	10:48:43	13.30	0.587	16.6	1.73	7.05	205	25.00
3/7/2003	10:48:13	13.32	0.597	15.3	1.60	7.07	205	25.50
3/7/2003	10:47:43	13.33	0.600	14.8	1.55	7.08	205	26.00
3/7/2003	10:47:13	13.33	0.601	14.7	1.54	7.09	204	26.50
3/7/2003	10:46:43	13.32	0.602	14.8	1.54	7.09	205	27.00
3/7/2003	10:46:13	13.30	0.603	14.9	1.56	7.09	204	27.50
3/7/2003	10:45:43	13.32	0.603	14.1	1.48	7.09	205	28.00
3/7/2003	10:45:13	13.29	0.605	14.4	1.51	7.10	205	28.50
3/7/2003	10:44:43	13.26	0.604	16.4	1.72	7.10	205	29.00
3/7/2003	10:44:13	13.27	0.604	19.2	2.00	7.11	205	29.50
3/7/2003	10:43:43	13.26	0.601	24.8	2.59	7.11	205	30.00

Notes:
m/d/y - month/day/year
h/m/s - hours/minutes/seconds
ºC - degrees Celcius
mS/c - milliSiemens per centimeter
% - percent
mg/L - milligrams per Liter
su - standard units
mV - millivolts
toc - top of casing

Table 2-5b
Water Quality Data - 54MW3
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Date m/d/y	Time h/m/s	Temp ºC	Sp Cond mS/cm	DO %	DO mg/L	pH su	ORP mV	Depth toc
3/7/2003	11:19:50	13.04	0.624	54.5	5.73	6.73	119	20.50
3/7/2003	11:19:20	13.05	0.624	54.3	5.71	6.72	115	21.00
3/7/2003	11:18:50	13.06	0.625	54.0	5.67	6.73	110	21.50
3/7/2003	11:18:20	13.07	0.625	53.7	5.64	6.72	105	22.00
3/7/2003	11:17:50	13.08	0.625	53.2	5.59	6.73	98	22.50
3/7/2003	11:17:20	13.09	0.626	52.2	5.48	6.73	92	23.00
3/7/2003	11:16:50	13.11	0.628	51.0	5.35	6.74	84	23.50
3/7/2003	11:16:20	13.12	0.632	48.8	5.12	6.74	75	24.00
3/7/2003	11:15:50	13.13	0.638	45.6	4.78	6.76	65	24.50
3/7/2003	11:15:20	13.15	0.650	39.7	4.17	6.78	53	25.00
3/7/2003	11:14:50	13.18	0.668	33.6	3.52	6.81	40	25.50
3/7/2003	11:14:20	13.21	0.688	24.5	2.56	6.86	25	26.00
3/7/2003	11:13:50	13.24	0.703	18.7	1.95	6.91	14	26.50
3/7/2003	11:13:20	13.24	0.720	12.3	1.29	6.94	6	27.00
3/7/2003	11:12:50	13.25	0.726	9.2	0.96	6.97	-1	27.50
3/7/2003	11:12:20	13.24	0.728	6.9	0.72	7.00	-7	28.00
3/7/2003	11:11:50	13.26	0.732	6.7	0.70	7.00	-9	28.50
3/7/2003	11:11:20	13.27	0.736	5.6	0.59	7.01	-13	29.00
3/7/2003	11:10:50	13.25	0.737	5.1	0.54	7.02	-16	29.50
3/7/2003	11:10:20	13.22	0.739	5.1	0.53	7.02	-19	30.00
3/7/2003	11:09:50	13.17	0.739	5.8	0.61	7.03	-18	30.50
3/7/2003	11:09:20	13.15	0.737	7.9	0.83	7.03	-16	31.00
3/7/2003	11:08:50	13.16	0.737	11.7	1.22	7.04	-10	31.50
3/7/2003	11:08:20	12.95	0.738	20.7	2.18	7.05	-2	32.00
3/7/2003	11:07:50	13.10	0.736	36.1	3.79	7.09	16	32.30

Notes:
m/d/y - month/day/year
h/m/s - hours/minutes/seconds
ºC - degrees Celcius
mS/c - milliSiemens per centimeter
% - percent
mg/L - milligrams per Liter
su - standard units
mV - millivolts
toc - top of casing

Table 2-5c
Water Quality Data - 54MW4
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Date m/d/y	Time h/m/s	Temp ºC	Sp Cond mS/cm	DO %	DO mg/L	pH su	ORP mV	Depth toc
3/7/2003	12.10.11	10.57	0.723	13.9	1.54	7.34	70	14.00
3/7/2003	12.09.41	10.61	0.723	12.7	1.41	7.34	68	14.50
3/7/2003	12.09.11	10.64	0.723	11.5	1.28	7.33	67	15.00
3/7/2003	12.08.41	10.76	0.723	10.2	1.13	7.33	64	15.50
3/7/2003	12.08.11	10.90	0.722	9.0	0.99	7.32	63	16.00
3/7/2003	12.07.41	11.01	0.721	8.0	0.89	7.33	61	16.50
3/7/2003	12.07.11	11.15	0.720	7.1	0.78	7.32	60	17.00
3/7/2003	12.06.41	11.31	0.720	6.6	0.72	7.32	59	17.50
3/7/2003	12.06.11	11.39	0.720	6.2	0.68	7.32	58	18.00
3/7/2003	12.05.41	11.46	0.719	6.0	0.65	7.32	57	18.50
3/7/2003	12.05.11	11.52	0.719	5.8	0.64	7.32	56	19.00
3/7/2003	12.04.41	11.61	0.719	5.7	0.62	7.32	55	19.50
3/7/2003	12.04.11	11.66	0.719	5.6	0.61	7.31	54	20.00
3/7/2003	12.03.41	11.75	0.719	5.6	0.60	7.32	53	20.50
3/7/2003	12.03.11	11.81	0.719	5.6	0.60	7.31	52	21.00
3/7/2003	12.02.41	11.86	0.719	5.5	0.60	7.32	51	21.50
3/7/2003	12.02.11	11.91	0.718	5.5	0.59	7.31	50	22.00
3/7/2003	12.01.41	11.96	0.718	5.4	0.58	7.32	48	22.50
3/7/2003	12.01.11	11.99	0.718	5.4	0.58	7.31	48	23.00
3/7/2003	12.00.41	12.04	0.718	5.4	0.58	7.31	46	23.50
3/7/2003	12.00.11	12.10	0.718	5.4	0.57	7.31	45	24.00
3/7/2003	11.59.41	12.15	0.719	5.3	0.57	7.31	44	24.50
3/7/2003	11.59.11	12.20	0.718	5.2	0.56	7.31	43	25.00
3/7/2003	11.58.41	12.25	0.718	5.2	0.56	7.31	41	25.50
3/7/2003	11.58.11	12.29	0.718	5.2	0.56	7.31	40	26.00
3/7/2003	11.57.41	12.31	0.718	5.2	0.55	7.31	39	26.50
3/7/2003	11.57.11	12.35	0.718	5.1	0.55	7.31	37	27.00
3/7/2003	11.56.41	12.40	0.717	5.1	0.54	7.31	36	27.50
3/7/2003	11.56.11	12.43	0.716	5.1	0.54	7.31	34	28.00
3/7/2003	11.55.41	12.44	0.717	5.0	0.54	7.31	33	28.50
3/7/2003	11.55.11	12.48	0.716	5.0	0.53	7.31	31	29.00
3/7/2003	11.54.41	12.50	0.716	4.9	0.52	7.31	29	29.50
3/7/2003	11.54.11	12.52	0.716	4.8	0.52	7.31	28	30.00
3/7/2003	11.53.41	12.54	0.716	4.8	0.51	7.31	26	30.50
3/7/2003	11.53.11	12.55	0.716	4.7	0.50	7.31	24	31.00
3/7/2003	11.52.41	12.57	0.716	4.7	0.49	7.31	22	31.50
3/7/2003	11.52.11	12.59	0.715	4.6	0.49	7.31	20	32.00
3/7/2003	11.51.41	12.60	0.716	4.6	0.49	7.31	18	32.50
3/7/2003	11.51.11	12.61	0.716	4.5	0.48	7.31	15	33.00
3/7/2003	11.50.41	12.62	0.718	4.5	0.48	7.31	12	33.50
3/7/2003	11.50.11	12.63	0.721	4.5	0.47	7.31	10	34.00
3/7/2003	11.49.41	12.64	0.726	4.4	0.46	7.31	7	34.50
3/7/2003	11.49.11	12.65	0.734	4.2	0.45	7.31	4	35.00
3/7/2003	11.48.41	12.65	0.747	4.1	0.44	7.30	0	35.50
3/7/2003	11.48.11	12.66	0.767	4.0	0.42	7.30	-3	36.00
3/7/2003	11.47.41	12.66	0.805	3.7	0.39	7.30	-6	36.50

Table 2-5c
Water Quality Data - 54MW4
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Date m/d/y	Time h/m/s	Temp ºC	Sp Cond mS/cm	DO %	DO mg/L	pH su	ORP mV	Depth toc
3/7/2003	11.47.11	12.66	0.847	3.4	0.36	7.29	-8	37.00
3/7/2003	11.46.41	12.66	0.889	3.0	0.32	7.29	-10	37.50
3/7/2003	11.46.11	12.66	0.948	2.7	0.29	7.28	-11	38.00
3/7/2003	11.45.41	12.66	0.988	2.5	0.26	7.28	-12	38.50
3/7/2003	11.45.11	12.64	1.026	2.4	0.25	7.27	-12	39.00
3/7/2003	11.44.41	12.64	1.033	2.3	0.25	7.27	-11	39.50
3/7/2003	11.44.11	12.63	1.038	2.3	0.25	7.27	-10	40.00
3/7/2003	11.43.41	12.62	1.039	2.4	0.25	7.27	-9	40.50
3/7/2003	11.43.11	12.61	1.040	2.4	0.25	7.27	-8	41.00
3/7/2003	11.42.41	12.60	1.039	2.5	0.26	7.27	-7	41.50
3/7/2003	11.42.11	12.60	1.040	2.5	0.26	7.27	-6	42.00
3/7/2003	11.41.41	12.59	1.040	2.5	0.27	7.27	-4	42.50
3/7/2003	11.41.11	12.56	1.040	2.6	0.27	7.28	-3	43.00
3/7/2003	11.40.41	12.53	1.039	2.6	0.28	7.28	-1	43.50
3/7/2003	11.40.11	12.53	1.039	2.7	0.28	7.28	2	44.00
3/7/2003	11.39.41	12.51	1.039	2.7	0.29	7.28	4	44.50
3/7/2003	11.39.11	12.49	1.038	2.8	0.30	7.28	7	45.00
3/7/2003	11.38.41	12.46	1.038	3.1	0.33	7.28	11	45.50
3/7/2003	11.38.11	12.41	1.039	3.7	0.39	7.28	15	46.00
3/7/2003	11.37.41	12.39	1.039	5.2	0.55	7.28	21	46.50
3/7/2003	11.37.11	12.40	1.026	6.9	0.73	7.28	28	47.00
3/7/2003	11.36.41	12.46	1.024	7.6	0.81	7.29	35	47.50

Notes:
m/d/y - month/day/year
h/m/s - hours/minutes/seconds
ºC - degrees Celcius
mS/cm - milliSiemens per centimeter
% - percent
mg/L - milligrams per Liter
su - standard units
mV - millivolts
toc - top of casing

Table 2-5d
Water Quality Data - 54MW5
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Date m/d/y	Time h/m/s	Temp ºC	Sp Cond mS/cm	DO mg/L	pH su	ORP mV	Depth toc
3/7/2003	12.46.49	11.95	0.556	3.05	6.91	185	25.00
3/7/2003	12.47.19	11.92	0.556	2.88	6.91	184	24.50
3/7/2003	12.47.49	12.04	0.559	2.71	6.90	184	24.00
3/7/2003	12.48.19	12.08	0.559	2.59	6.89	184	23.50
3/7/2003	12.48.49	12.10	0.560	2.55	6.90	183	23.00
3/7/2003	12.49.19	12.10	0.560	2.55	6.90	182	22.50
3/7/2003	12.49.49	12.10	0.560	2.52	6.90	182	22.00
3/7/2003	12.50.19	12.08	0.560	2.51	6.89	182	21.50
3/7/2003	12.50.49	12.07	0.560	2.51	6.89	182	21.00
3/7/2003	12.51.19	12.04	0.560	2.51	6.89	181	20.50
3/7/2003	12.51.49	12.01	0.560	2.52	6.89	181	20.00
3/7/2003	12.52.19	11.99	0.560	2.53	6.89	181	19.50
3/7/2003	12.52.49	11.97	0.559	2.54	6.89	181	19.00
3/7/2003	12.53.19	11.94	0.558	2.56	6.88	181	18.50
3/7/2003	12.53.49	11.90	0.556	2.63	6.89	181	18.00
3/7/2003	12.54.19	11.84	0.550	2.77	6.88	180	17.50
3/7/2003	12.54.49	11.75	0.540	2.95	6.87	181	17.00
3/7/2003	12.55.19	11.68	0.539	3.35	6.85	180	16.50
3/7/2003	12.55.49	11.61	0.527	3.68	6.84	181	16.00
3/7/2003	12.56.19	11.51	0.508	4.01	6.82	181	15.50
3/7/2003	12.56.49	11.38	0.485	4.50	6.80	182	15.00

Notes:
m/d/y - month/day/year
h/m/s - hours/minutes/seconds
ºC - degrees Celcius
mS/c - milliSiemens per centimeter
mg/L - milligrams per Liter
su - standard units
mV - millivolts
toc - top of casing

Table 2-5e
Water Quality Data - 54MW6
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Date m/d/y	Time h/m/s	Temp ºC	Sp Cond mS/cm	DO mg/L	pH su	ORP mV	Depth toc
3/7/2003	10.29.28	12.67	0.331	6.54	7.62	194	39.50
3/7/2003	10.28.58	12.65	0.332	6.44	7.63	194	40.00
3/7/2003	10.28.28	12.62	0.333	6.34	7.63	194	40.50
3/7/2003	10.27.58	12.61	0.333	6.23	7.63	193	41.00
3/7/2003	10.27.28	12.55	0.334	6.11	7.63	193	41.50
3/7/2003	10.26.58	12.58	0.333	6.02	7.63	193	42.00
3/7/2003	10.26.28	12.53	0.333	6.00	7.61	194	42.50
3/7/2003	10.25.58	12.50	0.332	6.05	7.60	194	43.00
3/7/2003	10.25.28	12.54	0.333	6.55	7.56	195	43.50

Notes:
m/d/y - month/day/year
h/m/s - hours/minutes/seconds
ºC - degrees Celcius
mS/c - milliSiemens per centimeter
mg/L - milligrams per Liter
su - standard units
mV - millivolts
toc - top of casing

Table 2-5f
Water Quality Data - 54MW7
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Date m/d/y	Time h/m/s	Temp ºC	Sp Cond mS/cm	DO mg/L	pH su	ORP mV	Depth toc
3/7/2003	12.54.00	10.54	0.392	6.11	6.82	167	13.60
3/7/2003	12.53.30	10.64	0.395	5.99	6.83	166	14.00
3/7/2003	12.53.00	10.68	0.400	5.88	6.85	166	14.50
3/7/2003	12.52.30	10.76	0.410	5.70	6.87	165	15.00
3/7/2003	12.52.00	10.82	0.427	5.43	6.90	164	15.50
3/7/2003	12.51.30	11.04	0.450	5.02	6.93	163	16.00
3/7/2003	12.51.00	11.22	0.472	4.55	6.96	162	16.50
3/7/2003	12.50.30	11.33	0.492	4.24	6.98	161	17.00
3/7/2003	12.50.00	11.43	0.513	4.05	6.99	161	17.50
3/7/2003	12.49.30	11.56	0.519	3.92	7.00	160	18.00
3/7/2003	12.49.00	11.59	0.526	3.84	7.01	160	18.50
3/7/2003	12.48.30	11.63	0.527	3.81	7.01	160	19.00
3/7/2003	12.48.00	11.66	0.528	3.80	7.01	160	19.50
3/7/2003	12.48.00	11.66	0.528	3.80	7.01	160	20.00
3/7/2003	12.47.30	11.71	0.529	3.77	7.02	160	20.50
3/7/2003	12.47.30	11.71	0.529	3.77	7.02	160	21.00
3/7/2003	12.47.00	11.73	0.529	3.77	7.02	160	21.50
3/7/2003	12.46.30	11.75	0.530	3.76	7.02	160	22.00
3/7/2003	12.46.00	11.77	0.531	3.76	7.02	160	22.50
3/7/2003	12.45.30	11.79	0.530	3.77	7.03	160	23.00
3/7/2003	12.45.00	11.80	0.530	3.80	7.03	160	23.50
3/7/2003	12.44.30	11.79	0.530	3.83	7.03	161	24.00
3/7/2003	12.44.00	11.78	0.529	3.90	7.04	161	24.50
3/7/2003	12.43.30	11.77	0.527	4.01	7.05	161	25.00
3/7/2003	12.43.00	11.76	0.527	4.15	7.07	161	25.20

Notes:
m/d/y - month/day/year
h/m/s - hours/minutes/seconds
ºC - degrees Celcius
mS/c - milliSiemens per centimeter
mg/L - milligrams per Liter
su - standard units
mV - millivolts
toc - top of casing

Table 2-6
Field Water Quality Measurements - Groundwater
November/December 2006
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID	54MW1	54MW2	54MW3	54MW4	54MW5	54MW6	54MW7	54MW8	54MW9	54MW10
Sample Date	11/29/2006	11/29/2006	12/5/2006	11/30/2006	11/29/2006	11/29/2006	12/5/2006	12/1/2006	12/1/2006	12/1/2006
pH (unitless)	7.86	7.15	7.26	7.77	7.20	8.00	7.56	7.53	7.65	7.39
Temperature (°C)	15.6	17.7	15.3	15	18.5	16.6	15.9	17.1	19.1	16.3
Conductivity (mS)	0.440	0.533	0.580	1.13	0.557	0.297	0.729	0.605	0.790	0.733
Dissolved Oxygen (mg/L)	11.95	10.29	11.94	9.9	10.1	11.63	10.46	8.94	8.51	8.13
Turbidity (NTU)	4.47	1.16	0.07	2.66	16.6	4.87	5.91	11.83	23.5	10.31
ORP (mV)	153	159	171	-92	231	181	170	32	53	36

Notes:
°C = degrees Celsius
mS = milliSiemen
mg/L = milligram per liter
ORP = oxidation-reduction potential
NTU = Nephelometric Turbidity Units
mV = millivolts

Table 2-7
Field Water Quality Measurements - Surface Water/Pore Water
November/December 2006
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID	NR-SW-1	NR-SW-2	NR-SW-3	NR-SW-4	NR-SW-5	NR-SW-6	NR-SW-7	NR-SW-8	NR-SW-9	NR-SW-10
Sample Date	**11/30/2006**	**11/30/2006**	**11/30/2006**	**11/30/2006**	**11/30/2006**	**11/30/2006**	**12/1/2006**	**12/1/2006**	**12/1/2006**	**12/1/2006**
pH (unitless)	8.9	8.1	7.96	7.81	7.67	8.30	8.11	7.8	7.62	7.83
Temperature (°C)	10.1	9.9	10.1	10.3	10.2	10.4	11.7	12.5	11.8	11
Conductivity (mS)	0.116	0.113	0.118	0.174	0.117	0.155	0.14	0.124	0.131	0.114
Dissolved Oxygen (mg/L)	17.05	15.83	14.64	12.93	14.83	15.11	13.13	13.27	13.76	14.69
Turbidity (NTU)	71.3	13.7	17.48	9.94	7.66	6.21	148	13.8	20.5	11.46
ORP (mV)	219	118	47	53	32	35	10	41	51	52

Sample ID	NR-PW-1	NR-PW-2	NR-PW-3	NR-PW-4	NR-PW-5	NR-PW-6	NR-PW-7	NR-PW-8	NR-PW-9	NR-PW-10
Sample Date	**11/30/2006**	**11/30/2006**	**11/30/2006**	**11/30/2006**	**11/30/2006**	**11/30/2006**	**12/1/2006**	**12/1/2006**	**12/1/2006**	**12/1/2006**
pH (unitless)	7.33	7.21	7.47	7.57	7.44	7.2	7.54	7.36	7.23	7.47
Temperature (°C)	12.8	10.7	10.8	10.6	13.2	11.9	13	12.9	13.2	13.1
Conductivity (mS)	0.307	0.344	0.248	0.38	0.253	0.353	0.517	0.660	0.533	0.479
Dissolved Oxygen (mg/L)	10.38	10.46	12.2	9.35	10.82	11.34	9.25	9.74	10.55	10.18
Turbidity (NTU)	16.35	37.9	22.7	4.86	3.63	11.85	3.72	5.6	15.87	1.66
ORP (mV)	-109	-174	20	-182	-44	-58	-194	-173	-173	-157

Notes:
°C = degrees Celsius
mS = milliSiemen
mg/L = milligram per liter
ORP = oxidation-reduction potential
NTU = Nephelometric Turbidity Units
mV = millivolts
SW = surface water
PW = pore water

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Table 2-8
Summary of Previous Site Investigations
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

REPORT	OBJECTIVES	DATA COLLECTED			WORK PLAN ADDENDUM 013 CONCLUSIONS	
		SAMPLING STRATEGY	MEDIA AND NO. OF SAMPLES	LABORATORY ANALYTICAL PARAMETERS[1]	DATA USEABILITY	CHEMICALS OF POTENTIAL CONCERN[3]
Verification Investigation, Dames & Moore (1992): **AREA A**	• "evaluate whether groundwater quality has been impacted by ash disposed of in the unit…" • "delineate the boundaries of the area [to] locate buried materials" and to • "map possible locations of ash disposal"	• Installation of three groundwater monitoring wells • Geophysical survey	GROUNDWATER • 1 round of 3 samples (54MW1, 54MW2 and 54MW3)	GROUNDWATER[2] • TAL dissolved metals (200) • Explosives (609) • VOCs (624) • SVOCs (625) • TOC (415.2) • TOX (9020)	GROUNDWATER • Data for COPC identification	GROUNDWATER – AREA A • Explosives
RFI for SWMUs 17, 31, 48, and 54, Parsons (1996): **AREA A**	• "define the extent of ash and the limits of soil contamination"	• Biased sampling, based upon previous geophysical investigation • Sediment and surface water samples collected • Samples collected for geotechnical analysis • Waste ash sampling	SOIL • 16 shallow (0-2 ft bgs) samples • 15 deep (10-22 ft bgs) samples GROUNDWATER • 1 round of 3 samples (54MW1, 54MW2 and 54MW3) ASH • 2 samples for TCLP analysis	SOIL • Metals (6010/7000) • Explosives (8330) • Select for TOC (415.1)[2] GROUNDWATER • Total & dissolved metals (6010/7000) • Explosives (8330) • TOC (415.1) [2] • TOX (9020) ASH • TCLP Metals (1211/6010/7000) • Ignitability (7.1.2.2) • Corrosivity (9045) • Reactivity (7/9030/9012) • Paint Filter Test (9095)	SOIL *Shallow soil* • Data for COPC identification • Screening data for site characterization *Deep soil* • Data for COPC identification • Data for site characterization GROUNDWATER • Data for COPC identification ASH • Data for waste characterization	SOIL – AREA A • Metals • Explosives GROUNDWATER – AREA A • Metals
Supplemental RFI Report, SWMU 54, MSE (1998): **AREA B**	• "to characterize the nature and extent of contamination within SWMU 54 and to summarize potential risks to human health."	• GPR to survey Area B • Used geophysics results to locate borings - biased sampling • Installed new well (54MW4), screened in bedrock	SOIL • 6 shallow depth samples • 5 intermediate depth samples GROUNDWATER • 1 round of 2 samples (54MW1 and 54MW4)	SOIL • TCL VOCs (8260B) • Explosives (8330) • TAL Inorganics (6010/7471) • TCLP SVOC (1311/8270) • TCLP VOC (1311/8260) • TCLP Metals (1311/6010/700) • TOC (9060) • TOX (9020) GROUNDWATER • TCL Organics (8260/8270) • TAL Inorganics (6010/7470) • Explosives (8330)	SOIL • Data for COPC identification • Screening data for site characterization GROUNDWATER • Data for COPC identification	SOIL – AREA B • Metals • Explosives • PAHs
Department of the Army, Decision Document Interim Action, (1999): **AREA A and AREA B**	• "define the COPCs, determine the vertical and lateral extent of contamination, and effect the removal, and treatment of disposal of the COPCs thereby allowing closure of the SWMU"	• Systematic grid sampling • Field screening for explosives and metals	SOIL • Approx. 1600 samples field screened based on systematic grid • >200 composite samples submitted for lab analysis (one per grid) • 217 samples submitted for TCLP metals • 1827 tons of soil removed GROUNDWATER • 1 round of 4 samples (54MW1, 54MW2, 54MW3 and 54MW4)	SOIL • VOCs (8260B) • Explosives (8330) • Metals (6010) • TCLP Metals (6010T) GROUNDWATER • VOCs (8260B) • SVOCs (8270C) • Pest/PCBs (8082) • Explosives (8330) • Metals (6010)	SOIL • Data for COPC identification • Screening data for site characterization GROUNDWATER • Data for COPC identification	SOIL – AREA A • Metals • Explosives SOIL – AREA B • Metals • Explosives GROUNDWATER – AREA A • Metals • Explosives

Notes:

RCRA = Resource Conservation & Recovery Act
SWMU = Solid Waste Management Unit
TCLP = Toxicity Characteristic Leaching Procedure
COPC = Constituent of Potential Concern
GW = Groundwater
GPR = Ground Penetrating Radar
TAL = Target Analyte List
TCL = Target Compound List
MWP = Master Work Plan
VOC = Volatile Organic Compounds
SVOC = Semi-volatile Organic Compounds
Pest/PCBs = Pesticides and Polychlorinated Biphenyls
WPA = Work Plan Addendum
MSE = Millenium Science and Engineering
TOC = Total Organic Carbon
EM = Electromagnetic
ATK = Alliant Techsystems, Inc.
ft bgs = feet below ground surface
1 = Method of analysis from USEPA SW-846 Test Methods, unless otherwise noted
2 = Method of analysis from "Methods of Chemical Analysis of Water and Wastes"
3 = COPCs as determined by comparison of historical data to 2002 screening criteria for MWP Addendum 013
TNT= Trinitrotoluene
DNT= Dinitrotoluene
TOX = Total Organic Halogens
CMS = Corrective Measures Study

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3.0 FIELD INVESTIGATION PROGRAM

3.1 SAMPLING AND ANALYSIS

The RFI sampling and analysis program is summarized in Table 3-1; this table identifies the boring locations, chemical and physical sample locations and depths, and analytical methods and parameters.

Figure 3-1 shows the soil sample locations. Figure 3-2 shows the location of groundwater direct push samples used to locate additional monitoring wells for the RFI. Figure 3-3 shows the monitoring well locations and sample stations for sediment pore water/surface water within the adjacent New River. Figure 3-4 shows the sediment sample locations in the New River.

3.1.1 Soil Borings and Soil Sampling

Direct push soil borings with chemical sampling were used to: characterize the nature and extent of constituents in soil at Areas A and B, identify the lateral and vertical extent of any waste material present, and characterize soil lithology and depth to groundwater and/or bedrock. Forty-three direct push borings were completed at Area A and 27 direct push borings were completed at Area B as summarized below and in Table 3-1. Figure 3-1 shows the boring locations. The RFI soil investigations and associated samples are summarized in the following table.

Soil Sampling and Analysis

Area	Investigation Date	Soil Borings	Analytical Parameters	Comments
Area A	December 2002	54SB17 through 54SB38	TCL SVOCs, PAHs, TAL metals, explosives, TCL pesticides/PCBs (selected samples), TCL dioxin furans (selected samples)	Characterize nature and extent of chemicals in soil at Area A.
	August 2004	54SB56 through 54SB70	Explosives with nitroglycerin, TAL metals, and TCL pesticides/PCBs	Further delineation of the nature and extent of explosives, pesticides, PCBs, and metals in soil east and north of Area A.
	January 2007	54SB81 through 54SB84	Selected samples analyzed for: Lead, explosives, TCL pesticides/PCBs, PCB Congeners, and TCL dioxin/furans	Further delineation of the nature and extent of lead, explosives, pesticides, PCBs, and dioxin furans in soil east and west of Area A. Additional samples collected from various previous boring locations including borings 54SB3 and 54SB10 (Parsons 1996).
Area B	December 2002	54SB39 through 54SB55	TCL SVOCs, PAHs, TAL metals, explosives, TCL pesticides/PCBs (selected samples), TCL dioxin furans (selected samples)	Characterize nature and extent of chemicals in soil at Area B.

Area	Investigation Date	Soil Borings	Analytical Parameters	Comments
Area B (Cont.)	August 2004	54SB71 through 54SB76	TCL pesticides/PCBs	Further delineation of the nature and extent of pesticides and PCBs in soil at Area B.
	January 2007	54SB77 through 54SB80	Selected samples analyzed for: TCL pesticides/PCBs, PCB Congeners, and TCL dioxin/furans	Further delineation of the nature and extent of pesticides, PCBs, and dioxin furans in Area B. Additional samples collected from various previous boring locations.

Soil samples for chemical analysis were generally collected from three intervals including: a surface sample ("A" sample), intermediate sample ("B" sample), and terminal depth sample ("C" sample). Surface samples were collected from 0 to 1 ft bgs. Intermediate depth samples were generally collected from 9 to 10 ft bgs. Terminal depth samples were collected from discrete intervals at depths of 22 ft or less.

For the initial RFI phase conducted in 2002, soil samples were analyzed for TCL SVOCs, PAHs, explosives (including nitroglycerin), and TAL metals. Selected samples were also analyzed for TCL pesticides, TCL PCBs, and TCL dioxin/furans. For the second phase of the RFI conducted in 2004, soil samples were analyzed for explosives (including nitroglycerin), TCL pesticides, TCL PCBs, and TAL metals to further define the nature and extent of the chemicals in soil. For the third phase of the RFI conducted in 2007, soil samples were selectively analyzed for lead, explosives, TCL pesticides, TCL PCBs, and TCL dioxin/furans to further define the nature and extent of these chemicals in soil. Refer to Table 3-1 for RFI boring and analyses information.

During the 2002 investigation, seven soil samples were collected for physical testing of moisture content, pH, porosity, bulk density, total organic content, grain size analysis, Atterberg limits, and hydraulic conductivity (Table 2-1).

3.1.2 Direct Push Groundwater Investigations

Three direct push investigations were conducted at the site to provide additional groundwater data on the nature and extent of perchlorate and explosives in groundwater. Direct push data were used to select the number and location of additional monitoring wells for the RFI groundwater characterization. Information on the three direct push investigations is summarized in the following table. Sample information is also summarized in Table 3-1 and locations are shown on Figure 3-2.

Direct Push Groundwater Investigations

Sampling Date	Boring/Sample Location	Analytical Parameters	Comment
December 2002	*Area A:* 54DPW1 54DPW2 54DPW3	Explosives (8330/8332) Perchlorate (314.0) TAL Metals (total) TAL Metals (dissolved)	54DPW1 and 54DPW2 between existing well 54MW3 and the New River 54DW2 downgradient of existing well 54MW2 Explosives data "R" flagged due to QC failure, except for HMX result from 54DPW1
August 2004	*Area A:* 54GW56 through 54GW70 (15 locations)	Explosives (8330/8332) Perchlorate (314.0)	Delineation and data for monitoring well location. Samples collected at 15 locations between Area A and the New River
October 2004	*Area A*: 54GP77 through 54GP87 (11 locations)	Perchlorate (314.0)	Delineation and additional data for monitoring well location. Samples collected between Area A and unnamed tributary to the New River, south of tributary, and southeast of Area A proximate to New River. Samples collected farther north of Area A proximate to the New River.

3.1.3 Monitoring Well Installation and Groundwater Sampling

In January 2003, monitoring wells 54MW5, 54MW6, and 54MW7 were installed at the site. Monitoring well 54MW5 was installed at Area A between upgradient well 54MW1 and the disposal unit (Figures 3-2 and 3-3). This additional upgradient well was installed closer to Area A at the request of the EPA due to concerns that well 54MW1 monitored groundwater at a location where groundwater was present only within bedrock and the fact that the top of the screened interval of bedrock in 54MW1 was near the bottom of the screened intervals of wells 54MW2 and 54MW3. Monitoring well 54MW6 was installed upgradient of Area B and monitoring well 54MW7 was installed downgradient of Area B near the edge of the disposal unit (Figures 3-2 and 3-3). Groundwater data collected during the direct push investigation indicated a progressive extension of the plume area for explosives and perchlorate northward from Area A along the New River.

In December 2004, monitoring wells 54MW8, 54MW9, and 54MW10 were installed at locations that were selected based on the direct push investigation results to further characterize the nature and extent of the dissolved phase constituent plume at Area A (Figures 3-2 and 3-3). Monitoring wells 54MW8 and 54MW10 were installed as close as practicable to the New River downgradient of Area A and wells 54MW2 and 54MW3. Monitoring well 54MW9 was installed northeast of Area A and north of well 54MW8 to evaluate the northern extent of the dissolved phase constituent plume.

Groundwater sampling dates (monitoring wells) and analytical parameters are summarized below and in Table 3-1. Figures 3-2 and 3-3 show the monitoring well locations.

Monitoring Well Sampling and Analysis

Sampling Date	Monitoring Wells Sampled	Analytical Parameters	Comment
March 2003	*Area A*: 54MW2 (D), 54MW3 (D), and 54MW5 (U) *Area B*: 54MW4 (D) 54MW6 (U), and 54MW7 (D)	TCL SVOCs, PAHs, explosives with nitroglycerin, perchlorate, and TAL metals (total and dissolved). Field water quality parameters: pH, temperature, specific conductance, dissolved oxygen, ORP, and turbidity.	Additional downgradient well (54MW7) installed at Area B for additional release evaluation. Additional upgradient wells installed at Areas A (54MW5) and B (54MW6).
August 2004 October 2004 November 2004 December 2004	*Area A:* 54MW1 (U) *Area B:* 54MW6 (U)	Total and dissolved manganese Field water quality parameters: pH, temperature, specific conductance, dissolved oxygen, ORP, and turbidity.	Background sampling to evaluate whether manganese detections were in groundwater were potentially site related.
December 2004	*Area A*: 54MW8 (D), 54MW9 (D), and 54MW10 (D)	Explosives with nitroglycerin, perchlorate, and total and dissolved manganese Field water quality parameters: pH, temperature, specific conductance, dissolved oxygen, ORP, and turbidity.	Three additional downgradient wells (54MW8, 54MW9, and 54MW10) installed at Area A for additional plume delineation.
November/ December 2006	*Area A:* 54MW1 (U), 54MW2 (D), 54MW3 (D), 54MW5 (U), 54MW8 (D), 54MW9 (D), and 54MW10 (D) *Area B*: 54MW4 (D) 54MW6 (U), and 54MW7 (D)	Explosives, perchlorate, pesticides, PCBs, and TCL dioxin/furans (selected locations) Field water quality parameters: pH, temperature, specific conductance, dissolved oxygen, ORP, and turbidity.	Additional sampling to evaluate the presence/absence of pesticides, PCBs, and dioxin/furans in groundwater. First quarterly site-wide sampling event to assess concentration trends and seasonal variation of perchlorate and explosives over time.
March 2007 June 2007 September 2007	*Area A:* 54MW1 (U), 54MW2 (D), 54MW3 (D), 54MW5 (U), 54MW8 (D), 54MW9 (D), and 54MW10 (D) *Area B*: 54MW4 (D) 54MW6 (U), and 54MW7 (D)	Explosives, perchlorate, TCL dioxin/furans (Area B - June 2007) Field water quality parameters: pH, temperature, specific conductance, dissolved oxygen, ORP, and turbidity.	Second and third quarterly site-wide groundwater sampling events to assess concentration trends and seasonal variations over time. Re-sampled for dioxin/furans in June 2007 to verify initial sample results at Area B.

Note: (U) = Upgradient and (D) = Downgradient.

3.1.4 New River – Surface Water, Sediment Pore Water, and Sediment Sampling

In November/December 2006, the groundwater/surface water interface was investigated along the shoreline of the New River at the site to assess for potential plume discharge to the New River. The investigation and sampling was conducted concurrent with the quarterly groundwater sampling event in November/December 2006; this provided for data to assess conditions in groundwater, at the groundwater/surface water interface, and in surface water of the New River. Surface water and sediment pore water samples were collected from 10 stations along the shoreline of the New River at the site as shown on Figure 3-3 and as described in Section 3.3.7.

Sediment sampling was conducted in the New River in November 2006 concurrent with the groundwater/surface water interface investigation at SWMU 54. Sediment samples were collected from 23 stations in the New River along a reach of approximately 5.9 miles; the reach extended from approximately 3.4 miles upstream of SWMU 54 to a location approximately 2.4 miles downstream of SWMU 54, as shown on Figure 3-4. Sample locations were selected based on a desktop assessment of flood plain and hydrologic data (to identify locations where sediment deposition occurs) and a field reconnaissance by boat conducted by representatives of URS, the Army, EPA, U.S. Fish and Wildlife, and the VDEQ. The purpose of the sediment sampling was to evaluate potential impacts on the New River from historical activities at SWMU 54 and to assess overall sediment quality in the RFAAP area.

The sampling and analysis program for the groundwater/surface water interface investigation and sediment sampling of the New River is summarized in the table below and in Table 3-1. Sample locations are shown on Figure 3-3 (sediment pore water/surface water) and Figure 3-4 (sediment).

Sediment, Surface Water, and Sediment Pore Water Sampling and Analysis

Sampling Date	Sample ID	Analytical Parameters	Comment
November 2006	NR-SED-1 through NR-SED-23	TAL metals and explosives Physical parameters: TOC, grain size analysis, and pH.	Sediment samples were collected upstream of the site, adjacent to the site, and downstream of the site.
December 2006	NR-PW-1 through NR-PW-10	Explosives and perchlorate Field water quality parameters: pH, temperature, specific conductance, dissolved oxygen, ORP, and turbidity.	Pore water samples were collected adjacent to the site to assess potential groundwater impacts to the New River.
	NR-SW-1 through NR-SW-10	Explosives and perchlorate Field water quality parameters: pH, temperature, specific conductance, dissolved oxygen, ORP, and turbidity.	Surface water samples were collected adjacent to the site to assess potential groundwater impacts to the New River.

3.1.5 Aquifer Testing

Rising head and falling head slug tests were conducted in monitoring wells 54MW4 through 54MW10 to assess hydraulic conductivity of the screened intervals of the uppermost aquifer at the site. Aquifer test data and analysis are presented in Appendix C.4 and results are discussed in Section 2.7.2. Slug test methods are discussed in Section 3.3.5.

3.2 QUALITY ASSURANCE

Quality Assurance (QA) planning defined the overall system of activities for assuring the reliability of data produced. The system integrated the quality planning, assessment, and corrective actions of various groups in the organization to provide the independent QA program necessary to establish and maintain an effective system for collection and analysis of environmental samples and related activities. The program encompasses the generation of complete data with its subsequent review, validation, and documentation.

The accuracy and integrity of RFI data were ensured through the implementation of internal quality control (QC) measures consistent with MWP Addendum 013 (URS 2003). QA and QC procedures, including field QC, laboratory QC, data management, and data validation, were integrated into the investigation program to meet data quality objectives (DQOs) established and approved for the RFI. The data were evaluated for each of the DQO indicators and the results of this evaluation are presented in Appendix D. DQOs for the RFI were met.

3.3 INVESTIGATION METHODOLOGY

3.3.1 Soil Sampling for Chemical Analysis

Surface and subsurface soil samples were collected for chemical analysis following the procedures outlined in standard operating procedure (SOP) 30.1 included in Appendix B and as described in Section 5.2 of the MWP (URS 2003).

The soil core interval was examined and classified by the site geologist and recorded in the field logbook and on the boring log consistent with SOPs 10.1 and 10.3, respectively (Appendix B). Soil was then extracted from the appropriate interval; sample containers were filled, labeled, and placed into coolers with ice and maintained at 4 degrees Celsius (°C) .

Soil samples were collected from the borings using a tractor-mounted direct push rig (Geoprobe®). This rig was equipped with 1.25-inch diameter push rods, 4-ft long, 2-inch diameter, stainless steel closed solid barrel sampler (Macro-Core®) with a disposable liner and stainless steel cutting shoes. A percussion hammer was used to advance the sampling assembly. Following withdrawal of the Macro-Core® and removal of the liner, a cutting device was used to open the liner before inspection and processing of the sample cores.

Once the termination depth of the boring was reached and sample collection was completed, the borehole was backfilled with hydrated bentonite chips. Excess soil cuttings were temporarily accumulated in 55-gallon drums at the Installation-approved area for disposal as discussed in Section 3.3.9. Soil boring logs for the RFI are included in Appendix C.3.

3.3.2 Monitoring Well Installation and Development

Monitoring wells 54MW5, 54MW6, 54MW7, 54MW8, 54MW9, and 54MW10 were installed following the procedures outlined in SOP 20.1 (Appendix B) and as described in Section 5.2 of the MWP (URS 2003). 54MW5, 54MW6, and 54MW7 were installed using a truck mounted, air rotary drill rig equipped with a 10-inch diameter bit. A roller bit was used to drill in overburden and an air hammer bit was used to drill in bedrock. 54MW8, 54MW9, and 54MW10 were installed using a track mounted drill rig using 8.25-inch inner diameter hollow stem augers for overburden drilling and a 7 7/8-inch diameter, air hammer bit for drilling into bedrock. Boring logs were completed as described in SOP 10.3 (Appendix B) and drilling activities were documented in the field logbook as described in SOP 10.1 (Appendix B). Downhole drill rig tools and equipment were decontaminated before use at each location following SOP 80.1 (Appendix B).

Monitoring wells were constructed with 4-inch diameter, Schedule 40 polyvinyl chloride (PVC) 0.01-inch factory slotted screen and riser pipe with threaded joints. Each monitoring well was screened across the overburden and weathered bedrock interface to monitor the uppermost zone of groundwater at the site.

Boring logs and construction diagrams for the monitoring wells are included in Appendix C.3. Monitoring well construction data are summarized in Table 2-3.

Prior to sampling, each of the monitoring wells was developed consistent with SOP 20.2 (Appendix B) and as described in Section 5.2 of the MWP (URS 2003) by using a surge block, disposable bailer, and stainless steel, adjustable flow rate submersible pump with new disposable tubing. Development was continued at each monitoring well until a minimum of three equivalent well volumes were purged, water quality indicator parameters had stabilized, development water was clear to the unaided eye, and any remaining sediment had been removed from the well.

3.3.3 Groundwater Sampling

Groundwater samples were collected for chemical analysis in accordance with SOP 30.2 (Appendix B) and as described in Section 5.2.10 of the MWP (URS 2003). Groundwater sampling information was recorded in the field logbooks as described in SOPs 10.1 and 10.2 (Appendix B). Groundwater sampling field data sheets are included in Appendix C.5.

Low flow purging and sampling techniques were used to collect the groundwater samples from the permanent monitoring wells following the procedure outlined in Section 3.3 of SOP 30.2 (Appendix B). Equipment used to purge and sample wells was thoroughly decontaminated before and after use following SOP 80.1 (Appendix B). All equipment used for monitoring water quality parameters was calibrated before use according to the manufacture's instructions and SOP 40.1 (Appendix B). Prior to the sampling round, the depth to water was measured at each well to the nearest 0.01 ft using an electronic water level indicator in accordance with SOP 40.2. Calibration and measurement data were recorded in the field logbook.

A stainless steel, adjustable flow rate submersible pump and/or a peristaltic pump, and new disposable tubing were used to collect the groundwater samples. The pump tubing was connected to an in-line flow-through cell and the multi-parameter meter probe was connected to the flow cell to monitor water quality parameters during purging. Pumping was started and the pump rate was adjusted to cause minimal drawdown (less than 0.2 ft if possible). A Horiba Model U-22 multi-parameter water quality meter was used to monitor pH, specific conductance, temperature, ORP, dissolved oxygen, and turbidity during purging. Purging was continued until parameter stabilization was achieved. Once purging was complete, the pumping rate was reduced to its lowest steady rate and the in-line flow cell was disconnected from the tubing to allow for sampling from the tubing directly into sample containers provided the laboratory.

Groundwater samples were collected and containerized in the order of volatilization sensitivity of the parameters. Filtered and unfiltered samples were collected for metals analysis. Metals samples were filtered with an in-line high capacity 0.45-micron disposable filter. The appropriate sample containers were filled, labeled, and placed into coolers with ice and maintained at 4 °C.

3.3.4 Water Quality Measurements

Field water quality measurements were collected consistent with SOP 40.1(Appendix B) using a Horiba Model U-22 multi-parameter water quality meter. Prior to its use each day, the meter was calibrated according to the manufacturer's instructions.

3.3.5 Aquifer Tests

Rising head and falling head slug tests were conducted at monitoring wells 54MW4 through 54MW10 in accordance with SOP 40.3 (Appendix B) and Section 5.9 of the MWP (URS 2003). A 3-inch diameter and 4-ft long solid PVC slug was used for the slug tests to induce instantaneous changes in water levels. Water level changes were recorded using a downhole pressure transducer with an internal data logger (*Insitu* Minitroll Standard P 30 pounds per square inch [PSI]). Slug-test data analysis was performed using AQTESOLV for Windows Pro Version 3.0. Appendix C.4 includes the slug test output and analysis.

3.3.6 Sediment Sampling

Sediment samples were collected for chemical analysis in accordance with SOP 30.4 included in Appendix B and as described in Section 5.4 of the MWP (URS 2003). The scoop and trowel method outlined in SOP 30.4 was used to collect the sediment samples. Sediment sampling of the New River was completed by starting at the farthest upstream sample location west of SWMU 13 and continued downstream to locations west of SWMU 54. The appropriate sample containers were filled, labeled, and placed into coolers with ice and maintained at 4 °C.

3.3.7 Surface Water and Sediment Pore Water Sampling

Surface water samples were collected for chemical analysis in accordance with SOP 30.3 included in Appendix B and as described in Section 5.3.1 of the MWP (URS 2003). Sampling was conducted by using a peristaltic pump as described in Section 3.4 of SOP 30.3. Samples were collected by starting at the farthest downstream location to minimize the potential for sediment interference from sediment disturbed in the water column during sampling. At each sampling location, surface water samples were collected prior to the sediment pore-water samples. Water quality measurements were obtained at each sampling location for surface water and sediment pore water using a Horiba U-10 multi-parameter probe following SOP 40.1.

Sediment pore-water sampling was conducting using MHE products Model PP27 (27-inch long) and PPX36 (36-inch long) push point samplers. The push point samplers are equipped with a guard-rod that provides structural support to the push point and prevents plugging and deformation of the screened zone during insertion into the sediment. Push point samplers are constructed of 316 stainless steel and have interlaced machined slots, which form a short screened zone (1.5-inches) with an approximately 20% open area. Push point samplers were thoroughly decontaminated before and after each use following SOP 80.1 (Appendix B). Samples were collected at each station by inserting the push point six inches (6 inches) into the sediment so that the top of the screened interval was 4.25-inches below the top of the sediment. The guard rod was then removed after reaching the target depth to expose the screened interval. A peristaltic pump and new Tygon® tubing were used to collect sediment pore-water samples from the push point via a sampling port. Tubing was connected to an in-line flow-through cell and the multi-parameter meter probe (Horiba U-22) was connected to the flow cell to monitor water quality parameters (pH, temperature, specific conductance, dissolved oxygen, ORP, and turbidity) during purging. After one minute, the inline flow cell was disconnected from the tubing to allow for sampling from the tubing directly into the sample containers provided by the laboratory. Samples were collected and containerized in the order of volatilization sensitivity of the parameters. The appropriate sample containers were filled, labeled, and placed into coolers with ice and maintained at 4 °C.

During purging, water quality data from the sediment pore water were compared to the surface-water quality data to verify that samples were representative of pore water. Samples of the pore water had a different geochemical signature than the river water, which included a lower pH, dissolved oxygen, and ORP levels and higher conductivity levels.

Appendix B includes a document entitled *Pushpoint Sampling for Defining Spatial and Temporal Variations in Contaminant Concentrations in Sediment Pore Water near the Ground-Water/Surface-Water Interface* (Zimmerman, Massey, and Campo 2005), which provides additional information on investigations of the groundwater/surface water interface using push point samplers.

3.3.8 Site Surveying

Anderson and Associates, Inc. completed a topographic survey of the site as part of the RFI. The initial survey was conducted in 2001 for the RFI work plan addendum and updated in 2003 to include new monitoring wells 54MW5, 54MW6, and 54MW7, direct push borings 54DPW1 through 54DPW3, and soil borings 54SB17 through 54SB52. In 2005, Draper Aden completed an updated survey of all monitoring wells at the site including new monitoring wells 54MW8, 54MW9, and 54MW10. URS

surveyed the locations of soil borings and direct push groundwater borings completed in 2004 and 2007 obtained using Trimble Pathfinder Pro XRS® global positioning system (GPS) equipment.

Surveying was conducted using the U.S. State [Virginia (South Zone)] Plane Coordinate System (measured in U.S. survey ft) using the North American Datum 1983. Vertical elevations at the site were surveyed to the nearest 0.01 ft using the National Vertical Datum of 1988. Sample location coordinates and elevations are presented in Appendix C.6.

3.3.9 Investigation-Derived Material (IDM) Management

IDM management activities were conducted consistent with the procedures outlined in WPA 013 (URS 2003) and documented in the field logbook, and conducted as described below.

3.3.9.1 Accumulation

IDM accumulated during field sampling activities included the following materials and containers:

- Soil cuttings – Thirty (30) 55-gallon drums;
- Personal protective equipment (PPE), probe liners, and plastic sheeting – Ten (10) 55-gallon drums; and
- Decontamination and purge water – Sixty-two (62) 55-gallon drums.

IDM accumulation and labeling was conducted as outlined in MWP SOP 70.1 (Appendix B). Drums were transferred to the Installation's approved container accumulation area at SWMU 17.

3.3.9.2 Material Characterization

Separate IDM characterization samples were collected from the soil cuttings and the drummed decontamination water. The analytical results for the IDM characterization samples indicated the soil cuttings and the decontamination water were non-hazardous material. IDM sample results are provided in Appendix C.7.

3.3.9.3 Transportation and Disposal

Before disposal, waste analytical results were provided to the Installation, IDM management subcontractor, and the disposal facilities for review and approval. Manifests were reviewed and signed by Installation personnel before loading and transport of the IDM. The Installation maintains a record of the manifests and related information including analytical testing results and waste profiles.

Freehold Cartage, Inc. and First Piedmont Corporation transported the non-hazardous soil IDM to the First Piedmont Corporation Landfill in Chatham, Virginia.

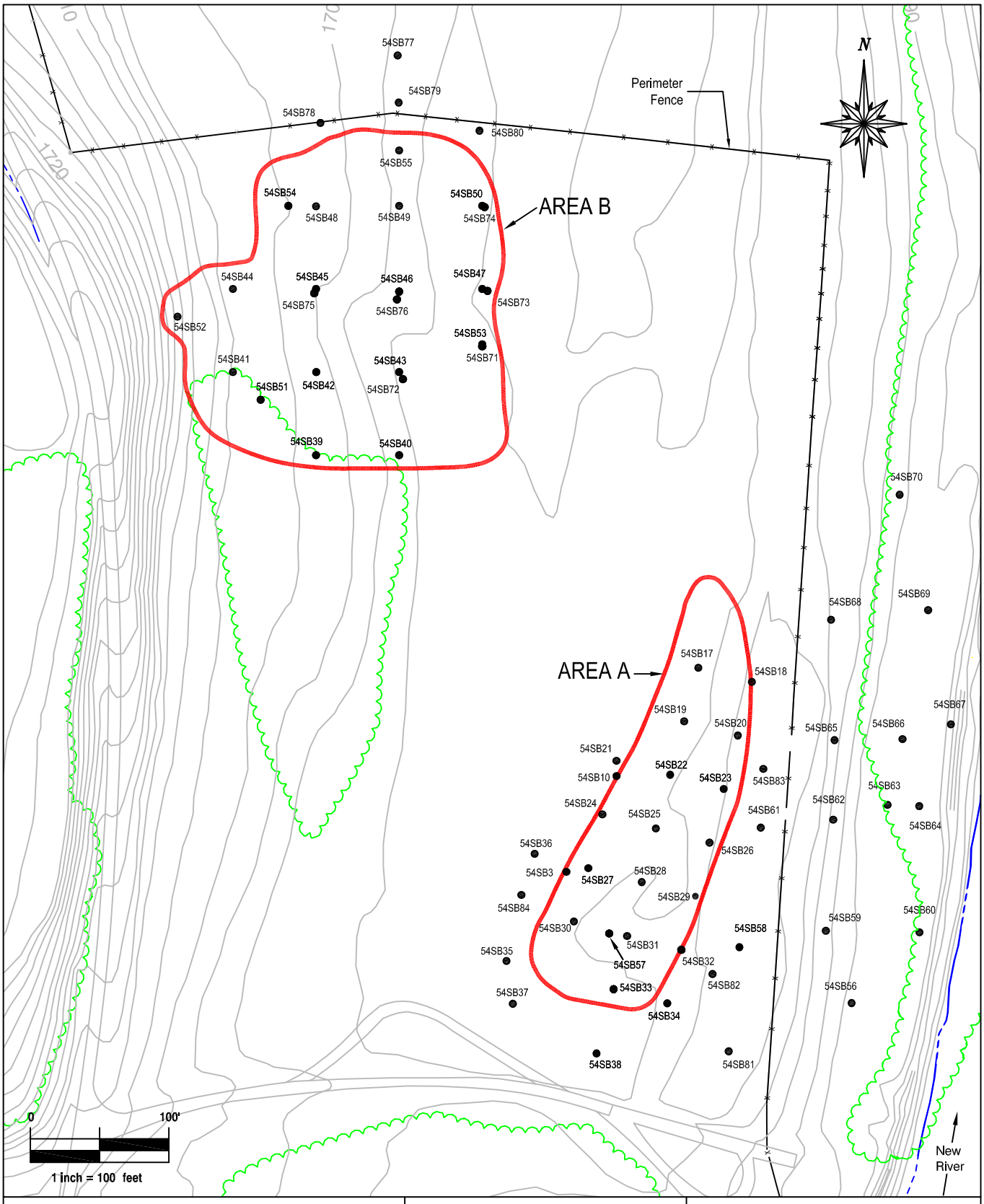
3.3.9.4 Decontamination Water

Following the waste characterization sample analysis, the Installation and RFAAP Process Water Treatment Plant engineers were provided a copy of the water IDM sample results and groundwater sample results. After receiving Plant approval, decontamination water and purge water were discharged into the collection system of the Process Water Treatment Plant.

3.4 WORK PLAN FIELD CHANGES

No field changes to the MWP addendum and additional investigation work plans were made to adjust to encountered field conditions and subsurface conditions.

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Legend

- SWMU Boundary
- Soil Boring Location

FIGURE 3-1

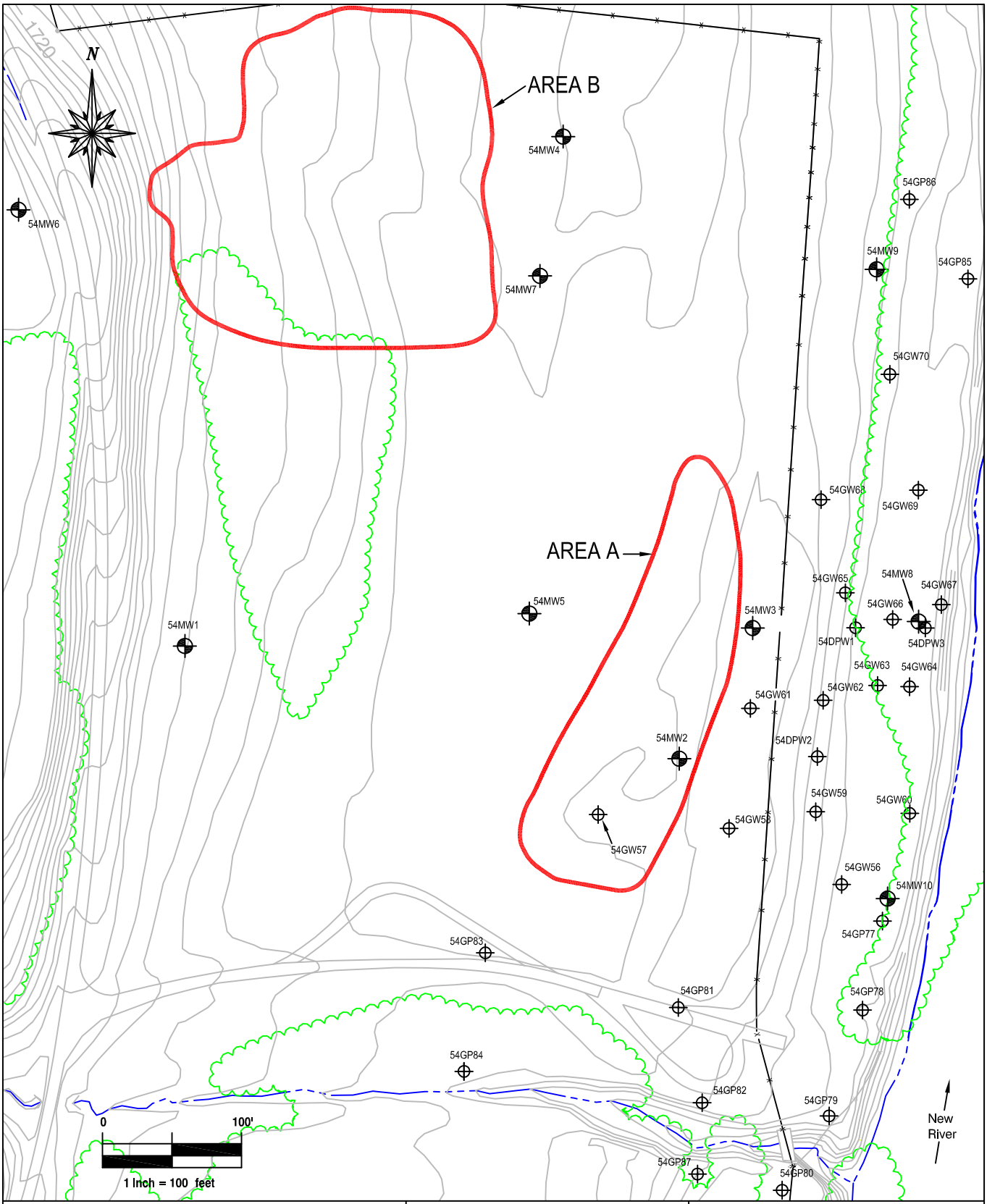
RFI Sample Soil Locations

Date: July 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 100 feet	File Name: Fig.3-1 RFILocs

SWMU 54

RCRA Facility Investigation
Radford Army Ammunition Plant
Radford, Virginia

URS Group, Inc.
5540 Falmouth Street
Suite 201
Richmond, Virginia 23230



Legend

- Approximate SWMU Boundary
- Monitoring Well Location
- Direct Push Groundwater Sample Location

FIGURE 3-2

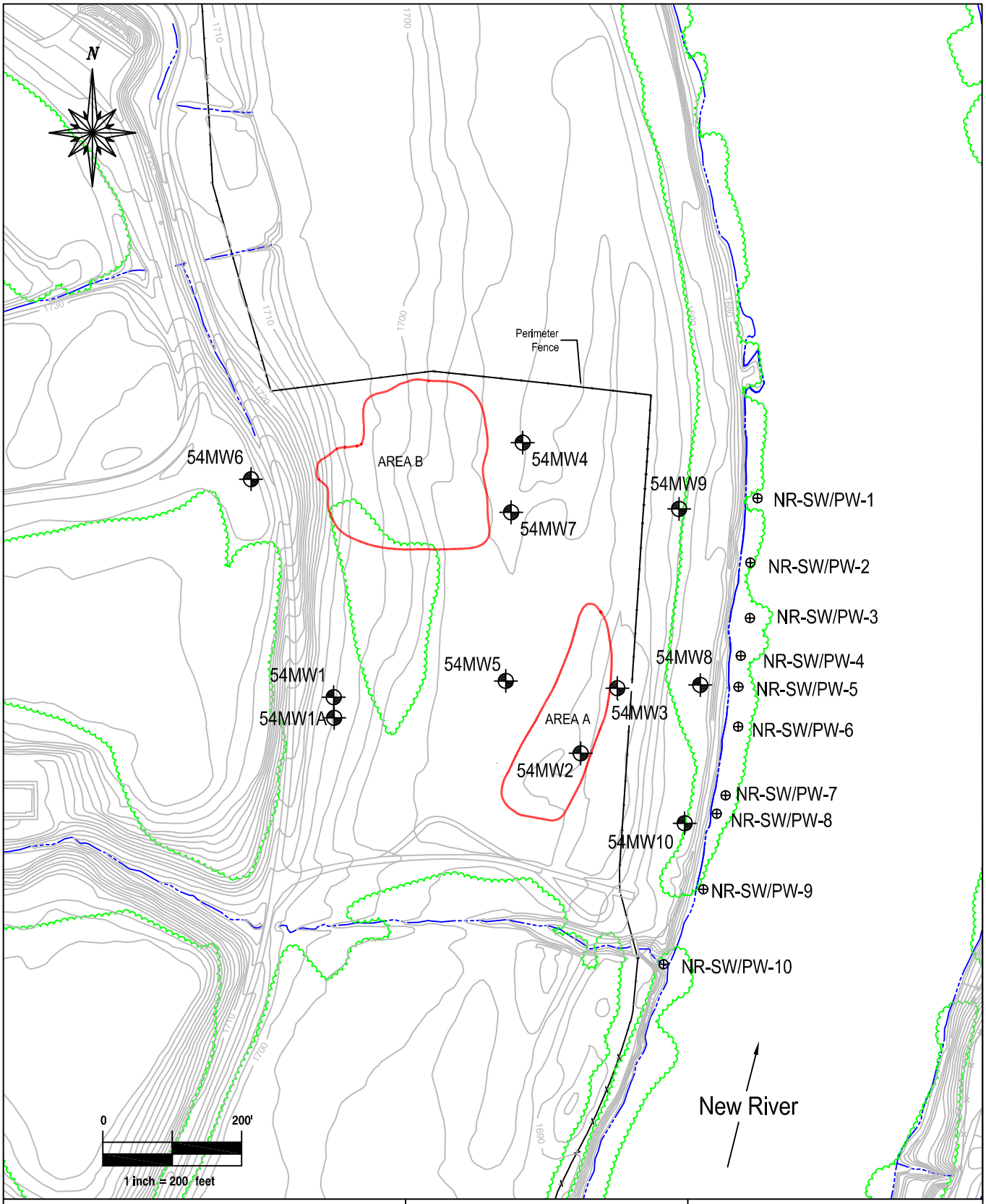
Direct Push Groundwater Sample and Monitoring Well Locations

Date: August 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 100 feet	File Name: Fig. 3-2 GP&GW Locs

SWMU 54

RCRA Facility Investigation
Radford Army Ammunition Plant
Radford, Virginia

URS Group, Inc.
5540 Falmouth Street
Suite 201
Richmond, Virginia 23230



Legend

- Approximate SWMU Boundaries
- Monitoring Well Location
- Surface Water / Pore Water Sample Location

FIGURE 3-3

Monitoring Well and Surface Water/Pore Water Sample Locations

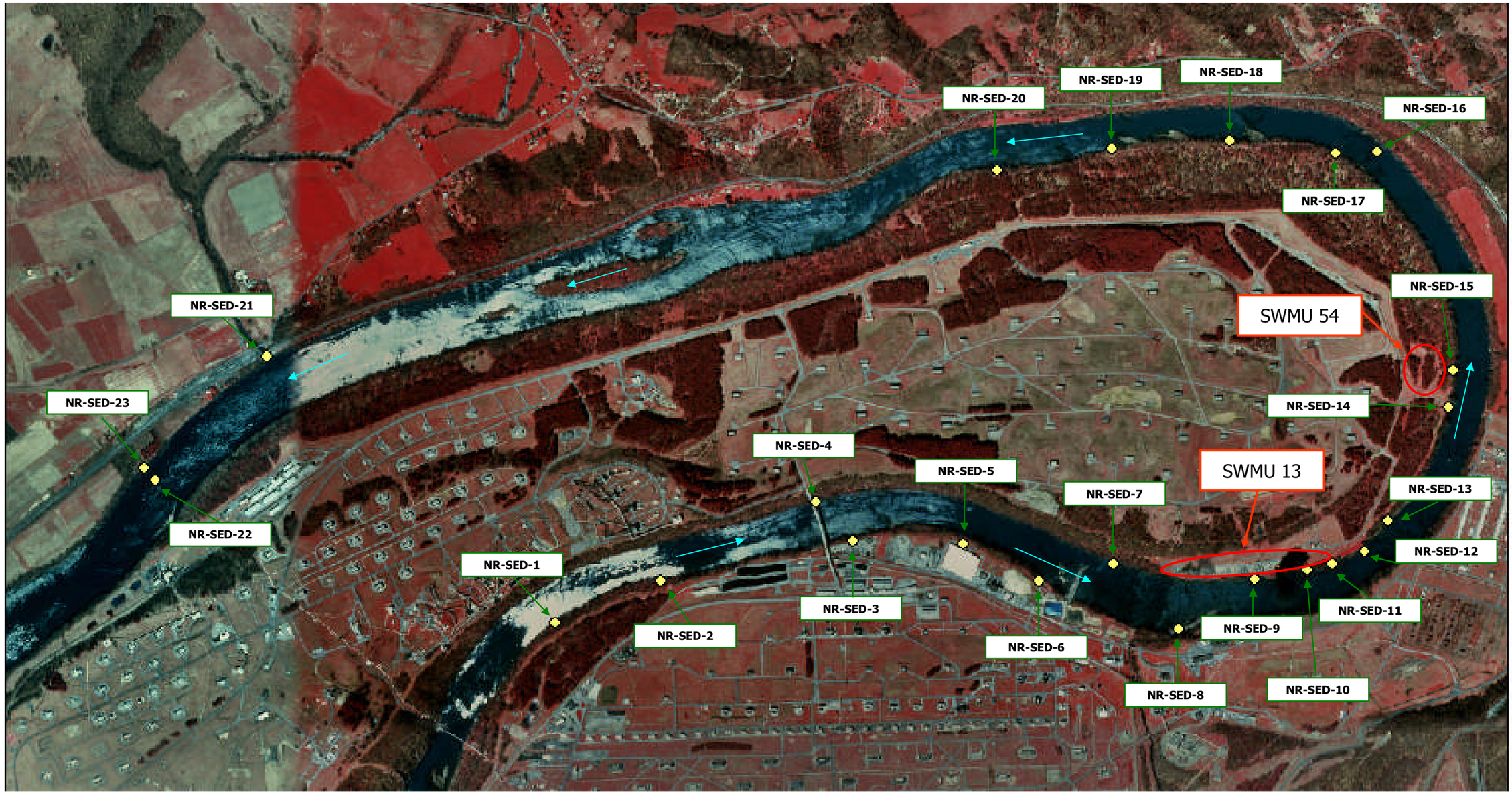
Date: June 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 200 feet	File Name: Fig 3-3 SW/PW Loc

SWMU 54

RCRA Facility Investigation
Radford Army Ammunition Plant
Radford, Virginia

URS Group, Inc.
5540 Falmouth Street
Suite 201
Richmond, Virginia 23230

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- ◇ Sediment Sampling Location
- NR-SED-1 Sampling Location ID
- → Flow Direction

N

FIGURE 3-4

Date: May 10, 2007

Drawn by: TLD/LAM

Reviewed by: JOS

Not to Scale

NEW RIVER SEDIMENT SAMPLING LOCATIONS

Radford Army Ammunition Plant
Radford, Virginia

URS

URS Group, Inc.
5540 FALMOUTH ST., SUITE 201
RICHMOND, VA 23230

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Table 3-1
Field Sample Identifiers, Depths, and Analytical Methods
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

					Chemical Analysis											Physical Analysis							
Sample ID	Date	Time	Dup Location	Depth (ft bgs)	TAL Metals/Hg (Unfiltered) SW-846 6010B/6020A/7471A	TAL Metals/Hg (Filtered) SW-846 6010B/6020A/7471A	Mnaganese	Pesticides/PCBs SW-846 8081A/8082	PCB Congeners SW-1668A	SVOCs SW-846 8270C	Dioxin/Furans SW-846 8290	PAHs SW-846 8310	Explosives/Nitroglycerin SW-846 8330/8332	Perchlorate EPA 314.0	Perchlorate EPA 6850	Total Organic Content ASTM D2974-00	Grain Size ASTM D422-92	Atterburg Limits ASTM D4318-00	Moisture Content ASTM D2216-98E1	pH ASTM D4972-01	Hydraulic Conductivity ASTM D5084-00E1-2000	Soil Porosity ASTM D4972-01	Soil Bulk Density ASTM D4253-00
Area A																							
Soil Borings																							
54SB17A	12/2/2002	10:15		0-1	X					X		X	X										
54SB17B	12/2/2002	10:30		9-10	X					X		X	X										
54SB18A	12/2/2002	11:45		0-1	X					X		X	X										
54SB18B	12/2/2002	11:00		9-10	X					X		X	X										
54SB19A	12/2/2002	11:10		0-1	X					X		X	X										
54SB19B	12/2/2002	11:20		9-10	X					X		X	X										
54SB20A	12/2/2002	15:15		0-1	X					X		X	X										
54SB20B	12/2/2002	15:25		9-10	X					X		X	X										
54SB21A	12/2/2002	15:35		0-1	X					X		X	X										
54SB21B	12/2/2002	15:45		9-10	X					X		X	X										
54SB22A	12/3/2002	8:45		0-1	X					X		X	X										
54SB22B	12/3/2002	8:55		9-10	X					X		X	X										
54SB23A	12/3/2002	9:00		0-1	X					X		X	X										
54SB23B	12/3/2002	9:10		9-10	X					X		X	X										
54SB24A	12/3/2002	9:25		0-1	X					X		X	X										
54SB24B	12/3/2002	9:35		9-10	X					X		X	X										
54SB25A	12/3/2002	9:50		0-1	X			X		X	X	X	X										
54SB25B	12/3/2002	10:00		9-10	X			X		X	X	X	X										
54SB26A	12/3/2002	10:10		0-1	X					X		X	X										
54SB26B	12/3/2002	10:20		9-10	X					X		X	X										
54SB27A	12/3/2002	10:30		0-1	X					X		X	X										
54SB27B	12/3/2002	10:40		9-10	X					X		X	X										
54SB28A	12/3/2002	10:45		0-1	X					X		X	X										
54SB28B	12/3/2002	10:55		8-10	X					X		X	X										
54SB29A	12/3/2002	11:15		0-1	X					X		X	X										
54SB29B	12/3/2002	11:25		9-10	X					X		X	X										
54SB30A	12/3/2002	11:30		0-1	X			X		X	X	X	X										
54SB30B	12/3/2002	11:40		9-10	X			X		X	X	X	X										
54SB31A	12/3/2002	12:15		0-1	X					X		X	X										
54SB31B	12/3/2002	12:25		9-10	X					X		X	X										
54SB32A	12/3/2002	12:45		0-1	X			X		X	X	X	X										
54SB32B	12/3/2002	12:55		9-10	X			X		X	X	X	X										
54SB33A	12/3/2002	13:15		1-2	X					X	X	X	X										
54SB33B	12/3/2002	13:25		9-10	X			X		X	X	X	X										
54SB34A	12/3/2002	13:45		0-1	X					X		X	X										
54SB34B	12/3/2002	13:55		9-10	X					X		X	X										
54SB35A	12/3/2002	14:10		0-1	X								X										
54SB35B	12/3/2002	14:20		9-10	X					X		X	X										
54SB36A	12/3/2002	14:30		0-1	X								X										
54SB36B	12/3/2002	14:40		9-10	X								X										
54SB37A	12/3/2002	14:50		0-1	X								X										
54SB37B	12/3/2002	15:00		9-10	X								X										
54SB38A	12/4/2002	8:45		0-1	X								X										
54SB38B	12/4/2002	8:50		9-10	X								X										
D-7	12/3/2002		54SB26B	9-10	X					X		X	X										
D-8	12/3/2002		54SB31B	9-10	X					X		X	X										
D-9	12/3/2002		54SB36B	9-10	X					X		X	X										
D-10	12/2/2002		54SB21B	9-10	X					X		X	X										
Additional Characterization: Work Instructions Samplin																							
54SB56A	8/18/2004	10:50		0-1	X			X					X										
54SB56B	8/18/2004	11:20		9-10	X			X					X										
54SB56C	8/18/2004	11:40		12.5-13.8	X			X					X										
54SB57A (previous 54SB6)	8/17/2004	14:45		0.1-1	X			X					X										
54SB57B (previous 54SB6)	8/17/2004	15:00		8-12	X			X					X										
54SB57C (previous 54SB6)	8/17/2004	15:30		16-18	X			X					X										
54SB58A	8/17/2004	16:30		0-1	X			X					X										
54SB58B	8/17/2004	16:40		9-10	X			X					X										
54SB58C	8/17/2004	16:55		16-18	X			X					X										
54SB59A	8/18/2004	11:50		0-1	X			X					X										
54SB59B	8/18/2004	14:00		9-10	X			X					X										
54SB59C	8/18/2004	14:20		13-15	X			X					X										
54SB60A	8/18/2004	16:45		0-1	X			X					X										

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54SB60B	8/18/2004	17:00		9-10	X			X					X										
54SB60C	8/18/2004	17:20		12-13.5	X			X					X										
54SB61A	8/17/2004	17:45		0-1	X			X					X										
54SB61B	8/17/2004	17:55		9-10	X			X					X										
54SB61C	8/17/2004	18:15		16-18	X			X					X										
54SB62A	8/19/2004	18:45		0-1	X			X					X										
54SB62B	8/19/2004	18:55		9-10	X			X					X										
54SB62C	8/19/2004	19:05		15-16	X			X					X										
54SB63A	8/19/2004	10:10		0-1	X			X					X										
54SB63B	8/19/2004	10:30		9-10	X			X					X										
54SB63C	8/19/2004	10:45		11-12	X			X					X										
54SB64A	8/18/2004	18:00		0-2	X			X					X										
54SB64B	8/18/2004	18:30		9-10	X			X					X										
54SB64C	8/18/2004	18:45		12.5-13.5	X			X					X										
54SB65A	8/19/2004	17:30		0-1	X			X					X										
54SB65B	8/19/2004	17:45		9-10	X			X					X										
54SB65C	8/19/2004	18:00		15-17	X			X					X										
54SB66A	8/19/2004	11:10		0-1	X			X					X										
54SB66B	8/19/2004	11:25		9-10	X			X					X										
54SB66C	8/19/2004	11:45		11-12	X			X					X										
54SB67A	8/19/2004	12:40		0-1	X			X					X										
54SB67B	8/19/2004	13:00		9-10	X			X					X										
54SB67C	8/19/2004	13:15		11-12.5	X			X					X										
54SB68A	8/19/2004	15:50		0-1	X			X					X										
54SB68B	8/19/2004	16:00		9-10	X			X					X										
54SB68C	8/19/2004	16:10		16-18	X			X					X										
54SB69A	8/19/2004	14:00		0-1	X			X					X										
54SB69B	8/19/2004	14:10		9-10	X			X					X										
54SB69C	8/19/2004	14:25		12-14	X			X					X										
54SB70A	8/19/2004	15:00		0-1	X			X					X										
54SB70B	8/19/2004	15:15		9-10	X			X					X										
54SB70C	8/19/2004	15:30		12.5-14	X			X					X										
D-1	8/17/2004		54SB57C	16-18	X			X					X										
D-2	8/18/2004		54SB59C	13-15	X			X					X										
D-4	8/19/2004		54SB63A	0-1	X			X					X										
D-5	8/19/2004		54SB69B	9-10	X			X					X										
D-6	8/19/2004		54SB62B	9-10	X			X					X										
RFI Additional Investigations Sampling																							
54SB3A	1/10/2007	10:05		0-0.5				X					X										
54SB3B	1/10/2007	10:10		9-10				X					X										
54SB3C	1/10/2007	10:15		13.3-14.3				X					X										
54SB10A	1/10/2007	10:51		0-0.5				X															
54SB10B	1/10/2007	10:57		9-10				X															
54SB10C	1/10/2007	11:04		13-14				X															
54SB22A	1/11/2007	15:05		0-0.5				X															
54SB22B	1/11/2007	15:10		9-10				X															
54SB22C	1/11/2007	15:15		15-16				X															
54SB23A	1/12/2007	9:18		0-0.5				X			X												
54SB23B	1/12/2007	9:23		9-10				X			X												
54SB23C	1/12/2007	9:28		16-17				X			X		X										
54SB27A	1/10/2007	9:36		0-0.5							X												
54SB27B	1/10/2007	9:41		9-10							X												
54SB27C	1/10/2007	9:48		14.3-15.3							X												
54SB32C	1/12/2007	9:05		16-17				X					X										
54SB33A	1/10/2007	14:35		0-0.5				X															
54SB34A	1/10/2007	13:40		0-0.5							X												
54SB34B	1/10/2007	13:45		9-10							X												
54SB34C	1/10/2007	13:50		18.5-19.5							X												
54SB38A	1/11/2007	11:35		0-0.5							X												
54SB38B	1/11/2007	11:42		9-10							X												
54SB38C	1/11/2007	11:50		16-17							X												
54SB57A	1/11/2007	12:10		0-0.5				X	X														
54SB58A	1/10/2007	11:17		0-0.5							X												
54SB58B	1/10/2007	11:23		9-10							X												

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54SB58C	1/10/2007	11:29		20.7-21-7							X												
54SB81A	1/10/2007	13:06		0-0.5	X*			X															
54SB81B	1/10/2007	13:11		9-10	X*			X															
54SB81C	1/10/2007	13:16		19-20	X*			X															
54SB82A	1/12/2007	10:05		0-0.5				X			X		X										
54SB82B	1/12/2007	10:10		9-10				X			X		X										
54SB82C	1/12/2007	10:15		18-19				X			X		X										
54SB83A	1/11/2007	10:12		0-0.5				X			X		X										
54SB83B	1/11/2007	10:17		9-10				X			X		X										
54SB83C	1/11/2007	10:24		21-22				X			X		X										
54SB84A	1/11/2007	9:45		0-0.5									X										
54SB84B	1/11/2007	9:50		9-10									X										
54SB84C	1/11/2007	9:55		15-16									X										
DUP-2	1/10/2007		54SB10C	13-14				X															
DUP3	1/10/2007		54SB81A	0-0.5	X*																		
DUP-3	1/11/2007		54SB83C	21-22				X			X		X										
DUP4	1/12/2007		54SB82C	18-19				X					X										
Dup-5	1/10/2007		54SB58C	20.7-21-7							X												
DUP 6	1/1/2007		54SB38C	16-17							X												
Dup 7	1/12/2007		54SB82C	18-19							X												
Groundwater																							
54DPW1	12/11/2002	10:20		--	X	X							X	X									
54DPW2	12/11/2002	13:30		--	X	X							X	X									
54DPW3	12/11/2002	9:00		--	X	X							X	X									
54MW2	3/4/2003	15:10		--	X	X				X		X	X	X									
54MW3	3/4/2003	13:55		--	X	X				X		X	X	X									
54MW5	3/4/2003	8:50		--	X	X				X		X	X	X									
54GW56	8/18/2004	12:15		--									X	X									
54GW57	8/17/2004	20:45		--									X	X									
54GW58	8/24/2004	11:00		--									X	X									
54GW59	8/18/2004	15:00		--									X	X									
54GW60	8/24/2004	11:30		--									X	X									
54GW61	8/24/2004	12:45		--									X	X									
54GW62	8/23/2004	16:00		--									X	X									
54GW63	8/23/2004	15:45		--									X	X									
54GW64	8/23/2004	15:00		--									X	X									
54GW65	8/20/2004	14:00		--									X	X									
54GW66	8/20/2004	14:15		--									X	X									
54GW67	8/20/2004	14:10		--									X	X									
54GW68	8/20/2004	13:15		--									X	X									
54GW69	8/20/2004	14:50		--									X	X									
54GW70	8/20/2004	12:00		--									X	X									
D-3	8/18/2004		54GW59	--									X	X									
D-9	8/23/2004		54GW64	--									X	X									
54GP77	10/13/2004	10:45		--										X									
54GP78	10/11/2004	16:00		--										X									
54GP79	10/11/2004	14:10		--										X									
54GP80	10/13/2004	16:40		--										X									
54GP81	10/11/2004	10:05		--										X									
54GP82	10/11/2004	10:35		--										X									
54GP83	10/11/2004	11:45		--										X									
54GP84	10/13/2004	15:15		--										X									
54GP85	10/14/2004	9:45		--										X									
54GP86	10/13/2004	11:45		--										X									
54GP87	10/14/2004	12:05		--										X									
D-1	10/11/2004		54GP78	--										X									
54MW-8	12/21/2004	14:35		--			X						X	X									
54MW-9	12/21/2004	13:20		--			X						X	X									
54MW-10	12/21/2004	16:10		--			X						X	X									
D-1	12/21/2004		54MW-10	--			X						X	X									
Manganese Background Monitorin																							
54MW1(1)	8/24/2004	17:30		--			X																
54MW1(2)	10/11/2004	12:40		--			X																
54MW1(3)	11/30/2004	12:00		--			X																

Table 3-1
Field Sample Identifiers, Depths, and Analytical Methods
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

					Chemical Analysis											Physical Analysis							
Sample ID	Date	Time	Dup Location	Depth (ft bgs)	TAL Metals/Hg (Unfiltered) SW-846 6010B/6020A/7471A	TAL Metals/Hg (Filtered) SW-846 6010B/6020A/7471A	Mnaganese	Pesticides/PCBs SW-846 8081A/8082	PCB Congeners SW-1668A	SVOCs SW-846 8270C	Dioxin/Furans SW-846 8290	PAHs SW-846 8310	Explosives/Nitroglycerin SW-846 8330/8332	Perchlorate EPA 314.0	Perchlorate EPA 6850	Total Organic Content ASTM D2974-00	Grain Size ASTM D422-92	Atterburg Limits ASTM D4318-00	Moisture Content ASTM D2216-98E1	pH ASTM D4972-01	Hydraulic Conductivity ASTM D5084-00E1-2000	Soil Porosity ASTM D4972-01	Soil Bulk Density ASTM D4253-00
54MW1(4)	12/15/2004	12:50		--			X																
Groundwater - RFI Quarterly Sampling																							
First Quarter																							
54MW1	11/29/2006	13:55		--				X			X		X	X									
54MW2	11/29/2006	15:05		--				X			X		X	X									
54MW3	12/5/2006	12:40		--				X			X		X	X									
54MW5	11/29/2006	17:05		--				X					X	X									
54MW8	12/1/2006	14:40		--				X					X	X									
54MW9	12/1/2006	13:20		--				X					X	X									
54MW10	12/1/2006	15:50		--				X					X	X									
DUP-5	12/5/2006		54MW3	--				X			X		X	X									
Second Quarter																							
54MW1	3/28/2007	9:55		--									X		X								
54MW2	3/28/2007	11:30		--									X		X								
54MW3	3/28/2007	12:21		--									X		X								
54MW5	3/28/2007	10:33		--									X		X								
54MW8	3/27/2007	13:30		--									X		X								
54MW9	3/27/2007	14:10		--									X		X								
54MW10	3/27/2007	12:11		--									X		X								
DUP-1	3/27/2007		54MW10	--									X		X								
Third Quarter																							
54MW1	6/5/2007	19:29		--									X		X								
54MW2	6/5/2007	17:10		--									X		X								
54MW3	6/5/2007	17:30		--									X		X								
54MW5	6/5/2007	16:40		--									X		X								
54MW8	6/5/2007	14:13		--									X		X								
54MW9	6/5/2007	14:35		--									X		X								
54MW10	6/5/2007	15:50		--									X		X								
Fourth Quarter																							
54MW1	9/19/2007	14:43		--									X		X								
54MW2	9/19/2007	10:37		--									X		X								
54MW3	9/19/2007	9:18		--									X		X								
54MW5	9/19/2007	11:35		--									X		X								
54MW8	9/19/2007	15:30		--									X		X								
54MW9	9/19/2007	14:05		--									X		X								
54MW10	9/19/2007	16:40		--									X		X								
Area B																							
Soil Borings																							
54SB39A	12/10/2002	10:00		0-1	X					X		X	X										
54SB39B	12/10/2002	10:10		9-10	X					X		X	X										
54SB40A	12/10/2002	10:35		0-1	X					X		X	X										
54SB40B	12/10/2002	10:45		9-10	X					X		X	X										
54SB41A	12/10/2002	9:40		0-1	X					X		X	X										
54SB41B	12/10/2002	9:50		9-10	X					X		X	X										
54SB42A	12/10/2002	11:00		0-1	X					X		X	X										
54SB42B	12/10/2002	11:10		9-10	X					X		X	X										
54SB43A	12/4/2002	9:15		0.5-1	X					X		X	X										
54SB43B	12/4/2002	9:30		8-9	X					X		X	X										
54SB43C	12/4/2002	9:45		10-11	X					X		X	X										
54SB44A	12/4/2002	10:00		0-1	X					X		X	X										
54SB44B	12/4/2002	10:10		9-10	X					X		X	X										
54SB44C	12/4/2002	10:20		17-18	X					X		X	X										
54SB45A	12/9/2002	14:25		0-1	X					X		X	X										
54SB45B	12/9/2002	14:35		9-10	X					X		X	X										
54SB46A	12/4/2002	10:40		0.5-1	X			X		X	X	X	X										
54SB46B	12/4/2002	10:50		7.5-9	X			X		X	X	X	X										
54SB46C	12/4/2002	11:00		11-12	X					X		X	X										
54SB47A	12/9/2002	14:45		0-1	X					X		X	X										
54SB47B	12/9/2002	14:55		9-10	X					X		X	X										
54SB48A	12/9/2002	13:10		0-1	X			X		X	X	X	X										
54SB48B	12/9/2002	13:20		9-10	X			X		X	X	X	X										
54SB49A	12/4/2002	11:15		1-2	X			X		X	X	X	X										
45SB49B	12/4/2002	11:25		9-10	X			X		X	X	X	X										
45SB49C	12/4/2002	11:35		13.5-14.5	X					X		X	X										

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Field Sample Identifiers, Depths, and Analytical Methods
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

					Chemical Analysis											Physical Analysis							
Sample ID	Date	Time	Dup Location	Depth (ft bgs)	TAL Metals/Hg (Unfiltered) SW-846 6010B/6020A/7471A	TAL Metals/Hg (Filtered) SW-846 6010B/6020A/7471A	Mnaganese	Pesticides/PCBs SW-846 8081A/8082	PCB Congeners SW-1668A	SVOCs SW-846 8270C	Dioxin/Furans SW-846 8290	PAHs SW-846 8310	Explosives/Nitroglycerin SW-846 8330/8332	Perchlorate EPA 314.0	Perchlorate EPA 6850	Total Organic Content ASTM D2974-00	Grain Size ASTM D422-92	Atterburg Limits ASTM D4318-00	Moisture Content ASTM D2216-98E1	pH ASTM D4972-01	Hydraulic Conductivity ASTM D5084-00E1-2000	Soil Porosity ASTM D4972-01	Soil Bulk Density ASTM D4253-00
54SB50A	12/9/2002	12:50		0-1	X					X		X	X										
54SB50B	12/9/2002	13:00		9-10	X					X		X	X										
54SB51A	12/4/2002	12:00		0-1	X					X		X	X										
54SB51B	12/4/2002	12:10		9-10	X					X		X	X										
54SB51C	12/4/2002	12:20		16-17	X					X		X	X										
54SB52A	12/10/2002	9:15		0-1	X					X		X	X										
54SB52B	12/10/2002	9:25		9-10	X					X		X	X										
54SB53A	12/10/2002	12:45		0-1	X					X		X	X										
54SB53B	12/10/2002	12:55		9-10	X					X		X	X										
54SB54A	12/9/2002	13:45		0-1	X					X		X	X										
54SB54B	12/9/2002	13:55		9-10	X					X		X	X										
54SB55A	12/9/2002	12:20		0-1	X			X		X	X	X	X										
54SB55B	12/9/2002	12:40		9-10	X			X		X	X	X	X										
D-11	12/4/2002		54SB44C	17-18	X					X		X	X										
D-12	12/9/2002		54SB55B	9-10	X			X		X		X	X										
D-13	12/9/2002		54SB47A	0-1	X					X		X	X										
D-14	12/10/2002		54SB42A	0-1	X					X		X	X										
Additional Characterization: Work Instructions Samplin																							
54SB71A	8/20/2004	17:10		0-1				X															
54SB71B	8/20/2004	17:15		9-10				X															
54SB71C	8/20/2004	17:20		12-12.8				X															
54SB72A	8/20/2004	10:15		0-1				X															
54SB72B	8/20/2004	10:25		9-10				X															
54SB72C	8/20/2004	10:35		10.3-10.7				X															
54SB73A	8/20/2004	15:00		0-1				X															
54SB73B	8/20/2004	15:10		9-10				X															
54SB73C	8/20/2004	15:15		10-11				X															
54SB74A	8/20/2004	15:45		0-1				X															
54SB74B	8/20/2004	15:50		9-10				X															
54SB74C	8/20/2004	16:00		12-12.5				X															
54SB75A	8/20/2004	10:50		0-1				X															
54SB75B	8/20/2004	11:00		9-10				X															
54SB75C	8/20/2004	11:10		13-14.5				X															
54SB76C (previous 54SB46)	8/20/2004	14:40		10-11				X															
D-7	8/20/2004		54SB76C	10-11				X															
D-8	8/20/2004		54SB74A	0-1				X															
RFI Additional Investigations Samplin																							
54SB39A	1/8/2007	15:35		0-0.5							X												
54SB39B	1/8/2007	15:40		9-10							X												
54SB39C	1/8/2007	15:45		15-16							X												
54SB40A	1/8/2007	15:15		0-0.5							X												
54SB40B	1/8/2007	15:25		8-9							X												
54SB40C	1/8/2007	15:30		11-12							X												
54SB41A	1/9/2007	8:50		0-0.5							X												
54SB41B	1/9/2007	8:55		9-10							X												
54SB41C	1/9/2007	9:00		14-15							X												
54SB42A	1/8/2007	16:00		0-0.5				X			X												
54SB42B	1/8/2007	16:15		9-10				X			X												
54SB42C	1/8/2007	16:25		13.5-14.5				X			X												
54SB43A	1/8/2007	14:46		0-0.5							X												
54SB43B	1/8/2007	14:50		5-6							X												
54SB43C	1/8/2007	14:55		8-9							X												
54SB45A	1/9/2007	9:14		0-0.5							X												
54SB45B	1/9/2007	9:18		9-10							X												
54SB45C	1/9/2007	9:23		12-13							X												
54SB46A	1/9/2007	10:30		0-0.5				X	X		X												
54SB46C	1/9/2007	10:45		9-10				X	X		X												
54SB47A	1/9/2007	11:13		0-0.5							X												
54SB47B	1/9/2007	11:23		6-7							X												
54SB47C	1/9/2007	11:33		9-10							X												
54SB50A	1/9/2007	12:50		0-0.5							X												
54SB50B	1/9/2007	13:00		9-10							X												
54SB50C	1/9/2007	13:05		11.5-12.5							X												
54SB53A	1/9/2007	10:50		0-0.5							X												

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					Chemical Analysis											Physical Analysis							
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54SB53B	1/9/2007	11:00		9-10							X												
54SB53C	1/9/2007	11:10		12-13							X												
54SB54A	1/9/2007	9:45		0-0.5							X												
54SB54B	1/9/2007	9:55		9-10							X												
54SB54C	1/9/2007	10:05		12-13							X												
54SB77A	1/9/2007	15:10		0-0.5							X												
54SB77B	1/9/2007	15:20		7-8							X												
54SB77C	1/9/2007	15:30		10-11							X												
54SB78A	1/9/2007	11:35		0-0.5							X												
54SB78B	1/9/2007	11:38		9-10							X												
54SB78C	1/9/2007	11:40		13.5-14.5							X												
54SB79A	1/9/2007	14:40		0-0.5							X												
54SB79B	1/9/2007	14:50		7-8							X												
54SB79C	1/9/2007	15:00		9.5-10.5							X												
54SB80A	1/9/2007	13:10		0-0.5							X												
54SB80B	1/9/2007	13:17		5-6							X												
54SB80C	1/9/2007	13:21		9-10							X												
DUP-1	1/8/2007		54SB42A	0-0.5				X			X												
DUP2	1/9/2007		54SB54B	9-10							X												
DUP3	1/9/2007		54SB78B	9-10							X												
DUP4	1/9/2007		54SB77C	10-11							X												
Groundwater																							
54MW4	3/4/2003	12:30		--	X	X				X		X	X	X									
54MW6	3/3/2003	15:05		--	X	X				X		X	X	X									
54MW7	3/4/2003	10:30		--	X	X				X		X	X	X									
D-1	3/4/2003		54MW7	--	X	X				X		X	X	X									
Manganese Background Monitoring																							
54MW6(1)	8/24/2004	16:30		--			X																
54MW6(2)	10/11/2004	17:20		--			X																
54MW6(3)	11/30/2004	13:25		--			X																
54MW6(4)	12/15/2004	14:40		--			X																
Groundwater - RFI Quarterly Sampling																							
First Quarter																							
54MW4	11/30/2006	16:00		--				X			X		X	X									
54MW6	11/29/2006	11:00		--				X			X		X	X									
54MW7	12/5/2006	11:50		--				X			X		X	X									
Second Quarter																							
54MW4	3/27/2007	15:55		--									X		X								
54MW6	3/27/2007	10:25		--									X		X								
54MW7	3/27/2007	16:28		--									X		X								
Third Quarter																							
54MW4	6/5/2007	12:18		--							X		X		X								
54MW6	6/5/2007	10:55		--							X		X		X								
54MW7	6/5/2007	12:37		--							X		X		X								
DUP-1	6/5/2007		54MW4	--							X		X		X								
Fourth Quarter																							
54MW4	9/19/2007	13:43		--									X		X								
54MW6	9/19/2007	16:35		--									X		X								
54MW7	9/19/2007	12:32		--									X		X								
DUP-1	9/19/2007		54MW7	--									X		X								
Sediment																							
NR-SED-1	11/8/2006	14:35		0-4 inches	X								X			X	X			X			
NR-SED-2	11/8/2006	14:25		0-4 inches	X								X			X	X			X			
NR-SED-3	11/8/2006	14:05		0-4 inches	X								X			X	X			X			
NR-SED-4	11/8/2006	14:50		0-4 inches	X								X			X	X			X			
NR-SED-5	11/8/2006	13:50		0-4 inches	X								X			X	X			X			
NR-SED-6	11/8/2006	13:40		0-4 inches	X								X			X	X			X			
NR-SED-7	11/8/2006	15:00		0-4 inches	X								X			X	X			X			
NR-SED-8	11/8/2006	13:25		0-4 inches	X								X			X	X			X			
NR-SED-9	11/8/2006	13:05		0-4 inches	X								X			X	X			X			
NR-SED-10	11/8/2006	12:50		0-4 inches	X								X			X	X			X			
NR-SED-11	11/8/2006	12:35		0-4 inches	X								X			X	X			X			
NR-SED-12	11/8/2006	12:00		0-4 inches	X								X			X	X			X			
NR-SED-13	11/8/2006	11:50		0-4 inches	X								X			X	X			X			

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					Chemical Analysis											Physical Analysis							
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NR-SED-14	11/8/2006	11:25		0-4 inches	X								X			X	X			X			
NR-SED-15	11/8/2006	11:00		0-4 inches	X								X			X	X			X			
NR-SED-16	11/8/2006	10:50		0-4 inches	X								X			X	X			X			
NR-SED-17	11/8/2006	10:35		0-4 inches	X								X			X	X			X			
NR-SED-18	11/8/2006	10:20		0-4 inches	X								X			X	X			X			
NR-SED-19	11/8/2006	10:10		0-4 inches	X								X			X	X			X			
NR-SED-20	11/8/2006	9:50		0-4 inches	X								X			X	X			X			
NR-SED-21	11/8/2006	9:25		0-4 inches	X								X			X	X			X			
NR-SED-22	11/8/2006	8:25		0-4 inches	X								X			X	X			X			
NR-SED-23	11/8/2006	9:05		0-4 inches	X								X			X	X			X			
DUP-1	11/8/2006		NR-SED-17	0-4 inches	X								X			X	X			X			
DUP-2	11/8/2006		NR-SED-9	0-4 inches	X								X			X	X			X			
Surface Water/Pore Water																							
NR-SW-1	11/30/2006	9:15		--									X	X									
NR-PW-1	11/30/2006	9:10		--									X	X									
NR-SW-2	11/30/2006	10:30		--									X	X									
NR-PW-2	11/30/2006	11:10		--									X	X									
NR-SW-3	11/30/2006	11:25		--									X	X									
NR-PW-3	11/30/2006	11:55		--									X	X									
NR-SW-4	11/30/2006	12:10		--									X	X									
NR-PW-4	11/30/2006	12:20		--									X	X									
NR-SW-5	11/30/2006	12:40		--									X	X									
NR-PW-5	11/30/2006	13:05		--									X	X									
NR-SW-6	11/30/2006	13:30		--									X	X									
NR-PW-6	11/30/2006	13:40		--									X	X									
NR-SW-7	12/1/2006	7:50		--									X	X									
NR-PW-7	12/1/2006	8:15		--									X	X									
NR-SW-8	12/1/2006	8:35		--									X	X									
NR-PW-8	12/1/2006	9:00		--									X	X									
NR-SW-9	12/1/2006	9:20		--									X	X									
NR-PW-9	12/1/2006	9:35		--									X	X									
NR-SW-10	12/1/2006	10:00		--									X	X									
NR-PW-10	12/1/2006	10:15		--									X	X									
DUP-3	11/30/2006		NR-PW-6	--									X	X									
DUP-4	12/1/2006		NR-SW-8	--									X	X									
Geotechnical Samples																							
54 A-SM				Composite												X	X	X	X	X	X	X	X
54 B-CL				Composite												X	X	X	X	X	X	X	X
54 B-GM				Composite												X	X	X	X	X	X	X	X
54 B-ML				Composite												X	X	X	X	X	X	X	X
54 B-SM				Composite												X	X	X	X	X	X	X	X
54 B-SP 1				Composite												X	X	X	X	X	X	X	X
54 B-SP 2				Composite												X	X	X	X	X	X	X	X

Notes:

ft bgs = Feet Below Ground Surface
D or DUP = Duplicate sample
EPA = U.S. Environmental Protection Agency
GP = GeoProbe
SB = Soil Boring
GW = Groundwater
MW = Monitoring Well
NR = New River

SED = Sediment
PW = Pore Water
SW = Surface Water
PAH = Polynuclear Aromatic Hydrocarbon
PCB =Polychlorinated Biphenyl
SVOC = Semivolatile Organic Compound
TAL = Target Analyte List
VOC = Volatile Organic Compound

RFI = RCRA Facility Investigation
TCLP = Toxicity Characteristic Leaching Procedure
X* = Samples tested for lead only

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4.0 NATURE AND EXTENT OF CHEMICALS

The following sections discuss the results of chemical sampling of soil and groundwater at the site and surface water, sediment, and sediment pore water in the New River and assess the nature and extent of detected chemicals in site media. Chemical results are evaluated with respect to the following: USEPA Region III R-RBCs and industrial RBCs (I-RBCs) for soil, and tap water RBCs (T-RBCs) (USEPA 2007), which are adjusted downward for non-carcinogenic chemicals to a hazard quotient (HQ) of 0.1 to account for potential additive toxicity effects of multiple chemicals; USEPA Region III soil transfer-to-groundwater screening levels (SSLs, dilution attenuation factor (DAF)1 default values); the most current USEPA Region III ecological soil screening levels (as presented in Section 7.0); and freshwater screening levels for surface water/pore water and sediment (USEPA 2006b, USEPA 2006c); USEPA maximum contaminant levels (MCLs) for groundwater and surface water; and facility-wide background concentrations for metals in soil as provided below (IT 2001).

Facility-Wide Point Estimates for Soil

Chemical	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	95% Upper Tolerance Limit (UTL) of the Mean (mg/kg)
Aluminum	3,620	47,900	40,041
Arsenic	1.2	35.9	15.8
Barium	23.4	174	209
Beryllium	0.61	5.4	1.02
Cadmium	0.62	2.5	0.69
Chromium	6.3	75.8	65.3
Cobalt	5.9	130	72.3
Copper	1.6	38.7	53.5
Iron	7,250	67,700	50,962
Lead	2.1	256	26.8
Manganese	16.7	2,040	2,543
Mercury	0.038	1.2	0.13
Nickel	4.6	94.2	62.8
Thallium	1.3	5	2.11
Vanadium	12.2	114	108
Zinc	4.7	598	202

Areas A and B are evaluated separately for the soil nature and extent assessment given the 200 ft separation between these areas, their topographic cross-gradient position, the lack of mobility of the chemicals in soil, and observed distributions of chemicals in soil. Groundwater sample results are evaluated both on an area-specific basis for release evaluations and on a site-wide basis for characterizing the nature and extent of dissolved phase COPCs in groundwater. With the exception of metals in soil, chemicals detected in one or more samples in a given medium at concentrations above their adjusted RBCs, SSL DAF1s, or ecological screening levels are identified in the nature and extent assessment as

COPCs. Metals in soil detected at concentrations above their background point estimates and an adjusted RBC, SSL DAF1, or ecological screening values are retained as COPCs in the nature and extent assessment. The facility-wide background concentrations are used in the nature and extent assessment to evaluate the significance of background exceedances in soil and to assist in bounding the lateral and vertical extent of metals concentrations potentially attributable to historical site activities. Additional chemical specific screening information is provided below.

Dioxin/furans were detected at the sites. Dioxin/furan results were converted into one total 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) toxicity equivalents concentration (TEQ) using the Toxicity Equivalent Factors (TEF) method outlined in *Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and Dibenzofurans (CDDs and CDFs)* (USEPA 1989a and WHO 2005). The TEQ concentration for each sample was then compared to the appropriate media specific screening level. TEQ calculations are provided in Section 6 for Area A - Tables 6-3A (soil) and 6-3B (groundwater) and Area B – Tables 6-3C (soil), 6-3D (groundwater), and 6-3E (groundwater). Similarly for the ecological assessment, dioxin/furan results were converted into one total 2,3,7,8-TCDD TEQ for each sample and then compared to the appropriate receptors specific screening values as presented in Section 7, Table 7-7 for Area A, and Table 7-11 for Area B.

Also note that for some explosives (i.e., DNT), the carcinogenic toxicity data available for DNTs (i.e., 2,4-DNT and 2,6-DNT) applies to the DNT mixture; therefore, the concentrations detected for 2,4-DNT and 2,6-DNT for each sample are summed and this value is screened against the carcinogenic RBC. Non-carcinogenic RBCs are available for both 2,4-DNT and 2,6-DNT; therefore, they are screened independently against the adjusted non-carcinogenic RBCs. Similarly, only one non-carcinogenic RBC is available for amino DNTs (2ADNT and 4-amino-2,6-dinitrotoluene [4ADNT]); therefore, the detected concentrations are summed and screened against the adjusted non-carcinogenic RBCs. If one compound is detected in the sample and the other compound is not, one half the detection limit of the non-detect is summed with the detected result.

Note that if a constituent was measured by two methods, results from the more sensitive analytical method were used for screening. For example if PAHs were analyzed as part of the SVOC method (Method 8270C), as well as, by a PAH specific method (Method 8310), the results from the PAH specific method were used. This also applies to explosives by Method 8330. If a PAH was detected by Method 8310 above a screening level but it was not detected by low level 8270C, the detection was not confirmed; therefore, the detection is not considered an exceedance of the screening level for the nature and extent assessment.

4.1 NATURE AND EXTENT - AREA A SOIL

4.1.1 Analytical Results

Forty-one surface soil samples and 62 subsurface soil samples for a total of 103 samples were collected for chemical analysis from Area A (Figure 3-1 and Table 3-1). Soil samples for chemical analysis were collected from three intervals including: a surface soil sample (“A” sample), an intermediate sample (“B” sample), and a terminal depth sample (“C” sample). Table 4-1 presents analytical results for chemicals detected in soil samples collected at Area A and screens these data with respect to adjusted RBCs, SSLs, and background concentrations. Table 4-2 summarizes the screening results for soil data including: constituents detected, minimum and maximum concentrations detected, number of detections, number of samples, and number of samples exceeding human health screening criteria or SSL DAF1 screening levels and background concentrations (inorganics only). Chemicals of potential ecological concern (COPECs) listed below were identified for the site as part of the refined screening level ecological risk assessment presented in Section 7.2.2 and above background point estimates (inorganics only) The screenings resulted in the identification of the following COPCs and COPECs (note that chemical which exceeded both its adjusted R-RBC and I-RBC are italicized):

TAL Metals (Methods 6010B, 6020A, 7471A) – 23 TAL metals were detected in soil samples with the following screening level exceedances:

RBC – antimony, cadmium, *iron*, lead, *manganese*, thallium, zinc;
SSL – antimony, cadmium, manganese, selenium, thallium, zinc; and
Eco – iron, mercury, selenium, and zinc.

TCL Pesticides (Method 8081A) – 11 pesticides were detected in soil samples with the following screening level exceedances:
RBC – heptachlor epoxide;
SSL – gamma-BHC, heptachlor epoxide; and
Eco – none.

TCL PCBs (Method 8082) – 2 PCBs were detected in soil samples with the following screening level exceedance:
RBC – Aroclor 1254;
SSL – Aroclor 1254; and
Eco – none.

TCL SVOCs (Method 8270C) – 6 SVOCs were detected in soil samples with the following screening level exceedances:
RBC – none;
SSL – N-nitrosodiphenylamine; and
Eco – none.

PAHs (Method 8310) – 16 PAHs were detected in soil samples with the following screening level exceedances:
RBC – benzo(a)anthracene, *benzo(a)pyrene*, benzo(b)fluoranthene, *dibenz(a,h)anthracene*, indeno(1,2,3-cd)pyrene;
SSL – acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene (acenaphthene and naphthalene detections not confirmed by low-level Method 8270C analysis); and
Eco – acenaphthene, acenaphthylene, and naphthalene (acenaphthene and naphthalene detections not confirmed by low-level Method 8270C analysis).

Explosives (Method 8330) and Nitroglycerin (Method 8332) – 7 explosives and nitroglycerin were detected in soil samples with the following screening level exceedances:
RBC – *2,4,6-TNT*, 2,4-DNT, 2,6-DNT, *DNT mixture, nitroglycerin*;
SSL – 2,4-DNT, 2,6-DNT; and
Eco – none (no screening values available for explosives).

Dioxin/Furans (Method 8290) – Dioxin/furans were detected in soil samples with the following screening level exceedance:
RBC –2,3,7,8-TCDD TEQ;
SSL – 2,3,7,8-TCDD TEQ; and
Eco – none.

4.1.2 Human Health Nature and Extent Assessment

A summary of the human health risk and background screening results for COPCs is presented in the table below.

Summary of COPCs for Soil

Chemical	Total # of Det/# of Samples	R-RBC Exceedances		I-RBC Exceedances	
		# of Exceed.	Sample IDs	# of Exceed.	Sample IDs
Antimony	44/82	1	54SB33B	0	NA
Cadmium	48/89	1	54SB23A	0	NA
Iron	89/89	4	54SB63A, 54SB66A, 54SB67B, 54SB67C	2	54SB67B, 54SB67C
Lead	92/92	4	54SB33A, 54SB34A, 54SB67B, 54SB67C	0	NA
Manganese	89/89	2	54SB67B, 54SB67C	2	54SB67B, 54SB67C
Thallium	43/70	2	54SB67B, 54SB67C	0	NA
Zinc	89/89	1	54SB67C	0	NA
Heptachlor Epoxide	5/75	3	54SB32A, 54SB25B, 54SB32B	0	NA
Aroclor 1254	7/75	1	54SB57A	0	NA
Benzo(a)anthracene*	17/36	1	54SB31B DUP AVG	0	NA
Benzo(a)pyrene*	13/36	2	54SB25A, 54SB31B DUP AVG,	1	54SB31B DUP AVG
Benzo(b)fluoranthene*	15/36	1	54SB31B DUP AVG	0	NA
Dibenz(a,h)anthracene*	6/36	1	54SB31B DUP AVG	1	54SB31B DUP AVG
Indeno(1,2,3-cd)pyrene*	7/36	1	54SB31B DUP AVG	0	NA
2,4,6-TNT	9/103	3	54SB27A, 54SB23B, 54SB32B	1	54SB27A
2,4-DNT	3/103	1	54SB27A	0	NA
2,6-DNT	2/103	1	54SB27A	0	NA
DNT Mix	3/103	2	54SB27A, 54SB23B	1	54SB27A
Nitroglycerin	1/89	1	54SB32B	1	54SB32B
2,3,7,8-TCDD TEQ	29/29	3	54SB32A, 54SB33A, 54SB32B	0	NA

Notes: NA=Not Applicable, DUP AVG = Duplicate Average, * Detections confirmed by both low-level 8270C and 8310 analysis

The nature and extent of COPCs identified in the above table, as well as SSL DAF 1 exceedances (above background concentrations for inorganics) identified in Section 4.1.1 and presented on Table 4-2, is discussed further in the following sections.

4.1.2.1 Lead

The approximate lateral and vertical extent of lead in soil at Area A at concentrations above the residential action level (AL) of 400 mg/kg is shown on Figure 4-1. This area includes borings 54SB33 and 54SB34, as shown on Figure 4-1. The vertical extent of soil with lead concentrations above the residential AL is less than 9 ft bgs based on analytical results from intermediate "B" samples collected from these borings. Lead concentrations detected in soil at Area A are below the industrial AL of 750 mg/kg.

Isolated detections of lead above the residential AL occurred in 1 of 12 borings completed outside of the security fence at Area A between the security fence and the New River (Figure 4-1). The intermediate and terminal samples collected from boring 54SB67 had lead concentrations above the residential AL but below the industrial AL. Explosives were not detected in these samples and lead concentrations in other borings completed between the security fence and the New River were less than the residential AL.

Based on these data and other available site information, it was concluded that the isolated detection of lead in boring 54SB67 was not related to propellant ash waste disposal activities at Area A.

Groundwater sample results from Area A did not indicate leaching of lead from soil to groundwater at detectable levels.

4.1.2.2 Pesticides

The approximate lateral and vertical extent of pesticides in soil at Area A at concentrations above adjusted R-RBCs is shown on Figure 4-2. Heptachlor epoxide was the only pesticide detected in soil at a concentration above its adjusted R-RBC; two non-contiguous areas of impact were identified around borings 54SB25 and 54SB32 as shown on Figure 4-2. The vertical extent of soil with heptachlor epoxide concentrations above the adjusted R-RBC is less than 16 ft bgs based on the analytical results from the terminal "C" sample collected from 54SB32. Terminal sample data are not available from 54SB25 so the precise vertical extent of impact at 54SB25 is uncertain. Detected concentrations of heptachlor epoxide were below the adjusted I-RBC. Heptachlor epoxide was the only pesticide detected in soil at a concentration above its adjusted R-RBC; two non-contiguous areas of impact were identified around borings 54SB25 and 54SB32 as shown on Figure 4-2. The precise lateral limit of impact of these non-contiguous areas is uncertain and therefore estimated given the lack of sample data immediately south, east, and west of 54SB25 near the center of the SWMU area.

Gamma-BHC and heptachlor epoxide were detected in one or more soil samples above their SSL DAF1s. Additional discussion and assessment of the soil-to-groundwater migration pathway for heptachlor epoxide and gamma-BHC is presented in Section 5.0. Groundwater sample results from Area A did not indicate leaching of heptachlor epoxide or other pesticides from soil to groundwater at detectable levels.

4.1.2.3 PCBs

The approximate lateral and vertical extent of PCBs in soil at Area A at concentrations above adjusted R-RBCs is shown on Figure 4-2. Aroclor 1254 was the only PCB detected in soil at a concentration above its adjusted R-RBC; one area of impact was identified around boring 54SB57 as shown on Figure 4-2. The vertical extent of soil with Aroclor concentrations above the adjusted R-RBC is less than 9 ft bgs based on the analytical results from the intermediate "B" sample collected from 54SB57. Detected concentrations of Aroclor 1254 were below the adjusted I-RBC.

Aroclor 1254 was detected in one or more soil samples above its SSL DAF1. Additional discussion and assessment of the soil-to-groundwater migration pathway for PCBs is presented in Section 5.0. Groundwater sample results from Area A did not indicate leaching of Aroclor 1254 or other PCBs from soil to groundwater at detectable levels.

4.1.2.4 Dioxins

The extent of 2,3,7-8-TCDD TEQ in soil at concentrations above the R-RBC shown on Figure 4-3 around the area of borings 54SB32 and 54SB33 has not been precisely delineated and is based on a combination of specific sample data for dioxins and inferences made from more extensive testing for lead and explosives at the site. Lead and explosives are indicator chemicals for propellant ash at Area A and one or both of these compounds would be expected to be co-located with elevated concentrations of dioxins. Impacts are not shown on Figure 4-3 in the northern portion of the SWMU given the lack of evidence of propellant ash or burned material (possibly resulting in dioxins) in the borings and low concentrations of lead and non detect explosives concentrations below risk-screening criteria. Given these results and the lack of detected concentrations above risk-screening criteria in borings 54SB23, 54SB25, 54SB27, 54SB30, 54SB83, and 54SB84 completed south of this area, the interpreted limits shown on Figure 4-3 are in the southern portion of the SWMU."

As shown on Figure 4-3, the vertical extent of dioxin impact at boring 54SB32 extends from the surface to a depth greater than 10 ft bgs and at boring 54SB33 the vertical extent of dioxin impact extends from

the surface to a depth less than 9 ft bgs. Detected concentrations of dioxins were below the adjusted I-RBC."

Dioxins were detected in one or more soil samples above their SSL DAF1. Additional discussion and assessment of the soil-to-groundwater migration pathway for dioxins is presented in Section 5.0. Groundwater sample results at Area A did not indicate leaching of dioxins from soil to groundwater at concentrations above adjusted T-RBCs.

4.1.2.5 Explosives

The approximate lateral and vertical extent of explosives in soil at Area A at concentrations above adjusted R-RBCs and I-RBCs is shown on Figure 4-4. Three non-contiguous areas of impacted soil with respect to RBC exceedances were identified around borings 54SB23, 54SB27, and 54SB32. At borings 54SB23 and 54SB32, the vertical extent of soil with one or more explosives concentrations above their adjusted RBCs extends from below the surface sample interval to a depth less than 16 ft bgs. At 54SB23, the vertical extent of nitroglycerin-impacted soil below 10 ft is uncertain but is inferred to be less than 16 ft bgs based on other explosives results from the boring, which are non-detect or below method reporting limits. At boring 54SB27, the vertical extent of soil with concentrations above their adjusted RBCs extends from the surface to a depth less than 9 ft bgs. Concentrations of 2,4,6-TNT and DNT mixture were above their adjusted I-RBCs in the surface sample from boring 54SB27. At boring 54SB32, the concentration of nitroglycerin was above the adjusted industrial I-RBC in the intermediate depth sample collected from 9 to 10 ft bgs.

Explosives were detected in one or more soil samples above their SSL DAF1. Additional discussion and assessment of the soil-to-groundwater migration pathway for explosives is presented in Section 5.0. Leaching of explosives from soil to groundwater has occurred at Area A with detected concentrations of one or more explosives above adjusted T-RBCs.

4.1.2.6 SVOCs and PAHs

SVOC compound N-nitrosodiphenylamine was detected in one or more soil samples at concentrations above its SSL DAF1. These sample locations are within the identified area where soil concentrations for one or more constituents are above their adjusted R-RBCs. Additional discussion and assessment of the soil-to-groundwater migration pathway for this COPC is presented in Section 5.0. Groundwater sample results from Area A did not indicate leaching of N-nitrosodiphenylamine to groundwater at detectable levels.

PAH compounds benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were detected in intermediate sample 54SB31B (duplicate average) at concentrations above their adjusted R-RBC. The concentration of benzo(a)pyrene was also above the adjusted I-RBC in this sample. A terminal sample was not collected from boring 54SB31 for PAH analysis, and therefore, the vertical extent of PAH impacted soil is uncertain at this location. Benzo(a)pyrene was detected in surface sample 54SB25A at concentrations above its R-RBC, but the intermediate sample was below the adjusted R-RBC.

PAH compounds were detected in one or more samples at concentrations above their SSL DAF1. Additional discussion and assessment of the soil-to-groundwater migration pathway for PAHs is presented in Section 5.0. Groundwater sample results from Area A did not indicate leaching of PAHs to groundwater at detectable levels.

4.1.2.7 Other Metals

Antimony was detected in 1 of 82 samples (54SB33B) collected from Area A at a concentration above its adjusted R-RBC. This sample location is within the identified area where soil concentrations for one or more constituents are above their adjusted R-RBCs as shown on Figure 4-14. At boring 54SB33, the vertical extent of soil with antimony concentrations above the adjusted R-RBC is greater than 9 ft bgs.

Although sample 54SB33B exceeded the SSL DAF1, groundwater sample results from Area A did not indicate leaching of antimony from soil to groundwater at detectable levels.

Cadmium was detected in one surface sample (54SB23A) at a concentration above its adjusted R-RBC and facility background concentration. Since the exceedance is limited to one sample, cadmium is not considered further in the nature and extent assessment. Although, six samples exceeded the SSL DAF1, groundwater results from Area A did not indicate leaching of cadmium from soil to groundwater at detectable levels.

Thallium and zinc were detected in one or more subsurface samples collected from boring location 54SB67 at concentrations above their adjusted R-RBCs and facility background concentrations. The terminal sample from this boring had concentrations above adjusted R-RBCs for these metals. This boring location and isolated detections are located outside of the identified disposal area at Area A and are not considered related to propellant ash or site disposal activities as previously discussed in Section 4.1.2.1 (Figure 4-1). Groundwater sample results from well 54MW8 and other monitoring wells did not indicate leaching of thallium from soil to groundwater at detectable levels. Zinc was detected in groundwater samples collected from Area A at low-level concentrations below the adjusted T-RBC.

Iron and manganese were detected in intermediate and terminal depth samples collected from boring location 54SB67 at concentrations above their adjusted I-RBCs and facility background concentrations. Iron was also detected in surface samples collected from borings 54SB63 and 54SB66, which like boring 54SB67, are located outside of the identified disposal area at Area A and not considered related to propellant ash or site disposal activities as previously discussed in Section 4.1.2.1 (Figure 4-1). Similarly, the manganese detections from 54SB67 are not considered related to propellant ash or site disposal activities. Statistical evaluations of manganese soil data at Area A were conducted to evaluate whether manganese concentrations within the disposal unit area were consistently higher than background concentrations of manganese outside of the fence and disposal area. A non-parametric Mann Whitney Wilcox Test was conducted given the non normal distribution of manganese from the disposal area. The results of this evaluation indicated that the mean concentration of manganese for the sample distribution from within the disposal unit area was lower than the mean concentration of manganese for the background sample distribution outside of the fence and disposal unit area. The results of the means test are provided in Appendix C.9. Groundwater sample results from Area A did not indicate leaching of iron from soil to groundwater at detectable levels. Manganese was detected at groundwater samples at concentrations ranging from below method detection limits to concentrations above the adjusted T-RBC but below the unadjusted T-RBC.

Eleven subsurface soil samples at Area A had selenium concentrations above the SSL DAF1 but below the adjusted R-RBC. Groundwater sample results from Area A did not indicate leaching of selenium from soil to groundwater at concentrations above adjusted T-RBCs.

4.1.3 Ecological Nature and Extent Assessment

The nature and extent of COPECs identified at the site are based on the conclusion and recommendations of the SLERA presented in Section 7.2.3. As presented in Section 7.2.3, after consideration of spatial distribution of data at the site, mean concentrations, background concentrations, the nature of the propellant waste historically disposed of at the site, and HQ exceedances indicating the potential for adverse effects, the SLERA concluded:

There is adequate information to conclude that the potential exists for an adverse ecological impact to plants, invertebrates, and the American robin due to 2,4,6-TNT concentrations in soil. Screening level exceedances were identified in the immediate area of soil borings 54SB27, 54SB30, and 54SB32 in the same area identified for human health RBC exceedances and/or SSL exceedances for explosives as shown on Figure 4-4 and Figure 5-1, respectively. No other significant potential impacts to ecological receptors due to site-related activities were identified. Significant uncertainty is associated with the potential

impact to the American robin. It is recommended that the need for remedial action to address this potential impact be evaluated along with the uncertainty associated with the derivation of the HQs, the location of HHRA COCs, the fate and transport evaluation, and other relevant factors, which would influence any decision to implement action.

The lateral extent of contamination for 2,4,6-TNT at Area A with respect to ecological receptors are presented in Section 7.0, Figure 7-2. As presented in Section 7.0 and on Figure 7-2, the extent of contamination of potential concern for ecological receptors is included within the area delineated for human health COPCs in soil at concentrations greater than R-RBCs.

4.2 NATURE AND EXTENT – AREA A GROUNDWATER

4.2.1 Direct Push Groundwater Investigation Results

Direct push groundwater sample results from Area A are summarized in Table 4-3. These data are screened in Table 4-3 with respect to adjusted T-RBCs and MCLs to identify COPCs. COPCs identified in these samples included 2,4,6-TNT, 2ADNT, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), perchlorate, and manganese. Direct push data from 2004 and monitoring well data from 2003 (54MW1 through 54MW7) were used to characterize the nature and extent of explosives and perchlorate in groundwater at the site, and to select the number and locations of additional monitoring wells for the RFI. Figures 4-5, 4-6, and 4-7 show the distribution of 2,4,6-TNT, RDX, and perchlorate in groundwater based on the direct push and monitoring well sample results. Monitoring well data from newly installed wells 54MW8, 54MW9, and 54MW10 collected in December 2004 are also shown on these figures to show the locations of wells selected based on the direct push data.

Review of Figures 4-5, 4-6, and 4-7 shows that the area of explosives and perchlorate impacted groundwater at Area A extended from the disposal unit area eastward to the area of the New River. Along the New River, the plume area for RDX and perchlorate extended northward to the area of well 54MW8. The highest concentrations generally extended from the area of 54MW3 southeastward toward 54MW10, which is consistent with one of the identified groundwater flow paths at Area A.

The dashed approximate isoconcentration lines that are shown on Figures 4-5 and 4-6 reflect the lack of groundwater data to precisely define and characterize dissolved phase concentrations of 2,4,6-TNT and RDX in groundwater south of 54MW2 and 54MW10. The inferences made for 2,4,6-TNT and RDX concentrations on Figures 4-5 and 4-6 south of 54MW2 and 54MW10 are based on the more extensive perchlorate data available for this area as shown on Figure 4-7. Perchlorate is typically co-located with the explosives in groundwater and occurs at the leading edge of the dissolved phase plume because of its higher solubility and mobility than 2,4,6-TNT and RDX. As shown on Figures 4-5 and 4-6, the distribution of 2,4,6-TNT and RDX in groundwater south of the SWMU has been conservatively assumed to be approximately equivalent to that shown for perchlorate on Figure 4-7.

4.2.2 Monitoring Well Analytical Results

A list of analytical parameters and sample locations used in the nature and extent groundwater screening to identify COPCs is presented in Table 4-4. Data from multiple sampling events were used to complete the screening. Table 4-5 presents the detected constituents from the March 2003 and December 2004 sampling events. Table 4-6 presents the quarterly sampling analytical results to date for explosives, perchlorate, and dioxin/furans (November/December 2006) in groundwater. These data are screened in Table 4-7 with respect to adjusted T-RBCs and MCLs and a summary is presented below. Quarterly monitoring was conducted at the site for explosives and perchlorate; therefore, data from the most recent sampling event is used in the screening.

TAL Metals (Methods 6010, 6020, 7470) – Fourteen TAL metals were detected in groundwater at concentrations below their adjusted T-RBCs with the exception of total and dissolved manganese.

TCL SVOCs (Method 8270C) – No SVOCs, with the exception of 2,4-DNT, were detected in groundwater. Explosives in groundwater are addressed below by Method 8330.

PAHs (Method 8310) – PAHs were not detected in groundwater.

TCL Pesticides (Method 8081A) – Pesticides were not detected in groundwater.

TCL PCBs (Method 8082) – PCBs were not detected in groundwater.

Explosives (Method 8330) and Nitroglycerin (Method 8332) – Eight explosives were detected in groundwater at concentrations below their adjusted T-RBCs with the exception of 2,4,6-TNT, DNT Mixture, and RDX. Nitroglycerin was not detected in groundwater samples.

TCL Dioxin/Furans (Method 8290) – Dioxin/furans were detected in groundwater at the site. Using the equivalency process previously discussed in Section 4.0, 2,3,7,8-TCDD TEQs did not exceed the adjusted T-RBC. Refer to Section 6, Table 6-3B for 2,3,7,8-TCDD TEQ calculations.

Perchlorate (Method 6850) – Perchlorate was detected in groundwater at above its adjusted T-RBC in 54MW10 during the September 2007 sampling event.

4.2.3 Human Health Nature and Extent Assessment

The groundwater risk screening identified 2,4,6-TNT, DNT mixture, RDX, perchlorate, and manganese as COPCs for groundwater at Area A. The nature and extent of these COPCs in groundwater is discussed in the following sections. Figure 4-8 shows the RFI sample results for 2,4,6-TNT, DNT Mixture, RDX, and perchlorate for 2003 through 2007. Surface water and sediment pore-water sample results for these COPCs are also shown on Figure 4-8; these results are discussed in Section 4.5.

4.2.3.1 2,4,6-TNT

Since 2003 and 2004, 2,4,6-TNT concentrations detected in groundwater have generally decreased from the levels above the adjusted T-RBC to levels just above or below the adjusted T-RBC. An exception is at well 54MW10 where the concentration of DNT mixture is above the non detect level reported in 2004, as shown in the table below and on Figure 4-8. Note that concentrations in bold font indicate an adjusted T-RBC exceedance and units are µg/L.

2,4,6-TNT Concentration Trends in Groundwater

Chemical	Adjusted T-RBC	Location	3/2003	12/2004	9/2007
2,4,6-TNT	1.83	54MW2	<0.365	--	<0.092
		54MW3	**38**	--	<0.092
		54MW8	--	<0.0794	<0.092
		54MW9	--	<0.0794	<0.092
		54MW10	--	**63.5**	**17**

4.2.3.2 DNT Mixture

DNT concentrations in groundwater have generally been non-detect except for two samples collected since in 2003. A detection of DNT was reported in the sample collected from well 54MW10 during the groundwater sampling event in September 2007. DNT was not detected in other groundwater samples collected at the site in September 2007.

DNT Mixture Concentration Trends in Groundwater

Chemical	Adjusted T-RBC	Location	3/2003	12/2004	9/2007
DNT Mixture	0.098	54MW2	ND	--	ND
		54MW3	ND	--	ND
		54MW8	--	ND	ND
		54MW9	--	ND	ND
		54MW10	--	ND	**0.696**

4.2.3.3 RDX

Since 2003 and 2004, RDX concentrations detected in groundwater have generally decreased over time, as shown in the following table and on Figure 4-8. As of September 2007, the concentrations of RDX were generally non-detects with the exception a detection at 54MW10 which was above the adjusted T-RBC.

RDX Concentration Trends in Groundwater

Chemical	Adjusted T-RBC	Location	3/2003	12/2004	9/2007
RDX	0.609	54MW2	<0.526	--	<0.092
		54MW3	**32**	--	<0.092
		54MW8	--	0.2 J	<0.092
		54MW9	--	**1.1 J**	<0.092
		54MW10	--	**28.5**	**8**

4.2.3.4 Perchlorate

Since 2003 and 2004, perchlorate concentrations detected in groundwater have decreased from levels above the adjusted T-RBC to concentrations below the adjusted T-RBC in September 2007 with the exception of 54WM10, as shown in the following table and on Figure 4-8.

Perchlorate Trends in Groundwater

Chemical	Adjusted T-RBC	Location	3/2003	12/2004	9/2007
Perchlorate	2.56	54MW2	**12**	--	0.57
		54MW3	**59.2**	--	0.31
		54MW8	--	0.22	0.37
		54MW9	--	0.21	<0.08
		54MW10	--	**9.45**	**2.9**

4.2.3.5 Explosives and Perchlorate Distribution in Groundwater

The lateral extent of explosives and perchlorate in groundwater at concentrations above adjusted T-RBCs is shown on Figure 4-8. This area of impacted groundwater extends from the Area A disposal unit eastward to the area of the New River. Sampling of the groundwater/surface water interface (sediment pore water) and surface water of the New River did not indicate detectable impacts to sediment pore water or surface water from COPCs in groundwater.

4.2.3.6 Manganese

Dissolved manganese was detected at concentrations above its adjusted T-RBC of 73 µg/L in samples collected from wells 54MW5 (160 µg/L) and 54MW10 (185 µg/L). Detected concentrations were below the unadjusted T-RBC of 730 µg/L. The occurrence of dissolved manganese at concentrations above the adjusted T-RBC may due in part to the site's location adjacent to the New River and inflow and mixing of surface water from the New River with groundwater. In addition, manganese concentrations in soil are higher adjacent to the New River than in the disposal area as described previously 4.1.2.7. The highest

dissolved manganese concentration occurred at well 54MW10, which is adjacent to the New River; this is contrasted with low-levels of dissolved manganese present in disposal unit wells 54MW2 and 54MW3 and in upgradient wells 54MW1 and 54MW6.

4.3 NATURE AND EXTENT – SOIL AREA B

4.3.1 Analytical Results

Eighteen surface soil samples and 33 subsurface soil samples for a total of 51 samples were collected for chemical analysis from Area B (Figure 3-1 and Table 3-1). Soil samples for chemical analysis were collected from three intervals including: a surface soil sample ("A" sample), an intermediate sample ("B" sample), and a terminal depth sample ("C" sample). Table 4-8 presents analytical results for chemicals detected in soil samples collected at Area B and screens these data with respect to adjusted RBCs, SSL DAF1s, and background concentrations. Table 4-9 summarizes the screening results for soil data including: constituents detected, minimum and maximum concentrations detected, number of detections, number of samples, and number of samples exceeding human health screening criteria or SSL DAF1 screening levels and background concentrations (inorganics only). Chemicals of potential ecological concern listed below were identified for the site as part of the refined screening level ecological risk assessment presented in Section 7.3.2 and above background point estimates (inorganics only). The screenings resulted in the identification of the following COPCs and COPECs (note that chemical which exceeded both its adjusted R-RBC and I-RBC are italicized):

TAL Metals (Methods 6010, 6020, and 7420) – 22 TAL metals were detected in soil samples with the following screening level exceedances:

RBC - antimony, copper, *lead*;
SSL - antimony, selenium, zinc; and
Eco – lead, mercury, selenium, and zinc.

TCL Pesticides (Method 8081A) – 14 pesticides were detected in soil samples with the following screening level exceedances:

RBC – *heptachlor epoxide*;
SSL – aldrin, alpha-BHC, beta-BHC, dieldrin, gamma-BHC, heptachlor epoxide; and
Eco – none.

TCL PCBs (Method 8082) – 2 PCBs were detected in soil samples with the following screening level exceedances:

RBC – *Aroclor 1254,* Aroclor 1260;
SSL – Aroclor 1254; and
Eco – none.

TCL SVOCs (Method 8270C) – 7 SVOCs were detected in soil samples with the following screening level exceedances:

RBC – none;
SSL – carbazole, diethylphthalate, and, N-nitrosodiphenylamine; and
Eco – none.

PAHs (Method 8310) – 16 PAHs were detected in soil samples with the following screening level exceedances:

RBC –benzo(a)pyrene;
SSL – acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, naphthalene (detections of acenaphthene and naphthalene not confirmed by low-level Method 8270C analysis); and
Eco – acenaphthene and naphthalene (detections not confirmed by low-level Method 8270C analysis).

Explosives (Method 8330) and Nitroglycerin (Method 8332) – 8 explosives and nitroglycerin were detected in soil samples with the following screening level exceedances:

RBC –*2,4,6-TNT*, 2,4-DNT, *DNT mixture*, amino DNTs, RDX, *nitroglycerin*;
SSL – 2,4-DNT; and
Eco – none (no screening values available).

Dioxin/Furans (Method 8290) – Dioxin/furans were detected in soil samples with the following screening level exceedances:

RBC –*2,3,7,8-TCDD TEQ*;
SSL – 2,3,7,8-TCDD TEQ; and
Eco – 2,3,7,8-TCDD TEQ.

4.3.2 Human Health Nature and Extent Assessment

A summary of the human health risk and background screening results for COPCs is presented in the table below.

Summary of COPCs for Soil

Chemical	Total # of Det/# of Samples	R-RBC Exceedances		I-RBC Exceedances	
		# of Exceed.	Sample IDs	# of Exceed.	Sample IDs
Antimony	13/31	1	54SB46B	0	NA
Copper	37/37	1	54SB46B	0	NA
Lead	39/39	3	54SB42A DUP AVG, 54SB46A, 54SB46B	3	54SB42A DUP AVG, 54SB46A, 54SB46B
Heptachlor Epoxide	5/27	1	54SB46B	1	54SB46B
Aroclor 1254	9/28	4	54SB46A, 54SB49A, 54SB46B, 54SB46C	2	54SB46A, 54SB46C
Aroclor 1260	5/28	2	54SB46A, 54SB46C	0	NA
Benzo(a)pyrene*	8/39	1	54SB46B	0	NA
2,4,6-TNT	4/39	3	54SB46A, 54SB49A, 54SB46B	3	54SB46A, 54SB49A, 54SB46B
2,4-DNT	3/39	1	54SB46B	0	NA
DNT Mix	3/39	2	54SB46A, 54SB46B	2	54SB46A, 54SB46B
Amino DNTs	2/39	2	54SB46A, 54SB46B	0	NA
RDX	1/39	1	54SB49A	0	NA
Nitroglycerin	2/39	2	54SB42A DUP AVG, 54SB46A	2	54SB42A DUP AVG, 54SB46A
2,3,7,8-TCDD TEQ	51/51	10	54SB42A DUP AVG, 54SB43A, 54SB46A, 54SB48A, 54SB49A, 54SB53A, 54SB55A, 54SB42B, 54SB46B, 54SB46C	6	54SB46A, 54SB48A, 54SB49A, 54SB55A, 54SB46B, 54SB46C

Notes: NA=Not Applicable, * Detections confirmed by both low-level 8270C and 8310 analysis

The nature and extent of COPCs identified in the above table, as well as SSL DAF 1 exceedances (above background concentrations for inorganics) identified in Section 4.3.1 and presented on Table 4-9, is discussed further in the following sections.

4.3.2.1 Lead

The approximate lateral and vertical extent of lead in soil at Area B at concentrations above the residential AL and industrial AL is shown on Figure 4-9. This area is in the central portion of the disposal unit and encompasses borings 54SB42 and 54SB46, as shown on Figure 4-9. At boring 54SB46,

the vertical extent of impact extends from the surface to a depth less than 11 ft bgs. The vertical extent of impact at boring 54SB42 is less than 9 ft bgs.

Lead concentrations detected in the surface samples from boring 54SB42 (1,605 mg/kg), which is a duplicate average, and 54SB46 (3,610 mg/kg) and the intermediate sample from boring 54SB46 (3,070 mg/kg) were above the industrial AL of 750 mg/kg.

Groundwater sample results from Area B did not indicate leaching of lead from soil to groundwater at levels above the residential AL of 15 µg/L.

4.3.2.2 Pesticides

The approximate lateral and vertical extent of pesticides in soil at Area B at concentrations above adjusted R-RBCs and I-RBCs is shown on Figure 4-10. Heptachlor epoxide was the only pesticide detected in soil at a concentration above its adjusted R-RBC; a limited area of impact was identified near the central part of the disposal unit around boring location 54SB46/54SB76 as shown on Figure 4-10. This area is within an identified "hot spot" with lead, explosives, dioxins, PCB, and pesticide concentrations above industrial risk-based screening criteria.

The detected concentration of heptachlor epoxide in intermediate sample 54SB46B (530 µg/kg) was above the adjusted I-RBC. Other detected concentrations of heptachlor epoxide at Area B were below the adjusted R-RBC.

Aldrin, alpha-BHC, beta-BHC, dieldrin, gamma-BHC, and heptachlor epoxide were detected in one or more soil samples at concentrations above their SSL DAF1. Additional discussion and assessment of the soil-to-groundwater migration pathway for these pesticides is presented in Section 5.0. Groundwater sample results from Area B did not indicate leaching of heptachlor epoxide or other pesticides from soil to groundwater at detectable levels.

4.3.2.3 PCBs

The approximate lateral and vertical extent of PCBs in soil at Area B at concentrations above adjusted R-RBCs and I-RBCs is shown on Figure 4-10. Aroclor 1254 and 1260 were the only PCBs detected in soil at concentrations above their adjusted R-RBC; one area of impact was identified near the central portion of the disposal unit encompassing borings 54SB46 and 54SB49. This area is within an identified "hot spot" with lead, explosives, dioxins, PCB, and pesticide concentrations above industrial risk-based screening criteria.

At boring 54SB46, the vertical extent of impact extends from the surface to an estimated depth greater than 12 ft bgs. At boring 54SB46, PCBs were detected in terminal sample 54SB46C at concentrations above adjusted RBCs; however, these exceedances were not confirmed by a verification sample 54SB76C collected from the same location and depth as shown on Figure 4-10. The vertical extent of PCB impact at boring 54SB49 above adjusted R-RBCs extends from the surface to a depth less than 9 ft bgs.

Aroclor 1254 was detected in one or more soil samples at concentrations above its SSL DAF1. Additional discussion and assessment of the soil-to-groundwater migration pathway for PCBs is presented in Section 5.0. Groundwater sample results from Area B did not indicate leaching of PCBs from soil to groundwater at detectable levels.

4.3.2.4 Dioxins

The approximate lateral and vertical extent of dioxin (2,3,7,8-TCDD TEQ) in soil at Area B at concentrations above adjusted R-RBCs and I-RBCs is shown on Figure 4-11. 2,3,7,8-TCDD TEQ was detected in soil at concentrations above its adjusted R-RBC and I-RBC; a contiguous area of impact was identified centered at boring 54SB46 and covering an area of approximately 23,000 ft^2, as shown on Figure 4-11. Dioxin concentrations in surface samples within this area were above the adjusted R-RBC or adjusted I-RBC. The delineated area of dioxin impacted soil includes the identified "hot spot" area

containing lead, explosives, PCB, and pesticide concentrations at concentrations above industrial risk-based screening criteria.

At boring 54SB46, the vertical extent of dioxin impact at concentrations above the adjusted I-RBC extended from the ground surface to a depth greater than 12 ft bgs. At locations north of 54SB46 where dioxin concentrations above the adjusted I-RBC were detected, the vertical extent of impact extended from the ground surface to depths less than 9 ft bgs. At locations south of 54SB46 where dioxin concentrations were above the adjusted R-RBC but below the adjusted I-RBC, the vertical extent of impact ranged from less than 8 ft bgs at boring 54SB43, less than 9 ft bgs at boring 54SB53, and less than 13.5 ft bgs at boring 54SB42. The precise lateral limit of dioxins in soil east of 54SB53 and southeast of 54SB43 is uncertain and therefore estimated given the lack of sample data in these areas.

Dioxins were detected in one or more samples at concentrations above their SSL DAF1. Additional discussion and assessment of the soil-to-groundwater migration pathway for explosives is presented in Section 5.0. Groundwater sample results at Area B did not indicate leaching of dioxins from soil to groundwater at concentrations above adjusted T-RBCs.

4.3.2.5 Explosives

The approximate lateral and vertical extent of explosives in soil at Area B at concentrations above adjusted R-RBCs and I-RBCs is shown on Figure 4-12. A contiguous area of impact was identified in the central portion of the disposal unit encompassing borings 54SB42, 54SB46, and 54SB49, as shown on Figure 4-12. Explosives concentrations in surface samples within this area were above the adjusted R-RBC or adjusted I-RBC. This delineated area of explosives impacted soil is within an identified "hot spot" with lead, dioxins, PCB, and pesticide concentrations above industrial risk-based screening criteria.

At borings 54SB42 and 54SB49, the vertical extent of impacted soil at concentrations above adjusted R-RBCs and I-RBCs extends from the ground surface to depths less than 9 ft bgs. In the center of the impacted area at boring 54SB46, the vertical extent of impacted soil is greater, with the depth of impact extending from the ground surface to a depth less than 11 ft bgs.

Explosives were detected in one or more samples at concentrations above their SSL DAF1. Additional discussion and assessment of the soil-to-groundwater migration pathway for explosives is presented in Section 5.0. Groundwater sample results at Area B did not indicate leaching of explosives from soil to groundwater at concentrations above adjusted T-RBCs.

4.3.2.6 SVOCs and PAHs

SVOC compounds carbazole and N-nitrosodiphenylamine were detected in intermediate sample 54SB46B at concentrations above their SSL DAF1s. Diethylphthalate was detected in surface sample 54SB46A at a concentration above its SSL DAF 1. These samples are located within the identified "hot spot" in the central portion of the disposal unit.

PAH compound benzo(a)pyrene was detected in intermediate sample 54SB46B at a concentration above its adjusted R-RBC. Samples collected at the surface and terminal depths at boring 54SB46 had PAH concentrations below the adjusted R-RBC. Sample 54SB46B is located within the identified "hot spot" in the central portion of the disposal unit.

One or more soil samples had concentrations of PAHs, carbazole, diethylphthalate and N-nitrosodiphenylamine above their SSL DAF1. Additional discussion and assessment of the soil-to-groundwater migration pathway for these COPCs is presented in Section 5.0. Groundwater sample results from Area B did not indicate leaching of PAHs, carbazole, diethylphthalate, or N-nitrosodiphenylamine to groundwater at detectable levels.

4.3.2.7 Other Metals

Antimony and copper were detected in one sample (54SB46B) collected from Area B at a concentration above their adjusted R-RBCs and background concentrations. This sample location is within the identified "hot spot" in the central portion of the disposal unit. Samples collected at surface and terminal depths at boring 54SB46 had antimony and copper concentrations below the adjusted R-RBC. Groundwater sample results from Area B did not indicate leaching of antimony or copper from soil to groundwater at detectable levels.

Thirteen subsurface soil samples at Area B had selenium concentrations above the SSL DAF1 and facility background concentration, but below the adjusted R-RBC. One subsurface soil sample had a zinc concentration above its SSL DAF1 and facility background concentration, but below the adjusted R-RBC. Groundwater sample results from Area B did not indicate leaching of selenium or zinc from soil to groundwater at concentrations above adjusted T-RBCs.

4.3.3 Ecological Nature and Extent Assessment

The nature and extent of COPECs identified at the site are based on the conclusion and recommendations of the SLERAs presented in Section 7.3.3. After consideration of spatial distribution of data at the site, mean concentrations, background concentrations, the nature of the propellant waste historically disposed of at the site, and HQ exceedances indicating the potential for adverse effects, the SLERA concluded:

There is adequate information to conclude that the potential exists for an adverse ecological impact to plants due to lead, 2,4-DNT, and 2,4,6-TNT concentrations in soil, invertebrates due to the lead and 2,4,6-TNT concentration in soil, the meadow vole due to exposure to nitroglycerin in soil, the short-tailed shrew due to exposure to 2,3,7,8-TCDD TEQ (dioxin/furans), and the American robin due to exposure to 2,3,7,8-TCDD TEQ, lead, 2,4,6-TNT, and 2,4-DNT in soil at the site. Hot spots for lead, explosives, and dioxins were identified in the immediate area of soil borings 54SB42, 54SB46, and 54SB49 in the same area identified for human health I-RBC exceedances for lead, explosives, and/or dioxins as presented on Figures 4-9, 4-11, and 4-12, respectively. No other significant potential impacts to ecological receptors due to site-related activities were identified. Significant uncertainty is associated with the potential impact to the meadow vole, short-tailed shrew and American robin. It is recommended that the need for remedial action to address this potential impact be evaluated along with the uncertainty associated with the derivation of the HQs, the location of HHRA COCs, the fate and transport evaluation, the "hot spot" locations, and other relevant factors, which would influence any decision to implement action.

The lateral extent of contamination for lead, 2,3,7,8-TCDD TEQ (dioxin/furans), and explosives at Area B with respect to ecological receptors are presented in Section 7.0, Figures 7-3, 7-4, and 7-5, respectively. As presented in Section 7.0 and on Figures 7-3, 7-4, and 7-5, the extent of contamination of potential concern for ecological receptors is included within the area delineated for human health COPCs in soil at concentrations greater than R-RBCs.

4.4 NATURE AND EXTENT – AREA B GROUNDWATER

4.4.1 Analytical Results

A list of analytical parameters and sample locations used in the nature and extent groundwater screening to identify COPCs is presented in Table 4-10. Data from multiple sampling events were used to complete the screening. Table 4-11 presents the detected constituents from the March 2003 and December 2004 sampling events. Table 4-12 presents the quarterly sampling analytical results to date for explosives, perchlorate, and dioxin/furans (December 2006 and September 2007) in groundwater. These data are screened in Table 4-13 with respect to adjusted T-RBCs and MCLs and a summary is presented below. Quarterly monitoring was conducted at the site for explosives and perchlorate; therefore, data from the most recent sampling event is used in the screening.

TAL Metals (Methods 6010B, 6020A, and 7471A) – Sixteen TAL metals were detected in groundwater. TAL metals were detected at concentrations below their adjusted T-RBCs and MCLs with the exception of total manganese which exceeded its adjusted T-RBC.

TCL SVOCs (Method 8270C) – One SVOC, bis(2-ethylhexyl)phthalate, was detected in sample 54MW4 at a concentration below its adjusted T-RBC and MCL.

PAHs (Method 8310) – PAHs were not detected in groundwater.

TCL Pesticides (Method 8081A) – Pesticides were not detected in groundwater.

TCL PCBs (Method 8082) – PCBs were not detected in groundwater.

Explosives (Method 8330) and Nitroglycerin (Method 8332) – One explosives, HMX, was detected at a concentration below its adjusted T-RBC. Nitroglycerin was not detected in groundwater samples.

Perchlorate (EPA 6850) – Perchlorate was not detected in groundwater samples above its adjusted T-RBC.

TCL Dioxin/Furans (Method 8290) – Dioxin/furans were detected in groundwater samples collected at the site during the December 2006 sampling event, but the detections were flagged as below the lower calibration limit of the equipment (A-flagged). Refer to Section 6, Table 6-3D, for the dioxin/furans results and 2,3,7,8-TCDD TEQ calculations for the December 2006 event. Verification samples were collected from the wells at the site during the June 2007 sampling event which resulted in non-detects; therefore, dioxin/furans are not considered a COPC in groundwater at the site. Refer to Section 6, Table 6-3E, for the dioxin/furan results and 2,3,7,8-TCDD calculations for the June 2007.

4.4.2 Human Health Nature and Extent Assessment

The groundwater risk screening identified total manganese as a COPC for groundwater at Area B. However, dissolved concentrations of manganese are below the adjusted T-RBC for groundwater at Area B, and therefore, manganese was not considered a COPC for groundwater at Area B for the nature and extent assessment given that the dissolved concentration result is more representative of the actual dissolved levels in groundwater. Figure 4-8 shows the RFI sample results for COPCs identified in Area A groundwater (explosives and perchlorate). Given the east/southeastern groundwater flow at the site, a complete delineation of the groundwater plume for explosives is not feasible due to the lack of a well in the area located south of 54MW-10; therefore, this presents a data gap for groundwater, No COPCs were identified for Area B groundwater.

4.5 NATURE AND EXTENT – NEW RIVER

In November/December 2006, the groundwater/surface water interface was investigated along the shoreline of the New River at the site to assess for potential groundwater plume discharge to the New River. Surface water and sediment pore water were collected from 10 stations along the shoreline of the New River at the site as shown on Figure 3-3.

Sediment sampling was conducted in the New River in November 2006 concurrent with the groundwater/surface water interface investigation at SWMU 54. Sediment samples were collected from 23 stations in the New River along a reach of approximately 5.9 miles; the reach extended from approximately 3.4 miles upstream of SWMU 54 to a location approximately 2.5 miles downstream of SWMU 54, as shown on Figure 3-4.

4.5.1 Surface Water and Sediment Pore Water

Surface water and sediment pore water samples were analyzed for groundwater COPCs including explosives and perchlorate. Surface water and sediment pore-water sample results are summarized in Table 4-14 and Figure 4-8 for groundwater COPCs. Targeted parameters were not detected in the samples with the exception of HMX, which was detected in the sediment pore water sample NR-PW-5 at

an estimated concentration (1.7 µg/L) below the laboratory reporting limit. The concentration of HMX detected was below its adjusted T-RBC (180.5 µg/L) and BTAG fresh water screening value (150 µg/L). HMX was not detected in the surface water samples. Groundwater COPCs 2,4,6-TNT, RDX, DNT mixture, and perchlorate were not detected in surface water or sediment pore water samples. A non-detect MDL versus available screening levels comparison is provided in Table 4-15.

The results of the surface water and sediment pore-water sampling did not indicate impacts at the groundwater/surface water interface or in surface water from site groundwater at levels of potential concern.

4.5.2 Sediment

Twenty-three sediment samples collected from the New River were analyzed for explosives and TAL metals. As shown on Figure 4-13, samples NR-SED-1 through NR-SED-8 were collected upstream of SWMU 13 (Open Burning Ground) and SWMU 54, samples NR-SED-9 through NR-SED-14 were collected between SWMU 13 and SWMU 54, and samples NR-SED-15 through NR-SED-23 were collected adjacent to and downstream of SWMU 54. Sediment sample results are summarized in Table 4-15.

Explosives were detected only in sediment samples collected upstream of SWMU 54 at stations NR-SED8 (across river from SWMU 13) and NR-SED10 (at SWMU 13). 2,4-DNT was detected in sediment sample NR-SED8 at an estimated concentration (1.4 mg/kg) below its laboratory reporting limit and adjusted R-RBC, but above its BTAG freshwater sediment screening value of 0.0416 mg/kg. 2,4,6-TNT was detected in sediment sample NR-SED-10 at an estimated concentration (0.38 mg/kg) below the method reporting limit and adjusted R-RBC, but above its BTAG freshwater sediment screening value of 0.092 mg/kg. These results did not indicate a specific impact to New River sediments from historical site activities at SWMU 54.

Lead sample results for sediment are presented on Figure 4-13 and summarized by segment in the following table.

Summary of Lead Sample Results for Sediment

		Lead Concentrations (mg/kg)		
River Segment	**Stations**	**Minimum**	**Maximum**	**Mean**
Upstream of SWMU 13	NR-SED-1 – NR-SED-8	43	160	87
From SWMU 13 to SWMU 54	NR-SED-9 – NR-SED-14	86	280	151
Adjacent to SWMU 54	NR-SED-15	190	190	190
Downstream of SWMU 13, SWMU 54, and MMA	NR-SED-16 – NR-SED-23	82	500	198
Entire Segment Sampled	NR-SED-1 – NR-SED 23	43	500	147

As shown in Figure 4-13 and in the above table, lead concentrations in New River sediment are below the human health residential AL of 400 mg/kg, with the exception of station NR-SED-16 (500 mg/kg) located downgradient of SWMU 13, SWMU 54, and the RFAAP MMA. The mean concentration of lead for each sub-segment sampled and the entire reach sampled were below 400 mg/kg. Detected lead concentrations in each sample were above the BTAG fresh water screening value of 35.8 mg/kg.

Attributing lead and other metals detected in sediment samples to a specific source or sources is not possible for this RFI given the complex transient flow and depositional patterns in the river, and therefore,

it is recommended that these data be used holistically as part of any overall evaluations of the facility and potential receptors conducted for the RCRA Corrective Action Permit.

4.6 NATURE AND EXTENT SUMMARY

4.6.1 Area A Nature and Extent Summary

The primary site-related chemicals of concern in soil and groundwater at Area A are those associated with propellant ash including lead, explosives, and dioxins in soil, and explosives and perchlorate in groundwater. These conclusions are supported by the results of the human health and ecological risks assessments presented in Sections 6.0 and 7.0, respectively.

The lateral and vertical extent of COPCs in soil at concentrations above adjusted R-RBCs is shown on Figure 4-14. This area encompasses most of the southern part of Area A. Within most of this area, the vertical extent of impact is less than 9 ft bgs, except for two areas encompassing 54SB23 and 54SB25 and 54SB32 and 54SB82 where the depth of impact is greater (less than 16 ft bgs). The lateral and vertical extent of COPCs in soil at concentrations above adjusted I-RBCs is shown on Figure 4-15. Two non-contiguous areas of impact were identified around borings 54SB27 and 54SB32. At boring 54SB27, the vertical extent of impact extends from the ground surface to a depth less than 9 ft bgs. At boring 54SB32, the vertical extent of impact extends from the ground surface to a depth less than 16 ft bgs.

Concentrations of explosives and perchlorate in groundwater have decreased since RFI monitoring began in 2003 and 2004. The lateral extent of explosives and perchlorate in groundwater at concentrations above adjusted T-RBCs extends from the Area A disposal unit eastward to the area of the New River, as shown on Figure 4-8. For the final quarterly sampling event (September 2007), 2,4,6-TNT, DNT mixture, RDX, and perchlorate were detected at concentrations above their adjusted T-RBCs. Sampling of the groundwater/surface water interface (sediment pore water) and surface water of the New River did not indicate detectable impacts to sediment pore water or surface water from COPCs in groundwater.

As presented in Section 7.0 on Figure 7-2, the extent of contamination of potential concern for ecological receptors is primarily included within the area delineated for COPCs in soil at concentrations greater than adjusted R-RBCs (Figure 4-14).

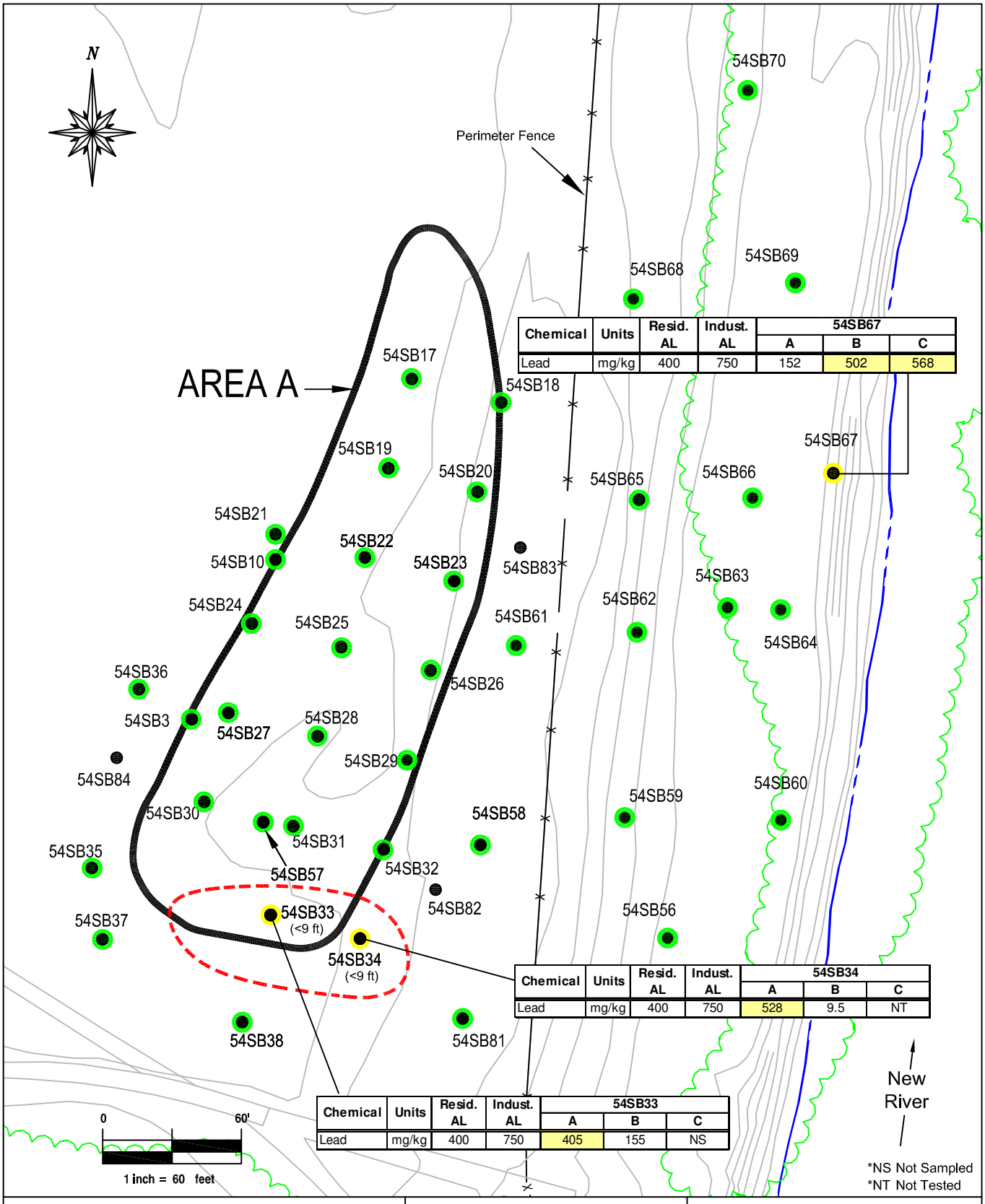
4.6.2 Area B Nature and Extent Summary

The primary site-related chemicals of concern in soil at Area B are those associated with propellant ash including lead, explosives, and dioxins. Site-related chemicals of concern were not identified for groundwater. These conclusions are supported by the results of the human health and ecological risks assessments presented in Sections 6.0 and 7.0, respectively.

The lateral and vertical extent of COPCs in soil above adjusted R-RBC is shown on Figure 4-16. As shown on Figure 4-16, at Area B a contiguous area of impact of approximately 21,800 ft^2 within the disposal area has been identified including a "hot spot" primarily centered around borings 54SB42, 54SB46, and 54SB49 where, the concentrations of lead, explosives, and/or dioxins are above their industrial risk-based screening criteria as shown on Figures 4-9, 4-11, and 4-12, respectively. The vertical extent of impact is greater than 12 feet in the center of the hot spot area.

The lateral and vertical extent of COPCs in soil above adjusted I-RBCs is shown on Figure 4-17. A contiguous area of impact with an area of approximately 15,000 ft^2 was identified in the disposal area centered at boring 54SB46. The vertical extent of impact is greatest in the area of boring 54SB46, which is located in the "hot spot" area identified around borings 54SB42, 54SB46, and 54SB49, where impacts to extend to depths greater than 12 ft. Outside of this area, the vertical extent of impact is generally less than 9 ft bgs.

As presented in Section 7.0 on Figures 7-3, 7-4, and 7-5, the extent of contamination of potential concern for ecological receptors is included within the area delineated for COPCs in soil at concentrations greater than adjusted R-RBCs (Figure 4-16).



Chemical	Units	Resid. AL	Indust. AL	54SB67 A	54SB67 B	54SB67 C
Lead	mg/kg	400	750	152	502	568

Chemical	Units	Resid. AL	Indust. AL	54SB34 A	54SB34 B	54SB34 C
Lead	mg/kg	400	750	528	9.5	NT

Chemical	Units	Resid. AL	Indust. AL	54SB33 A	54SB33 B	54SB33 C
Lead	mg/kg	400	750	405	155	NS

Legend

- Approximate SWMU Boundary
- Soil Borings
- Below Residential Action Level of 400 mg/kg
- Above Residential Action Level of 400 mg/kg
- Approximate Lateral Extent of Lead
- (<9 ft) Approximate Vertical Extent below Ground Surface
- mg/kg Milligram per Kilogram

Figure 4-1

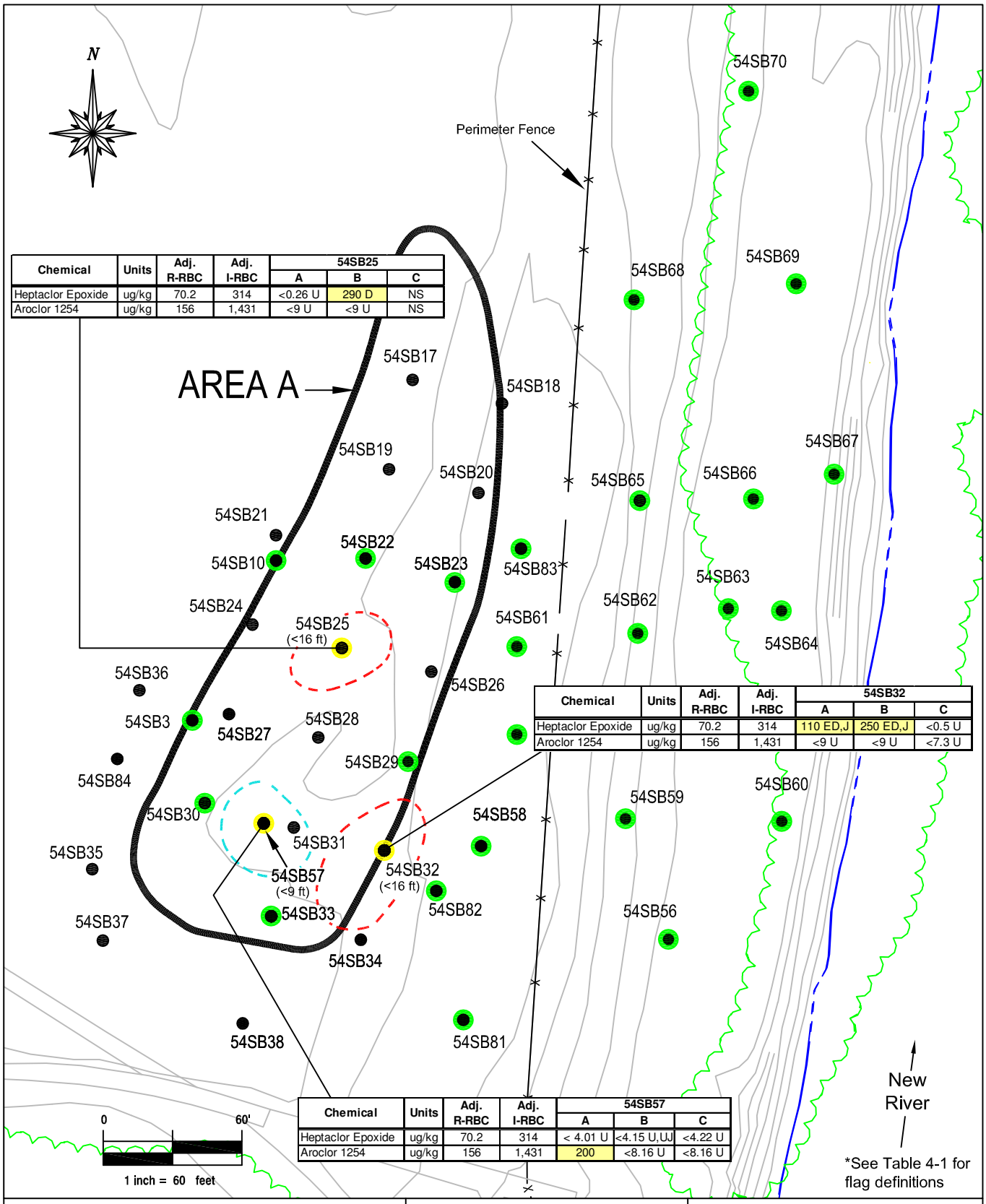
Area A - Extent of Lead in Soil

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.4-1 A Lead in Soil

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Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB25		
				A	B	C
Heptaclor Epoxide	ug/kg	70.2	314	<0.26 U	290 D	NS
Aroclor 1254	ug/kg	156	1,431	<9 U	<9 U	NS

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB32		
				A	B	C
Heptaclor Epoxide	ug/kg	70.2	314	110 ED,J	250 ED,J	<0.5 U
Aroclor 1254	ug/kg	156	1,431	<9 U	<9 U	<7.3 U

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB57		
				A	B	C
Heptaclor Epoxide	ug/kg	70.2	314	< 4.01 U	<4.15 U,UJ	<4.22 U
Aroclor 1254	ug/kg	156	1,431	200	<8.16 U	<8.16 U

Legend

- Approx. SWMU Boundary
- Soil Borings
- Below Adjusted RBCs
- Above Adjusted R-RBC
- Approximate Lateral Extent of Pesticides
- Approximate Lateral Extent of PCBs
- (<9 ft) Approximate Vertical Extent below Ground Surface

ug/kg microgram per kilogram
NS Not Sampled
<MDL Non-Detect

Figure 4-2

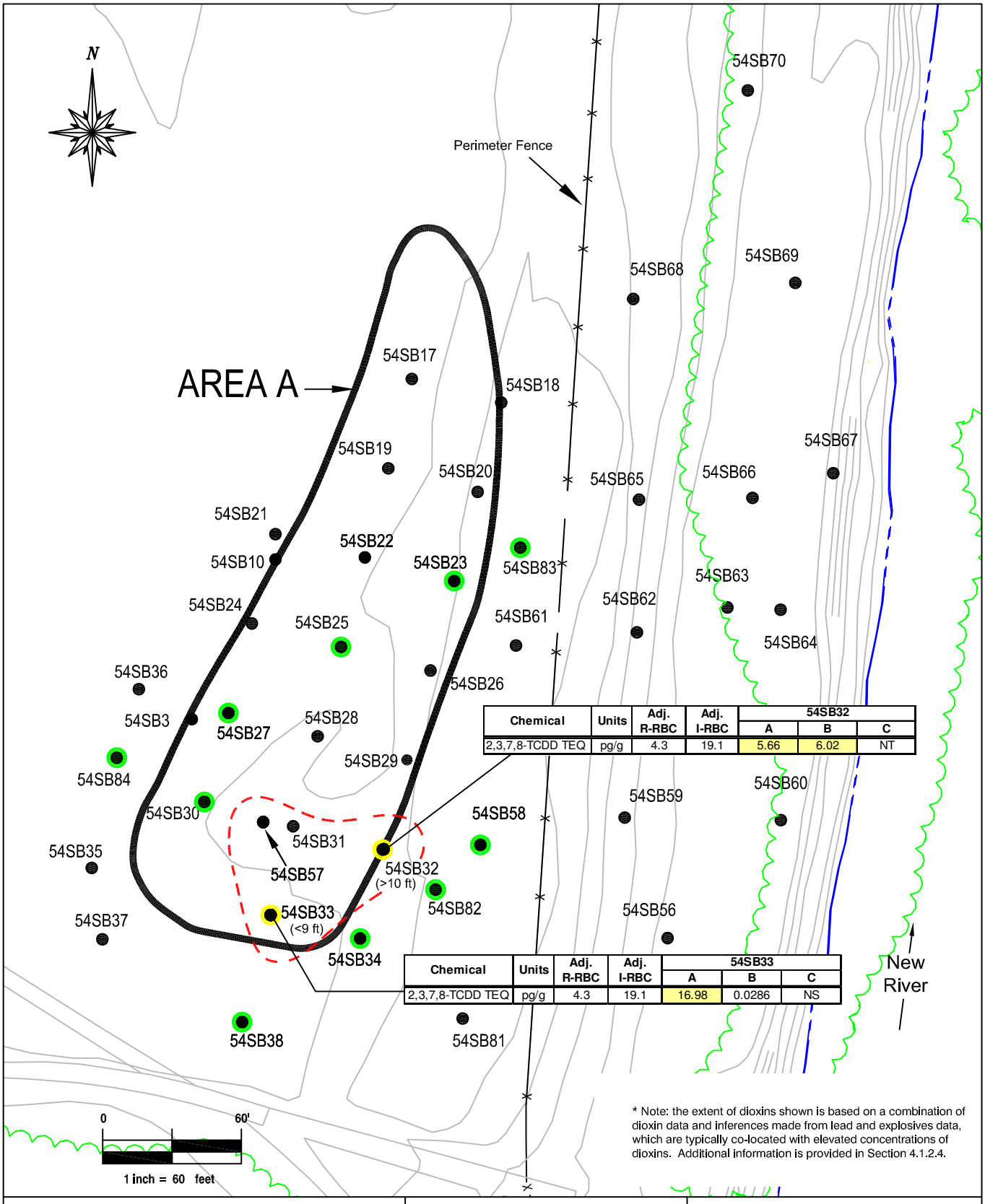
Area A - Extent of Pesticides/PCBs in Soil

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.4-2 A PestPCB

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Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB32 A	54SB32 B	54SB32 C
2,3,7,8-TCDD TEQ	pg/g	4.3	19.1	5.66	6.02	NT

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB33 A	54SB33 B	54SB33 C
2,3,7,8-TCDD TEQ	pg/g	4.3	19.1	16.98	0.0286	NS

* Note: the extent of dioxins shown is based on a combination of dioxin data and inferences made from lead and explosives data, which are typically co-located with elevated concentrations of dioxins. Additional information is provided in Section 4.1.2.4.

Legend

- Approximate SWMU Boundary
- Soil Borings
- Below Adjusted RBCs
- Above Adjusted R-RBC
- Approximate Lateral Extent of Dioxin/Furans
- (<9 ft) Approximate Vertical Extent below Ground Surface

NS Not Sampled
NT Not Tested
pg/g Picogram per gram

Figure 4-3

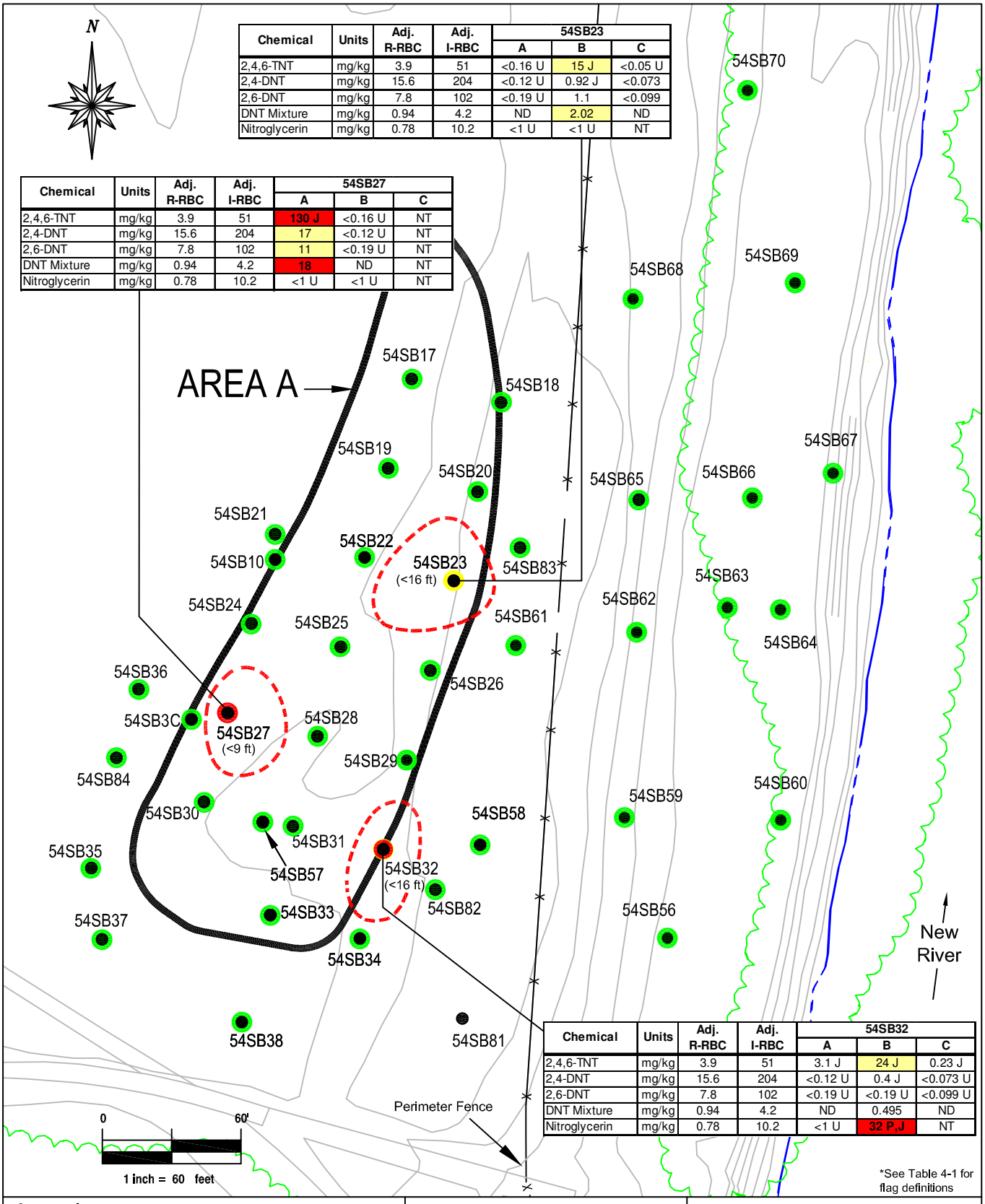
Area A - Extent of Dioxin/Furans in Soil

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.4-3 A DioFur

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Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB23		
				A	B	C
2,4,6-TNT	mg/kg	3.9	51	<0.16 U	15 J	<0.05 U
2,4-DNT	mg/kg	15.6	204	<0.12 U	0.92 J	<0.073
2,6-DNT	mg/kg	7.8	102	<0.19 U	1.1	<0.099
DNT Mixture	mg/kg	0.94	4.2	ND	2.02	ND
Nitroglycerin	mg/kg	0.78	10.2	<1 U	<1 U	NT

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB27		
				A	B	C
2,4,6-TNT	mg/kg	3.9	51	130 J	<0.16 U	NT
2,4-DNT	mg/kg	15.6	204	17	<0.12 U	NT
2,6-DNT	mg/kg	7.8	102	11	<0.19 U	NT
DNT Mixture	mg/kg	0.94	4.2	18	ND	NT
Nitroglycerin	mg/kg	0.78	10.2	<1 U	<1 U	NT

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB32		
				A	B	C
2,4,6-TNT	mg/kg	3.9	51	3.1 J	24 J	0.23 J
2,4-DNT	mg/kg	15.6	204	<0.12 U	0.4 J	<0.073 U
2,6-DNT	mg/kg	7.8	102	<0.19 U	<0.19 U	<0.099 U
DNT Mixture	mg/kg	0.94	4.2	ND	0.495	ND
Nitroglycerin	mg/kg	0.78	10.2	<1 U	32 P,J	NT

*See Table 4-1 for flag definitions

Legend

- Approximate SWMU Boundary
- Soil Borings
- Below Adjusted RBCs
- Above Adjusted R-RBC
- Above Adjusted I-RBC
- NT Not Tested
- Approximate Lateral Extent of Explosives
- (<9 ft) Approximate Vertical Extent below Ground Surface

ND Non-Detect for mixtures
mg/kg Milligram per kilogram
<MDL Non-Detect

Figure 4-4

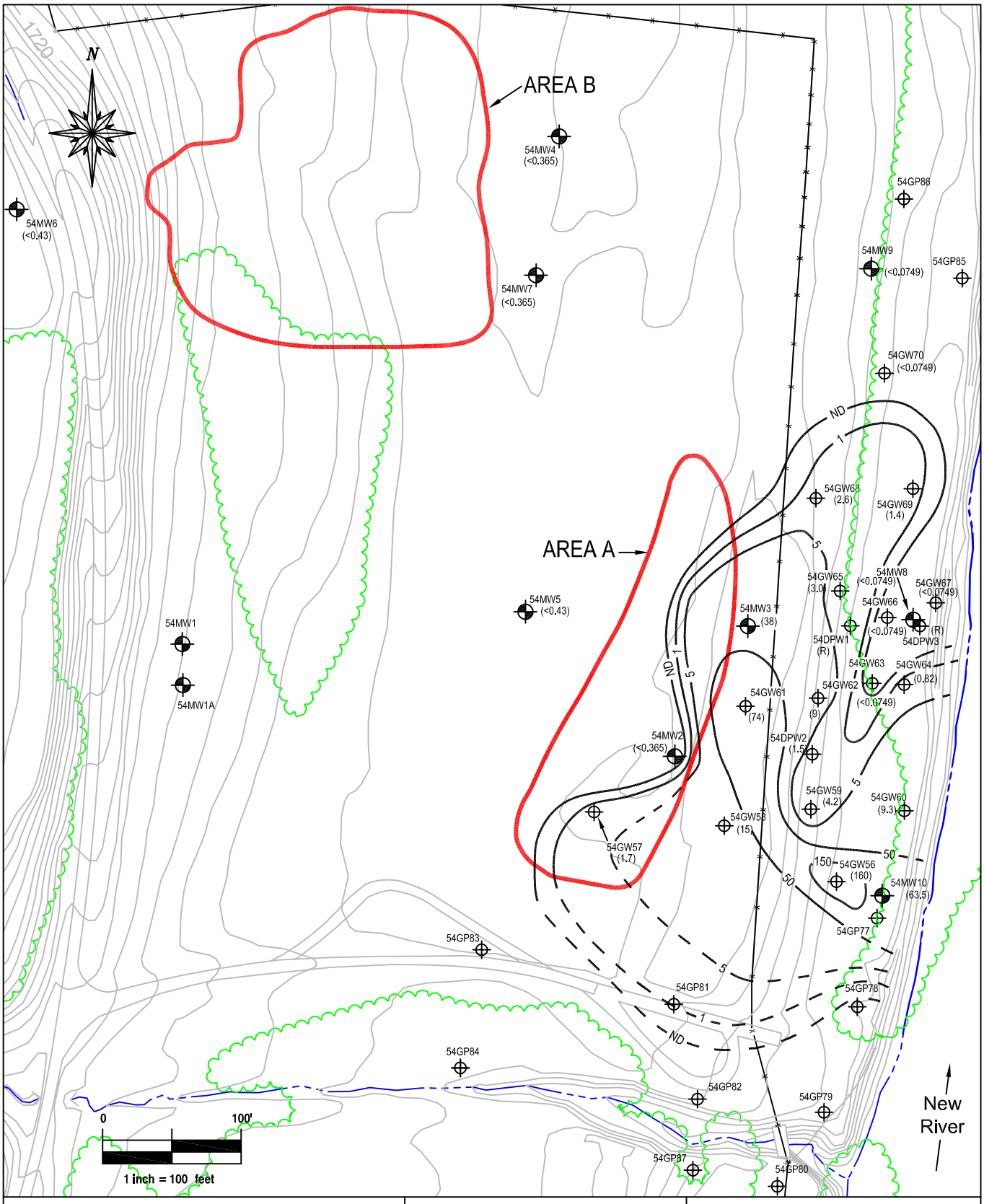
Area A - Extent of Explosives in Soil

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.4-4A Expl in Soil

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Legend

- Approximate SWMU Boundary
- Isoconcentration Contour Line
- Monitoring Well Location
- Groundwater Sample Location
- (15) Concentration of 2,4,6-TNT in micrograms per liter (ug/L)

FIGURE 4-5

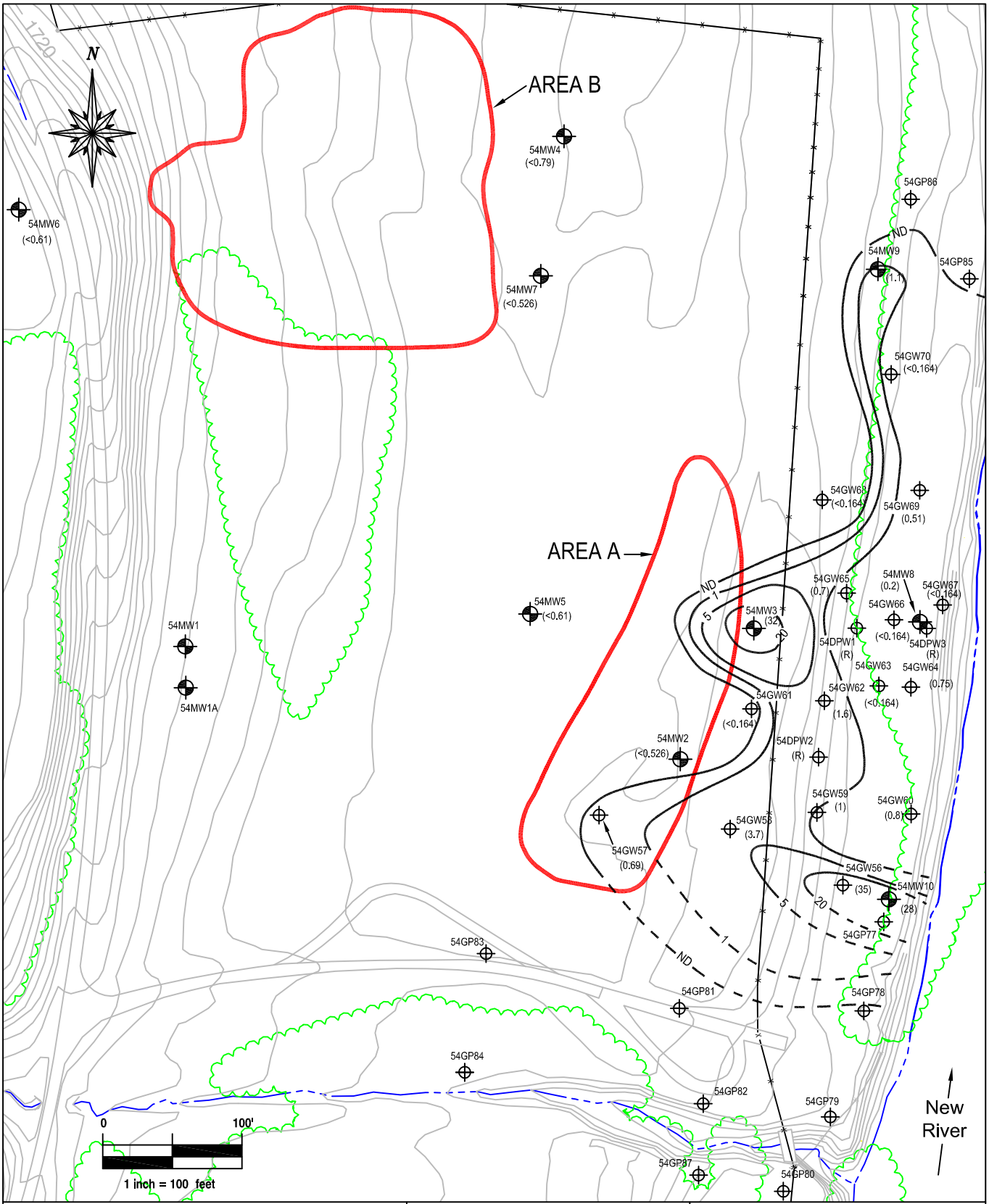
2,4,6-TNT in Groundwater Isoconcentration Map - Direct Push/Monitoring Well Data 2003/2004

Date: December 2005	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 100 feet	File Name: Fig.4-5 TNT GW

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Legend

- Approximate SWMU Boundary
- Isoconcentration Contour Line
- Monitoring Well Location
- Groundwater Sample Location
- (1) Concentration of RDX in micrograms per liter (ug/L)

FIGURE 4-6

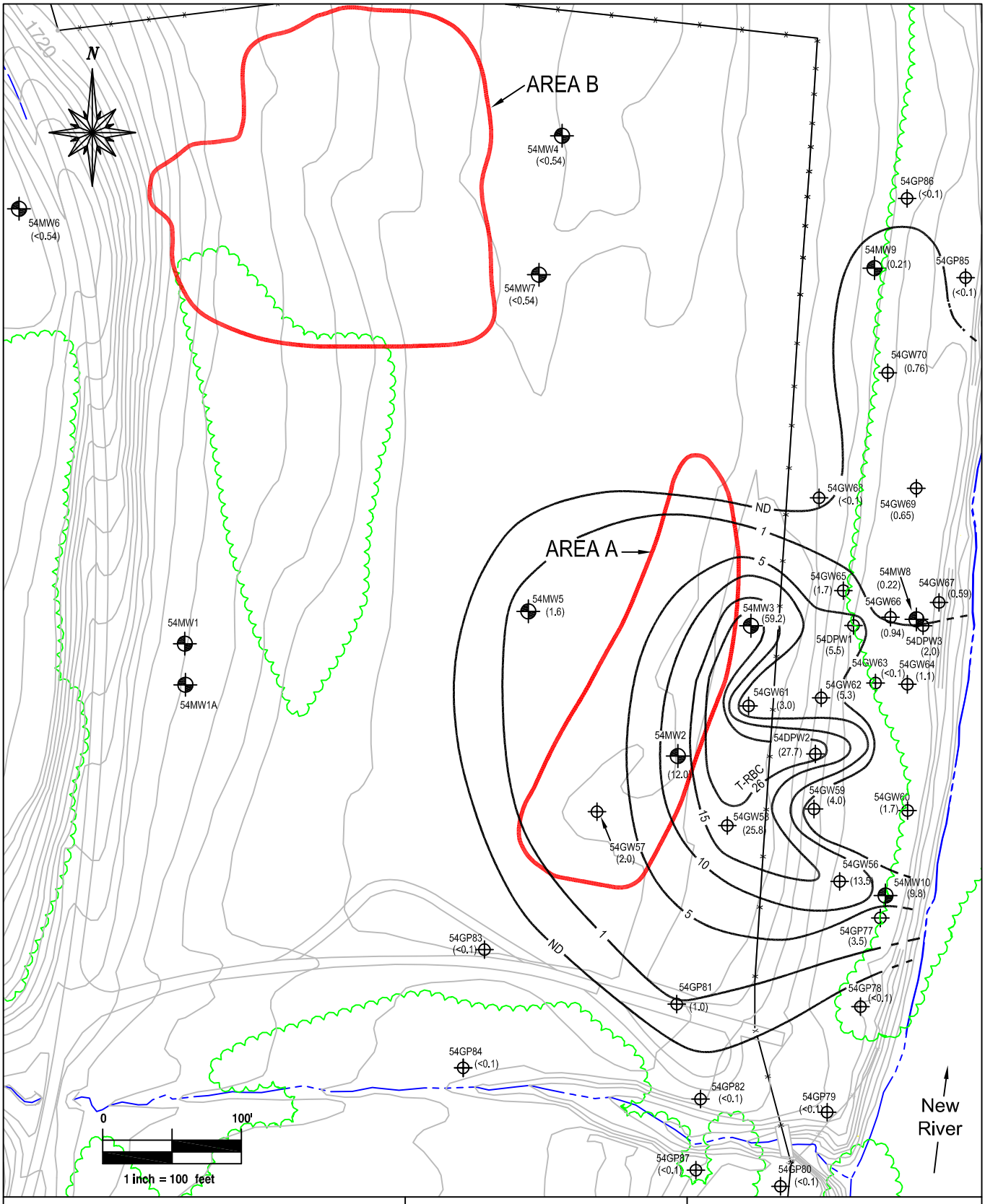
RDX in Groundwater Isoconcentration Map - Direct Push/Monitoring Well Data 2004

Date: December 2005	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 100 feet	File Name: Fig.4-6 RDX GW

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Legend

- Approximate SWMU Boundary
- Isoconcentration Contour Line
- Monitoring Well Location
- Groundwater Sample Location
- (3) Concentration of perchlorate in micrograms per liters (ug/L)

FIGURE 4-7

Perchlorate in Groundwater Isoconcentration Map - Direct Push/Monitoring Well Data 2004

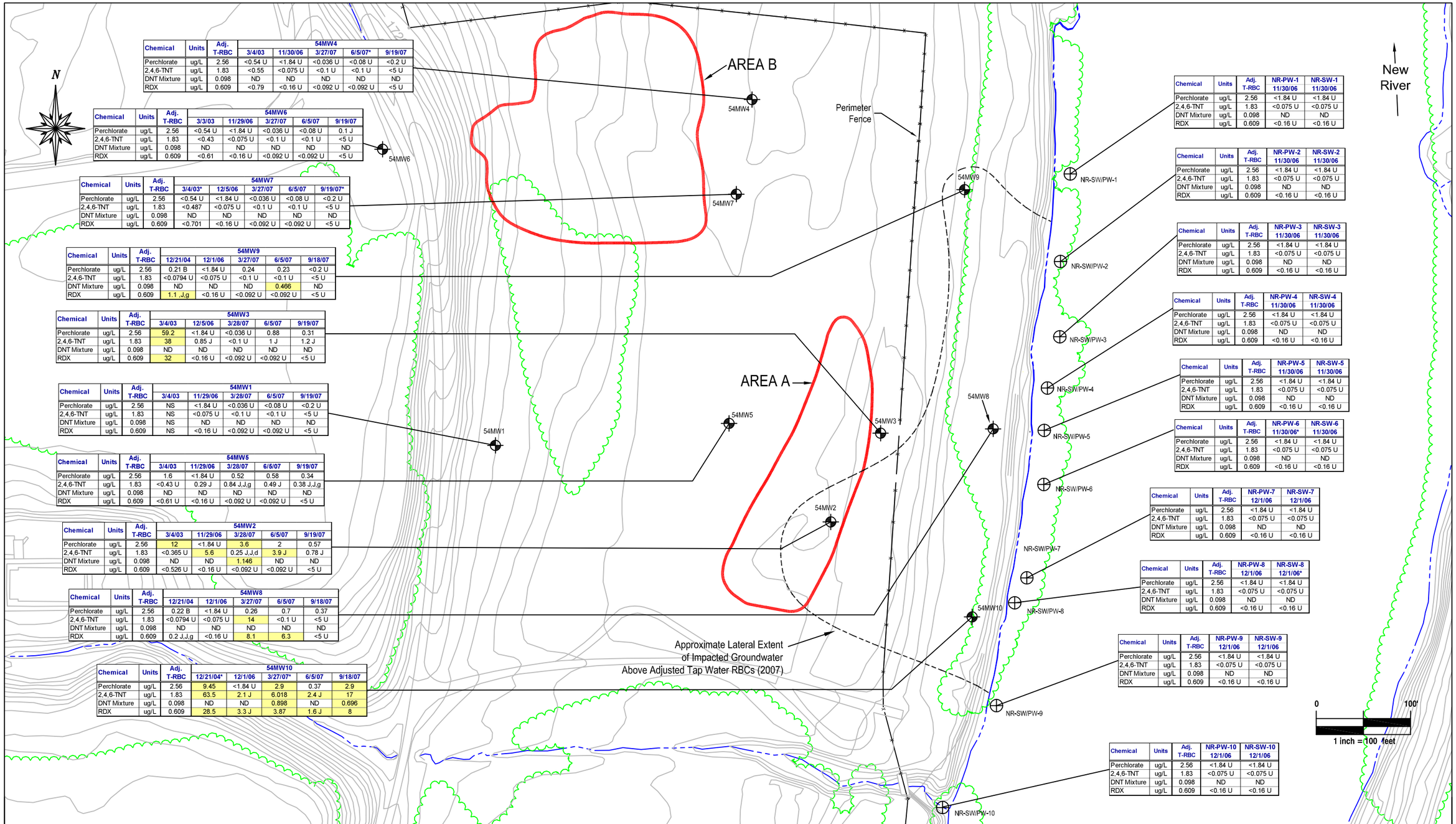
Date: December 2005	URS Project #: 21355035
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 100 feet	File Name: Fig.4-7 Perch. GW

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Chemical	Units	Adj. T-RBC	54MW4				
			3/4/03	11/30/06	3/27/07	6/5/07*	9/19/07
Perchlorate	ug/L	2.56	<0.54 U	<1.84 U	<0.036 U	<0.08 U	<0.2 U
2,4,6-TNT	ug/L	1.83	<0.55	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.098	ND	ND	ND	ND	ND
RDX	ug/L	0.609	<0.79	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	Adj. T-RBC	54MW6				
			3/3/03	11/29/06	3/27/07	6/5/07	9/19/07
Perchlorate	ug/L	2.56	<0.54 U	<1.84 U	<0.036 U	<0.08 U	0.1 J
2,4,6-TNT	ug/L	1.83	<0.43	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.098	ND	ND	ND	ND	ND
RDX	ug/L	0.609	<0.61	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	Adj. T-RBC	54MW7				
			3/4/03*	12/5/06	3/27/07	6/5/07	9/19/07*
Perchlorate	ug/L	2.56	<0.54 U	<1.84 U	<0.036 U	<0.08 U	<0.2 U
2,4,6-TNT	ug/L	1.83	<0.487	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.098	ND	ND	ND	ND	ND
RDX	ug/L	0.609	<0.701	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	Adj. T-RBC	54MW9				
			12/21/04	12/1/06	3/27/07	6/5/07	9/18/07
Perchlorate	ug/L	2.56	0.21 B	<1.84 U	0.24	0.23	<0.2 U
2,4,6-TNT	ug/L	1.83	<0.0794 U	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.098	ND	ND	ND	0.466	ND
RDX	ug/L	0.609	1.1 ,J,g	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	Adj. T-RBC	54MW3				
			3/4/03	12/5/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	2.56	59.2	<1.84 U	<0.036 U	0.88	0.31
2,4,6-TNT	ug/L	1.83	38	0.85 J	<0.1 U	1 J	1.2 J
DNT Mixture	ug/L	0.098	ND	ND	ND	ND	ND
RDX	ug/L	0.609	32	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	Adj. T-RBC	54MW1				
			3/4/03	11/29/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	2.56	NS	<1.84 U	<0.036 U	<0.08 U	<0.2 U
2,4,6-TNT	ug/L	1.83	NS	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.098	NS	ND	ND	ND	ND
RDX	ug/L	0.609	NS	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	Adj. T-RBC	54MW5				
			3/4/03	11/29/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	2.56	1.6	<1.84 U	0.52	0.58	0.34
2,4,6-TNT	ug/L	1.83	<0.43 U	0.29 J	0.84 J,J,g	0.49 J	0.38 J,J,g
DNT Mixture	ug/L	0.098	ND	ND	ND	ND	ND
RDX	ug/L	0.609	<0.61 U	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	Adj. T-RBC	54MW2				
			3/4/03	11/29/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	2.56	12	<1.84 U	3.6	2	0.57
2,4,6-TNT	ug/L	1.83	<0.365 U	5.6	0.25 J,J,d	3.9 J	0.78 J
DNT Mixture	ug/L	0.098	ND	ND	1.146	ND	ND
RDX	ug/L	0.609	<0.526 U	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	Adj. T-RBC	54MW8				
			12/21/04	12/1/06	3/27/07	6/5/07	9/18/07
Perchlorate	ug/L	2.56	0.22 B	<1.84 U	0.26	0.7	0.37
2,4,6-TNT	ug/L	1.83	<0.0794 U	<0.075 U	14	<0.1 U	<5 U
DNT Mixture	ug/L	0.098	ND	ND	ND	ND	ND
RDX	ug/L	0.609	0.2 J,J,g	<0.16 U	8.1	6.3	<5 U

Chemical	Units	Adj. T-RBC	54MW10				
			12/21/04*	12/1/06	3/27/07*	6/5/07	9/18/07
Perchlorate	ug/L	2.56	9.45	<1.84 U	2.9	0.37	2.9
2,4,6-TNT	ug/L	1.83	63.5	2.1 J	6.018	2.4 J	17
DNT Mixture	ug/L	0.098	ND	ND	0.898	ND	0.696
RDX	ug/L	0.609	28.5	3.3 J	3.87	1.6 J	8

Chemical	Units	Adj. T-RBC	NR-PW-1	NR-SW-1
			11/30/06	11/30/06
Perchlorate	ug/L	2.56	<1.84 U	<1.84 U
2,4,6-TNT	ug/L	1.83	<0.075 U	<0.075 U
DNT Mixture	ug/L	0.098	ND	ND
RDX	ug/L	0.609	<0.16 U	<0.16 U

Chemical	Units	Adj. T-RBC	NR-PW-2	NR-SW-2
			11/30/06	11/30/06
Perchlorate	ug/L	2.56	<1.84 U	<1.84 U
2,4,6-TNT	ug/L	1.83	<0.075 U	<0.075 U
DNT Mixture	ug/L	0.098	ND	ND
RDX	ug/L	0.609	<0.16 U	<0.16 U

Chemical	Units	Adj. T-RBC	NR-PW-3	NR-SW-3
			11/30/06	11/30/06
Perchlorate	ug/L	2.56	<1.84 U	<1.84 U
2,4,6-TNT	ug/L	1.83	<0.075 U	<0.075 U
DNT Mixture	ug/L	0.098	ND	ND
RDX	ug/L	0.609	<0.16 U	<0.16 U

Chemical	Units	Adj. T-RBC	NR-PW-4	NR-SW-4
			11/30/06	11/30/06
Perchlorate	ug/L	2.56	<1.84 U	<1.84 U
2,4,6-TNT	ug/L	1.83	<0.075 U	<0.075 U
DNT Mixture	ug/L	0.098	ND	ND
RDX	ug/L	0.609	<0.16 U	<0.16 U

Chemical	Units	Adj. T-RBC	NR-PW-5	NR-SW-5
			11/30/06	11/30/06
Perchlorate	ug/L	2.56	<1.84 U	<1.84 U
2,4,6-TNT	ug/L	1.83	<0.075 U	<0.075 U
DNT Mixture	ug/L	0.098	ND	ND
RDX	ug/L	0.609	<0.16 U	<0.16 U

Chemical	Units	Adj. T-RBC	NR-PW-6	NR-SW-6
			11/30/06*	11/30/06
Perchlorate	ug/L	2.56	<1.84 U	<1.84 U
2,4,6-TNT	ug/L	1.83	<0.075 U	<0.075 U
DNT Mixture	ug/L	0.098	ND	ND
RDX	ug/L	0.609	<0.16 U	<0.16 U

Chemical	Units	Adj. T-RBC	NR-PW-7	NR-SW-7
			12/1/06	12/1/06
Perchlorate	ug/L	2.56	<1.84 U	<1.84 U
2,4,6-TNT	ug/L	1.83	<0.075 U	<0.075 U
DNT Mixture	ug/L	0.098	ND	ND
RDX	ug/L	0.609	<0.16 U	<0.16 U

Chemical	Units	Adj. T-RBC	NR-PW-8	NR-SW-8
			12/1/06	12/1/06*
Perchlorate	ug/L	2.56	<1.84 U	<1.84 U
2,4,6-TNT	ug/L	1.83	<0.075 U	<0.075 U
DNT Mixture	ug/L	0.098	ND	ND
RDX	ug/L	0.609	<0.16 U	<0.16 U

Chemical	Units	Adj. T-RBC	NR-PW-9	NR-SW-9
			12/1/06	12/1/06
Perchlorate	ug/L	2.56	<1.84 U	<1.84 U
2,4,6-TNT	ug/L	1.83	<0.075 U	<0.075 U
DNT Mixture	ug/L	0.098	ND	ND
RDX	ug/L	0.609	<0.16 U	<0.16 U

Chemical	Units	Adj. T-RBC	NR-PW-10	NR-SW-10
			12/1/06	12/1/06
Perchlorate	ug/L	2.56	<1.84 U	<1.84 U
2,4,6-TNT	ug/L	1.83	<0.075 U	<0.075 U
DNT Mixture	ug/L	0.098	ND	ND
RDX	ug/L	0.609	<0.16 U	<0.16 U

Legend

- Approximate SWMU Boundary
- Monitoring Well Location (MW)
- Surface Water and Pore Water Sample Location (SW/PW)
- ug/L — Micrograms per Liter
- < — Less than Sample Method Detection Limit
- Exceeds Adjusted Tap Water RBC (T-RBC)
- ND — Non-Detect for Mixture
- NS — Not Sampled
- NR — New River

* Duplicate Average Result
See Tables 4-5 and 4-11 for flag definitions

FIGURE 4-8

Groundwater, Surface Water, and Pore Water Results for Groundwater Chemicals of Potential Concern (COPCs)

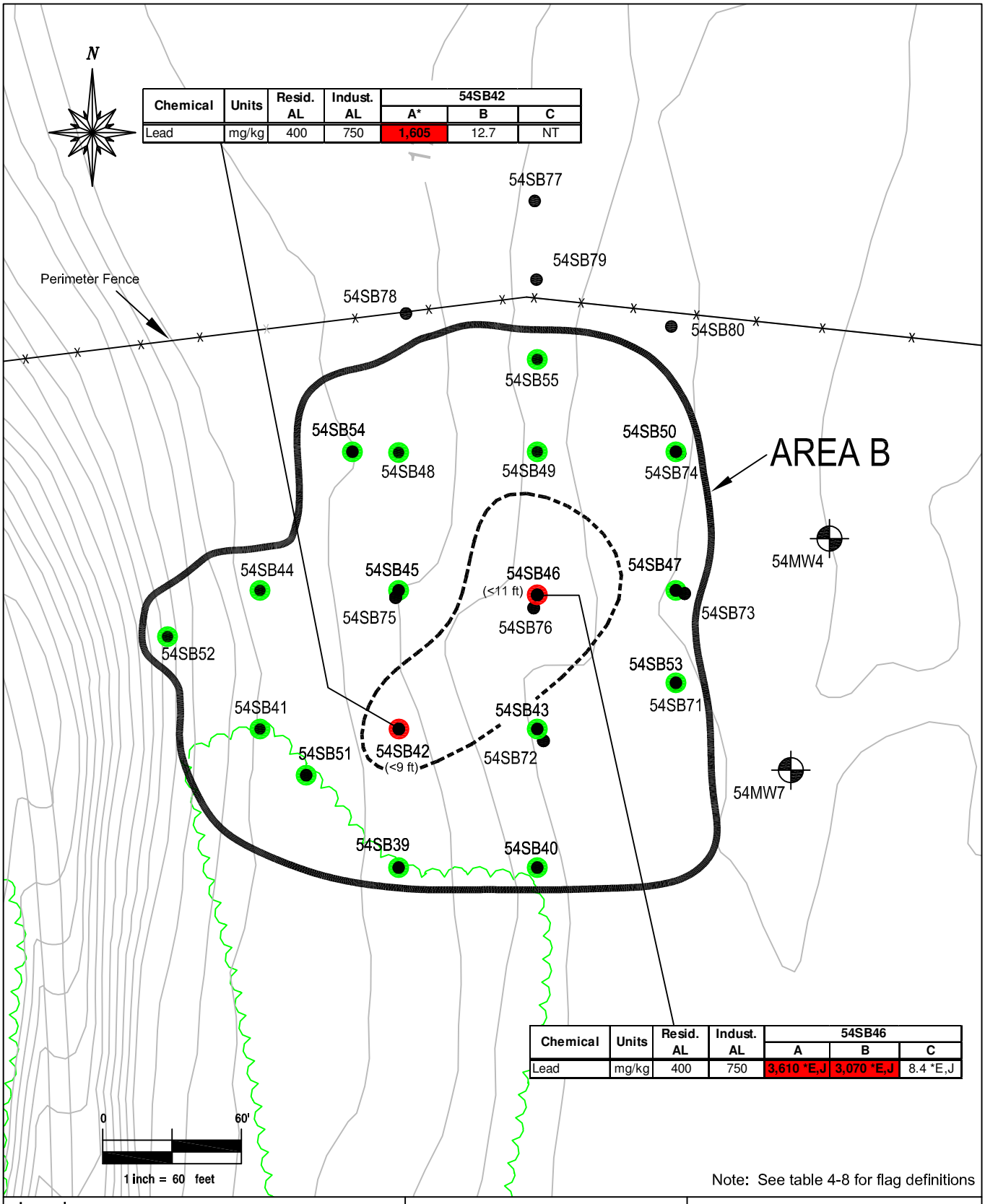
Date: January 2008	URS Project #: 21354893
Prepared by: CLD	Approved by: JOS
Scale: 1 inch = 100 feet	File Name: Fig.4-8 GW,SW,PW Results

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Legend

- Approximate SWMU Boundary
- Monitoring Well
- Soil Borings
- Below Residential Action Level of 400 mg/kg
- Above Industrial Action Level of 750 mg/kg
- Approximate Lateral Extent of Lead
- (<9 ft) Approximate Vertical Extent below Ground Surface

NT Not Tested

* Duplicate Average

Figure 4-9

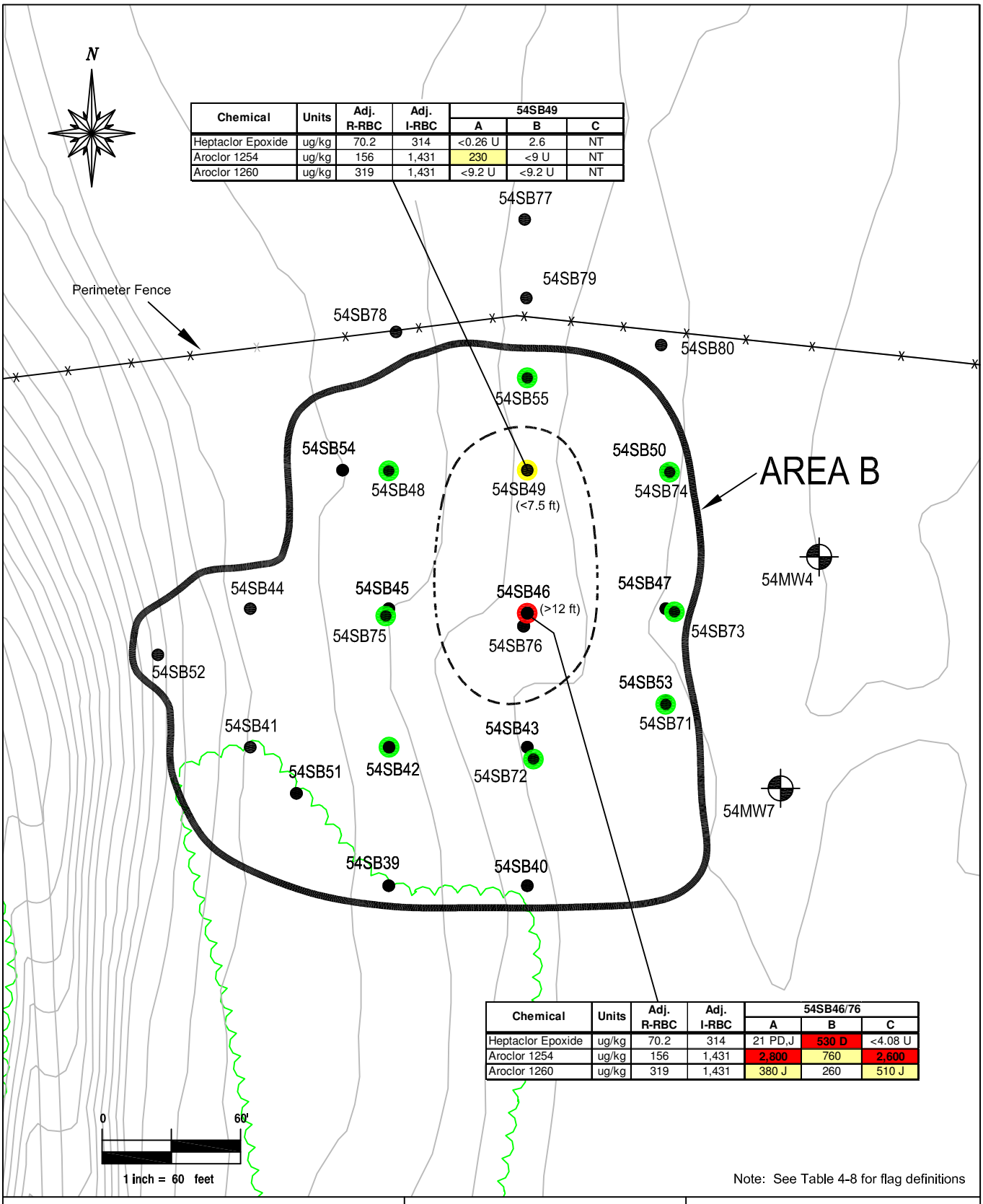
Area B - Extent of Lead in Soil

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.4-9 'B' Lead - Soil

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Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB49		
				A	B	C
Heptaclor Epoxide	ug/kg	70.2	314	<0.26 U	2.6	NT
Aroclor 1254	ug/kg	156	1,431	230	<9 U	NT
Aroclor 1260	ug/kg	319	1,431	<9.2 U	<9.2 U	NT

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB46/76		
				A	B	C
Heptaclor Epoxide	ug/kg	70.2	314	21 PD,J	530 D	<4.08 U
Aroclor 1254	ug/kg	156	1,431	2,800	760	2,600
Aroclor 1260	ug/kg	319	1,431	380 J	260	510 J

Note: See Table 4-8 for flag definitions

Legend

- Approximate SWMU Boundary
- Monitoring Well
- Soil Borings
- Below Adjusted RBCs
- Above Adjusted R-RBC
- Above Adjusted I-RBC
- (<9 ft) Approximate Vertical Extent below Ground Surface
- NT Not Tested
- <MDL Non-Detect
- ug/kg Microgram per kilogram
- Approximate Lateral Extent of Pesticides/PCBs

Figure 4-10

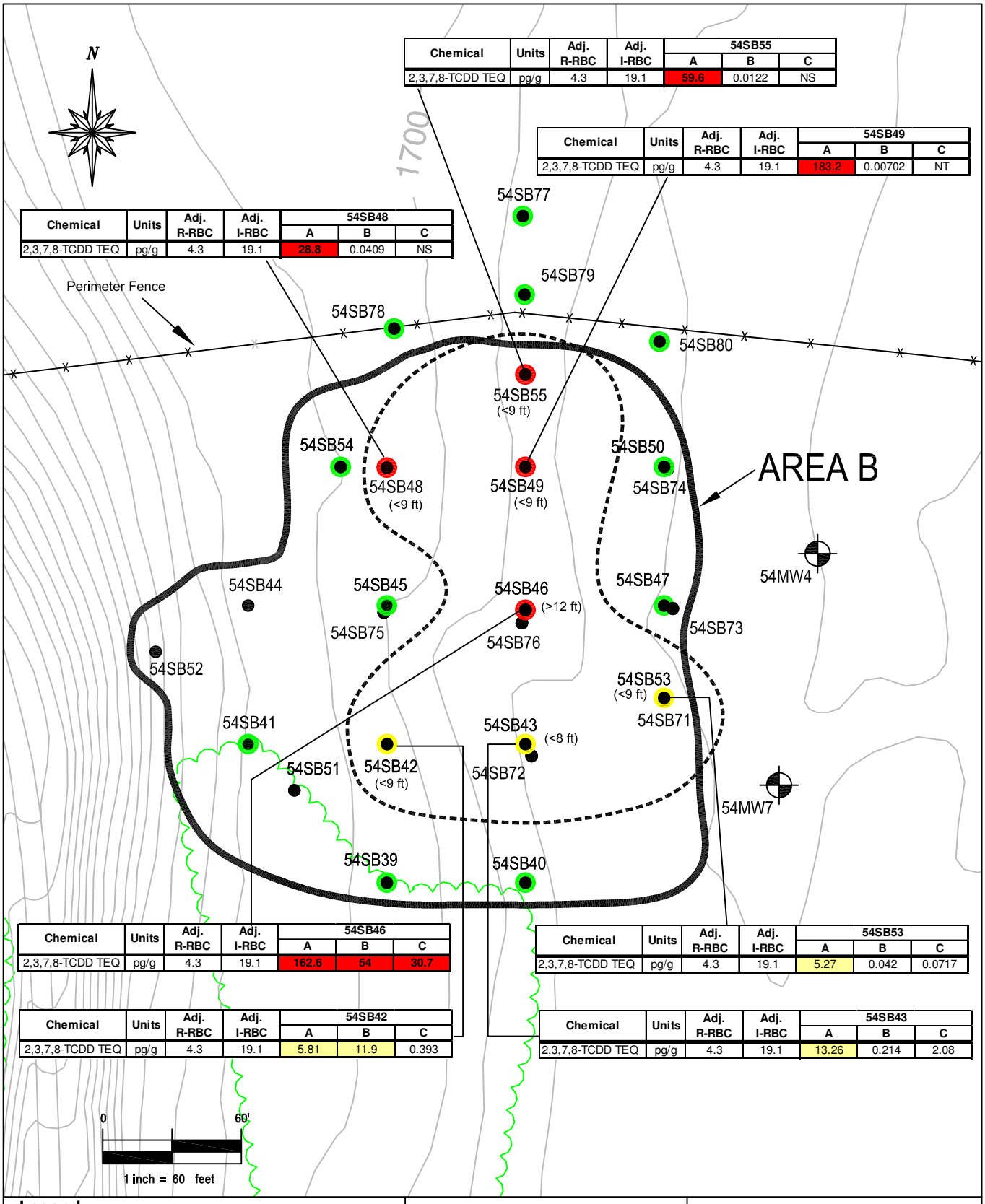
Area B - Extent of Pesticides/PCBs in Soil

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.4-10 B PCB Soil

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Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB55 A	54SB55 B	54SB55 C
2,3,7,8-TCDD TEQ	pg/g	4.3	19.1	59.6	0.0122	NS

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB49 A	54SB49 B	54SB49 C
2,3,7,8-TCDD TEQ	pg/g	4.3	19.1	183.2	0.00702	NT

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB48 A	54SB48 B	54SB48 C
2,3,7,8-TCDD TEQ	pg/g	4.3	19.1	28.8	0.0409	NS

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB46 A	54SB46 B	54SB46 C
2,3,7,8-TCDD TEQ	pg/g	4.3	19.1	162.6	54	30.7

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB53 A	54SB53 B	54SB53 C
2,3,7,8-TCDD TEQ	pg/g	4.3	19.1	5.27	0.042	0.0717

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB42 A	54SB42 B	54SB42 C
2,3,7,8-TCDD TEQ	pg/g	4.3	19.1	5.81	11.9	0.393

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB43 A	54SB43 B	54SB43 C
2,3,7,8-TCDD TEQ	pg/g	4.3	19.1	13.26	0.214	2.08

Legend

- Approximate SWMU Boundary
- Monitoring Well
- Soil Borings
- Below Adjusted RBCs
- Above Adjusted R-RBC
- Above Adjusted I-RBC
- (<9 ft) Approximate Vertical Extent below Ground Surface
- NT Not Tested
- NS Not Sampled
- pg/g Picogram per gram
- Approximate Lateral Extent of Dioxin/Furans

Figure 4-11

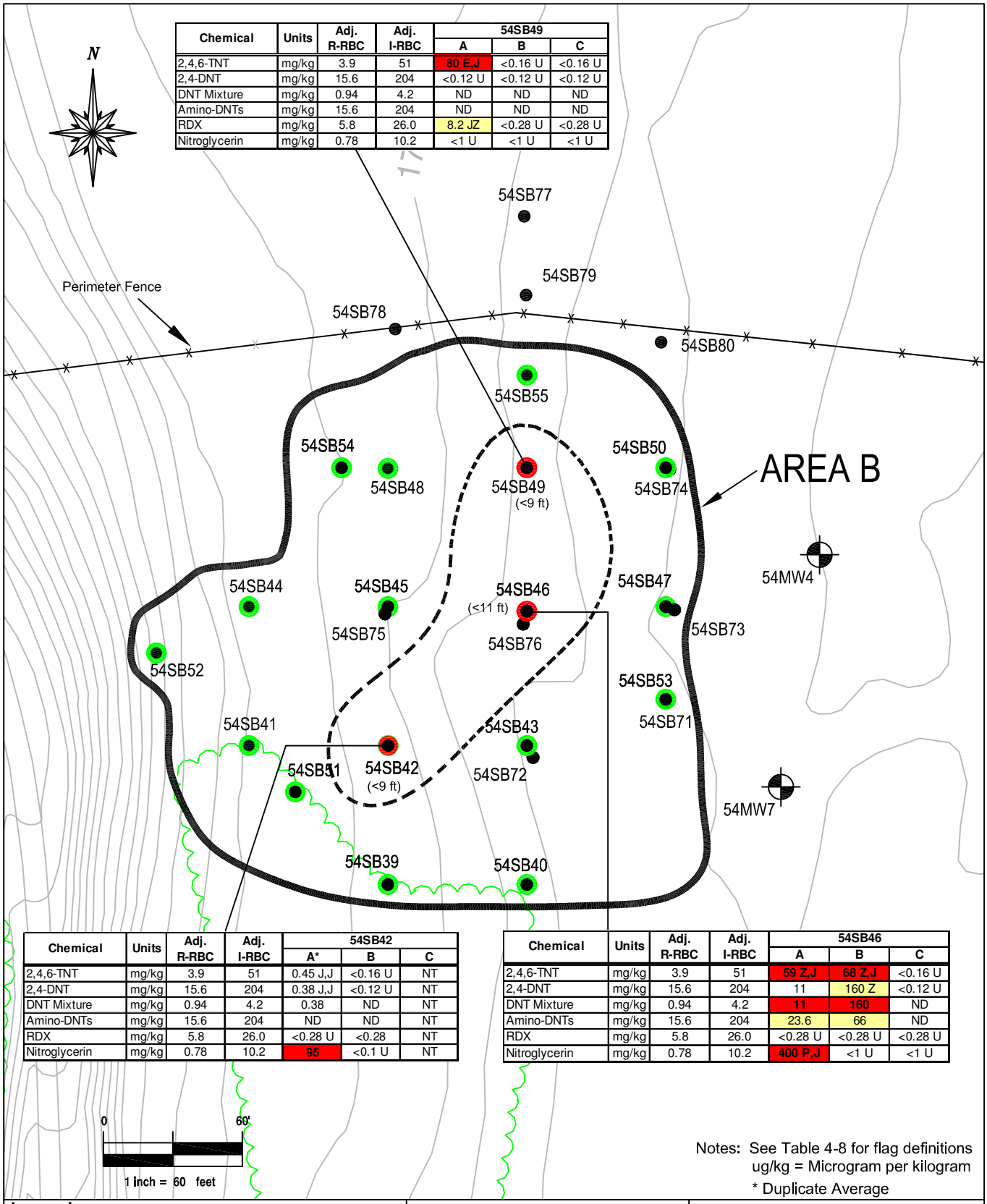
Area B - Extent of Dioxin/Furans in Soil

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.4-11B DioFur Soil

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Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB49 A	54SB49 B	54SB49 C
2,4,6-TNT	mg/kg	3.9	51	80 E,J	<0.16 U	<0.16 U
2,4-DNT	mg/kg	15.6	204	<0.12 U	<0.12 U	<0.12 U
DNT Mixture	mg/kg	0.94	4.2	ND	ND	ND
Amino-DNTs	mg/kg	15.6	204	ND	ND	ND
RDX	mg/kg	5.8	26.0	8.2 JZ	<0.28 U	<0.28 U
Nitroglycerin	mg/kg	0.78	10.2	<1 U	<1 U	<1 U

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB42 A*	54SB42 B	54SB42 C
2,4,6-TNT	mg/kg	3.9	51	0.45 J,J	<0.16 U	NT
2,4-DNT	mg/kg	15.6	204	0.38 J,J	<0.12 U	NT
DNT Mixture	mg/kg	0.94	4.2	0.38	ND	NT
Amino-DNTs	mg/kg	15.6	204	ND	ND	NT
RDX	mg/kg	5.8	26.0	<0.28 U	<0.28	NT
Nitroglycerin	mg/kg	0.78	10.2	95	<0.1 U	NT

Chemical	Units	Adj. R-RBC	Adj. I-RBC	54SB46 A	54SB46 B	54SB46 C
2,4,6-TNT	mg/kg	3.9	51	59 Z,J	68 Z,J	<0.16 U
2,4-DNT	mg/kg	15.6	204	11	160 Z	<0.12 U
DNT Mixture	mg/kg	0.94	4.2	11	160	ND
Amino-DNTs	mg/kg	15.6	204	23.6	66	ND
RDX	mg/kg	5.8	26.0	<0.28 U	<0.28 U	<0.28 U
Nitroglycerin	mg/kg	0.78	10.2	400 P,J	<1 U	<1 U

Notes: See Table 4-8 for flag definitions
ug/kg = Microgram per kilogram
* Duplicate Average

Legend

- Approximate SWMU Boundary
- Monitoring Well
- Soil Borings
- Below Adjusted RBCs
- Above Adjusted I-RBC
- (<9 ft) Approximate Vertical Extent below Ground Surface
- NT Not Tested
- ND Non-Detect for mixtures
- Approximate Lateral Extent of Explosives
- <MDL Non-Detect

Figure 4-12

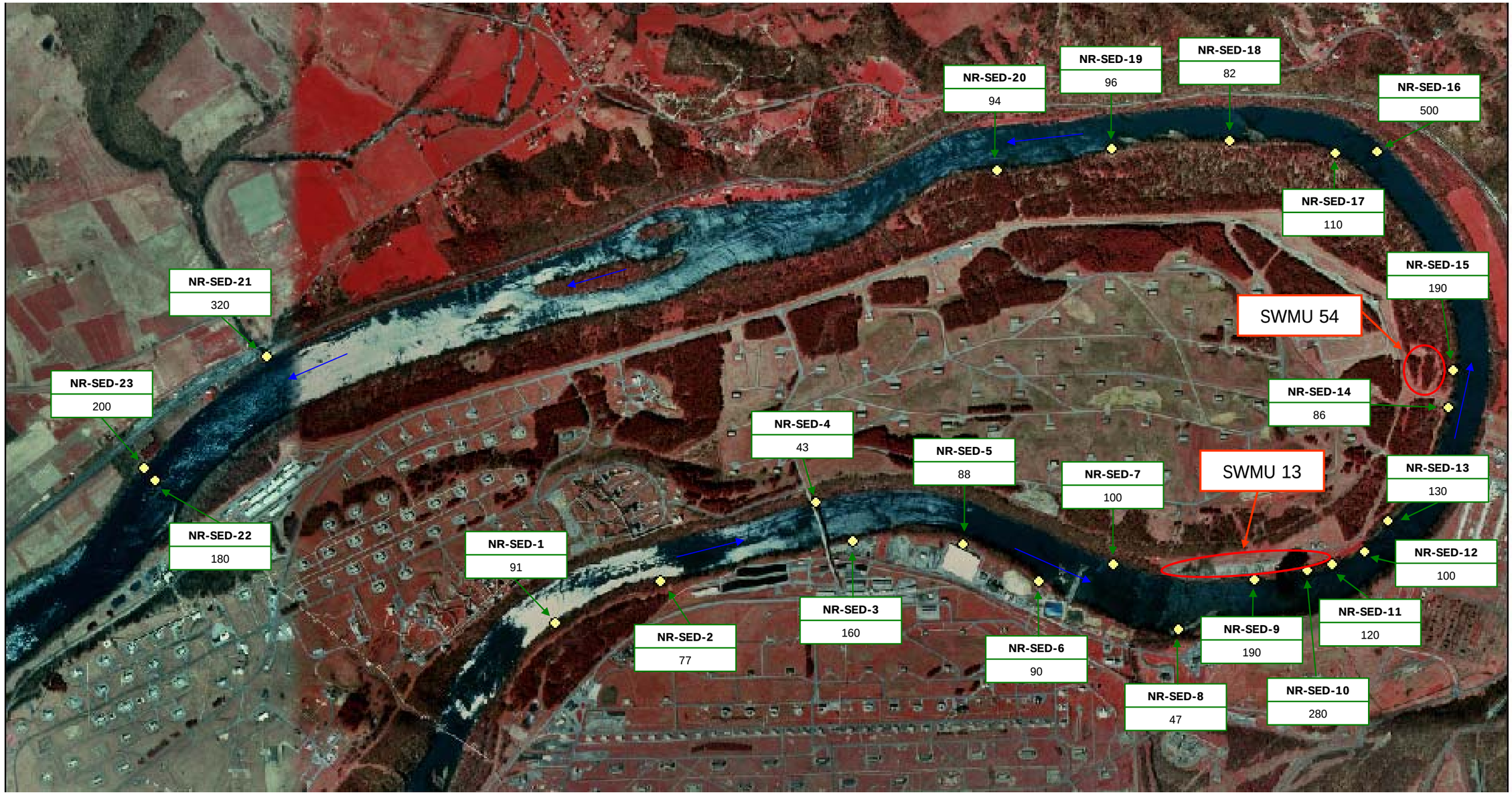
Area B - Extent of Explosives in Soil

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.4-12 B Expl Soil

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Legend

◇ Sediment Sampling Location

NR-SED-1 Sampling Location ID

91 Concentration of Lead (mg/kg)

→ Flow Direction

N

FIGURE 4-13

Date: May 10, 2007

Drawn by: TLD/LAM

Reviewed by: JOS

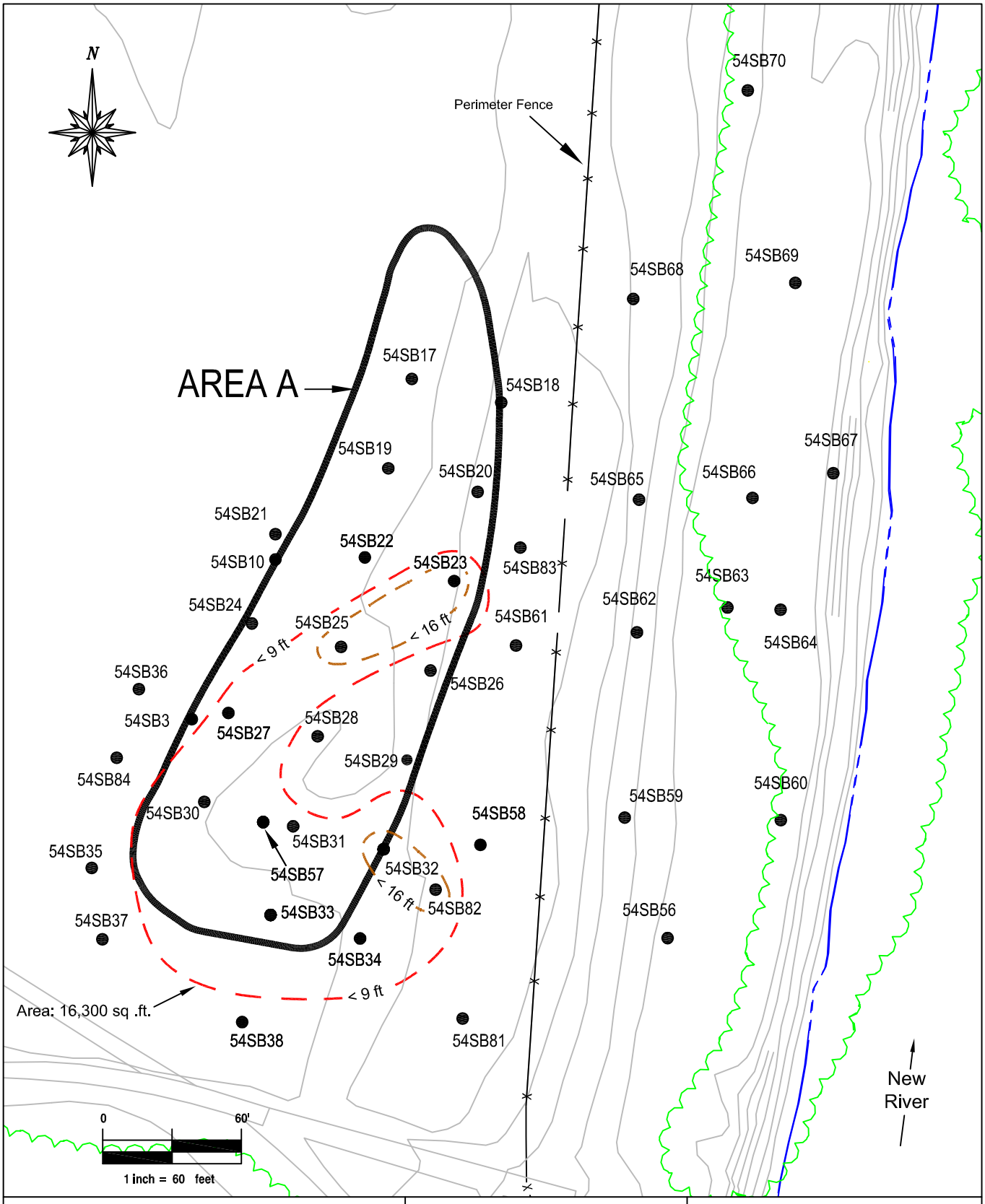
LEAD CONCENTRATIONS IN SEDIMENT

Radford Army Ammunition Plant
Radford, Virginia

URS

URS Group, Inc.
5540 FALMOUTH ST., SUITE 201
RICHMOND, VA 23230

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Legend

- Approximate SWMU Boundary
- Topographic Contour
- Vegetation
- Soil Boring Location
- < 9 ft — Approximate Vertical and Lateral Extent of Impacted Soil Above Adjusted Residential RBCs
- < 16 ft — Approximate Vertical Extent of Impacted Soil Above Adjusted Residential RBCs

Figure 4-14

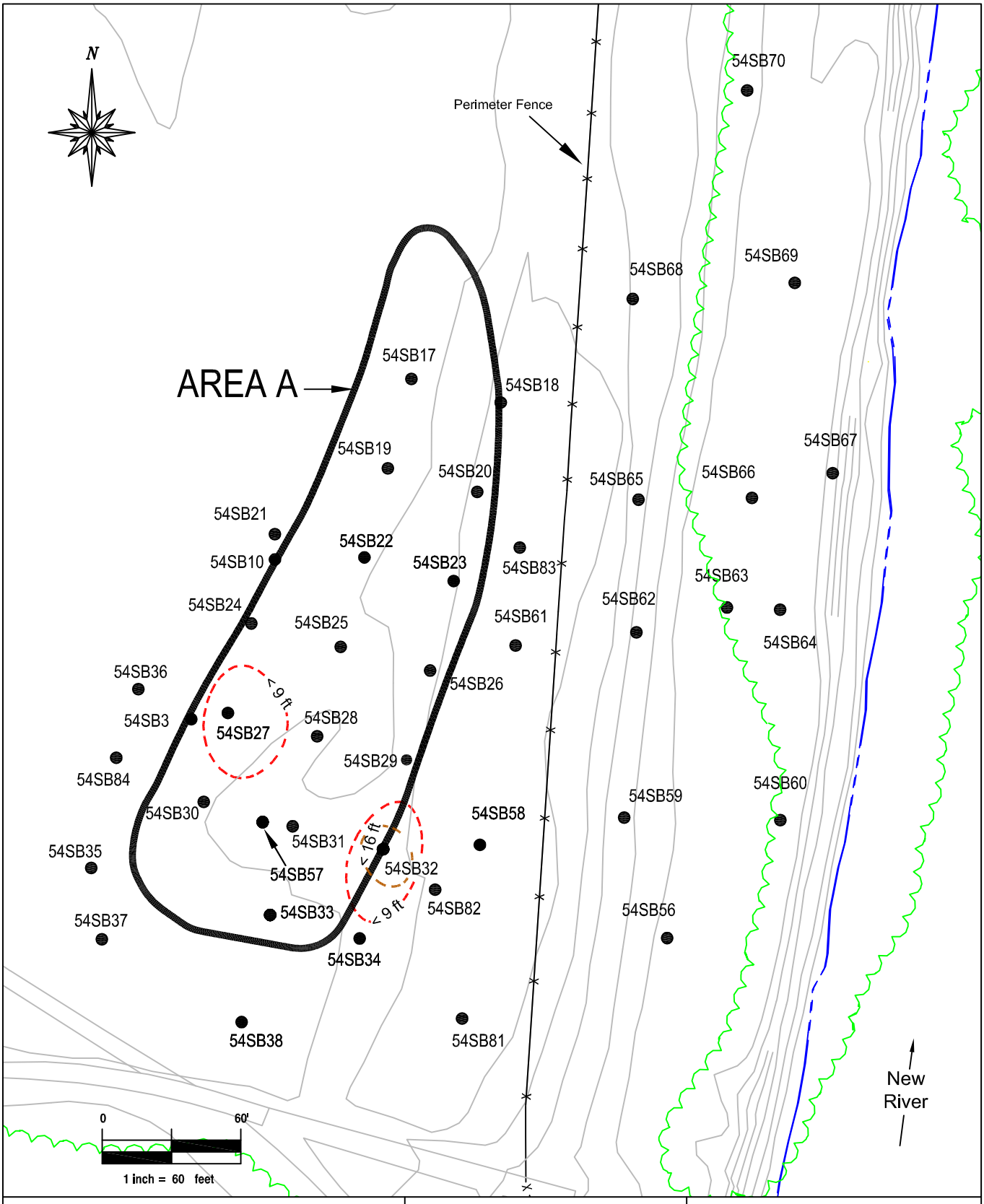
Area A - Lateral and Vertical Extent of Constituents in Soil Above Adjusted Residential Risk-Based Concentrations

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.4-14 A R-RBC Soil

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Legend

- Approximate SWMU Boundary
- Topographic Contour
- Vegetation
- Soil Boring Location
- < 9 ft — Approximate Vertical and Lateral Extent of Impacted Soil Above Adjusted Industrial RBCs
- < 16 ft — Approximate Vertical Extent of Impacted Soil Above Adjusted Industrial RBCs

Figure 4-15

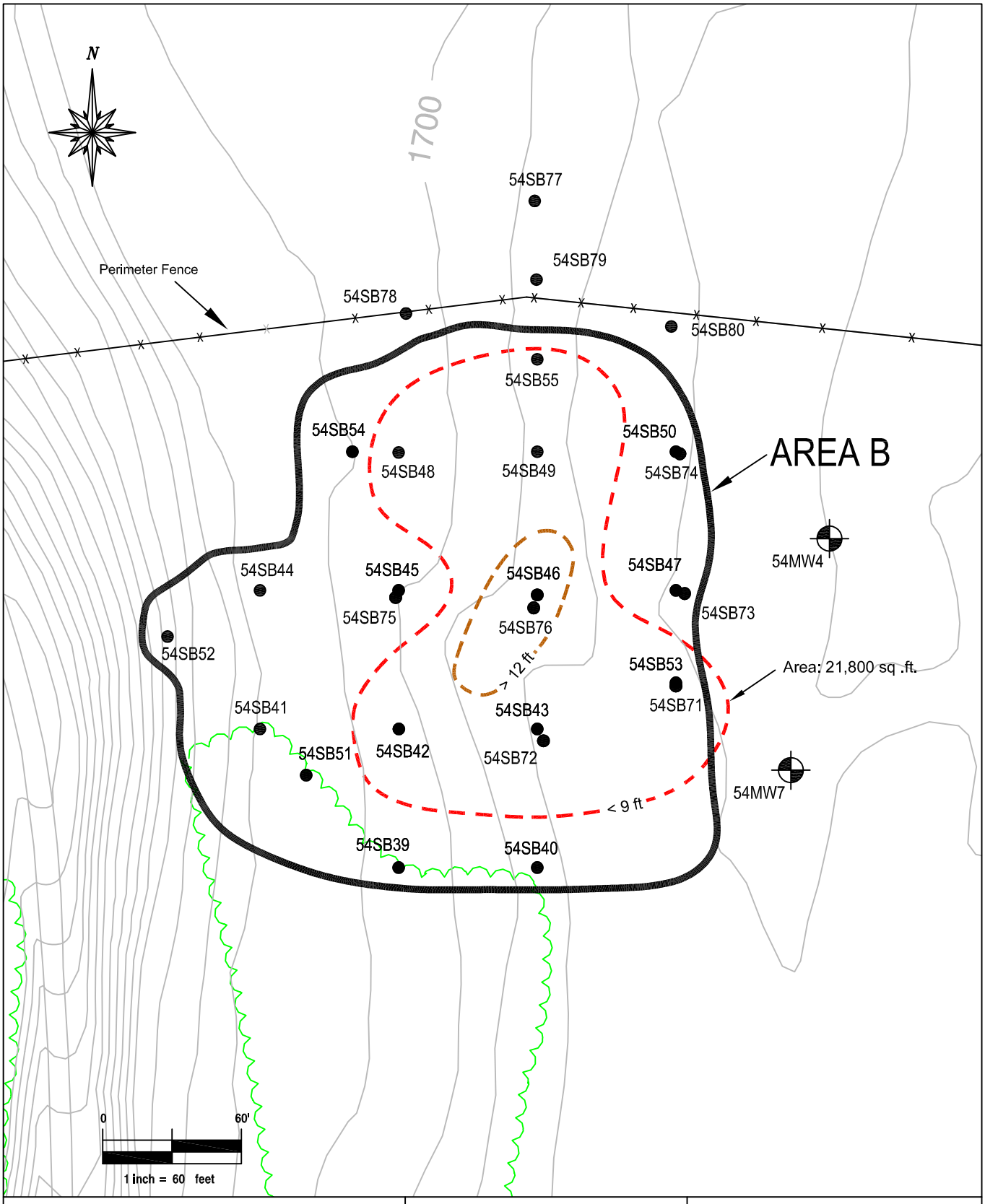
Area A - Lateral and Vertical Extent of Constituents in Soil Above Adjusted Industrial Risk-Based Concentrations

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.4-15 A I-RBC Soil

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Legend

- Approximate SWMU Boundary
- Topographic Contour
- Vegetation
- Soil Boring Location
- < 9 ft — Approximate Vertical and Lateral Extent of Impacted Soil Above Adjusted Residential RBCs
- < 12 ft — Approximate Vertical Extent of Impacted Soil Above Adjusted Residential RBCs

Figure 4-16

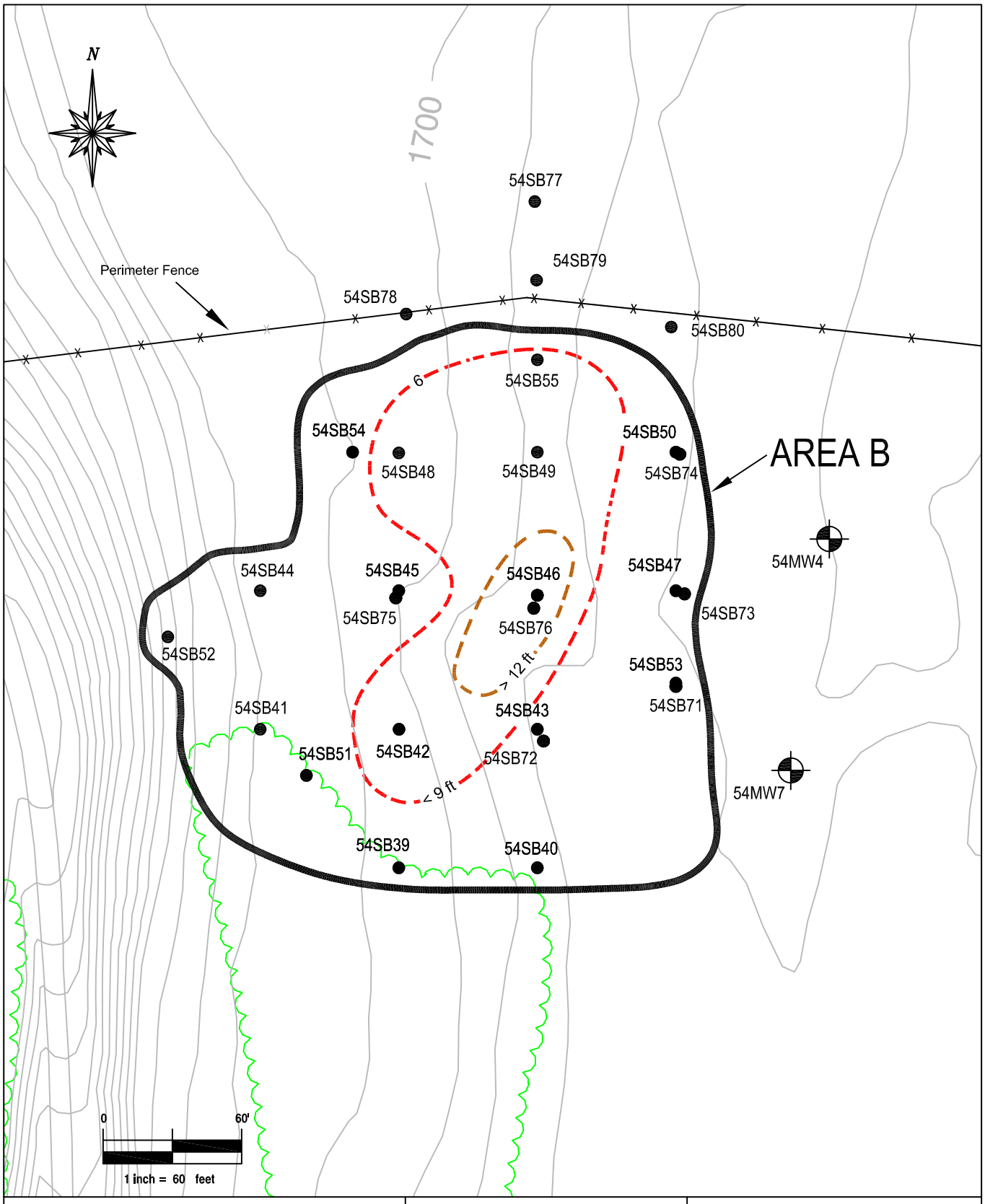
Area B - Lateral and Vertical Extent of Constituents in Soil Above Adjusted Residential Risk-Based Concentrations

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.4-16 B R-RBC Soil

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Legend

- Approximate SWMU Boundary
- Topographic Contour
- Vegetation
- Soil Boring Location
- < 9 ft — Approximate Vertical and Lateral Extent of Impacted Soil Above Adjusted Industrial RBCs
- < 12 ft — Approximate Vertical Extent of Impacted Soil Above Adjusted Industrial RBCs

Figure 4-17

Area B - Lateral and Vertical Extent of Constituents in Soil Above Adjusted Industrial Risk-Based Concentrations

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.4-17 B I-RBC Soil

SWMU 54

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Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB3A 1/10/2007 0-0.5		MDL	RL	54SB3B 1/10/2007 9-10		MDL	RL	54SB3C 1/10/2007 13.3-14.3		MDL	RL	54SB10A 1/10/2007 0-0.5		MDL	RL	54SB10B 1/10/2007 9-10		MDL	RL	54SB10C 1/10/2007 13-14		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				NT				NT				NT				NT				NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				NT				NT				NT				NT				NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				NT				NT				NT				NT				NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				NT				NT				NT				NT				NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	NT				NT				NT				NT				NT				NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				NT				NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Chromium[1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				NT				NT				NT				NT				NT			
Cobalt	7440-48-4	--	72.3	--	--	--	NT				NT				NT				NT				NT				NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				NT				NT				NT				NT				NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				NT				NT				NT				NT				NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				NT				NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				NT				NT				NT				NT				NT			
Mercury[3]	7439-97-6	--	0.13	2.35	30.66	--	NT				NT				NT				NT				NT				NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				NT				NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				NT				NT				NT				NT				NT			
Silver	7440-22-4	N	--	39.11	511	1.551	NT				NT				NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	NT				NT				NT				NT				NT				NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				NT				NT				NT				NT				NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				NT				NT				NT				NT				NT			
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<4	U	1.1	4	<3.7	U	1	3.7	<3.8	U	1	3.8	<4	U	1.1	4	<4.1	U	1.1	4.1	<3.8	U	1	3.8
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	<4	U	1.3	4	<3.7	U	1.2	3.7	<3.8	U	1.2	3.8	<4	U	1.2	4	<4.1	U	1.3	4.1	<3.8	U	1.2	3.8
alpha-Chlordane[4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<4	U	0.82	4	<3.7	U	0.76	3.7	<3.8	U	0.78	3.8	<4	U	0.82	4	<4.1	U	0.85	4.1	<3.8	U	0.79	3.8
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<4	U	1.1	4	<3.7	U	1.1	3.7	<3.8	U	1.1	3.8	<4	U	1.1	4	<4.1	U	1.2	4.1	<3.8	U	1.1	3.8
Endosulfan Sulfate[6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	<4	U	1.2	4	<3.7	U	1.1	3.7	<3.8	U	1.1	3.8	<4	U	1.2	4	<4.1	U	1.3	4.1	<3.8	U	1.2	3.8
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<4	U	1.3	4	<3.7	U	1.2	3.7	<3.8	U	1.2	3.8	<4	U	1.3	4	<4.1	U	1.3	4.1	<3.8	U	1.2	3.8
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<2.1	U	0.78	2.1	<1.9	U	0.72	1.9	<1.9	U	0.73	1.9	<2	U	0.77	2	<2.1	U	0.81	2.1	<2	U	0.75	2
gamma-Chlordane[4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<4	U	0.57	4	<3.7	U	0.53	3.7	<3.8	U	0.54	3.8	<4	U	0.57	4	<4.1	U	0.59	4.1	<3.8	U	0.55	3.8
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<8.1	U	1.5	8.1	<7.5	U	1.4	7.5	<7.7	U	1.4	7.7	<8.1	U	1.5	8.1	<8.4	U	1.5	8.4	<7.8	U	1.4	7.8
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<2.1	U	0.5	2.1	<1.9	U	0.47	1.9	<1.9	U	0.47	1.9	<2	U	0.5	2	<2.1	U	0.52	2.1	<2	U	0.48	2
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<21	U	1.6	21	<19	U	1.5	19	<19	U	1.5	19	<20	U	1.6	20	<21	U	1.6	21	<20	U	1.5	20
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	28	J,J,g	7.3	40	<37	U	6.8	37	<38	U	6.9	38	<40	U	7.2	40	<41	U	7.5	41	<38	U	7	38
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	78		5.3	40	<37	U	5	37	<38	U	5	38	<40	U	5.3	40	<41	U	5.5	41	<38	U	5.1	38
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene[8]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB3A 1/10/2007 0-0.5		MDL	RL	54SB3B 1/10/2007 9-10		MDL	RL	54SB3C 1/10/2007 13.3-14.3		MDL	RL	54SB10A 1/10/2007 0-0.5		MDL	RL	54SB10B 1/10/2007 9-10		MDL	RL	54SB10C 1/10/2007 13-14		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene[9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene[9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB3A 1/10/2007 0-0.5		MDL	RL	54SB3B 1/10/2007 9-10		MDL	RL	54SB3C 1/10/2007 13.3-14.3		MDL	RL	54SB10A 1/10/2007 0-0.5		MDL	RL	54SB10B 1/10/2007 9-10		MDL	RL	54SB10C 1/10/2007 13-14		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<2.5	U	0.2	2.5	<2.5	U	0.2	2.5	<2.5	U	0.2	2.5	NT				NT				NT			
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<2.5	U	0.051	2.5	0.64	J	0.051	2.5	<2.5	U	0.051	2.5	NT				NT				NT			
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<2.5	U	0.099	2.5	<2.5	U	0.099	2.5	<2.5	U	0.099	2.5	NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	ND				ND				ND				NT				NT				NT			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<2.5	U	0.088	2.5	1.1	J	0.088	2.5	<2.5	U	0.088	2.5	NT				NT				NT			
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<2.5	U	0.053	2.5	0.74	J	0.053	2.5	<2.5	U	0.053	2.5	NT				NT				NT			
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				1.84	J	0.088	2.5	ND				NT				NT				NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<2.5	U	0.17	2.5	<2.5	U	0.17	2.5	<2.5	U	0.17	2.5	NT				NT				NT			
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				NT				NT				NT				NT				NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	82		0.1	0.1	89		0.1	0.1	87		0.1	0.1	83		0.1	0.1	80		0.1	0.1	86		0.1	0.1

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Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB10C-DUP(DUP2) 1/10/2007 13-14		MDL	RL	54SB17A 12/2/2002 0-1		MDL	RL	54SB17B 12/2/2002 9-10		MDL	RL	54SB18A 12/2/2002 0-1		MDL	RL	54SB18B 12/2/2002 9-10		MDL	RL	54SB19A 12/2/2002 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				9,210		2.6	11.7	17,000		2.7	12.2	8,050		2.5	11.3	10,200		2.6	12	11,200		2.5	11.3
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				<1.2	UN,UL,m	0.43	1.2	<1.2	UN,UL,m	0.45	1.2	<1.1	UN,UL,m	0.42	1.1	<1.2	UN,UL,m	0.44	1.2	<1.1	UN,UL,m	0.42	1.1
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				***1***	B	0.29	1.2	***1.6***		0.3	1.2	***1***	B	0.28	1.1	***0.83***	B	0.3	1.2	***1***	B	0.28	1.1
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				145	E	0.02	1.2	178	E,J,s	0.02	1.2	155	E,J,s	0.02	1.1	110	E,J,s	0.02	1.2	142	E,J,s	0.02	1.1
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	NT				0.74		0.01	0.59	1.1		0.01	0.61	0.66		0.01	0.56	0.74		0.01	0.6	0.83		0.01	0.57
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				<0.59	UN,UL,m	0.05	0.59	<0.61	UN,UL,m	0.05	0.61	<0.56	UN,UL,m	0.05	0.56	<0.6	UN,UL,m	0.05	0.6	<0.57	UN,UL,m	0.05	0.57
Calcium	7440-70-2	--	--	--	--	--	NT				1,440	E,J,s	1.1	117	1,870	E,J,s	1.2	122	1,200	E,J,s	1.1	113	1,470	E,J,s	1.2	120	1,530	E,J,s	1.1	113
Chromium[1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				***16.4***		0.07	0.59	***23.6***		0.07	0.61	***14.5***		0.07	0.56	***16.6***		0.07	0.6	***17.7***		0.07	0.57
Cobalt	7440-48-4	--	72.3	--	--	--	NT				6.7	E,J,s	0.07	0.59	11.1	E,J,s	0.07	0.61	6	E,J,s	0.07	0.56	8.2	E,J,s	0.07	0.6	8.1	E,J,s	0.07	0.57
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				7.1		0.16	0.59	19.8		0.17	0.61	4		0.16	0.56	8		0.17	0.6	9.9		0.16	0.57
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				14,700	E,J,s	1.6	11.7	22,500	E,J,s	1.7	12.2	14,500	E,J,s	1.5	11.3	15,300	E,J,s	1.6	12	16,900	E,J,s	1.6	11.3
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				21.2	N*,J,k	0.27	0.35	10.9	N*,J,k	0.28	0.36	34.4	N*,J,k	0.26	0.34	6.9	N*,J,k	0.28	0.36	17.9	N*,J,k	0.26	0.34
Magnesium	7439-95-4	--	--	--	--	--	NT				2,450	E,J,s	0.72	117	3,820	E,J,s	0.74	122	2,170	E,J,s	0.69	113	2,620	E,J,s	0.73	120	2,770	E,J,s	0.69	113
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				***543***	E,J,s	0.02	1.2	***691***	E,J,s	0.02	1.2	***528***	E,J,s	0.02	1.1	***476***	E,J,s	0.02	1.2	***546***	E,J,s	0.02	1.1
Mercury[3]	7439-97-6	--	0.13	2.35	30.66	--	NT				0.057		0.018	0.037	0.047		0.018	0.036	0.061		0.019	0.039	0.031	B	0.018	0.036	0.036	B	0.019	0.038
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				10.8		0.12	0.59	16		0.12	0.61	9.6		0.11	0.56	10.8		0.12	0.6	11.6		0.11	0.57
Potassium	7440-09-7	--	--	--	--	--	NT				954	E,J,s	13.9	117	1,240	E,J,s	14.4	122	966	E,J,s	13.4	113	983	E,J,s	14.2	120	1,110	E,J,s	13.4	113
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				***1.1***	N,L,m	0.39	0.59	***1.2***	N,L,m	0.4	0.61	***1***	N,L,m	0.37	0.56	***1***	N,L,m	0.4	0.6	***1.1***	N,L,m	0.37	0.57
Silver	7440-22-4	N	--	39.11	511	1.551	NT				<0.59	U	0.08	0.59	<0.61	U	0.09	0.61	<0.56	U	0.08	0.56	<0.6	U	0.08	0.6	<0.57	U	0.08	0.57
Sodium	7440-23-5	--	--	--	--	--	NT				217	B,L,w	29.2	235	235	B,L,w	30.3	243	254	L,w	28.1	226	241	L,w	29.8	240	226	B,L,w	28.2	226
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	NT				<1.2	UN,UL,m	0.6	1.2	<1.2	UN,UL,m	0.62	1.2	<1.1	UN,UL,m	0.58	1.1	<1.2	UN,UL,m	0.61	1.2	<1.1	UN,UL,m	0.58	1.1
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				20.8		0.08	2.3	36.4		0.09	2.4	18.9		0.08	2.3	22.2		0.08	2.4	25.1		0.08	2.3
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				91.4	*E,J,s	0.12	2.3	69.2	*E,J,s	0.12	2.4	120	*E,J,s	0.11	2.3	49.8	*E,J,s	0.12	2.4	81.6	*E,J,s	0.11	2.3
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<3.9	U	1.1	3.9	NT				NT				NT				NT				NT			
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	<3.9	U	1.2	3.9	NT				NT				NT				NT				NT			
alpha-Chlordane[4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<3.9	U	0.8	3.9	NT				NT				NT				NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<3.9	U	1.1	3.9	NT				NT				NT				NT				NT			
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	<3.9	U	1.2	3.9	NT				NT				NT				NT				NT			
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<3.9	U	1.2	3.9	NT				NT				NT				NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<2	U	0.76	2	NT				NT				NT				NT				NT			
gamma-Chlordane[4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<3.9	U	0.56	3.9	NT				NT				NT				NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<8	U	1.4	8	NT				NT				NT				NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<2	U	0.49	2	NT				NT				NT				NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U	1.5	20	NT				NT				NT				NT				NT			
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<39	U	7.1	39	NT				NT				NT				NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<39	U	5.2	39	NT				NT				NT				NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				<400	U	20	400	<410	U	20	410	<390	U	20	390	<400	U	20	400	<400	U	20	400
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				<400	U	21	400	<410	U	21	410	<390	U	21	390	<400	U	21	400	<400	U	21	400
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				ND				ND				ND				ND				ND			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				<800	U	29	800	<830	U	29	830	<790	U	29	790	<800	U	29	800	<800	U	29	800
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				<400	U	17	400	<410	U	17	410	<390	U	17	390	<400	U	17	400	<400	U	17	400
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				<400	U	25	400	<410	U	25	410	<390	U	25	390	<400	U	25	400	<400	U	25	400
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				<400	U	29	400	<410	U	29	410	<390	U	29	390	<400	U	29	400	<400	U	29	400
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				<400	U	23	400	<410	U	23	410	<390	U	23	390	<400	U	23	400	<400	U	23	400
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				<400	U	36	400	<410	U	36	410	<390	U	36	390	<400	U	36	400	<400	U	36	400
Benzo(g,h,i)perylene[8]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				<400	U	23	400	<410	U	23	410	<390	U	23	390	<400	U	23	400	<400	U	23	400
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				<400	U	29	400	<410	U	29	410	<390	U	29	390	<400	U	29	400	<400	U	29	400
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				<400	U	32	400	<410	U	32	410	<390	U	32	390	<400	U	32	400	<400	U	32	400
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				<400	U	28	400	<410	U	28	410	<390	U	28	390	<400	U	28	400	<400	U	28	400
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				<400	U	400	400	<410	U	410	410	<390	U	390	390	<400	U	400	400	<400	U	400	400
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				57	J	400	400	<410	U	410	410	<390	U	390	390	<400	U	400	400	<400	U	400	400
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				<400	U	21	400	<410	U	21	410	<390	U	21	390	<400	U	21	400	<400	U	21	400
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				<400	U	400	400	<410	U	410	410	<390	U	390	390	<400	U	400	400	<400	U	400	400
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				<400	U	18	400	45	JB,B,z	18	410	<390	U	18	390	<400	U	18	400	<400	U	18	400
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				<400	U	20	400	<410	U	20	410	<390	U	20	390	<400	U	20	400	<400	U	20	400
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				<400	U	400	400	<410	U	410	410	<390	U	390	390	<400	U	400	400	<400	U	400	400
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				<400	U	24	400	<410	U	24	410	<390	U	24	390	<400	U	24	400	<400	U	24	400
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				<400	U	24	400	<410	U	24	410	<390	U	24	390	<400	U	24	400	<400	U	24	400
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NI				NI				NI				NI				NI			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NI				NI				NI				NI				NI			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NI				NI				NI				NI				NI			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NI				NI				NI				NI				NI			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB10C-DUP(DUP2) 1/10/2007 13-14		MDL	RL	54SB17A 12/2/2002 0-1		MDL	RL	54SB17B 12/2/2002 9-10		MDL	RL	54SB18A 12/2/2002 0-1		MDL	RL	54SB18B 12/2/2002 9-10		MDL	RL	54SB19A 12/2/2002 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NI				NI				NI				NI				220	NJ,NJ,t	0	0
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				61	P,J,I	51	51	<52	U,R,I	5.9	52	53	P,J,I	5.9	50	<51	U,R,I	5.9	51	<51	U,R,I	5.9	51
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				<51	U	51	51	<52	U	5.9	52	36	JP,J,g	5.9	50	10	J	5.9	51	<51	U	5.9	51
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				<51	U	51	51	<52	U	5.4	52	<50	U	5.4	50	<51	U	5.4	51	<51	U	5.4	51
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				8.8	J	10	10	17		2.2	10	<9.9	U	2.2	9.9	<10	U	2.2	10	8.9	JP,J,g	2.2	10
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				<10	U	10	10	2.6	J	1.6	10	<9.9	U	1.6	9.9	<10	U	1.6	10	3.4	J	1.6	10
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				5.2	J	10	10	5.2	J	1.7	10	<9.9	U	1.7	9.9	<10	U	1.7	10	<10	U	1.7	10
Benzo(g,h,i)perylene[9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				<10	U	10	10	<10	U	3.6	10	<9.9	U	3.6	9.9	<10	U	3.6	10	<10	U	3.6	10
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				4.2	J	10	10	5.1	JP,J,g	1.4	10	<9.9	U	1.4	9.9	<10	U	1.4	10	3.7	JP,J,g	1.4	10
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				9.3	J	10	10	13		2.4	10	<9.9	U	2.4	9.9	<10	U	2.4	10	<10	U	2.4	10
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				<10	U	10	10	<10	U	4.2	10	<9.9	U	4.2	9.9	<10	U	4.2	10	<10	U	4.2	10
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				39	B,B,z	20	20	24	B,B,z	2.1	21	9.2	BJ,B,z	2.1	20	13	BJ,B,z	2.1	21	30	B,B,z	2.1	21
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				<51	U,R,I	51	51	<52	U,R,I	14	52	<50	U,R,I	14	50	<51	U,R,I	14	51	<51	U,R,I	14	51
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				<10	U	10	10	<10	U	2.5	10	<9.9	U	2.5	9.9	<10	U	2.5	10	<10	U	2.5	10
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				<51	U,R,I	51	51	***23***	J,J,I	14	52	<50	U,R,I	14	50	<51	U,R,I	14	51	***130***	P,J,I	14	51
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				<51	U	51	51	<52	U	8.5	52	<50	U	8.5	50	<51	U	8.5	51	<51	U	8.5	51
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				24		20	20	24	P,J,g	4.3	21	<20	U	4.3	20	15	JP,J,g	4.3	21	18	J	4.3	21
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB10C-DUP(DUP2) 1/10/2007 13-14		MDL	RL	54SB17A 12/2/2002 0-1		MDL	RL	54SB17B 12/2/2002 9-10		MDL	RL	54SB18A 12/2/2002 0-1		MDL	RL	54SB18B 12/2/2002 9-10		MDL	RL	54SB19A 12/2/2002 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT				<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT				<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT				<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	NT				<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	NT				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	NT				<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT				<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	NT				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT				<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	84		0.1	0.1	--				--				--				--				--			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB19B 12/2/2002 9-10		MDL	RL	54SB20A 12/2/2002 0-1		MDL	RL	54SB20B 12/2/2002 9-10		MDL	RL	54SB21A 12/2/2002 0-1		MDL	RL	54SB21B 12/2/2002 9-10		MDL	RL	54SB21B-DUP (D-10) 12/2/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	17,400		2.6	12	8,390		2.5	11.7	8,730		2.6	11.7	11,400		2.5	11.6	9,950		2.5	11.6	11,400		2.5	11.5
Antimony	7440-36-0	N	--	3.13	40.88	0.66	<1.2	UN,UL,m	0.44	1.2	<1.2	UN,UL,m	0.43	1.2	<1.2	UN,UL,m	0.43	1.2	<1.2	UN,UL,m	0.43	1.2	<1.2	UN,UL,m	0.43	1.2	<1.2	UN,UL,m	0.43	1.2
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***1.5***		0.3	1.2	***1.1***	B	0.29	1.2	***0.84***	B	0.29	1.2	***0.7***	B	0.29	1.2	***0.58***	B	0.29	1.2	***1.2***		0.29	1.2
Barium	7440-39-3	N	209	1,564	20,440	300.8	166	E,J,s	0.02	1.2	119	E,J,s	0.02	1.2	86.3	E,J,s	0.02	1.2	123	E,J,s	0.02	1.2	95.1	E,J,s	0.02	1.2	106	E,J,s	0.02	1.2
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	1.1		0.01	0.6	0.66		0.01	0.58	0.65		0.01	0.58	0.73		0.01	0.58	0.67		0.01	0.58	0.75		0.01	0.58
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.6	UN,UL,m	0.05	0.6	<0.58	UN,UL,m	0.05	0.58	<0.58	UN,UL,m	0.05	0.58	<0.58	UN,UL,m	0.05	0.58	<0.58	UN,UL,m	0.05	0.58	<0.58	UN,UL,m	0.05	0.58
Calcium	7440-70-2	--	--	--	--	--	1,890	E,J,s	1.1	120	1,280	E,J,s	1.1	117	1,030	E,J,s	1.1	117	21,500	E,J,s	1.1	116	1,240	E,J,s	1.1	116	1,350	E,J,s	1.1	115
Chromium[1]	7440-47-3	N	65.3	23.46	306.6	2.102	***23.2***		0.07	0.6	***14.6***		0.07	0.58	***14.1***		0.07	0.58	***19.5***		0.07	0.58	***15.3***		0.07	0.58	***16.7***		0.07	0.58
Cobalt	7440-48-4	--	72.3	--	--	--	11.4	E,J,s	0.07	0.6	6.2	E,J,s	0.07	0.58	6.4	E,J,s	0.07	0.58	6.8	E,J,s	0.07	0.58	7.4	E,J,s	0.07	0.58	7.9	E,J,s	0.07	0.58
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	20.6		0.17	0.6	6.3		0.16	0.58	7.5		0.16	0.58	5.3		0.16	0.58	4.6		0.16	0.58	9.9		0.16	0.58
Iron	7439-89-6	N	50,962	5,475	71,540	--	22,500	E,J,s	1.6	12	15,000	E,J,s	1.6	11.7	13,700	E,J,s	1.6	11.7	13,700	E,J,s	1.6	11.6	15,300	E,J,s	1.6	11.6	16,800	E,J,s	1.6	11.5
Lead [2]	7439-92-1	--	26.8	400	750	--	10.3	N*,J,k	0.28	0.36	29	N*,J,k	0.27	0.35	6.3	N*,J,k	0.27	0.35	10.6	N*,J,k	0.27	0.35	6.8	N*,J,k	0.27	0.35	7.5	N*,J,k	0.26	0.35
Magnesium	7439-95-4	--	--	--	--	--	3,600	E,J,s	0.73	120	2,160	E,J,s	0.71	117	2,460	E,J,s	0.71	117	3,140	E,J,s	0.71	116	2,590	E,J,s	0.71	116	2,750	E,J,s	0.7	115
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***674***	E,J,s	0.02	1.2	***502***	E,J,s	0.02	1.2	***380***	E,J,s	0.02	1.2	***309***	E,J,s	0.02	1.2	***405***	E,J,s	0.02	1.2	***450***	E,J,s	0.02	1.2
Mercury[3]	7439-97-6	--	0.13	2.35	30.66	--	0.038	B	0.02	0.041	0.031	B	0.018	0.035	0.026	B	0.019	0.038	0.037		0.017	0.035	0.038	B	0.019	0.038	0.036	B	0.019	0.038
Nickel	7440-02-0	N	62.8	156.4	2,044	--	16		0.12	0.6	9.3		0.12	0.58	9		0.12	0.58	10.8		0.12	0.58	10.3		0.12	0.58	11.4		0.12	0.58
Potassium	7440-09-7	--	--	--	--	--	1,270	E,J,s	14.2	120	924	E,J,s	13.8	117	910	E,J,s	13.9	117	1,170	E,J,s	13.7	116	1,130	E,J,s	13.8	116	1,140	E,J,s	13.6	115
Selenium	7782-49-2	N	--	39.11	511	0.949	***1.4***	N,L,m	0.4	0.6	***0.99***	N,L,m	0.38	0.58	0.86	N,L,m	0.39	0.58	0.54	BN,L,m	0.38	0.58	0.78	N,L,m	0.38	0.58	***1***	N,L,m	0.38	0.58
Silver	7440-22-4	N	--	39.11	511	1.551	<0.6	U	0.08	0.6	<0.58	U	0.08	0.58	<0.58	U	0.08	0.58	<0.58	U	0.08	0.58	<0.58	U	0.08	0.58	<0.58	U	0.08	0.58
Sodium	7440-23-5	--	--	--	--	--	246	L,w	29.8	239	243	L,w	29	233	171	B,L,w	29.1	234	187	B,L,w	28.8	232	200	B,L,w	28.9	232	171	B,L,w	28.6	230
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	<1.2	UN,UL,m	0.61	1.2	<1.2	UN,UL,m	0.59	1.2	<1.2	UN,UL,m	0.6	1.2	<1.2	UN,UL,m	0.59	1.2	<1.2	UN,UL,m	0.59	1.2	<1.2	UN,UL,m	0.59	1.2
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	36.2		0.08	2.4	19.8		0.08	2.3	19.5		0.08	2.3	23.7		0.08	2.3	24.2		0.08	2.3	26.1		0.08	2.3
Zinc	7440-66-6	N	202	2,346	30,660	681.1	68.3	*E,J,s	0.12	2.4	112	*E,J,s	0.12	2.3	44.4	*E,J,s	0.12	2.3	54.9	*E,J,s	0.12	2.3	46.5	*E,J,s	0.12	2.3	51.2	*E,J,s	0.12	2.3
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				NT				NT				NT				NT			
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	NT				NT				NT				NT				NT				NT			
alpha-Chlordane[4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				NT				NT				NT				NT			
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	NT				NT				NT				NT				NT				NT			
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				NT				NT				NT				NT			
gamma-Chlordane[4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				NT				NT				NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				NT				NT				NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				NT				NT				NT				NT			
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				NT				NT				NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				NT				NT				NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<420	U	20	420	<390	U	20	390	<400	U	20	400	<400	U	20	400	<390	U	20	390	<400	U	20	400
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<420	U	21	420	<390	U	21	390	<400	U	21	400	<400	U	21	400	<390	U	21	390	<400	U	21	400
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				ND				ND				ND				ND				ND			
2-Nitroaniline	88-74-4	--	--	--	--	--	<840	U	29	840	<790	U	29	790	<800	U	29	800	<800	U	29	800	<780	U	29	780	<800	U	29	800
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	<420	U	17	420	<390	U	17	390	<400	U	17	400	<400	U	17	400	<390	U	17	390	<400	U	17	400
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<420	U	25	420	<390	U	25	390	<400	U	25	400	<400	U	25	400	<390	U	25	390	<400	U	25	400
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	***70***	J	29	420	<390	U	29	390	<400	U	29	400	<400	U	29	400	<390	U	29	390	<400	U	29	400
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<420	U	23	420	<390	U	23	390	<400	U	23	400	<400	U	23	400	<390	U	23	390	<400	U	23	400
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	***75***	J	36	420	<390	U	36	390	<400	U	36	400	<400	U	36	400	<390	U	36	390	<400	U	36	400
Benzo(g,h,i)perylene[9]	191-24-2	N	--	2.3E+05	3.1E+06	--	<420	U	23	420	<390	U	23	390	<400	U	23	400	<400	U	23	400	<390	U	23	390	<400	U	23	400
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	77	J	29	420	<390	U	29	390	<400	U	29	400	<400	U	29	400	<390	U	29	390	<400	U	29	400
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	<420	U	32	420	<390	U	32	390	92	J	32	400	75	J	32	400	95	J	32	390	55	J	32	400
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	120	J	28	420	<390	U	28	390	<400	U	28	400	<400	U	28	400	<390	U	28	390	<400	U	28	400
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	<420	U	420	420	<390	U	390	390	<400	U	400	400	<400	U	400	400	<390	U	390	390	<400	U	400	400
Di-n-octylphthalate	117-84-0	--	--	--	--	--	<420	U	420	420	<390	U	390	390	300	J	400	400	150	J	400	400	<390	U	390	390	<400	U	400	400
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<420	U	21	420	<390	U	21	390	<400	U	21	400	<400	U	21	400	<390	U	21	390	<400	U	21	400
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	<420	U	420	420	<390	U	390	390	<400	U	400	400	<400	U	400	400	<390	U	390	390	<400	U	400	400
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	340	JB	18	420	<390	U	18	390	<400	U	18	400	<400	U	18	400	<390	U	18	390	46	BJ,B,z	18	400
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<420	U	20	420	<390	U	20	390	<400	U	20	400	<400	U	20	400	<390	U	20	390	<400	U	20	400
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<420	U	420	420	<390	U	390	390	<400	U	400	400	<400	U	400	400	<390	U	390	390	<400	U	400	400
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	52	J	24	420	<390	U	24	390	<400	U	24	400	<400	U	24	400	<390	U	24	390	<400	U	24	400
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	220	J	24	420	<390	U	24	390	<400	U	24	400	<400	U	24	400	<390	U	24	390	<400	U	24	400
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
13-Octadecenal	56554-90-6	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NI				NI				NI				NI				NI				NI			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NI				NI				NI				NI				NI				NI			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				NI				NI				NI				NI				NI			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NI				NI				NI				NI				NI				NI			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB19B 12/2/2002 9-10		MDL	RL	54SB20A 12/2/2002 0-1		MDL	RL	54SB20B 12/2/2002 9-10		MDL	RL	54SB21A 12/2/2002 0-1		MDL	RL	54SB21B 12/2/2002 9-10		MDL	RL	54SB21B-DUP (D-10) 12/2/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NI				NI				NI				NI				320	NJ,NJ,t	0	0	740	NJ,NJ,t	0	0
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	27	JP,J,l	5.9	53	<50	U,R,l	5.9	50	170	P,J,l	5.9	51	76	P,J,l	5.9	51	<49	U,R,l	5.9	49	<51	U,R,l	51	51
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	<53	U	5.9	53	<50	U	5.9	50	43	JP,J,g	5.9	51	22	JP,J,g	5.9	51	<49	U	5.9	49	<51	U	51	51
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<53	U	5.4	53	<50	U	5.4	50	15	J	5.4	51	<51	U	5.4	51	<49	U	5.4	49	<51	U	51	51
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<10	U	2.2	10	<9.9	U	2.2	9.9	***80***	P,J,g	2.2	10	***40***		2.2	10	<9.8	U	2.2	9.8	<10	U	10	10
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<10	U	1.6	10	<9.9	U	1.6	9.9	***42***	P,J,g	1.6	10	***9.7***	J	1.6	10	<9.8	U	1.6	9.8	<10	U	10	10
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<10	U	1.7	10	<9.9	U	1.7	9.9	***110***	P,J,g	1.7	10	28		1.7	10	<9.8	U	1.7	9.8	<10	U	10	10
Benzo(g,h,i)perylene[9]	191-24-2	N	--	2.3E+05	3.1E+06	--	<10	U	3.6	10	<9.9	U	3.6	9.9	32		3.6	10	<10	U	3.6	10	<9.8	U	3.6	9.8	<10	U	10	10
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<10	U	1.4	10	<9.9	U	1.4	9.9	120		1.4	10	30	P,J,g	1.4	10	<9.8	U	1.4	9.8	<10	U	10	10
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<10	U	2.4	10	<9.9	U	2.4	9.9	19	P,J,g	2.4	10	42		2.4	10	<9.8	U	2.4	9.8	<10	U	10	10
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<10	U	4.2	10	<9.9	U	4.2	9.9	***30***	P,J,g	4.2	10	16	P,J,g	4.2	10	<9.8	U	4.2	9.8	<10	U	10	10
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	5.8	BJ,B,z	2.1	22	5.3	BJ,B,z	2.1	20	460	BEP,J,g	2.1	20	4.8	BJP,B,z	2.1	20	<20	U	2.1	20	16	BJ,B,z	21	21
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<53	U,R,l	14	53	<50	U,R,l	14	50	26	JP,J,l	14	51	<51	U,R,l	14	51	<49	U,R,l	14	49	<51	U,R,l	51	51
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<10	U	2.5	10	<9.9	U	2.5	9.9	<10	U	2.5	10	14	P,J,g	2.5	10	<9.8	U	2.5	9.8	<10	U	10	10
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	<53	U,R,l	14	53	<50	U,R,l	14	50	<51	U,R,l	14	51	***130***	P,J,l	14	51	<49	U,R,l	14	49	<51	U,R,l	51	51
Phenanthrene[9]	85-01-8	N	--	2.3E+05	3.1E+06	--	<53	U	8.5	53	<50	U	8.5	50	<51	U	8.5	51	<51	U	8.5	51	<49	U	8.5	49	<51	U	51	51
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	<22	U	4.3	22	<20	U	4.3	20	320		4.3	20	70		4.3	20	<20	U	4.3	20	14	JP,J,g	21	21
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB19B 12/2/2002 9-10		MDL	RL	54SB20A 12/2/2002 0-1		MDL	RL	54SB20B 12/2/2002 9-10		MDL	RL	54SB21A 12/2/2002 0-1		MDL	RL	54SB21B 12/2/2002 9-10		MDL	RL	54SB21B-DUP (D-10) 12/2/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	ND				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				--				--				--				--			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB22A [B] 12/3/2002 0-1		MDL	RL	54SB22B [B] 12/3/2002 9-10		MDL	RL	54SB22C 1/11/2007 15-16		MDL	RL	54SB23A [C] 12/3/2002 0-1		MDL	RL	54SB23B [C] 12/3/2002 9-10		MDL	RL	54SB23C 1/12/2007 16-17		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	10,700		2.6	11.7	14,600		2.5	11.4	NT				19,400		2.5	11.4	10,400		2.7	12.3	NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	<1.2	UN,UL,m	0.43	1.2	<1.1	UN,UL,m	0.42	1.1	NT				<1.1	UN,UL,m	0.42	1.1	<1.2	UN,UL,m	0.46	1.2	NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***1.3***		0.29	1.2	***1.4***		0.29	1.1	NT				***1.9***		0.29	1.1	***0.78***	B	0.31	1.2	NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	147	E,J,s	0.02	1.2	153	E,J,s	0.02	1.1	NT				84.9	E,J,s	0.02	1.1	112	E,J,s	0.02	1.2	NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.83		0.01	0.58	1		0.01	0.57	NT				0.73		0.01	0.57	0.73		0.01	0.62	NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.58	UN,UL,m	0.05	0.58	<0.57	UN,UL,m	0.05	0.57	NT				<0.57	UN,UL,m	0.05	0.57	<0.62	UN,UL,m	0.05	0.62	NT			
Calcium	7440-70-2	--	--	--	--	--	1,700	E,J,s	1.1	117	1,860	E,J,s	1.1	114	NT				3,610	E,J,s	1.1	114	1,180	E,J,s	1.2	123	NT			
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***17.6***		0.07	0.58	***20.5***		0.07	0.57	NT				***26.5***		0.07	0.57	***16.8***		0.07	0.62	NT			
Cobalt	7440-48-4	--	72.3	--	--	--	7.7	E,J,s	0.07	0.58	9.6	E,J,s	0.07	0.57	NT				10	E,J,s	0.07	0.57	7.6	E,J,s	0.07	0.62	NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	11.5		0.16	0.58	17.7		0.16	0.57	NT				11.7		0.16	0.57	6.7		0.17	0.62	NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	17,800	E,J,s	1.6	11.7	19,900	E,J,s	1.6	11.4	NT				25,600	E,J,s	1.6	11.4	15,700	E,J,s	1.7	12.3	NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	33.7	N*,J,k	0.27	0.35	9.3	N*,J,k	0.26	0.34	NT				16.6	N*,J,k	0.26	0.34	8.6	N*,J,k	0.28	0.37	NT			
Magnesium	7439-95-4	--	--	--	--	--	2,540	E,J,s	0.71	117	3,220	E,J,s	0.7	114	NT				2,960	E,J,s	0.7	114	2,770	E,J,s	0.75	123	NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***591***	E,J,s	0.02	1.2	***588***	E,J,s	0.02	1.1	NT				***429***	E,J,s	0.02	1.1	***431***	E,J,s	0.02	1.2	NT			
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	0.042		0.018	0.036	0.038	B	0.02	0.04	NT				0.073		0.02	0.039	0.039	B	0.021	0.041	NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	11.5		0.12	0.58	13.9		0.11	0.57	NT				10.9		0.11	0.57	10.7		0.12	0.62	NT			
Potassium	7440-09-7	--	--	--	--	--	1,310	E,J,s	13.9	117	1,190	E,J,s	13.5	114	NT				1,380	E,J,s	13.5	114	1,050	E,J,s	14.6	123	NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	***1.3***	N,L,m	0.39	0.58	***1.2***	N,L,m	0.38	0.57	NT				***1.2***	N,L,m	0.38	0.57	***1.1***	N,L,m	0.41	0.62	NT			
Silver	7440-22-4	N	--	39.11	511	1.551	<0.58	U	0.08	0.58	<0.57	U	0.08	0.57	NT				<0.57	U	0.08	0.57	<0.62	U	0.09	0.62	NT			
Sodium	7440-23-5	--	--	--	--	--	250	L,w	29.1	234	198	B,L,w	28.4	228	NT				177	B,L,w	28.4	228	180	B,L,w	30.6	246	NT			
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	<1.2	UN,UL,m	0.6	1.2	<1.1	UN,UL,m	0.58	1.1	NT				<1.1	UN,UL,m	0.58	1.1	<1.2	UN,UL,m	0.63	1.2	NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	24.5		0.08	2.3	30.5		0.08	2.3	NT				***55.3***		0.08	2.3	23.4		0.09	2.5	NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	121	*E,J,s	0.12	2.3	60.7	*E,J,s	0.11	2.3	NT				54.8	*E,J,s	0.11	2.3	51.5	*E,J,s	0.12	2.5	NT			
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<4	U	1.1	4	<4.1	U	1.1	4.1	<4.1	U	1.1	4.1	<3.8	U	1	3.8	<4	U	1.1	4	<4	U	1.1	4
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	<4	U	1.2	4	<4.1	U	1.3	4.1	<4.1	U	1.3	4.1	<3.8	U	1.2	3.8	<4	U	1.2	4	<4	U	1.2	4
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<4	U	0.82	4	<4.1	U	0.83	4.1	<4.1	U	0.85	4.1	<3.8	U	0.79	3.8	<4	U	0.82	4	<4	U	0.82	4
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<4	U	1.1	4	<4.1	U	1.2	4.1	<4.1	U	1.2	4.1	<3.8	U	1.1	3.8	<4	U	1.1	4	<4	U	1.1	4
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	<4	U	1.2	4	<4.1	U	1.2	4.1	<4.1	U	1.3	4.1	<3.8	U	1.2	3.8	<4	U	1.2	4	<4	U	1.2	4
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<4	U	1.3	4	<4.1	U	1.3	4.1	<4.1	U	1.3	4.1	<3.8	U	1.2	3.8	<4	U	1.3	4	<4	U	1.3	4
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<2	U	0.77	2	<2.1	U	0.79	2.1	<2.1	U	0.81	2.1	<2	U	0.75	2	<2.1	U	0.78	2.1	<2	U	0.77	2
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<4	U	0.57	4	<4.1	U	0.58	4.1	<4.1	U	0.59	4.1	<3.8	U	0.55	3.8	<4	U	0.57	4	<4	U	0.57	4
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<8.1	U	1.5	8.1	<8.2	U	1.5	8.2	<8.4	U	1.5	8.4	<7.8	U	1.4	7.8	<8.1	U	1.5	8.1	<8.1	U	1.5	8.1
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<2	U	0.5	2	<2.1	U	0.51	2.1	<2.1	U	0.52	2.1	<2	U	0.48	2	<2.1	U	0.5	2.1	<2	U	0.5	2
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U	1.6	20	<21	U	1.6	21	<21	U	1.6	21	<20	U	1.5	20	<21	U	1.6	21	<20	U	1.6	20
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<40	U	7.2	40	<41	U	7.4	41	<41	U	7.5	41	<38	U	7	38	<40	U	7.3	40	<40	U	7.2	40
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<40	U	5.3	40	<41	U	5.4	41	<41	U	5.5	41	<38	U	5.1	38	<40	U	5.3	40	<40	U	5.3	40
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<400	U	20	400	<400	U	20	400	NT				<410	U	20	410	***950***		20	410	NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<400	U	21	400	<400	U	21	400	NT				<410	U	21	410	***1,000***		21	410	NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				ND				NT				ND				1,950		21	410	NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	<800	U	29	800	<800	U	29	800	NT				<830	U	29	830	<810	U	29	810	NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	<400	U	17	400	<400	U	17	400	NT				<410	U	17	410	<410	U	17	410	NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<400	U	25	400	<400	U	25	400	NT				<410	U	25	410	<410	U	25	410	NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<400	U	29	400	<400	U	29	400	NT				<410	U	29	410	<410	U	29	410	NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<400	U	23	400	<400	U	23	400	NT				<410	U	23	410	<410	U	23	410	NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<400	U	36	400	<400	U	36	400	NT				<410	U	36	410	<410	U	36	410	NT			
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	<400	U	23	400	<400	U	23	400	NT				<410	U	23	410	<410	U	23	410	NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<400	U	29	400	<400	U	29	400	NT				<410	U	29	410	<410	U	29	410	NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	150	JB,B,z	32	400	190	JB,B,z	32	400	NT				85	JB,B,z	32	410	2,200	B	32	410	NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<400	U	28	400	<400	U	28	400	NT				<410	U	28	410	<410	U	28	410	NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	<400	U	400	400	<400	U	400	400	NT				<410	U	410	410	37	J	410	410	NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	<400	U	400	400	<400	U	400	400	NT				200	J	410	410	<410	U	410	410	NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<400	U	21	400	<400	U	21	400	NT				<410	U	21	410	<410	U	21	410	NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	<400	U	400	400	<400	U	400	400	NT				<410	U	410	410	<410	U	410	410	NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<400	U	18	400	<400	U	18	400	NT				<410	U	18	410	<410	U	18	410	NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<400	U	20	400	<400	U	20	400	NT				<410	U	20	410	<410	U	20	410	NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<400	U	400	400	<400	U	400	400	NT				<410	U	410	410	<410	U	410	410	NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	<400	U	24	400	<400	U	24	400	NT				<410	U	24	410	<410	U	24	410	NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	<400	U	24	400	<400	U	24	400	NT				<410	U	24	410	<410	U	24	410	NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				NI				NT				540	NJ,NJ,t	0	0	NI				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NI				NI				NT				NI				NI				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NI				NI				NT				NI				NI				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				NI				NT				NI				NI				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NI				NI				NT				NI				190	NJ,NJ,t	0	0	NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NI				590	NJ,NJ,t	0	0	NT				NI				NI				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NI				NI				NT				NI				NI				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB22A[B] 12/3/2002 0-1		MDL	RL	54SB22B[B] 12/3/2002 9-10		MDL	RL	54SB22C 1/11/2007 15-16		MDL	RL	54SB23A[C] 12/3/2002 0-1		MDL	RL	54SB23B[C] 12/3/2002 9-10		MDL	RL	54SB23C 1/12/2007 16-17		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				326		1.07	1.07	156		0.952	0.952	169		1.03	1.03
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				0.491	A	1.07	1.07	<0.952	U	0.952	0.952	<1.03	U	1.03	1.03
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				6.12		0.536	0.536	2.94	A	0.476	0.476	2.95	A	0.526	0.526
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				0.322	A	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				<0.536	U	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				0.109	A	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				<0.536	U	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				0.142	A	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				<0.536	U	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				0.215	A	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				<0.536	U	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				<0.536	U	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				0.088	A,J,w	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				<0.536	U	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				0.103	A,B,z	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				0.204	A,J,w	0.107	0.107	<0.243	U	0.243	0.243	<0.288	U	0.288	0.288
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				0.44	A,B,z	0.107	0.107	0.488	A,B,z	0.212	0.212	0.571	A,B,z	0.266	0.266
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				0.284		0	0	0.125		0	0	0.137		0	0
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				0.724		0	0	0.735		0	0	0.811		0	0
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				0.491		0	0	0.125		0	0	0.137		0	0
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				0.869		0	0	0.735		0	0	0.811		0	0
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				16.7		0.536	0.536	8.04		0.476	0.476	8.21		0.526	0.526
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				0.558		0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				2.3		0.536	0.536	<0.476	U	0.476	0.476	1.13		0.517	0.517
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				0.341		0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				0.313		0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				0.487	,B,z	0.536	0.536	<0.476	U	0.476	0.476	<0.517	U	0.517	0.517
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				<0.107	U	0.107	0.107	<0.243	U	0.243	0.243	<0.288	U	0.288	0.288
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				0.989	,B,z	0.107	0.107	0.836	,B,z	0.212	0.212	1.01	,B,z	0.266	0.266
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	<51	U,R,l	5.9	51	<51	U,R,l	5.9	51	NT				<52	U,R,l	5.9	52	400	BP,B,z	5.9	52	NT			
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	<51	U	5.9	51	<51	U	5.9	51	NT				<52	U	5.9	52	41	JP,J,m	5.9	52	NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<51	U	5.4	51	<51	U	5.4	51	NT				<52	U	5.4	52	<52	U	5.4	52	NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<10	U	2.2	10	<10	U	2.2	10	NT				4.9	J	2.2	10	<10	U	2.2	10	NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<10	U	1.6	10	<10	U	1.6	10	NT				***8.5***	BJ,B,z	1.6	10	<10	U	1.6	10	NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<10	U	1.7	10	<10	U	1.7	10	NT				9.8	BJ,B,z	1.7	10	<10	U	1.7	10	NT			
Benzo(g,h,i)perylene[9]	191-24-2	N	--	2.3E+05	3.1E+06	--	<10	U	3.6	10	<10	U	3.6	10	NT				<10	U	3.6	10	<10	U	3.6	10	NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<10	U	1.4	10	<10	U	1.4	10	NT				<10	U	1.4	10	<10	U	1.4	10	NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<10	U	2.4	10	<10	U	2.4	10	NT				5.7	J	2.4	10	<10	U	2.4	10	NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<10	U	4.2	10	<10	U	4.2	10	NT				<10	U	4.2	10	<10	U	4.2	10	NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	28	BP,B,z	2.1	21	7.8	BJ,B,z	2.1	21	NT				27	B,B,z	2.1	21	10	BJ,B,z	2.1	21	NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<51	U,R,l	14	51	<51	U,R,l	14	51	NT				<52	U,R,l	14	52	<52	U	14	52	NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<10	U	2.5	10	<10	U	2.5	10	NT				14	BP,B,z	2.5	10	<10	U	2.5	10	NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	<51	U,R,l	14	51	<51	U,R,l	14	51	NT				<52	U,R,l	14	52	***760***	J,m	14	52	NT			
Phenanthrene[9]	85-01-8	N	--	2.3E+05	3.1E+06	--	27	J	8.5	51	11	J	8.5	51	NT				<52	U	8.5	52	<52	U	8.5	52	NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	14	JP,J,g	4.3	21	<21	U	4.3	21	NT				13	J	4.3	21	<21	U	4.3	21	NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
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Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB22A [B] 12/3/2002 0-1		MDL	RL	54SB22B [B] 12/3/2002 9-10		MDL	RL	54SB22C 1/11/2007 15-16		MDL	RL	54SB23A [C] 12/3/2002 0-1		MDL	RL	54SB23B [C] 12/3/2002 9-10		MDL	RL	54SB23C 1/12/2007 16-17		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	NT				<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<2.5	U	0.2	2.5
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	<1	U	0.16	1	NT				<1	U	0.16	1	15	J,d	0.16	1	<2.5	U	0.051	2.5
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	<1	U	0.12	1	NT				<1	U	0.12	1	***0.92***	J	0.12	1	<2.5	U	0.073	2.5
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.19	1	<1	U	0.19	1	NT				<1	U	0.19	1	***1.1***		0.19	1	<2.5	U	0.099	2.5
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	ND				ND				NT				ND				2.02		0.19	1	ND			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	<1	U	0.1	1	NT				<1	U	0.1	1	0.78	J	0.1	1	<2.5	U	0.088	2.5
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	<1	U	0.095	1	NT				<1	U	0.095	1	0.99	J	0.095	1	<2.5	U	0.053	2.5
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				NT				ND				1.77		0.1	1	ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	<1	U	0.1	1	NT				<1	U	0.1	1	<1	U	0.1	1	<2.5	U	0.17	2.5
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	<10	U	1	10	NT				<10	U	1	10	<10	U	1	10	NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				80		0.1	0.1	--				--				83		0.1	0.1

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
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Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB24A 12/3/2002 0-1		MDL	RL	54SB24B 12/3/2002 9-10		MDL	RL	54SB25A 12/3/2002 0-1		MDL	RL	54SB25B 12/3/2002 9-10		MDL	RL	54SB26A 12/3/2002 0-1		MDL	RL	54SB26B 12/3/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	15,600		2.4	10.9	12,800		2.6	12	18,000		6.3	11.2	12,700		6.5	11.5	7,270		2.5	11.3	11,900		2.5	11.6
Antimony	7440-36-0	N	--	3.13	40.88	0.66	<1.1	UN,UL,m	0.4	1.1	<1.2	UN,UL,m	0.44	1.2	0.47	BN*,J,k	0.13	1.1	0.44	BN*,J,k	0.14	1.1	<1.1	UN,UL,m	0.42	1.1	<1.2	UN,UL,m	0.43	1.2
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***1.5***		0.27	1.1	***1***	B	0.3	1.2	***2.3***		0.33	1.1	***1.5***		0.34	1.1	***1.1***		0.28	1.1	***1***	B	0.29	1.2
Barium	7440-39-3	N	209	1,564	20,440	300.8	126	E,J,s	0.02	1.1	161	E,J,s	0.02	1.2	88.9	E,J,s	0.03	1.1	145	E,J,s	0.03	1.1	117	E,J,s	0.02	1.1	125	E,J,s	0.02	1.2
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.81		0.01	0.54	0.9		0.01	0.6	0.79		0.02	0.56	0.95		0.02	0.57	0.62		0.01	0.57	0.85		0.01	0.58
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.54	UN,UL,m	0.04	0.54	<0.6	UN,UL,m	0.05	0.6	<0.56	U	0.03	0.56	<0.57	U	0.03	0.57	<0.57	UN,UL,m	0.05	0.57	<0.58	UN,UL,m	0.05	0.58
Calcium	7440-70-2	--	--	--	--	--	6,070	E,J,s	1	109	1,730	E,J,s	1.2	120	3,070	E,J,s	1.7	112	3,140	E,J,s	1.7	115	1,020	E,J,s	1.1	113	1,040	E,J,s	1.1	116
Chromium[1]	7440-47-3	N	65.3	23.46	306.6	2.102	***21.4***		0.07	0.54	***19.6***		0.07	0.6	***25.4***	E,J,s	0.09	0.56	***19.8***	E,J,s	0.09	0.57	***13.8***		0.07	0.57	***17.9***		0.07	0.58
Cobalt	7440-48-4	--	72.3	--	--	--	9	E,J,s	0.07	0.54	9	E,J,s	0.07	0.6	10.5	E,J,s	0.08	0.56	8.5	E,J,s	0.08	0.57	5.8	E,J,s	0.07	0.57	7.5	E,J,s	0.07	0.58
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	9.6		0.15	0.54	12.4		0.17	0.6	25.5	E,J,s	0.17	0.56	17	E,J,s	0.17	0.57	3.9		0.16	0.57	12.4		0.16	0.58
Iron	7439-89-6	N	50,962	5,475	71,540	--	21,300	E,J,s	1.5	10.9	17,900	E,J,s	1.6	12	27,200	E,J,s	1.4	11.2	20,400	E,J,s	1.4	11.5	16,200	E,J,s	1.5	11.3	16,800	E,J,s	1.6	11.6
Lead [2]	7439-92-1	--	26.8	400	750	--	21.6	N*,J,k	0.25	0.33	9.5	N*,J,k	0.28	0.36	15.4	*E,J,k	0.13	0.33	67.3	*E,J,k	0.14	0.34	57	N*,J,k	0.26	0.34	7.8	N*,J,k	0.27	0.35
Magnesium	7439-95-4	--	--	--	--	--	4,490	E,J,s	0.66	109	3,040	E,J,s	0.73	120	3,470	E,J,s	1.4	112	4,130	E,J,s	1.4	115	1,880	E,J,s	0.69	113	2,900	E,J,s	0.71	116
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***493***	E,J,s	0.02	1.1	***587***	E,J,s	0.02	1.2	***474***	E,J,s	0.02	1.1	***567***	E,J,s	0.02	1.1	***598***	E,J,s	0.02	1.1	***484***	E,J,s	0.02	1.2
Mercury[3]	7439-97-6	--	0.13	2.35	30.66	--	0.047		0.018	0.037	0.038	B	0.02	0.041	0.062	N,L,m	0.019	0.038	0.54	N,L,m	0.02	0.04	0.036		0.018	0.035	0.029	B	0.019	0.037
Nickel	7440-02-0	N	62.8	156.4	2,044	--	11.9		0.11	0.54	13		0.12	0.6	11.5	E,J,s	0.11	0.56	13.8	E,J,s	0.11	0.57	8.4		0.11	0.57	12.5		0.12	0.58
Potassium	7440-09-7	--	--	--	--	--	1,460	E,J,s	12.9	109	1,200	E,J,s	14.2	120	1,330		4.5	112	1,080		4.6	115	939	E,J,s	13.4	113	1,100	E,J,s	13.8	116
Selenium	7782-49-2	N	--	39.11	511	0.949	***1.3***	N,L,m	0.36	0.54	***1.2***	N,L,m	0.4	0.6	***1.1***	N,B,x	0.33	0.56	***1.2***	N,B,x	0.34	0.57	***1.1***	N,L,m	0.37	0.57	***1.2***	N,L,m	0.38	0.58
Silver	7440-22-4	N	--	39.11	511	1.551	<0.54	U	0.08	0.54	<0.6	U	0.08	0.6	<0.56	U	0.09	0.56	<0.57	U	0.09	0.57	<0.57	U	0.08	0.57	<0.58	U	0.08	0.58
Sodium	7440-23-5	--	--	--	--	--	201	B,L,w	27.1	218	199	B,L,w	29.8	240	89	B,K,w	34	223	115	B,K,w	34.9	230	312	L,w	28.1	226	180	B,L,w	28.9	233
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	<1.1	UN,UL,m	0.55	1.1	<1.2	UN,UL,m	0.61	1.2	<1.1	UN,R,m	0.27	1.1	<1.1	UN,R,m	0.28	1.1	<1.1	UN,UL,m	0.58	1.1	<1.2	UN,UL,m	0.59	1.2
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	***39.9***		0.08	2.2	27.5		0.08	2.4	***52***	E,J,s	0.08	2.2	27.7	E,J,s	0.08	2.3	18.2		0.08	2.3	24.4		0.08	2.3
Zinc	7440-66-6	N	202	2,346	30,660	681.1	71.2	*E,J,s	0.11	2.2	62.3	*E,J,s	0.12	2.4	57.1	*E,J,s	0.12	2.2	79.8	*E,J,s	0.13	2.3	191	*E,J,s	0.11	2.3	56.8	*E,J,s	0.12	2.3
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				<2.1	U	0.4	2.1	<100	U	0.4	100	NT				NT			
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	NT				NT				2.1	J,J,l	0.39	6.1	17	J,s	0.39	6.2	NT				NT			
alpha-Chlordane[4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				<2.1	U	0.22	2.1	<100	U	0.22	100	NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				<1	U	0.15	1	<51	U	0.15	51	NT				NT			
Endosulfan Sulfate[6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	NT				NT				1.8	JP,J,g	0.4	4	<200	U	0.4	200	NT				NT			
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				<4	U	0.35	4	26	P,J,s	0.35	4.1	NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				<1	U	0.22	1	<51	U	0.22	51	NT				NT			
gamma-Chlordane[4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				<1	U	0.35	1	13	E,J,s	0.35	1	NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				<1	U	0.34	1	<51	U	0.34	51	NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				<1	U	0.26	1	***290***	D	0.26	51	NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				<10	U	1.4	10	<510	U	1.4	510	NT				NT			
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				<55	U	9	55	<2,800	U	9	2800	NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				<79	U	9.2	79	<4,000	U	9.2	4,000	NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<390	U	20	390	<420	U	20	420	<400	U	20	400	***160***	J	20	410	<380	U	20	380	<390	U	20	390
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<390	U	21	390	<420	U	21	420	<400	U	21	400	***280***	J	21	410	<380	U	21	380	<390	U	21	390
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				ND				ND				440		21	410	ND				ND			
2-Nitroaniline	88-74-4	--	--	--	--	--	<780	U	29	780	<840	U	29	840	<800	U	29	800	<810	U	29	810	<760	U	29	760	<790	U	29	790
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	<390	U	17	390	<420	U	17	420	83	J	17	400	<410	U	17	410	<380	U	17	380	<390	U	17	390
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<390	U	25	390	<420	U	25	420	<400	U	25	400	<410	U	25	410	<380	U	25	380	<390	U	25	390
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<390	U	29	390	<420	U	29	420	***52***	J	29	400	<410	U	29	410	<380	U	29	380	<390	U	29	390
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<390	U	23	390	<420	U	23	420	***62***	J	23	400	<410	U	23	410	<380	U	23	380	<390	U	23	390
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<390	U	36	390	<420	U	36	420	<400	U	36	400	<410	U	36	410	<380	U	36	380	<390	U	36	390
Benzo(g,h,i)perylene[8]	191-24-2	N	--	2.3E+05	3.1E+06	--	<390	U	23	390	<420	U	23	420	40	J	23	400	<410	U	23	410	<380	U	23	380	<390	U	23	390
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<390	U	29	390	<420	U	29	420	50	J	29	400	<410	U	29	410	<380	U	29	380	<390	U	29	390
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	120	JB,B,z	32	390	95	JB,B,z	32	420	190	J	32	400	220	J	32	410	84	JB,B,z	32	380	<390	U	32	390
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<390	U	28	390	<420	U	28	420	48	J	28	400	<410	U	28	410	<380	U	28	380	<390	U	28	390
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	<390	U	390	390	<420	U	420	420	<400	U	400	400	<410	U	410	410	<380	U	380	380	<390	U	390	390
Di-n-octylphthalate	117-84-0	--	--	--	--	--	220	J	390	390	<420	U	420	420	<400	U	400	400	31	J	410	410	<380	U	380	380	<390	U	390	390
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<390	U	21	390	<420	U	21	420	<400	U	21	400	<410	U	21	410	<380	U	21	380	<390	U	21	390
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	<390	U	390	390	<420	U	420	420	<400	U	400	400	<410	U	410	410	270	J	380	380	<390	U	390	390
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<390	U	18	390	<420	U	18	420	52	J	18	400	<410	U	18	410	<380	U	18	380	<390	U	18	390
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<390	U	20	390	29	J	20	420	<400	U	20	400	<410	U	20	410	<380	U	20	380	<390	U	20	390
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<390	U	390	390	<420	U	420	420	<400	U	400	400	<410	U	410	410	<380	U	380	380	<390	U	390	390
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	<390	U	24	390	<420	U	24	420	<400	U	24	400	<410	U	24	410	<380	U	24	380	<390	U	24	390
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	<390	U	24	390	<420	U	24	420	93	J	24	400	<410	U	24	410	<380	U	24	380	<390	U	24	390
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	440	NJ,NJ,t	0	0	NI				NI				NI				NI				NI			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
13-Octadecenal	56554-90-6	--	--	--	--	--	NI				NI				NI				NI				160	NJ,NJ,t	0	0	NI			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NI				NI				NI				220	NJ,NJ,t	0	0	NI				NI			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NI				NI				NI				NI				NI				NI			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				NI				NI				1,300	NJ,NJ,t	0	0	NI				NI			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NI				NI				330	NJ,NJ,t	0	0	NI				NI				NI			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NI				NI				NI				NI				510	NJ,NJ,t	0	0	NI			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NI				NI				NI				NI				NI				NI			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB24A 12/3/2002 0-1		MDL	RL	54SB24B 12/3/2002 9-10		MDL	RL	54SB25A 12/3/2002 0-1		MDL	RL	54SB25B 12/3/2002 9-10		MDL	RL	54SB26A 12/3/2002 0-1		MDL	RL	54SB26B 12/3/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	250	NJ,NJ,t	0	0	NI				NI				NI				NI				NI			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	720	NJ,NJ,t	0	0	NI				NI				NI				NI				NI			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				1,500	J,c	1.7	9.9	112	J,c	1.3	9.9	NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				15.8	J,c	1.2	9.9	3.7	J,J,c	1	9.9	NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				34.4		1	5	7.4		0.8	5	NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				3.8	J	0.4	5	0.85	MJ	0.4	5	NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				<5		0.5	5	<5		0.5	5	NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				<5		0.5	5	<5		0.4	5	NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				<5		0.2	5	0.45	J	0.2	5	NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				0.57	MJ	0.4	5	<5		0.4	5	NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				<5		0.2	5	0.15	MJ	0.2	5	NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				<5		0.5	5	<5		0.4	5	NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				<5		0.3	5	<5		0.3	5	NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				<5		0.3	5	<5		0.3	5	NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				<5		0.2	5	<5		0.2	5	NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				<5		0.2	5	<5		0.2	5	NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				<5		0.2	5	<5		0.2	5	NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				<1		0.2	1	<1		0.2	1	NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				<1		0.1	1	0.87	J,R,p	0.2	1	NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NR				NR				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NR				NR				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NR				NR				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NR				NR				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				70.5		1	5	15.1		0.8	5	NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				12.7		0.5	5	3.2	M	0.4	5	NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				4.5	M	0.5	5	2.4		0.4	5	NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				4.3	MX,J,w	0.2	5	1.8	M	0.2	5	NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				<5		0.3	5	0.44	M	0.3	5	NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				2.9	M	0.2	5	1.3	M	0.2	5	NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				<1		0.2	1	<1		0.2	1	NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				1.3	M	0.1	1	3.9	M	0.2	1	NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	<49	U,R,l	49	49	260	BP,B,z	53	53	<51	U	5.9	51	160	P,J,g	5.9	52	81	BP,B,z	48	48	<51	U,R,l	51	51
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	<49	U	49	49	<53	U,UL,s	53	53	<51	U	5.9	51	<52	U	5.9	52	<48	U	48	48	<51	U	51	51
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<49	U	49	49	<53	U,UL,s	53	53	<51	U	5.4	51	<52	U	5.4	52	<48	U	48	48	<51	U	51	51
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	15		9.8	9.8	<10	U,UL,s	10	10	***32***		2.2	10	6.6	J	2.2	10	4.4	J	9.5	9.5	<10	U	10	10
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	***19***	B,B,z	9.8	9.8	<10	U,UL,s	10	10	***58***		1.6	10	***8***	J	1.6	10	<9.5	U	9.5	9.5	<10	U	10	10
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	18	BP,B,z	9.8	9.8	4.9	BJ,B,z	10	10	35		1.7	10	6.8	J	1.7	10	5.9	BJP,B,z	9.5	9.5	<10	U	10	10
Benzo(g,h,i)perylene[9]	191-24-2	N	--	2.3E+05	3.1E+06	--	32	BP,J,g	9.8	9.8	<10	U,UL,s	10	10	28		3.6	10	<10	U	3.6	10	<9.5	U	9.5	9.5	<10	U	10	10
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	40	P,J,g	9.8	9.8	5.8	JP,J,g	10	10	57	P,J,g	1.4	10	7.4	JP,J,g	1.4	10	<9.5	U	9.5	9.5	<10	U	10	10
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	16		9.8	9.8	<10	U,UL,s	10	10	32		2.4	10	7.5	J	2.4	10	4.5	J	9.5	9.5	<10	U	10	10
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	***36***	BP,J,g	9.8	9.8	<10	U,UL,s	10	10	19	P,J,g	4.2	10	<10	U	4.2	10	<9.5	U	9.5	9.5	<10	U	10	10
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	57	BP,J,g	20	20	11	BJ,B,z	22	22	90		2.1	21	18	JP,J,g	2.1	21	23	B,B,z	20	20	<20	U	20	20
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<49	U,R,l	49	49	<53	U,R,l	53	53	<51	U	14	51	<52	U	14	52	<48	U,R,l	48	48	<51	U,R,l	51	51
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	110	BP	9.8	9.8	5.9	BJP,B,z	10	10	38		2.5	10	<10	U	2.5	10	<9.5	U	9.5	9.5	<10	U	10	10
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	***170***	P,J,l	49	49	<53	U,R,l	53	53	<51	U	14	51	***590***	P,J,g	14	52	<48	U,R,l	48	48	<51	U,R,l	51	51
Phenanthrene[9]	85-01-8	N	--	2.3E+05	3.1E+06	--	24	J	49	49	<53	U,UL,s	53	53	23	J	8.5	51	<52	U	8.5	52	<48	U	48	48	<51	U	51	51
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	35		20	20	110	P,J,g	22	22	86	P,J,c	4.3	21	12	J,J,c	4.3	21	<20	U	20	20	9.4	J	20	20
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB24A 12/3/2002 0-1		MDL	RL	54SB24B 12/3/2002 9-10		MDL	RL	54SB25A 12/3/2002 0-1		MDL	RL	54SB25B 12/3/2002 9-10		MDL	RL	54SB26A 12/3/2002 0-1		MDL	RL	54SB26B 12/3/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<1	U	0.079	1	<1	U	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	2.7	J,c	0.16	1	<1	U	0.16	1	<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	ND				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	0.4	J	0.1	1	<1	U	0.1	1	<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	0.38	JP,J,g	0.095	1	<1	U	0.095	1	<1	U	0.095	1
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				ND				0.78	J	0.1	1	ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				--				--				--				--			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB26B-DUP (D-7) 12/3/2002 9-10		MDL	RL	54SB27A [D] 12/3/2002 0-1		MDL	RL	54SB27B [D] 12/3/2002 9-10		MDL	RL	54SB27C 1/10/2007 14.3-15.3		MDL	RL	54SB28A 12/3/2002 0-1		MDL	RL	54SB28B 12/3/2002 8-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	11,500		2.5	11.4	10,500		6.1	10.7	11,100		6.6	11.6	NT				9,460		6.2	10.9	11,100		6.7	11.7
Antimony	7440-36-0	N	--	3.13	40.88	0.66	<1.1	UN,UL,m	0.42	1.1	0.38	BN*,J,k	0.13	1.1	0.53	BN*,J,k	0.14	1.2	NT				0.55	BN*,J,k	0.13	1.1	0.3	BN*,J,k	0.14	1.2
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***1.1***	B	0.28	1.1	***2***		0.32	1.1	***1.4***		0.35	1.2	NT				***1.5***		0.33	1.1	***1.3***		0.35	1.2
Barium	7440-39-3	N	209	1,564	20,440	300.8	125	E,J,s	0.02	1.1	169	E,J,s	0.03	1.1	119	E,J,s	0.03	1.2	NT				155	E,J,s	0.03	1.1	136	E,J,s	0.04	1.2
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.87		0.01	0.57	0.81		0.02	0.54	0.77		0.02	0.58	NT				0.8		0.02	0.55	0.86		0.02	0.59
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.57	UN,UL,m	0.05	0.57	0.17	B	0.03	0.54	<0.58	U	0.03	0.58	NT				<0.55	U	0.03	0.55	<0.59	U	0.04	0.59
Calcium	7440-70-2	--	--	--	--	--	1,110	E,J,s	1.1	114	2,490	E,J,s	1.6	107	1,280	E,J,s	1.7	116	NT				1,620	E,J,s	1.6	109	1,510	E,J,s	1.8	117
Chromium[1]	7440-47-3	N	65.3	23.46	306.6	2.102	***17.4***		0.07	0.57	***17.8***	E,J,s	0.09	0.54	***17.6***	E,J,s	0.09	0.58	NT				***19***	E,J,s	0.09	0.55	***18.1***	E,J,s	0.09	0.59
Cobalt	7440-48-4	--	72.3	--	--	--	8.2	E,J,s	0.07	0.57	7.5	E,J,s	0.08	0.54	8.4	E,J,s	0.08	0.58	NT				7.5	E,J,s	0.08	0.55	8.7	E,J,s	0.08	0.59
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	11		0.16	0.57	26.7	E,J,s	0.16	0.54	9.9	E,J,s	0.17	0.58	NT				12.2	E,J,s	0.16	0.55	11.6	E,J,s	0.18	0.59
Iron	7439-89-6	N	50,962	5,475	71,540	--	16,600	E,J,s	1.6	11.4	20,600	E,J,s	1.3	10.7	18,500	E,J,s	1.4	11.6	NT				19,400	E,J,s	1.4	10.9	19,200	E,J,s	1.5	11.7
Lead [2]	7439-92-1	--	26.8	400	750	--	7.8	N*,J,k	0.26	0.34	142	*E,J,k	0.13	0.32	7	*E,J,k	0.14	0.35	NT				67.6	*E,J,k	0.13	0.33	7.7	*E,J,k	0.14	0.35
Magnesium	7439-95-4	--	--	--	--	--	2,980	E,J,s	0.69	114	2,930	E,J,s	1.3	107	3,060	E,J,s	1.4	116	NT				2,910	E,J,s	1.3	109	3,390	E,J,s	1.4	117
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***554***	E,J,s	0.02	1.1	***394***	E	0.02	1.1	***434***	E,J,s	0.02	1.2	NT				***660***	E,J,s	0.02	1.1	***519***	E,J,s	0.02	1.2
Mercury[3]	7439-97-6	--	0.13	2.35	30.66	--	0.039		0.017	0.035	0.24	N,L,m	0.017	0.034	0.026	BN,L,m	0.018	0.035	NT				0.038	N,L,m	0.019	0.038	0.026	BN,L,m	0.02	0.041
Nickel	7440-02-0	N	62.8	156.4	2,044	--	12.4		0.11	0.57	10.9	E,J,s	0.11	0.54	12.1	E,J,s	0.12	0.58	NT				11.3	E,J,s	0.11	0.55	12.5	E,J,s	0.12	0.59
Potassium	7440-09-7	--	--	--	--	--	1,080	E,J,s	13.5	114	1,070		4.3	107	909		4.6	116	NT				910		4.4	109	1,030		4.7	117
Selenium	7782-49-2	N	--	39.11	511	0.949	***0.97***	N,L,m	0.37	0.57	***1.1***	N,B,x	0.32	0.54	0.78	N,B,x	0.35	0.58	NT				***1.2***	N,B,x	0.33	0.55	0.86	N,B,x	0.35	0.59
Silver	7440-22-4	N	--	39.11	511	1.551	<0.57	U	0.08	0.57	<0.54	U	0.09	0.54	<0.58	U	0.09	0.58	NT				<0.55	U	0.09	0.55	<0.59	U	0.09	0.59
Sodium	7440-23-5	--	--	--	--	--	197	B,L,w	28.2	227	<214	U	32.6	214	120	B,K,w	35.3	232	NT				<218	U	33.2	218	101	B,K,w	35.7	235
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	<1.1	UN,UL,m	0.58	1.1	<1.1	UN,R,m	0.26	1.1	<1.2	UN,R,m	0.28	1.2	NT				<1.1	UN,R,m	0.26	1.1	<1.2	UN,R,m	0.28	1.2
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	24.4		0.08	2.3	26.2	E,J,s	0.08	2.1	27.7	E,J,s	0.08	2.3	NT				22.9	E,J,s	0.08	2.2	25.8	E,J,s	0.08	2.3
Zinc	7440-66-6	N	202	2,346	30,660	681.1	57.1	*E	0.11	2.3	189	*E,J,s	0.12	2.1	55.7	*E,J,s	0.13	2.3	NT				164	*E,J,s	0.12	2.2	55.4	*E,J,s	0.13	2.3
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				NT				NT				NT				NT			
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	NT				NT				NT				NT				NT				NT			
alpha-Chlordane[4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				NT				NT				NT				NT			
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	NT				NT				NT				NT				NT				NT			
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				NT				NT				NT				NT			
gamma-Chlordane[4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				NT				NT				NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				NT				NT				NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				NT				NT				NT				NT			
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				NT				NT				NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				NT				NT				NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<390	U	20	390	***14,000***	D	20	1,500	***57***	J	20	400	NT				***40***	J	20	390	<410	U	20	410
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<390	U	21	390	***10,000***	D	21	1,500	***110***	J	21	400	NT				<390	U	21	390	<410	U	21	410
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				24,000	D	21	1,500	167	J	21	400	NT				40	J	20	390	ND			
2-Nitroaniline	88-74-4	--	--	--	--	--	<790	U	29	790	55	J	29	770	<800	U	29	800	NT				<790	U	29	790	<830	U	29	830
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	<390	U	17	390	<380	U	17	380	<400	U	17	400	NT				<390	U	17	390	<410	U	17	410
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<390	U	25	390	<380	U	25	380	<400	U	25	400	NT				<390	U	25	390	<410	U	25	410
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<390	U	29	390	<380	U	29	380	<400	U	29	400	NT				<390	U	29	390	<410	U	29	410
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<390	U	23	390	<380	U	23	380	<400	U	23	400	NT				<390	U	23	390	<410	U	23	410
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<390	U	36	390	<380	U	36	380	<400	U	36	400	NT				<390	U	36	390	<410	U	36	410
Benzo(g,h,i)perylene[8]	191-24-2	N	--	2.3E+05	3.1E+06	--	<390	U	23	390	<380	U	23	380	<400	U	23	400	NT				<390	U	23	390	<410	U	23	410
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<390	U	29	390	<380	U	29	380	<400	U	29	400	NT				<390	U	29	390	<410	U	29	410
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	43	JB,B,z	32	390	2,600		32	380	56	J,B,x	32	400	NT				79	J,B,x	32	390	<410	U	32	410
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<390	U	28	390	<380	U	28	380	<400	U	28	400	NT				<390	U	28	390	<410	U	28	410
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	<390	U	390	390	800		380	380	<400	U	400	400	NT				200	J	390	390	<410	U	410	410
Di-n-octylphthalate	117-84-0	--	--	--	--	--	<390	U	390	390	<380	U	380	380	42	J	400	400	NT				320	J	390	390	35	J	410	410
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<390	U	21	390	<380	U	21	380	<400	U	21	400	NT				<390	U	21	390	<410	U	21	410
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	<390	U	390	390	200	J,J,c	380	380	<400	U	400	400	NT				<390	U	390	390	<410	U	410	410
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<390	U	18	390	<380	U	18	380	<400	U	18	400	NT				<390	U	18	390	<410	U	18	410
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<390	U	20	390	<380	U	20	380	<400	U	20	400	NT				<390	U	20	390	<410	U	20	410
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<390	U	390	390	***1,200***	J,r	380	380	<400	U	400	400	NT				<390	U	390	390	<410	U	410	410
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	<390	U	24	390	<380	U	24	380	<400	U	24	400	NT				<390	U	24	390	<410	U	24	410
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	<390	U	24	390	<380	U	24	380	<400	U	24	400	NT				<390	U	24	390	<410	U	24	410
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
13-Octadecenal	56554-90-6	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NI				NI				NI				NT				NI				NI			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				690	NJ,NJ,t	0	0	NI				NT				NI				NI			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NI				500	NJ,NJ,t	0	0	NI				NT				NI				NI			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NI				1,800	NJ,NJ,t	0	0	NI				NT				NI				NI			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NI				410	NJ,NJ,t	0	0	NI				NT				NI				NI			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NI				290	NJ,NJ,t	0	0	NI				NT				NI				NI			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				60,000	NJ,NJ,t	0	0	NI				NT				NI				NI			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NI				890	NJ,NJ,t	0	0	NI				NT				NI				NI			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NI				NI				NI				NT				NI				NI			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB26B-DUP (D-7) 12/3/2002 9-10		MDL	RL	54SB27A [D] 12/3/2002 0-1		MDL	RL	54SB27B [D] 12/3/2002 9-10		MDL	RL	54SB27C 1/10/2007 14.3-15.3		MDL	RL	54SB28A 12/3/2002 0-1		MDL	RL	54SB28B 12/3/2002 8-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NI				160	NJ,NJ,t	0	0	NI				NT				NI				NI			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				4,220	E,J,q	0.89	0.89	215		0.961	0.961	95.4		0.905	0.905	NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				23.3		0.89	0.89	<0.961	U	0.961	0.961	<0.905	U	0.905	0.905	NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				69.4		0.477	0.477	3.33	A	0.48	0.48	1.34	A	0.453	0.453	NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				7.12		0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				0.47	A	0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				0.523	A	0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				0.513	A	0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				1.44	A	0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				0.345	A	0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				1.13	A	0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				0.151	A	0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				0.326	A	0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				0.279	A	0.445	0.445	<0.48	U	0.48	0.48	0.0742	A	0.453	0.453	NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				0.376	A	0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				0.406	A	0.445	0.445	<0.48	U	0.48	0.48	0.0778	A	0.453	0.453	NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				<0.258	U	0.258	0.258	<0.24	U	0.24	0.24	<0.0954	U	0.0954	0.0954	NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				0.511	A,B,z	0.261	0.261	0.363	A,B,z	0.228	0.228	0.348	A,B,z	0.0905	0.0905	NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				3		0	0	0.134		0	0	0.102		0	0	NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				3.13		0	0	0.747		0	0	0.539		0	0	NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				3		0	0	0.134		0	0	0.102		0	0	NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				3.13		0	0	0.747		0	0	0.539		0	0	NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				139		0.477	0.477	9.93		0.48	0.48	3.51		0.453	0.453	NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				22.4		0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				9.73		0.445	0.445	0.963		0.48	0.48	0.525		0.453	0.453	NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				7.5		0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				0.853		0.445	0.445	<0.48	U	0.48	0.48	<0.453	U	0.453	0.453	NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				3.69		0.445	0.445	<0.48	U	0.48	0.48	0.228		0.453	0.453	NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				<0.258	U	0.258	0.258	0.0672		0.24	0.24	<0.0954	U	0.0954	0.0954	NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				1.53	,B,z	0.261	0.261	0.634	,B,z	0.228	0.228	0.744	,B,z	0.0905	0.0905	NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	<50	U,R,l	50	50	1,600	EP,J,g	5.8	49	<51	U	5.9	51	NT				33	J	5.9	50	<52	U	5.9	52
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	<50	U	50	50	1,100	PD,J,g	5.9	980	<51	U	5.9	51	NT				<50	U	5.9	50	<52	U	5.9	52
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<50	U	50	50	<49	U	5.4	49	<51	U	5.4	51	NT				<50	U	5.4	50	<52	U	5.4	52
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<9.9	U	9.9	9.9	<9.6	U	2.2	9.6	<10	U	2.2	10	NT				3.6	J	2.2	9.9	<10	U	2.2	10
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<9.9	U	9.9	9.9	<9.6	U	1.6	9.6	<10	U	1.6	10	NT				<9.9	U	1.6	9.9	<10	U	1.6	10
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<9.9	U	9.9	9.9	***110***	JPZ,J,g	1.7	190	<10	U	1.7	10	NT				<9.9	U	1.7	9.9	<10	U	1.7	10
Benzo(g,h,i)perylene[9]	191-24-2	N	--	2.3E+05	3.1E+06	--	<9.9	U	9.9	9.9	<9.6	U	3.6	9.6	<10	U	3.6	10	NT				<9.9	U	3.6	9.9	<10	U	3.6	10
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<9.9	U	9.9	9.9	<9.6	U	1.4	9.6	<10	U	1.4	10	NT				<9.9	U	1.4	9.9	<10	U	1.4	10
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<9.9	U	9.9	9.9	<9.6	U	2.4	9.6	<10	U	2.4	10	NT				<9.9	U	2.4	9.9	<10	U	2.4	10
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<9.9	U	9.9	9.9	<9.6	U	4.2	9.6	<10	U	4.2	10	NT				<9.9	U	4.2	9.9	<10	U	4.2	10
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	6.2	BJ,B,z	20	20	<20	U	2.1	20	<21	U	2.1	21	NT				28		2.1	20	<21	U	2.1	21
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<50	U,R,l	50	50	<49	U	14	49	<51	U	14	51	NT				<50	U	14	50	<52	U	14	52
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<9.9	U	9.9	9.9	<9.6	U	2.5	9.6	<10	U	2.5	10	NT				<9.9	U	2.5	9.9	<10	U	2.5	10
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	<50	U,R,l	50	50	***6,700***	EP,J,g	14	49	<51	U	14	51	NT				***210***		14	50	<52	U	14	52
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	<50	U	50	50	<49	U	8.5	49	<51	U	8.5	51	NT				19	J	8.5	50	<52	U	8.5	52
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	10	J	20	20	180	JPZ,J,g	4.3	390	13	JP,J,c	4.3	21	NT				13	J,J,c	4.3	20	<21	U	4.3	21
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB26B-DUP (D-7) 12/3/2002 9-10		MDL	RL	54SB27A [D] 12/3/2002 0-1		MDL	RL	54SB27B [D] 12/3/2002 9-10		MDL	RL	54SB27C 1/10/2007 14.3-15.3		MDL	RL	54SB28A 12/3/2002 0-1		MDL	RL	54SB28B 12/3/2002 8-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U,R,I	0.079	1	7.6	J	0.079	10	<1	U	0.079	1	NT				<1	U	0.079	1	<1	U	0.079	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	130	J,c	0.16	10	<1	U	0.16	1	NT				<1	U	0.16	1	<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	***17***		0.12	10	<1	U	0.12	1	NT				<1	U	0.12	1	<1	U	0.12	1
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.19	1	***11***		0.19	10	<1	U	0.19	1	NT				<1	U	0.19	1	<1	U	0.19	1
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	ND				28		0.19	10	ND				NT				ND				ND			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	5.7	J	0.1	10	<1	U	1	1	NT				<1	U	0.1	1	<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	5.2	J	0.095	10	<1	U	0.095	1	NT				<1	U	0.095	1	<1	U	0.095	1
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				10.9		0.1	10	ND				NT				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	6.8	J,J,c	0.1	10	<1	U	0.1	1	NT				<1	U	0.1	1	<1	U	0.1	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	<10	U	1	10	<10	U	1	10	NT				<10	U	1	10	<10	U	1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				--				NT				--				--			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB29A 12/3/2002 0-1		MDL	RL	54SB29B 12/3/2002 9-10		MDL	RL	54SB30A 12/3/2002 0-1		MDL	RL	54SB30B 12/3/2002 9-10		MDL	RL	54SB31A 12/3/2002 0-1		MDL	RL	54SB31B 12/3/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	6,740		6.4	11.3	14,300		7.1	12.5	10,400		6.1	10.7	10,200		6.9	12.2	15,600		6.6	11.6	12,800		6.6	11.6
Antimony	7440-36-0	N	--	3.13	40.88	0.66	0.31	BN*,J,k	0.14	1.1	0.45	BN*,J,k	0.15	1.2	0.34	BN*,J,k	0.13	1.1	0.48	BN*,J,k	0.15	1.2	0.48	BN*,J,k	0.14	1.2	0.36	BN*,J,k	0.14	1.2
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***1.4***		0.34	1.1	***1.7***		0.37	1.2	***1.2***		0.32	1.1	***0.94***	B	0.36	1.2	***2.5***		0.35	1.2	***1.9***		0.35	1.2
Barium	7440-39-3	N	209	1,564	20,440	300.8	122	E,J,s	0.03	1.1	179	E,J,s	0.04	1.2	133	E,J,s	0.03	1.1	128	E,J,s	0.04	1.2	89.1	E,J,s	0.03	1.2	82.3	E,J,s	0.03	1.2
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.63		0.02	0.56	1.1		0.02	0.62	0.8		0.02	0.53	0.75		0.02	0.61	0.7		0.02	0.58	0.63		0.02	0.58
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.56	U	0.03	0.56	<0.62	U	0.04	0.62	<0.53	U	0.03	0.53	<0.61	U	0.04	0.61	<0.58	U	0.03	0.58	<0.58	U	0.03	0.58
Calcium	7440-70-2	--	--	--	--	--	1,030	E,J,s	1.7	113	1,870	E,J,s	1.9	125	1,470	E,J,s	1.6	107	1,360	E,J,s	1.8	122	4,610	E,J,s	1.7	116	7,890	E,J,s	1.7	116
Chromium[1]	7440-47-3	N	65.3	23.46	306.6	2.102	***13.3***	E,J,s	0.09	0.56	***24.3***	E,J,s	0.1	0.62	***18.1***	E,J,s	0.09	0.53	***18.6***	E,J,s	0.1	0.61	***29.5***	E,J,s	0.09	0.58	***19.9***	E,J,s	0.09	0.58
Cobalt	7440-48-4	--	72.3	--	--	--	5.9	E,J,s	0.08	0.56	9.3	E,J,s	0.09	0.62	8.9	E,J,s	0.07	0.53	7.9	E,J,s	0.09	0.61	8.9	E,J,s	0.08	0.58	9.7	E,J,s	0.08	0.58
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	7.9	E,J,s	0.17	0.56	12.1	E,J,s	0.19	0.62	12.3	E,J,s	0.16	0.53	9.4	E,J,s	0.18	0.61	12	E,J,s	0.17	0.58	15.3	E,J,s	0.17	0.58
Iron	7439-89-6	N	50,962	5,475	71,540	--	16,600	E,J,s	1.4	11.3	23,100	E,J,s	1.6	12.5	18,500	E,J,s	1.3	10.7	17,800	E,J,s	1.5	12.2	24,500	E,J,s	1.5	11.6	22,800	E,J,s	1.4	11.6
Lead [2]	7439-92-1	--	26.8	400	750	--	52.2	*E,J,k	0.14	0.34	9.3	*E,J,k	0.15	0.37	13.1	*E,J,k	0.13	0.32	8	*E,J,k	0.15	0.36	11.6	*E,J,k	0.14	0.35	15.7	*E,J,k	0.14	0.35
Magnesium	7439-95-4	--	--	--	--	--	2,030	E,J,s	1.4	113	3,830	E,J,s	1.5	125	3,090	E,J,s	1.3	107	3,060	E,J,s	1.5	122	3,780	E,J,s	1.4	116	5,640	E,J,s	1.4	116
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***556***	E,J,s	0.02	1.1	***578***	E,J,s	0.02	1.2	***524***	E,J,s	0.02	1.1	***455***	E,J,s	0.02	1.2	***407***	E,J,s	0.02	1.2	***552***	E,J,s	0.02	1.2
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	0.037	BN,L,m	0.019	0.039	0.042	N,L,m	0.021	0.041	0.03	BN,L,m	0.018	0.036	0.032	BN,L,m	0.018	0.035	0.052	N,L,m	0.019	0.038	0.057	N,L,m	0.019	0.039
Nickel	7440-02-0	N	62.8	156.4	2,044	--	8.7	E,J,s	0.11	0.56	15.1	E,J,s	0.12	0.62	11.7	E,J,s	0.11	0.53	11.5	E,J,s	0.12	0.61	9.4	E,J,s	0.12	0.58	9.2	E,J,s	0.12	0.58
Potassium	7440-09-7	--	--	--	--	--	832		4.5	113	819		5	125	1,050		4.3	107	1,030		4.9	122	1,090		4.7	116	1,050		4.6	116
Selenium	7782-49-2	N	--	39.11	511	0.949	***0.96***	N,B,x	0.34	0.56	0.91	N,B,x	0.37	0.62	0.72	N,B,x	0.32	0.53	0.61	BN,B,x	0.36	0.61	***1***	N,B,x	0.35	0.58	***1.1***	N,B,x	0.35	0.58
Silver	7440-22-4	N	--	39.11	511	1.551	<0.56	U	0.09	0.56	<0.62	U	0.1	0.62	<0.53	U	0.09	0.53	<0.61	U	0.1	0.61	<0.58	U	0.09	0.58	<0.58	U	0.09	0.58
Sodium	7440-23-5	--	--	--	--	--	<226	U	34.3	226	63.1	B,K,w	38	249	72.2	B,K,w	32.5	214	120	B,K,w	37	243	110	B,K,w	35.4	233	119	B,K,w	35.2	231
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	<1.1	UN,R,m	0.27	1.1	<1.2	UN,R,m	0.3	1.2	<1.1	UN,R,m	0.26	1.1	<1.2	UN,R,m	0.29	1.2	<1.2	UN,R,m	0.28	1.2	<1.2	UN,R,m	0.28	1.2
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	17.5	E,J,s	0.08	2.3	32.9	E,J,s	0.09	2.5	25.3	E,J,s	0.07	2.1	25.7	E,J,s	0.09	2.4	***48.4***	E,J,s	0.08	2.3	***41.3***	E,J,s	0.08	2.3
Zinc	7440-66-6	N	202	2,346	30,660	681.1	176	*E,J,s	0.12	2.3	74.4	*E,J,s	0.14	2.5	59.3	*E,J,s	0.12	2.1	52.9	*E,J,s	0.13	2.4	43.2	*E,J,s	0.13	2.3	51	*E,J,s	0.13	2.3
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				<2	U	0.4	2	<2.1	U	0.4	2.1	NT				NT			
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	NT				NT				4.1	JP,J,l	0.39	5.8	<6.1	U	0.39	6.1	NT				NT			
alpha-Chlordane[4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				<2	U	0.22	2	<2.1	U	0.22	2.1	NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				0.5	J	0.15	0.97	0.46	J	0.15	1	NT				NT			
Endosulfan Sulfate[6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	NT				NT				<3.8	U	0.4	3.8	<4	U	0.4	4	NT				NT			
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				1.2	J	0.35	3.8	<4	U	0.35	4	NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				***1.6***		0.22	0.97	<1	U	0.22	1	NT				NT			
gamma-Chlordane[4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				<0.97	U	0.35	0.97	<1	U	0.35	1	NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				4.8	P,J,g	0.34	0.97	<1	U	0.34	1	NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				<9.7	U	0.26	9.7	***7.4***		0.26	1	NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				7.4	JP,J,g	1.4	9.7	<10	U	1.4	10	NT				NT			
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				<52	U	9	52	<55	U	9	55	NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				<76	U	9.2	76	<79	U	9.2	79	NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<390	U	20	390	<420	U	20	420	***500***		20	380	<400	U	20	400	<420	U	20	420	***76***	J	20	400
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<390	U	21	390	<420	U	21	420	***500***		21	380	<400	U	21	400	<420	U	21	420	***40***	J	21	400
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				ND				1,000		21	380	ND				ND				116	J	21	400
2-Nitroaniline	88-74-4	--	--	--	--	--	<790	U	29	790	<840	U	29	840	<770	U	29	770	<800	U	29	800	<840	U	29	840	<800	U	29	800
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	<390	U	17	390	<420	U	17	420	<380	U	17	380	<400	U	17	400	<420	U	17	420	<400	U	17	400
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<390	U	25	390	<420	U	25	420	<380	U	25	380	<400	U	25	400	<420	U	25	420	<400	U	25	400
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<390	U	29	390	<420	U	29	420	<380	U	29	380	<400	U	29	400	<420	U	29	420	<400	U	29	400
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<390	U	23	390	<420	U	23	420	<380	U	23	380	<400	U	23	400	<420	U	23	420	<400	U	23	400
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<390	U	36	390	<420	U	36	420	<380	U	36	380	<400	U	36	400	<420	U	36	420	<400	U	36	400
Benzo(g,h,i)perylene[8]	191-24-2	N	--	2.3E+05	3.1E+06	--	<390	U	23	390	<420	U	23	420	<380	U	23	380	<400	U	23	400	<420	U	23	420	<400	U	23	400
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<390	U	29	390	<420	U	29	420	<380	U	29	380	<400	U	29	400	<420	U	29	420	<400	U	29	400
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	61	J,B,x	32	390	70	J,B,x	32	420	120	J	32	380	<400	U	32	400	<420	U	32	420	140	J	32	400
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<390	U	28	390	<420	U	28	420	<380	U	28	380	<400	U	28	400	<420	U	28	420	<400	U	28	400
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	<390	U	390	390	<420	U	420	420	65	J	380	380	<400	U	400	400	<420	U	420	420	130	J	400	400
Di-n-octylphthalate	117-84-0	--	--	--	--	--	<390	U	390	390	<420	U	420	420	<380	U	380	380	<400	U	400	400	<420	U	420	420	<400	U	400	400
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<390	U	21	390	<420	U	21	420	<380	U	21	380	<400	U	21	400	<420	U	21	420	<400	U	21	400
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	<390	U	390	390	<420	U	420	420	460	J,c	380	380	<400	U	400	400	<420	U	420	420	140	J,J,c	400	400
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<390	U	18	390	<420	U	18	420	<380	U	18	380	<400	U	18	400	40	J	18	420	<400	U	18	400
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<390	U	20	390	<420	U	20	420	<380	U	20	380	<400	U	20	400	<420	U	20	420	<400	U	20	400
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<390	U	390	390	<420	U	420	420	***66***	J,J,r	380	380	<400	U	400	400	<420	U	420	420	30	J,J,r	400	400
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	<390	U	24	390	<420	U	24	420	<380	U	24	380	<400	U	24	400	<420	U	24	420	<400	U	24	400
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	<390	U	24	390	<420	U	24	420	<380	U	24	380	<400	U	24	400	56	J	24	420	<400	U	24	400
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
13-Octadecenal	56554-90-6	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NI				NI				NI				NI				NI				NI			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				NI				330	NJ,NJ,t	0	0	NI				NI				NI			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NI				NI				NI				NI				NI				NI			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				NI				1,300	NJ,NJ,t	0	0	NI				NI				180	NJ,NJ,t	0	0
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NI				NI				NI				NI				NI				NI			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB29A 12/3/2002 0-1		MDL	RL	54SB29B 12/3/2002 9-10		MDL	RL	54SB30A 12/3/2002 0-1		MDL	RL	54SB30B 12/3/2002 9-10		MDL	RL	54SB31A 12/3/2002 0-1		MDL	RL	54SB31B 12/3/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NI				NI				NI				NI				NI				190	NJ,NJ,t	0	0
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				122	J,c	1.7	10	99.7	J,c	1.5	9.9	NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				<10		1.3	10	<9.9		1.1	9.9	NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				6		1.1	5	4.3	J	0.9	5	NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				0.9	MJ	0.5	5	<5		0.4	5	NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				<5		0.7	5	<5		0.6	5	NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				<5		0.6	5	<5		0.4	5	NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				<5		0.3	5	<5		0.2	5	NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				<5		0.6	5	<5		0.4	5	NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				<5		0.3	5	<5		0.2	5	NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				<5		0.6	5	<5		0.5	5	NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				<5		0.4	5	<5		0.3	5	NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				<5		0.4	5	<5		0.3	5	NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				<5		0.3	5	<5		0.2	5	NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				<5		0.3	5	<5		0.3	5	NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				<5		0.3	5	<5		0.2	5	NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				<1		0.3	1	<1		0.2	1	NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				<1		0.2	1	<1		0.2	1	NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NR				NR				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NR				NR				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NR				NR				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NR				NR				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				15.2		1.1	5	9.1		0.9	5	NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				2.2	M	0.6	5	<5		0.5	5	NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				2.9		0.6	5	<5		0.4	5	NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				1.3		0.3	5	<5		0.3	5	NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				<5		0.4	5	<5		0.3	5	NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				<5		0.3	5	<5		0.2	5	NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				<1		0.3	1	<1		0.2	1	NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				<1		0.2	1	<1		0.2	1	NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	<50	U	5.9	50	<53	U	5.9	53	210	P,J,g	5.8	49	<51	U	5.9	51	<53	U	5.9	53	***16,000***	EP,K,s	5.8	51
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	30	JP,J,g	5.9	50	<53	U	5.9	53	260	JPZ,J,g	5.9	490	<51	U	5.9	51	<53	U	5.9	53	46	JP,K,s	5.9	51
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<50	U	5.4	50	<53	U	5.4	53	<49	U	5.4	49	<51	U	5.4	51	<53	U	5.4	53	37	JP,K,s	5.4	51
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<9.9	U	2.2	9.9	<10	U	2.2	10	***49***		2.2	9.6	<10	U	2.2	10	15		2.2	10	***160***	K,s	2.2	10
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<9.9	U	1.6	9.9	<10	U	1.6	10	<9.6	U	1.6	9.6	<10	U	1.6	10	***21***		1.6	10	***150***	P,K,s	1.6	10
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<9.9	U	1.7	9.9	<10	U	1.7	10	<9.6	U	1.7	9.6	<10	U	1.7	10	13		1.7	10	***150***	P,K,s	1.7	10
Benzo(g,h,i)perylene[9]	191-24-2	N	--	2.3E+05	3.1E+06	--	<9.9	U	3.6	9.9	<10	U	3.6	10	<9.6	U	3.6	9.6	<10	U	3.6	10	21	P,J,g	3.6	10	130	P,K,s	3.6	10
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<9.9	U	1.4	9.9	<10	U	1.4	10	46		1.4	9.6	<10	U	1.4	10	9.2	JP,J,g	1.4	10	200	P,K,s	1.4	10
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<9.9	U	2.4	9.9	<10	U	2.4	10	49		2.4	9.6	<10	U	2.4	10	13		2.4	10	120	K,s	2.4	10
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<9.9	U	4.2	9.9	<10	U	4.2	10	<9.6	U	4.2	9.6	<10	U	4.2	10	***34***	P,J,g	4.2	10	***62***	K,s	4.2	10
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	5.4	JP,J,g	2.1	20	<22	U	2.1	22	<20	U	2.1	20	<21	U	2.1	21	39	P,J,g	2.1	22	620	EP,K,s	2.1	21
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<50	U	14	50	<53	U	14	53	<49	U	14	49	<51	U	14	51	<53	U	14	53	<51	U	14	51
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<9.9	U	2.5	9.9	<10	U	2.5	10	<9.6	U	2.5	9.6	<10	U	2.5	10	<10	U	2.5	10	94	P,K,s	2.5	10
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	<50	U	14	50	<53	U	14	53	***9,400***	Z	14	490	***63***	P,J,g	14	51	<53	U	14	53	***720***	P,K,s	14	51
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	<50	U	8.5	50	<53	U	8.5	53	120	JPZ,J,g	8.5	490	<51	U	8.5	51	<53	U	8.5	53	230	K,s	8.5	51
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	<20	U	4.3	20	13	JP,J,c	4.3	22	67	JZ	4.3	200	9.9	J,J,c	4.3	21	27	P,J,c	4.3	22	320	K,s	4.3	21
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB29A 12/3/2002 0-1		MDL	RL	54SB29B 12/3/2002 9-10		MDL	RL	54SB30A 12/3/2002 0-1		MDL	RL	54SB30B 12/3/2002 9-10		MDL	RL	54SB31A 12/3/2002 0-1		MDL	RL	54SB31B 12/3/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U	0.079	1	<1	U	0.079	1	<1	U	0.079	1	<1	U	0.079	1	<1	U	0.079	1	<1	U	0.079	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	<1	U	0.16	1	1.4	J,c	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	ND				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				--				--				--				--			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB31B-DUP (D-8) 12/3/2002 9-10		MDL	RL	54SB32A 12/3/2002 0-1		MDL	RL	54SB32B 12/3/2002 9-10		MDL	RL	54SB32C 1/12/2007 16-17		MDL	RL	54SB33A [B] 12/3/2002 1-2		MDL	RL	54SB33B 12/3/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r				Result	LQ, VQ, r					
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	16,600		6.5	11.5	12,000		6.4	11.3	9,920		6.6	11.7	NT				11,400		6.6	11.6	10,700		6.8	12.1
Antimony	7440-36-0	N	--	3.13	40.88	0.66	0.56	BN*,J,k	0.14	1.1	0.52	BN*,J,k	0.14	1.1	0.61	BN*,J,k	0.14	1.2	NT				0.49	BN*,J,k	0.14	1.2	***4.8***	N*,J,k	0.14	1.2
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***2.1***		0.34	1.1	***1.4***		0.34	1.1	***1.3***		0.35	1.2	NT				***1.1***	B	0.35	1.2	***1.4***		0.36	1.2
Barium	7440-39-3	N	209	1,564	20,440	300.8	92.3	E,J,s	0.03	1.1	148	E,J,s	0.03	1.1	146	E,J,s	0.04	1.2	NT				163	E,J,s	0.03	1.2	148	E,J,s	0.04	1.2
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.75		0.02	0.57	0.9		0.02	0.57	0.78		0.02	0.59	NT				0.88		0.02	0.58	0.85		0.02	0.6
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.57	U	0.03	0.57	<0.57	U	0.03	0.57	<0.59	U	0.04	0.59	NT				<0.58	U	0.03	0.58	<0.6	U	0.04	0.6
Calcium	7440-70-2	--	--	--	--	--	13,800	E,J,s	1.7	115	1,550	E,J,s	1.7	113	1,760	E,J,s	1.8	117	NT				2,130	E,J,s	1.7	116	1,720	E,J,s	1.8	121
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***24.4***	E,J,s	0.09	0.57	***20.9***	E,J,s	0.09	0.57	***24.4***	E,J,s	0.09	0.59	NT				***20***	E,J,s	0.09	0.58	***18.9***	E,J,s	0.1	0.6
Cobalt	7440-48-4	--	72.3	--	--	--	10.9	E,J,s	0.08	0.57	9.2	E,J,s	0.08	0.57	7.9	E,J,s	0.08	0.59	NT				7.8	E,J,s	0.08	0.58	8.2	E,J,s	0.08	0.6
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	14.7	E,J,s	0.17	0.57	20.2	E,J,s	0.17	0.57	21.6	E,J,s	0.18	0.59	NT				19.6	E,J,s	0.17	0.58	18.3	E,J,s	0.18	0.6
Iron	7439-89-6	N	50,962	5,475	71,540	--	25,200	E,J,s	1.4	11.5	20,300	E,J,s	1.4	11.3	17,500	E,J,s	1.5	11.7	NT				18,800	E,J,s	1.4	11.6	18,700	E,J,s	1.5	12.1
Lead [2]	7439-92-1	--	26.8	400	750	--	15.8	*E,J,k	0.14	0.34	99.2	*E,J,k	0.14	0.34	199	*E,J,k	0.14	0.35	NT				405	*E,J,k	0.14	0.35	155	*E,J,k	0.14	0.36
Magnesium	7439-95-4	--	--	--	--	--	9,290	E,J,s	1.4	115	3,510	E,J,s	1.4	113	2,950	E,J,s	1.4	117	NT				3,240	E,J,s	1.4	116	3,230	E,J,s	1.5	121
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***484***	E,J,s	0.02	1.1	***512***	E,J,s	0.02	1.1	***520***	E,J,s	0.02	1.2	NT				***598***	E,J,s	0.02	1.2	***534***	E,J,s	0.02	1.2
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	0.05	N,L,m	0.019	0.037	0.11	N,L,m	0.018	0.035	0.057	N,L,m	0.018	0.036	NT				0.31	N,L,m	0.019	0.038	0.22	N,L,m	0.02	0.04
Nickel	7440-02-0	N	62.8	156.4	2,044	--	11.7	E,J,s	0.11	0.57	13.5	E,J,s	0.11	0.57	11.4	E,J,s	0.12	0.59	NT				13	E,J,s	0.12	0.58	12.1	E,J,s	0.12	0.6
Potassium	7440-09-7	--	--	--	--	--	1,540		4.6	115	1,010		4.5	113	1,080		4.7	117	NT				1,220		4.7	116	1,080		4.8	121
Selenium	7782-49-2	N	--	39.11	511	0.949	0.69	N,B,x	0.34	0.57	***1***	N,B,x	0.34	0.57	***0.98***	N,B,x	0.35	0.59	NT				0.52	BN,B,x	0.35	0.58	0.75	N,B,x	0.36	0.6
Silver	7440-22-4	N	--	39.11	511	1.551	<0.57	U	0.09	0.57	<0.57	U	0.09	0.57	<0.59	U	0.09	0.59	NT				<0.58	U	0.09	0.58	<0.6	U	0.1	0.6
Sodium	7440-23-5	--	--	--	--	--	117	B,K,w	34.9	229	347	K,w	34.4	226	111	B,K,w	35.7	235	NT				327	K,w	35.3	232	525		36.8	242
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	<1.1	UN,R,m	0.28	1.1	<1.1	UN,R,m	0.27	1.1	<1.2	UN,R,m	0.28	1.2	NT				<1.2	UN,R,m	0.28	1.2	<1.2	UN,R,m	0.29	1.2
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	***50.8***	E,J,s	0.08	2.3	27.9	E,J,s	0.08	2.3	23.3	E,J,s	0.08	2.3	NT				26	E,J,s	0.08	2.3	25.7	E,J,s	0.08	2.4
Zinc	7440-66-6	N	202	2,346	30,660	681.1	55.8	*E,J,s	0.13	2.3	85.8	*E,J,s	0.12	2.3	185	*E,J,s	0.13	2.3	NT				151	*E,J,s	0.13	2.3	102	*E,J,s	0.13	2.4
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				<2	U	0.4	2	<2	U	0.4	2	<4	U	1.1	4	<4	U	1.1	4	<2	U	0.4	2
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	NT				<6	U	0.39	6	12	J,I	0.39	6	<4	U	1.2	4	<4	U	1.3	4	<6	U	0.39	6
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				<2	U	0.22	2	<2	U	0.22	2	<4	U	0.82	4	<4	U	0.83	4	<2	U	0.22	2
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				<1	U	0.15	1	<0.99	U	0.15	0.99	<4	U	1.1	4	<4	U	1.1	4	<1	U	0.15	1
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	NT				<40	U	0.4	40	<3.9	U	0.4	3.9	<4	U	1.2	4	<4	U	1.2	4	<4	U	0.4	4
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				<4	U	0.35	4	1.4	J	0.35	3.9	<4	U	1.3	4	<4	U	1.3	4	<4	U	0.35	4
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				<1	U	0.22	1	<0.99	U	0.22	0.99	<2.1	U	0.78	2.1	<2.1	U	0.78	2.1	<1	U	0.22	1
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				<1	U	0.35	1	<0.99	U	0.35	0.99	<4	U	0.57	4	<4	U	0.57	4	<1	U	0.35	1
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				1.1		0.34	1	<0.99	U	0.34	0.99	<8.1	U	1.5	8.1	<8.2	U	1.5	8.2	<1	U	0.34	1
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				***110***	ED,J,q	0.26	10	***250***	ED,J,q	0.26	20	<2.1	U	0.5	2.1	<2.1	U	0.51	2.1	***1.9***	P,J,g	0.26	1
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				<10	U	1.4	10	<9.9	U	1.4	9.9	<21	U	1.6	21	<21	U	1.6	21	<10	U	1.4	10
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				<54	U	9	54	<54	U	9	54	<40	U	7.3	40	***65***		7.3	40	<54	U	9	54
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				<78	U	9.2	78	<77	U	9.2	77	<40	U	5.3	40	<40	U	5.4	40	<78	U	9.2	78
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<400	U	20	400	***430***		20	400	***1,100***		20	390	NT				<400	U	20	400	***220***	J	20	400
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<400	U	21	400	***400***		21	400	***560***		21	390	NT				<400	U	21	400	***28***	J	21	400
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				830		21	400	1,660		21	390	NT				ND				248	J	21	400
2-Nitroaniline	88-74-4	--	--	--	--	--	<800	U	29	800	<800	U	29	800	<790	U	29	790	NT				<800	U	29	800	<800	U	29	800
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	<400	U	17	400	<400	U	17	400	<390	U	17	390	NT				<400	U	17	400	<400	U	17	400
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	51	J	25	400	<400	U	25	400	<390	U	25	390	NT				<400	U	25	400	<400	U	25	400
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	***290***	J	29	400	<400	U	29	400	<390	U	29	390	NT				<400	U	29	400	<400	U	29	400
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	***250***	J	23	400	<400	U	23	400	<390	U	23	390	NT				<400	U	23	400	<400	U	23	400
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	***160***	J	36	400	<400	U	36	400	<390	U	36	390	NT				<400	U	36	400	<400	U	36	400
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	150	J	23	400	<400	U	23	400	<390	U	23	390	NT				<400	U	23	400	<400	U	23	400
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	260	J	29	400	<400	U	29	400	<390	U	29	390	NT				<400	U	29	400	<400	U	29	400
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	140	J	32	400	82	J,B,x	32	400	160	J	32	390	NT				290	J	32	400	85	J,B,x	32	400
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	370	J	28	400	<400	U	28	400	<390	U	28	390	NT				<400	U	28	400	<400	U	28	400
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	36	J	400	400	550		400	400	250	J	390	390	NT				64	J	400	400	340	J	400	400
Di-n-octylphthalate	117-84-0	--	--	--	--	--	570		400	400	<400	U	400	400	<390	U	390	390	NT				100	J	400	400	<400	U	400	400
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	***72***	J	21	400	<400	U	21	400	<390	U	21	390	NT				<400	U	21	400	<400	U	21	400
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	<400	U	400	400	680		400	400	320	J	390	390	NT				<400	U	400	400	210	J	400	400
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	270	J	18	400	<400	U	18	400	<390	U	18	390	NT				37	J	18	400	41	J	18	400
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	150	J	20	400	<400	U	20	400	<390	U	20	390	NT				<400	U	20	400	<400	U	20	400
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<400	U	400	400	***110***	J,J,r	400	400	***76***	J,J,r	390	390	NT				<400	U	400	400	***130***	J,J,r	400	400
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	51	J	24	400	<400	U	24	400	<390	U	24	390	NT				<400	U	24	400	<400	U	24	400
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	600		24	400	<400	U	24	400	<390	U	24	390	NT				44	J	24	400	34	J	24	400
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	1,400	NJ,NJ,t	0	0	NI				NI				NT				NI				NI			
13-Octadecenal	56554-90-6	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NI				NI				NI				NT				NI				NI			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				360	NJ,NJ,t	0	0	230	NJ,NJ,t	0	0	NT				NI				NI			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NI				NI				200	NJ,NJ,t	0	0	NT				NI				NI			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NI				NI				NI				NT				NI				NI			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				2,000	NJ,NJ,t	0	0	130,000	NJ,NJ,t	0	0	NT				NI				NI			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	740	NJ,NJ,t	0	0	NI				NI				NT				NI				NI			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	740	NJ,NJ,t	0	0	NI				NI				NT				NI				NI			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	1,300	NJ,NJ,t	0	0	NI				NI				NT				NI				NI			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NI				NI				NI				NT				NI				NI			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB31B-DUP (D-8) 12/3/2002 9-10		MDL	RL	54SB32A 12/3/2002 0-1		MDL	RL	54SB32B 12/3/2002 9-10		MDL	RL	54SB32C 1/12/2007 16-17		MDL	RL	54SB33A [B] 12/3/2002 1-2		MDL	RL	54SB33B 12/3/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				530	J,c	2.2	10	663	J,c	0.5	9.9	NT				3,040	J,c	2	9.9	62	J,c	1.1	10
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				28.5	J,c	1.6	10	38.5	J,c	0.3	9.9	NT				163	J,c	1.5	9.9	<10		0.8	10
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				66.8		1.3	5	82.7		0.3	5	NT				331		1.2	5	1	MJ	0.6	5
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				14.3		0.6	5	15.7		0.1	5	NT				58.6		0.5	5	<5		0.3	5
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				1.1	J	0.8	5	1.5	J	0.2	5	NT				5.5		0.8	5	<5		0.4	5
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				1.3	J	0.6	5	1.4	J	0.2	5	NT				4.6	J	0.6	5	<5		0.4	5
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				4.8	J	0.3	5	4	J	0.1	5	NT				9.6		0.3	5	<5		0.2	5
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				4	J	0.5	5	3.8	J	0.2	5	NT				19.6		0.6	5	<5		0.3	5
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				1.8	MJ	0.2	5	1.8	J	0.09	5	NT				3.5	MJ	0.3	5	<5		0.2	5
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				4.4	J	0.6	5	4.2	J	0.2	5	NT				17.8		0.6	5	<5		0.4	5
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				<5		0.4	5	0.42	J	0.1	5	NT				1.4	J	0.4	5	<5		0.3	5
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				1.4	J	0.3	5	1.2	J	0.1	5	NT				3.6	J	0.4	5	<5		0.2	5
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				1.8	J	0.2	5	2.4	J	0.1	5	NT				2.2	J	0.2	5	<5		0.2	5
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				2.2	J	0.3	5	2.2	J	0.1	5	NT				5		0.3	5	<5		0.2	5
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				2.8	J	0.2	5	3.3	J	0.1	5	NT				3.8	J	0.2	5	<5		0.2	5
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				0.33	J	0.2	1	***0.51***	J	0.1	1	NT				***0.83***	J	0.2	1	<1		0.2	1
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				2		0.1	1	2.6		0.07	1	NT				2.9		0.05	1	<1		0.1	1
TEQ (ND=0)	--	--	--	--	--	--	NT				NR				NR				NT				NR				NR			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NR				NR				NT				NR				NR			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NR				NR				NT				NR				NR			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NR				NR				NT				NR				NR			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				127		1.3	5	149		0.3	5	NT				610		1.2	5	3.7	M	0.6	5
Total HpCDF	38998-75-3	--	--	--	--	--	NT				40	M	0.7	5	51.2	M	0.2	5	NT				203	M	0.6	5	<5		0.3	5
Total HxCDD	34465-46-8	--	--	--	--	--	NT				44		0.6	5	36		0.2	5	NT				165		0.6	5	<5		0.4	5
Total HxCDF	55684-94-1	--	--	--	--	--	NT				35.2	MX,J,w	0.3	5	34.8	MX,J,w	0.1	5	NT				115	MX,J,w	0.3	5	<5		0.2	5
Total PeCDD	36088-22-9	--	--	--	--	--	NT				14.5	M	0.3	5	10.6	M	0.1	5	NT				28.8	M	0.4	5	<5		0.2	5
Total PeCDF	30402-15-4	--	--	--	--	--	NT				41	M	0.2	5	37.5	M	0.1	5	NT				77.6	MX,J,w	0.2	5	<5		0.2	5
Total TCDD	41903-57-5	--	--	--	--	--	NT				10.6		0.2	1	9.5	M	0.1	1	NT				17.1	M	0.2	1	<1		0.2	1
Total TCDF	55722-27-5	--	--	--	--	--	NT				55.4	M	0.2	1	60.9	M	0.08	1	NT				89.6	MX,J,w	0.2	1	<1		0.1	1
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	1,200	PZ,K,s	5.8	510	460	P,J,g	5.8	51	600	P,J,g	5.9	50	NT				520	P,J,g	5.8	51	74		5.9	51
Acenaphthylene[9]	208-96-8	N	--	2.3E+05	3.1E+06	--	190	JPZ,K,s	5.9	510	<51	U	5.9	51	380	P,J,g	5.9	50	NT				<51	U	5.9	51	<51	U	5.9	51
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	140	JPZ,K,s	5.4	510	<51	U	5.4	51	<50	U	5.4	50	NT				<51	U	5.4	51	<51	U	5.4	51
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	***540***	E,K,s	2.2	10	<10	U	2.2	10	***39***	P,J,g	2.2	9.9	NT				10	J	2.2	10	<10	U	2.2	10
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	***1,200***	Z,K,s	1.6	100	<10	U	1.6	10	***24***	P,J,g	1.6	9.9	NT				***17***	P,J,g	1.6	10	2	J	1.6	10
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	***1,300***	K,s	1.7	10	<10	U	1.7	10	38	P,J,g	1.7	9.9	NT				17		1.7	10	<10	U	1.7	10
Benzo(g,h,i)perylene[9]	191-24-2	N	--	2.3E+05	3.1E+06	--	900	PZ,K,s	3.6	100	<10	U	3.6	10	<9.9	U	3.6	9.9	NT				11	JZ	3.6	20	<10	U	3.6	10
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	***1,800***	EP,K,s	1.4	10	<10	U	1.4	10	32	P,J,g	1.4	9.9	NT				14		1.4	10	<10	U	1.4	10
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	690	Z,K,s	2.4	100	<10	U	2.4	10	56		2.4	9.9	NT				210	PD,J,g	2.4	20	<10	U	2.4	10
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	***1,300***	EP,K,s	4.2	10	<10	U	4.2	10	<9.9	U	4.2	9.9	NT				<10	U	4.2	10	<10	U	4.2	10
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	1,600	E,K,s	2.1	21	<20	U	2.1	20	41		2.1	20	NT				25	JPZ,J,g	2.1	41	<20	U	2.1	20
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<51	U	14	51	<51	U	14	51	<50	U	14	50	NT				<51	U	14	51	<51	U	14	51
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	***940***	E,K,s	2.5	10	<10	U	2.5	10	<9.9	U	2.5	9.9	NT				***390***	EP,J,g	2.5	10	<10	U	2.5	10
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	***830***	PZ,K,s	14	510	***480***		14	51	***2,500***	EP,J,g	14	50	NT				***700***	P,J,g	14	51	***100***	J,m	14	51
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	250	P,K,s	8.5	51	<51	U	8.5	51	<50	U	8.5	50	NT				<51	U	8.5	51	<51	U	8.5	51
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	2,100	E,K,s	4.3	21	<20	U	4.3	20	27	J,c	4.3	20	NT				37	JPZ,J,g	4.3	41	<20	U	4.3	20
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

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SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB31B-DUP (D-8) 12/3/2002 9-10		MDL	RL	54SB32A 12/3/2002 0-1		MDL	RL	54SB32B 12/3/2002 9-10		MDL	RL	54SB32C 1/12/2007 16-17		MDL	RL	54SB33A [B] 12/3/2002 1-2		MDL	RL	54SB33B 12/3/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U	0.079	1	<1	U	0.079	1	1.8		0.079	1	<2.5	U	0.2	2.5	<1	U	0.079	1	<1	U	0.079	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	3.1	J,c	0.16	1	24	J,c	0.16	1	0.23	J	0.051	2.5	<1	U	0.16	1	<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	<1	U	0.12	1	***0.4***	J	0.12	1	<2.5	U	0.073	2.5	<1	U	0.12	1	<1	U	0.12	1
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<2.5	U	0.099	2.5	<1	U	0.19	1	<1	U	0.19	1
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	ND				ND				0.4	J	0.12	1	ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	1.1		0.1	1	1.5		0.1	1	<2.5	U	0.088	2.5	<1	U	0.1	1	<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	0.76	J	0.095	1	1.2		0.095	1	<2.5	U	0.053	2.5	<1	U	0.095	1	<1	U	0.095	1
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				1.86		0.1	1	2.7		0.1	1	ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<2.5	U	0.17	2.5	<1	U	0.1	1	<1	U	0.1	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	<10	U	1	10	32	P,J,g	1	10	NT				<10	U	1	10	<10	U	1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				--				82		0.1	0.1	--				--			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB34A [D] 12/3/2002 0-1		MDL	RL	54SB34B [D] 12/3/2002 9-10		MDL	RL	54SB34C 1/10/2007 18.5-19.5		MDL	RL	54SB35A 12/3/2002 0-1		MDL	RL	54SB35B 12/3/2002 9-10		MDL	RL	54SB36A 12/3/2002 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	8,520		6.2	11	13,100		6.8	12	NT				11,800		6.8	12	5,550		2.3	10.4	10,600		2.4	11.2
Antimony	7440-36-0	N	--	3.13	40.88	0.66	***0.76***	BN*,J,k	0.13	1.1	0.43	BN*,J,k	0.14	1.2	NT				0.46	BN*,J,k	0.14	1.2	<1	UN*,R,m	0.39	1	<1.1	UN*,R,m	0.41	1.1
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***1.4***		0.33	1.1	***1.8***		0.36	1.2	NT				***1.3***		0.36	1.2	<1	UN,UL,w	0.26	1	***0.73***	BN,K,w	0.28	1.1
Barium	7440-39-3	N	209	1,564	20,440	300.8	154	E,J,s	0.03	1.1	159	E,J,s	0.04	1.2	NT				158	E,J,s	0.04	1.2	57.5	E,J,s	0.02	1	105	E,J,s	0.02	1.1
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.7		0.02	0.55	1		0.02	0.6	NT				0.88		0.02	0.6	0.37	B	0.01	0.52	0.67		0.01	0.56
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	0.45	B	0.03	0.55	<0.6	U	0.04	0.6	NT				<0.6	U	0.04	0.6	<0.52	U	0.04	0.52	<0.56	U	0.04	0.56
Calcium	7440-70-2	--	--	--	--	--	2,190	E,J,s	1.7	110	1,630	E,J,s	1.8	120	NT				1,500	E,J,s	1.8	120	666	E,J,s	1	104	1,210	E,J,s	1.1	112
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***16.8***	E,J,s	0.09	0.55	***20.5***	E,J,s	0.1	0.6	NT				***20.3***	E,J,s	0.1	0.6	***9.7***	N,L,m	0.06	0.52	***16.8***	N,L,m	0.07	0.56
Cobalt	7440-48-4	--	72.3	--	--	--	6.7	E,J,s	0.08	0.55	10.4	E,J,s	0.08	0.6	NT				9.6	E,J,s	0.08	0.6	4.7	E,J,s	0.06	0.52	8.2	E,J,s	0.07	0.56
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	84.1	E,J,s	0.17	0.55	11.8	E,J,s	0.18	0.6	NT				11.4	E,J,s	0.18	0.6	2	N*E,J,k	0.15	0.52	7	N*E,J,k	0.16	0.56
Iron	7439-89-6	N	50,962	5,475	71,540	--	18,000	E,J,s	1.4	11	21,800	E,J,s	1.5	12	NT				20,100	E,J,s	1.5	12	10,100	E,J,s	1.4	10.4	16,300	E,J,s	1.5	11.2
Lead [2]	7439-92-1	--	26.8	400	750	--	528	*E,J,k	0.13	0.33	9.5	*E,J,k	0.14	0.36	NT				9.6	*E,J,k	0.14	0.36	4.4	*E,J,k	0.24	0.31	7.9	*E,J,k	0.26	0.33
Magnesium	7439-95-4	--	--	--	--	--	2,960	E,J,s	1.4	110	3,770	E,J,s	1.5	120	NT				3,410	E,J,s	1.5	120	1,760	E,J,s	0.64	104	2,540	E,J,s	0.68	112
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***561***	E,J,s	0.02	1.1	***674***	E,J,s	0.02	1.2	NT				***607***	E,J,s	0.02	1.2	***220***	E,J,s	0.02	1	***385***	E,J,s	0.02	1.1
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	0.043	N,L,m	0.019	0.038	0.035	BN,L,m	0.019	0.037	NT				0.044	N,L,m	0.017	0.035	0.018	BN*,J,k	0.017	0.035	0.03	BN*,J,k	0.018	0.036
Nickel	7440-02-0	N	62.8	156.4	2,044	--	10.3	E,J,s	0.11	0.55	14.7	E,J,s	0.12	0.6	NT				12.9	E,J,s	0.12	0.6	6.2	E,J,s	0.1	0.52	9.8	E,J,s	0.11	0.56
Potassium	7440-09-7	--	--	--	--	--	1,440		4.4	110	1,150		4.8	120	NT				1,160		4.8	120	943	E,J,s	12.4	104	1,120	E,J,s	13.2	112
Selenium	7782-49-2	N	--	39.11	511	0.949	***0.99***	N,B,x	0.33	0.55	0.84	N,B,x	0.36	0.6	NT				0.85	N,B,x	0.36	0.6	0.86	N,B,x	0.34	0.52	***1.3***	N,B,x	0.37	0.56
Silver	7440-22-4	N	--	39.11	511	1.551	<0.55	U	0.09	0.55	<0.6	U	0.1	0.6	NT				<0.6	U	0.1	0.6	<0.52	U	0.07	0.52	<0.56	U	0.08	0.56
Sodium	7440-23-5	--	--	--	--	--	<220	U	33.5	220	251	K,w	36.4	239	NT				95.4	B,K,w	36.4	239	129	B,L,w	25.9	209	155	B,L,w	27.7	223
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	<1.1	UN,R,m	0.26	1.1	<1.2	UN,R,m	0.29	1.2	NT				<1.2	UN,R,m	0.29	1.2	<1	UN,UL,m	0.53	1	<1.1	UN,UL,m	0.57	1.1
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	20.4	E,J,s	0.08	2.2	29.7	E,J,s	0.08	2.4	NT				29.3	E,J,s	0.08	2.4	14.6	E,J,s	0.07	2.1	24.9	E,J,s	0.08	2.2
Zinc	7440-66-6	N	202	2,346	30,660	681.1	337	*E,J,s	0.12	2.2	65.3	*E,J,s	0.13	2.4	NT				65.6	*E,J,s	0.13	2.4	30.1	N*E,J,k	0.1	2.1	47.9	N*E,J,k	0.11	2.2
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				NT				NT				NT				NT			
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	NT				NT				NT				NT				NT				NT			
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				NT				NT				NT				NT			
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	NT				NT				NT				NT				NT				NT			
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				NT				NT				NT				NT			
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				NT				NT				NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				NT				NT				NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				NT				NT				NT				NT			
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				NT				NT				NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				NT				NT				NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<400	U	20	400	<420	U	20	420	NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<400	U	21	400	<420	U	21	420	NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				ND				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	<800	U	29	800	<850	U	29	850	NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	<400	U	17	400	<420	U	17	420	NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<400	U	25	400	<420	U	25	420	NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<400	U	29	400	<420	U	29	420	NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<400	U	23	400	<420	U	23	420	NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<400	U	36	400	<420	U	36	420	NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	<400	U	23	400	<420	U	23	420	NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<400	U	29	400	<420	U	29	420	NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	75	J,B,x	32	400	<420	U	32	420	NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<400	U	28	400	<420	U	28	420	NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	49	J	400	400	<420	U	420	420	NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	140	J	400	400	<420	U	420	420	NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<400	U	21	400	<420	U	21	420	NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	120	J	400	400	<420	U	420	420	NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<400	U	18	400	<420	U	18	420	NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<400	U	20	400	<420	U	20	420	NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<400	U	400	400	<420	U	420	420	NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	<400	U	24	400	<420	U	24	420	NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	<400	U	24	400	<420	U	24	420	NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NI				NI				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NI				NI				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				NI				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	180	NJ,NJ,t	0	0	NI				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB34A [D] 12/3/2002 0-1		MDL	RL	54SB34B [D] 12/3/2002 9-10		MDL	RL	54SB34C 1/10/2007 18.5-19.5		MDL	RL	54SB35A 12/3/2002 0-1		MDL	RL	54SB35B 12/3/2002 9-10		MDL	RL	54SB36A 12/3/2002 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	740	NJ,NJ,t	0	0	NI				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NI				NI				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	132		0.964	0.964	374		0.895	0.895	371		1.11	1.11	NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	<0.964	U	0.964	0.964	0.263	A	0.895	0.895	<1.11	U	1.11	1.11	NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	1.69	A	0.482	0.482	6.02		0.448	0.448	7.11		0.554	0.554	NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	0.112	A,J,w	0.482	0.482	<0.448	U	0.448	0.448	0.233	,B,z	0.554	0.554	NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	<0.482	U	0.482	0.482	<0.448	U	0.448	0.448	<0.554	U	0.554	0.554	NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	<0.482	U	0.482	0.482	0.118	A	0.448	0.448	<0.554	U	0.554	0.554	NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	<0.482	U	0.482	0.482	<0.448	U	0.448	0.448	<0.554	U	0.554	0.554	NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	<0.482	U	0.482	0.482	0.15	A	0.448	0.448	0.184	A,J,w	0.554	0.554	NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	<0.482	U	0.482	0.482	<0.448	U	0.448	0.448	<0.554	U	0.554	0.554	NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	<0.482	U	0.482	0.482	0.269	A	0.448	0.448	0.284	A	0.554	0.554	NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	<0.482	U	0.482	0.482	0.131	A,J,w	0.448	0.448	0.16	A	0.554	0.554	NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	<0.482	U	0.482	0.482	<0.448	U	0.448	0.448	<0.554	U	0.554	0.554	NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	0.0656	A	0.482	0.482	0.0788	A,B,z	0.448	0.448	0.0821	A,B,z	0.554	0.554	NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	<0.482	U	0.482	0.482	0.0573	A	0.448	0.448	<0.554	U	0.554	0.554	NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	0.0887	A	0.482	0.482	0.0913	,J,w	0.448	0.448	0.115	A,B,z	0.554	0.554	NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	<0.0964	U	0.0964	0.0964	<0.0931	U	0.0931	0.0931	<0.111	U	0.111	0.111	NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	0.345	A,B,z	0.0964	0.0964	0.491	A,B,z	0.0895	0.0895	0.517	A,B,z	0.111	0.111	NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	0.12		0	0	0.283		0	0	0.318		0	0	NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	0.583		0	0	0.693		0	0	0.792		0	0	NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	0.121		0	0	0.438		0	0	0.348		0	0	NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	0.581		0	0	0.509		0	0	0.767		0	0	NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	5.74		0.482	0.482	17.4		0.448	0.448	19.9		0.554	0.554	NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	<0.482	U	0.482	0.482	<0.448	U	0.448	0.448	0.233	A,B,z	0.554	0.554	NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	0.669		0.482	0.482	2.79		0.448	0.448	3.56		0.554	0.554	NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	0.125		0.482	0.482	0.226	,B,z	0.448	0.448	0.353	,B,z	0.554	0.554	NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	0.241		0.482	0.482	0.285		0.448	0.448	0.37		0.554	0.554	NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	0.5		0.482	0.482	0.31	,B,z	0.448	0.448	0.197	,B,z	0.554	0.554	NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	<0.0964	U	0.0964	0.0964	<0.0931	U	0.0931	0.0931	<0.111	U	0.111	0.111	NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	0.772	,B,z	0.0964	0.0964	1.01	,B,z	0.0895	0.0895	1.08	,B,z	0.111	0.111	NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	<51	U,UL,s	5.9	51	<54	U	5.8	54	NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	<51	U,UL,s	5.9	51	<54	U	5.9	54	NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<51	U,UL,s	5.4	51	<54	U	5.4	54	NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	3.6	J,L,s	2.2	10	<11	U	2.2	11	NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<10	U,UL,s	1.6	10	<11	U	1.6	11	NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<10	U,UL,s	1.7	10	<11	U	1.7	11	NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	<10	U,UL,s	3.6	10	<11	U	3.6	11	NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<10	U,UL,s	1.4	10	<11	U	1.4	11	NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	4.6	JP,L,s	2.4	10	<11	U	2.4	11	NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<10	U,UL,s	4.2	10	<11	U	4.2	11	NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	12	J,L,s	2.1	20	<22	U	2.1	22	NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<51	U,UL,s	14	51	<54	U	14	54	NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<10	U,UL,s	2.5	10	<11	U	2.5	11	NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	***46***	JP,L,s	14	51	<54	U	14	54	NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	<51	U,UL,s	8.5	51	<54	U	8.5	54	NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	17	JP,L,s	4.3	20	<22	U	4.3	22	NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB34A [D] 12/3/2002 0-1		MDL	RL	54SB34B [D] 12/3/2002 9-10		MDL	RL	54SB34C 1/10/2007 18.5-19.5		MDL	RL	54SB35A 12/3/2002 0-1		MDL	RL	54SB35B 12/3/2002 9-10		MDL	RL	54SB36A 12/3/2002 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U	0.079	1	<1	U	0.079	1	NT				<1	U	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	0.43	J,J,c	0.16	1	<1	U	0.16	1	NT				<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	<1	U	0.12	1	NT				<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.19	1	<1	U	0.19	1	NT				<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1
Dinitrotoluene Mix				9.4E-01	4.2E+00		ND				ND				NT				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	<1	U	0.1	1	NT				<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	<1	U	0.095	1	NT				<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1
Aminodinitrotoluenes				1.6E+01	2.0E+02		ND				ND				NT				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	<1	U	0.1	1	NT				<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	<10	U	1	10	NT				<10	U	1	10	<10	U	1	10	<10	U	1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				NT				--				--				--			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
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Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB36B 12/3/2002 9-10		MDL	RL	54SB36B-DUP (D-9) 12/3/2002 9-10		MDL	RL	54SB37A 12/3/2002 0-1		MDL	RL	54SB37B 12/3/2002 9-10		MDL	RL	54SB38A [D] 12/4/2002 0-1		MDL	RL	54SB38B [D] 12/4/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	10,100		2.5	11.3	6,140		2.4	11.1	15,000		2.5	11.5	9,570		2.5	11.4	13,800		2.7	12.5	11,000		2.7	12.2
Antimony	7440-36-0	N	--	3.13	40.88	0.66	<1.1	UN*,R,m	0.42	1.1	<1.1	UN*,R,m	0.41	1.1	<1.2	UN*,R,m	0.43	1.2	<1.1	UN*,R,m	0.42	1.1	<1.3	UN*,R,m	0.46	1.3	<1.2	UN*,R,m	0.45	1.2
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***0.44***	BN,K,w	0.28	1.1	<1.1	UN,UL,w	0.28	1.1	***1.3***	N,K,w	0.29	1.2	***0.6***	BN,K,w	0.29	1.1	***1.6***	N,K,w	0.31	1.3	***0.78***	BN,K,w	0.3	1.2
Barium	7440-39-3	N	209	1,564	20,440	300.8	103	E,J,s	0.02	1.1	62.2	E,J,s	0.02	1.1	193	E,J,s	0.02	1.2	95.5	E,J,s	0.02	1.1	206	E,J,s	0.03	1.3	110	E,J,s	0.02	1.2
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.61		0.01	0.57	0.38	B	0.01	0.55	0.96		0.01	0.58	0.59		0.01	0.57	1		0.01	0.63	0.72		0.01	0.61
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.57	U	0.05	0.57	<0.55	U	0.04	0.55	<0.58	U	0.05	0.58	<0.57	U	0.05	0.57	0.1	B	0.05	0.63	<0.61	U	0.05	0.61
Calcium	7440-70-2	--	--	--	--	--	1,220	E,J,s	1.1	113	839	E,J,s	1.1	111	1,920	E,J,s	1.1	115	1,210	E,J,s	1.1	114	1,770	E,J,s	1.2	125	1,450	E,J,s	1.2	122
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***14.6***	N,L,m	0.07	0.57	***10.5***	N,L,m	0.07	0.55	***22***	N,L,m	0.07	0.58	***15.5***	N,L,m	0.07	0.57	***21.4***	N,L,m	0.08	0.63	***17.2***	N,L,m	0.07	0.61
Cobalt	7440-48-4	--	72.3	--	--	--	7.6	E	0.07	0.57	4.7	E,J,s	0.07	0.55	10.2	E,J,s	0.07	0.58	7.1	E,J,s	0.07	0.57	8.9	E,J,s	0.08	0.63	8.8	E	0.07	0.61
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	7	N*E,J,k	0.16	0.57	0.86	N*E,J,k	0.15	0.55	22.8	N*E,J,k	0.16	0.58	5.3	N*E,J,k	0.16	0.57	21.7	N*E,J,k	0.18	0.63	13.3	N*E,J,k	0.17	0.61
Iron	7439-89-6	N	50,962	5,475	71,540	--	15,100	E,J,s	1.6	11.3	10,200	E,J,s	1.5	11.1	21,500	E,J,s	1.6	11.5	15,800	E,J,s	1.6	11.4	24,500	E,J,s	1.7	12.5	17,000	E,J,s	1.7	12.2
Lead [2]	7439-92-1	--	26.8	400	750	--	6.1	*E,J,k	0.26	0.34	4.7	*E,J,k	0.25	0.33	18.4	*E,J,k	0.26	0.35	5.7	*E,J,k	0.26	0.34	85.3	*E,J,k	0.29	0.38	7	*E,J,k	0.28	0.36
Magnesium	7439-95-4	--	--	--	--	--	2,560	E,J,s	0.69	113	1,820	E,J,s	0.67	111	3,260	E,J,s	0.7	115	2,720	E,J,s	0.7	114	2,750	E,J,s	0.77	125	2,990	E,J,s	0.74	122
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***341***	E,J,s	0.02	1.1	***200***	E,J,s	0.02	1.1	***826***	E,J,s	0.02	1.2	***331***	E,J,s	0.02	1.1	***909***	E,J,s	0.03	1.3	***465***	E,J,s	0.02	1.2
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	<0.037	UN*,UJ,k	0.018	0.037	<0.032	UN*,J,k	0.016	0.032	0.044	N*,J,k	0.018	0.036	<0.038	UN*,UJ,k	0.019	0.038	0.036	BN*,J,k	0.021	0.042	0.026	BN*,J,k	0.018	0.036
Nickel	7440-02-0	N	62.8	156.4	2,044	--	9.4	E,J,s	0.11	0.57	6.3	E,J,s	0.11	0.55	13.4	E,J,s	0.12	0.58	9.8	E,J,s	0.11	0.57	12.7	E,J,s	0.13	0.63	10.4	E,J,s	0.12	0.61
Potassium	7440-09-7	--	--	--	--	--	1,030	E,J,s	13.4	113	850	E,J,s	13.1	111	1,360	E,J,s	13.6	115	1,330	E,J,s	13.5	114	1,510	E,J,s	14.9	125	1,190	E,J,s	14.4	122
Selenium	7782-49-2	N	--	39.11	511	0.949	***1.1***	N,B,x	0.37	0.57	0.79	N,B,x	0.36	0.55	***1.8***	N,B,x	0.38	0.58	***1.1***	N,B,x	0.38	0.57	***2***	N,L,m	0.41	0.63	***1.3***	N,L,m	0.4	0.61
Silver	7440-22-4	N	--	39.11	511	1.551	<0.57	U	0.08	0.57	<0.55	U	0.08	0.55	<0.58	U	0.08	0.58	<0.57	U	0.08	0.57	<0.63	U	0.09	0.63	<0.61	U	0.09	0.61
Sodium	7440-23-5	--	--	--	--	--	158	B,L,w	28.1	226	144	B,L,w	27.5	221	212	B,L,w	28.6	230	165	B,L,w	28.4	229	469	L,w	31.2	251	178	B,L,w	30.3	243
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	<1.1	UN,UL,m	0.58	1.1	<1.1	UN,UL,m	0.56	1.1	<1.2	UN,UL,m	0.59	1.2	<1.1	UN,UL,m	0.58	1.1	<1.3	UN,UL,m	0.64	1.3	<1.2	UN,UL,m	0.62	1.2
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	23.2	E,J,s	0.08	2.3	15.4	E,J,s	0.08	2.2	31.6	E,J,s	0.08	2.3	24.1	E,J,s	0.08	2.3	29.2	E,J,s	0.09	2.5	25.4	E,J,s	0.09	2.4
Zinc	7440-66-6	N	202	2,346	30,660	681.1	45.1	N*E,J,k	0.11	2.3	30.8	N*E,J,k	0.11	2.2	87.3	N*E,J,k	0.12	2.3	45.2	N*E,J,k	0.11	2.3	317	N*E,J,k	0.13	2.5	51.2	N*E,J,k	0.12	2.4
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				NT				NT				NT				NT			
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	NT				NT				NT				NT				NT				NT			
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				NT				NT				NT				NT			
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	NT				NT				NT				NT				NT				NT			
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				NT				NT				NT				NT			
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				NT				NT				NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				NT				NT				NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				NT				NT				NT				NT			
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				NT				NT				NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				NT				NT				NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB36B 12/3/2002 9-10		MDL	RL	54SB36B-DUP (D-9) 12/3/2002 9-10		MDL	RL	54SB37A 12/3/2002 0-1		MDL	RL	54SB37B 12/3/2002 9-10		MDL	RL	54SB38A[D] 12/4/2002 0-1		MDL	RL	54SB38B[D] 12/4/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				766		1.02	1.02	152		1.33	1.33
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				8.32	A	1.02	1.02	<1.73	U	1.73	1.73
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				25.6		0.511	0.511	2.01	A	0.465	0.465
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				2.88	A	0.511	0.511	<0.465	U	0.465	0.465
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				0.18	A	0.511	0.511	<0.465	U	0.465	0.465
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				0.319	A	0.511	0.511	<0.465	U	0.465	0.465
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				0.239	A	0.511	0.511	<0.465	U	0.465	0.465
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				0.666	A	0.511	0.511	<0.465	U	0.465	0.465
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				0.19	A	0.511	0.511	<0.465	U	0.465	0.465
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				0.701	A	0.511	0.511	<0.465	U	0.465	0.465
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				0.0879	A	0.511	0.511	<0.465	U	0.465	0.465
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				<0.511	U	0.511	0.511	<0.465	U	0.465	0.465
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				0.151	,J,w	0.511	0.511	<0.465	U	0.465	0.465
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				0.219	A	0.511	0.511	<0.465	U	0.465	0.465
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				0.217	A,B,z	0.511	0.511	<0.465	U	0.465	0.465
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				<0.102	U	0.102	0.102	<0.226	U	0.226	0.226
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				0.554	A,B,z	0.102	0.102	0.394	A,B,z	0.207	0.207
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				0.882		0	0	0.105		0	0
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				1.2		0	0	0.694		0	0
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				1.23		0	0	0.105		0	0
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				1.23		0	0	0.694		0	0
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				56.3		0.511	0.511	6.47		0.465	0.465
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				8.62		0.511	0.511	<0.465	U	0.465	0.465
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				7.8		0.511	0.511	<0.465	U	0.465	0.465
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				3.64		0.511	0.511	<0.465	U	0.465	0.465
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				0.717		0.511	0.511	<0.465	U	0.465	0.465
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				2.02		0.511	0.511	<0.465	U	0.465	0.465
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				0.349		0.102	0.102	<0.226	U	0.226	0.226
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				3.45		0.102	0.102	0.727	,B,z	0.207	0.207
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB36B 12/3/2002 9-10		MDL	RL	54SB36B-DUP (D-9) 12/3/2002 9-10		MDL	RL	54SB37A 12/3/2002 0-1		MDL	RL	54SB37B 12/3/2002 9-10		MDL	RL	54SB38A [D] 12/4/2002 0-1		MDL	RL	54SB38B [D] 12/4/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1
Dinitrotoluene Mix				9.4E-01	4.2E+00		ND				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1
Aminodinitrotoluenes				1.6E+01	2.0E+02		ND				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				--				--				--				--			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB38C 1/11/2007 16-17		MDL	RL	54SB38C-DUP(Dup 6) 1/11/2007 16-17		MDL	RL	54SB56A 8/18/2004 0-1		MDL	RL	54SB56B 8/18/2004 9-10		MDL	RL	54SB56C 8/18/2004 12.5-13.8		MDL	RL	54SB57A [E] 8/17/2004 0.1-1.0		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r				Result	LQ, VQ, r				Result	LQ, VQ, r		
TAL Metals (mg/kg)																																
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				NT				13,300		4.2	50	7,730		4.2	50	7,410		4.2	50	16,400		4.2	50
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				NT				0.17	J	0.0386	0.5	<0.5	U	0.0386	0.5	<0.5	U	0.0386	0.5	0.3	J	0.0386	0.5
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				NT				***2.5***		0.058	0.4	***0.53***		0.058	0.4	***0.6***		0.058	0.4	***1.4***		0.058	0.4
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				NT				175		0.103	5	100		0.103	5	84		0.103	5	142		0.103	5
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	NT				NT				0.2	J	0.0267	1	0.36	J	0.0267	1	0.3	J	0.0267	1	0.21	J	0.0267	1
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				NT				2.5		0.25	1	1.3		0.25	1	1.3		0.25	1	1.6		0.25	1
Calcium	7440-70-2	--	--	--	--	--	NT				NT				1,390		17.5	250	1,520		17.5	250	1,370		17.5	250	6,530		17.5	250
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				NT				***19***		0.998	5	***14***		0.998	5	***15***		0.998	5	***25***		0.998	5
Cobalt	7440-48-4	--	72.3	--	--	--	NT				NT				11	,J,s	0.233	1	6.5	,J,s	0.233	1	6	,J,s	0.233	1	16	,J,s	0.233	1
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				NT				16		0.516	5	6.4		0.516	5	6.5		0.516	5	18		0.516	5
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				NT				38,800		0.731	10	13,200		0.731	10	13,500		0.731	10	25,600		0.731	10
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				NT				265		3.88	50	6.4		0.0776	1	28		0.0776	1	63		0.776	10
Magnesium	7439-95-4	--	--	--	--	--	NT				NT				2,580		7.67	250	2,100		7.67	250	2,080		7.67	250	5,000		7.67	250
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				NT				***1,520***		0.474	5	***342***		0.474	5	***344***		0.474	5	***850***		0.474	5
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT				NT				0.043	J	0.0077	0.1	0.013	J	0.0077	0.1	0.013	J	0.0077	0.1	0.05	J	0.0077	0.1
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				NT				12	,J,s	0.0775	0.5	9.4	,J,s	0.0775	0.5	9.3	,J,s	0.0775	0.5	12	,J,s	0.0775	0.5
Potassium	7440-09-7	--	--	--	--	--	NT				NT				1,390		7.79	100	778		7.79	100	798		7.79	100	1,810		7.79	100
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				NT				0.14	J	0.0486	1	<1	U	0.0486	1	<1	U	0.0486	1	<1	U	0.0486	1
Silver	7440-22-4	N	--	39.11	511	1.551	NT				NT				0.12	J	0.0178	3	0.044	J	0.0178	3	0.05	J	0.0178	3	0.089	J	0.0178	3
Sodium	7440-23-5	--	--	--	--	--	NT				NT				72	J,B,o	31.4	100	69	J,B,o	31.4	100	71	J,B,o	31.4	100	76	J	31.4	100
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	NT				NT				***0.92***		0.0733	0.5	0.1	J	0.0733	0.5	0.13	J	0.0733	0.5	***0.2***	J	0.0733	0.5
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				NT				32		0.401	1.2	19		0.401	1.2	20		0.401	1.2	***44***		0.401	1.2
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				NT				***833***	,J,s	0.789	4	52	,J,s	0.789	4	86	,J,s	0.789	4	103	,J,s	0.789	4
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				<20	U	2.52	20	<20	U	2.39	20	<20	U	2.39	20	4.8	J,J,g	3.35	20
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	NT				NT				<20	U	2.61	20	<20	U	2.48	20	<20	U	2.48	20	26	,J,g	3.12	20
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				<20	U	2.14	20	<20	U	2.03	20	<20	U	2.03	20	3.1	J,J,g	2.6	20
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				<20	U	2.45	20	<20	U	2.33	20	<20	U	2.33	20	<20	U	2.26	20
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	NT				NT				<20	U	2.59	20	<20	U	2.46	20	<20	U	2.46	20	<20	U	3.11	20
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				<20	U	4.01	20	<20	U	3.81	20	<20	U	3.81	20	<20	U	2.52	20
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				<20	U	1.87	20	<20	U	1.77	20	<20	U	1.77	20	<20	U	3.04	20
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				<20	U	2.38	20	<20	U	2.26	20	<20	U	2.26	20	10	J	2.65	20
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				<20	U	1.88	20	<20	U	1.78	20	<20	U	1.78	20	<20	U	2.85	20
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				<20	U	2.15	20	<20	U	2.05	20	<20	U	2.05	20	<20	U	4.01	20
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				<20	U	2.98	20	<20	U	2.83	20	<20	U	2.83	20	6.3	J,J,g	5.41	20
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				<33	U	8.16	33	<33	U	7.48	33	<33	U	7.48	33	***200***		7	38
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				<66	U	12.1	66	<66	U	11.1	66	<66	U	11.1	66	<38	U	5.1	38
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB38C 1/11/2007 16-17		MDL	RL	54SB38C-DUP(Dup 6) 1/11/2007 16-17		MDL	RL	54SB56A 8/18/2004 0-1		MDL	RL	54SB56B 8/18/2004 9-10		MDL	RL	54SB56C 8/18/2004 12.5-13.8		MDL	RL	54SB57A [E] 8/17/2004 0.1-1.0		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	214		0.93	0.93	271		0.878	0.878	NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	<0.93	U	0.93	0.93	0.481	A	0.878	0.878	NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	3.18	A	0.465	0.465	3.69	A	0.439	0.439	NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	<0.465	U	0.465	0.465	0.111	A,B,z	0.439	0.439	NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	0.106	A,J,w	0.465	0.465	0.146	A	0.439	0.439	NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	<0.093	U	0.093	0.093	<0.0878	U	0.0878	0.0878	NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	0.396	A,B,z	0.0967	0.0967	0.351	A,B,z	0.0878	0.0878	NT				NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	0.136		0	0	0.169		0	0	NT				NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	0.659		0	0	0.639		0	0	NT				NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	0.146		0	0	0.175		0	0	NT				NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	0.646		0	0	0.623		0	0	NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	9.93		0.465	0.465	11.2		0.439	0.439	NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	<0.465	U	0.465	0.465	0.191	,B,z	0.439	0.439	NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	1.24		0.465	0.465	1.34		0.439	0.439	NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	<0.465	U	0.465	0.465	<0.439	U	0.439	0.439	NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	<0.093	U	0.093	0.093	<0.0878	U	0.0878	0.0878	NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	0.725	,B,z	0.0967	0.0967	0.688	,B,z	0.0878	0.0878	NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				7.46	,B,z	3.83	3.83
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				9.96	,B,z	7.67	7.67
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				17.9	,B,z	7.67	7.67
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				19.5	,B,z	3.83	3.83
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				11.1	,B,z	3.83	3.83
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				247		11.5	11.5
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				123		7.67	7.67
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				716		3.83	3.83
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				54.2		3.83	3.83
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				23.1		3.83	3.83
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				578		15.3	15.3
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				143		3.83	3.83
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				9.25		3.83	3.83
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				1,180		23	23
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				1,760		11.5	11.5
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				1,320		3.83	3.83
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				685		3.83	3.83
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				745		3.83	3.83
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				38.4		3.83	3.83
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				1,640		3.83	3.83
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				642		7.67	7.67
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				3,900		11.5	11.5
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				1,020		3.83	3.83
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				795		7.67	7.67
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				363		3.83	3.83
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				2,560		7.67	7.67
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				381		7.67	7.67
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				350		3.83	3.83

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
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Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB38C 1/11/2007 16-17		MDL	RL	54SB38C-DUP(Dup 6) 1/11/2007 16-17		MDL	RL	54SB56A 8/18/2004 0-1		MDL	RL	54SB56B 8/18/2004 9-10		MDL	RL	54SB56C 8/18/2004 12.5-13.8		MDL	RL	54SB57A [E] 8/17/2004 0.1-1.0		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				135		3.83	3.83
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				698		3.83	3.83
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				374		3.83	3.83
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				1,270		7.67	7.67
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				378		7.67	7.67
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				640		3.83	3.83
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				21.7		3.83	3.83
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				264		3.83	3.83
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				119		3.83	3.83
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				152		3.83	3.83
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				31.8		3.83	3.83
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				155		3.83	3.83
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				57.8		3.83	3.83
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT				NT				<1	U	0.246	1	<1	U	0.226	1	<1	U	0.226	1	<1	U	0.246	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT				NT				<0.5	U	0.0616	0.5	<0.5	U	0.0564	0.5	<0.5	U	0.0564	0.5	<0.5	U	0.0616	0.5
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT				NT				<0.5	U	0.0874	0.5	<0.5	U	0.0801	0.5	<0.5	U	0.0801	0.5	<0.5	U	0.0874	0.5
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	NT				NT				<1	U	0.118	1	<1	U	0.109	1	<1	U	0.109	1	<1	U	0.118	1
Dinitrotoluene Mix				9.4E-01	4.2E+00		NT				NT				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	NT				NT				<0.5	U	0.106	0.5	<0.5	U	0.0972	0.5	<0.5	U	0.0972	0.5	0.17	J	0.106	0.5
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT				NT				<0.5	U	0.0641	0.5	<0.5	U	0.0587	0.5	<0.5	U	0.0587	0.5	<0.5	U	0.0641	0.5
Aminodinitrotoluenes				1.6E+01	2.0E+02		NT				NT				ND				ND				ND				0.17	J	0.106	0.5
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT				NT				<1	U	0.208	1	<1	U,UJ,c	0.19	1	<1	U	0.19	1	<1	U	0.208	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				NT				<10	U	1.45	10	<10	U	1.33	10	<10	U	1.33	10	<10	U	1.45	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	NT				NT				84		0.1	0.1	87		0.1	0.1	88		0.1	0.1	86		0.1	0.1

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
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Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB57B 8/17/2004 8-12		MDL	RL	54SB57C 8/17/2004 16-18		MDL	RL	54SB57C-DUP(DUP-1) 8/17/2004 16-18		MDL	RL	54SB58A [D] 8/17/2004 0-1		MDL	RL	54SB58B [D] 8/17/2004 9-10		MDL	RL	54SB58C [D] 8/17/2004 16-18		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	13,400		4.2	50	11,900		4.2	50	11,300		4.2	50	7,150		4.2	50	9,150		4.2	50	10,500		4.2	50
Antimony	7440-36-0	N	--	3.13	40.88	0.66	0.057	J	0.0386	0.5	0.077	J	0.0386	0.5	0.05	J	0.0386	0.5	0.068	J	0.0386	0.5	0.055	J	0.0386	0.5	0.068	J	0.0386	0.5
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***0.92***		0.058	0.4	***0.85***		0.058	0.4	***0.75***		0.058	0.4	***0.84***		0.058	0.4	***0.72***		0.058	0.4	***0.75***		0.058	0.4
Barium	7440-39-3	N	209	1,564	20,440	300.8	143		0.103	5	140		0.103	5	128		0.103	5	116		0.103	5	113		0.103	5	114		0.103	5
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.33	J	0.0267	1	0.33	J	0.0267	1	0.26	J	0.0267	1	0.22	J	0.0267	1	0.28	J	0.0267	1	0.35	J	0.0267	1
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	1.5		0.25	1	1.4		0.25	1	1.5		0.25	1	1.4		0.25	1	1.5		0.25	1	1.6		0.25	1
Calcium	7440-70-2	--	--	--	--	--	1,760		17.5	250	1,650		17.5	250	1,590		17.5	250	1,930		17.5	250	1,550		17.5	250	1,630		17.5	250
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***22***		0.998	5	***20***		0.998	5	***20***		0.998	5	***13***		0.998	5	***17***		0.998	5	***18***		0.998	5
Cobalt	7440-48-4	--	72.3	--	--	--	11	,J,s	0.233	1	9.1	,J,s	0.233	1	8.5	,J,s	0.233	1	6	,J,s	0.233	1	7.3	,J,s	0.233	1	8.5	,J,s	0.233	1
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	11		0.516	5	10		0.516	5	9.2		0.516	5	7.2		0.516	5	8.1		0.516	5	9.9		0.516	5
Iron	7439-89-6	N	50,962	5,475	71,540	--	22,500		0.731	10	20,200		0.731	10	19,200		0.731	10	14,600		0.731	10	16,200		0.731	10	18,900		0.731	10
Lead [2]	7439-92-1	--	26.8	400	750	--	9.7		0.0776	1	11		0.0776	1	8.8		0.0776	1	29		0.0776	1	8.1		0.0776	1	8.5		0.0776	1
Magnesium	7439-95-4	--	--	--	--	--	3,490		7.67	250	3,200		7.67	250	3,030		7.67	250	2,120		7.67	250	2,560		7.67	250	2,990		7.67	250
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***562***		0.474	5	***454***		0.474	5	***403***		0.474	5	***428***		0.474	5	***376***		0.474	5	***473***		0.474	5
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	0.016	J	0.0077	0.1	0.017	J	0.0077	0.1	0.014	J	0.0077	0.1	0.021	J	0.0077	0.1	0.014	J	0.0077	0.1	0.015	J	0.0077	0.1
Nickel	7440-02-0	N	62.8	156.4	2,044	--	13	,J,s	0.0775	0.5	13	,J,s	0.0775	0.5	12	,J,s	0.0775	0.5	8.6	,J,s	0.0775	0.5	11	,J,s	0.0775	0.5	12	,J,s	0.0775	0.5
Potassium	7440-09-7	--	--	--	--	--	1,490		7.79	100	1,360		7.79	100	1,320		7.79	100	1,320		7.79	100	1,310		7.79	100	1,150		7.79	100
Selenium	7782-49-2	N	--	39.11	511	0.949	0.11	J	0.0486	1	<1	U	0.0486	1	<1	U	0.0486	1	0.057	J	0.0486	1	<1	U	0.0486	1	<1	U	0.0486	1
Silver	7440-22-4	N	--	39.11	511	1.551	0.061	J	0.0178	3	0.48	J	0.0178	3	0.06	J	0.0178	3	0.052	J	0.0178	3	0.05	J	0.0178	3	0.061	J	0.0178	3
Sodium	7440-23-5	--	--	--	--	--	138		31.4	100	102		31.4	100	113		31.4	100	38	J,B,o	31.4	100	32	J,B,o	31.4	100	74	J,B,o	31.4	100
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	0.17	J	0.0733	0.5	0.16	J	0.0733	0.5	0.14	J	0.0733	0.5	0.16	J	0.0733	0.5	0.13	J	0.0733	0.5	0.14	J	0.0733	0.5
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	32		0.401	1.2	29		0.401	1.2	27		0.401	1.2	18		0.401	1.2	22		0.401	1.2	25		0.401	1.2
Zinc	7440-66-6	N	202	2,346	30,660	681.1	66	,J,s	0.789	4	76	,J,s	0.789	4	57	,J,s	0.789	4	104	,J,s	0.789	4	54	,J,s	0.789	4	65	,J,s	0.789	4
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<20	U	3.46	20	<20	U	3.52	20	<20	U	3.52	20	<20	U	3.23	20	<20	U	3.4	20	<20	U	3.46	20
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	<20	U	3.23	20	<20	U	3.28	20	<20	U	3.28	20	<20	U	3.01	20	<20	U	3.17	20	<20	U	3.23	20
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<20	U	2.69	20	<20	U	2.74	20	<20	U	2.74	20	<20	U	2.51	20	<20	U	2.65	20	<20	U	2.69	20
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<20	U	2.33	20	<20	U	2.37	20	<20	U	2.37	20	<20	U	2.18	20	<20	U	2.3	20	<20	U	2.33	20
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	<20	U	3.22	20	<20	U	3.28	20	<20	U	3.28	20	<20	U	3.01	20	<20	U	3.17	20	<20	U	3.22	20
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<20	U	2.6	20	<20	U	2.65	20	<20	U	2.65	20	<20	U	2.43	20	<20	U	2.56	20	<20	U	2.6	20
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<20	U	3.14	20	<20	U	3.2	20	<20	U	3.2	20	<20	U	2.93	20	<20	U	3.09	20	<20	U	3.14	20
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<20	U	2.74	20	<20	U	2.79	20	<20	U	2.79	20	<20	U	2.56	20	<20	U	2.7	20	<20	U	2.74	20
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<20	U	2.95	20	<20	U	3	20	<20	U	3	20	<20	U	2.76	20	<20	U	2.9	20	<20	U	2.95	20
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<20	U	4.15	20	<20	U	4.22	20	<20	U	4.22	20	<20	U	3.88	20	<20	U	4.08	20	<20	U	4.15	20
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U,UJ,c	5.6	20	<20	U	5.69	20	<20	U	5.69	20	<20	U	5.22	20	<20	U	5.5	20	<20	U	5.6	20
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<33	U	8.16	33	<33	U	8.16	33	<33	U	8.16	33	<33	U	7.48	33	<33	U	8.16	33	<33	U	8.16	33
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<66	U	12.1	66	<66	U	12.1	66	<66	U	12.1	66	<66	U	11.1	66	<66	U	12.1	66	<66	U	12.1	66
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB57B 8/17/2004 8-12		MDL	RL	54SB57C 8/17/2004 16-18		MDL	RL	54SB57C-DUP(DUP-1) 8/17/2004 16-18		MDL	RL	54SB58A [D] 8/17/2004 0-1		MDL	RL	54SB58B [D] 8/17/2004 9-10		MDL	RL	54SB58C [D] 8/17/2004 16-18		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				151		0.937	0.937	142		0.963	0.963	279		0.972	0.972
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				1.36	A	0.937	0.937	<0.963	U	0.963	0.963	<1.03	U	1.03	1.03
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				6.83		0.468	0.468	2.77	A	0.481	0.481	4.89		0.486	0.486
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				1.02	A	0.468	0.468	0.143	A,J,w	0.481	0.481	0.167	A,B,z	0.486	0.486
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				<0.468	U	0.468	0.468	<0.481	U	0.481	0.481	<0.486	U	0.486	0.486
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				0.152	A	0.468	0.468	<0.481	U	0.481	0.481	<0.486	U	0.486	0.486
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				0.15	A	0.468	0.468	<0.481	U	0.481	0.481	<0.486	U	0.486	0.486
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				0.259	A	0.468	0.468	<0.481	U	0.481	0.481	0.15	A	0.486	0.486
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				0.148	A,J,w	0.468	0.468	<0.481	U	0.481	0.481	<0.486	U	0.486	0.486
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				0.333	A,J,w	0.468	0.468	<0.481	U	0.481	0.481	0.282	A	0.486	0.486
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				<0.468	U	0.468	0.468	<0.481	U	0.481	0.481	<0.486	U	0.486	0.486
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				<0.468	U	0.468	0.468	<0.481	U	0.481	0.481	<0.486	U	0.486	0.486
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				0.172	A,B,z	0.468	0.468	0.0655	A,J,w	0.481	0.481	<0.486	U	0.486	0.486
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				0.135	A	0.468	0.468	<0.481	U	0.481	0.481	<0.486	U	0.486	0.486
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				0.2	A,B,z	0.468	0.468	0.0693	A,B,z	0.481	0.481	<0.486	U	0.486	0.486
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				***2.13***		0.107	0.107	<0.125	U	0.125	0.125	<0.121	U	0.121	0.121
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				0.922	A,B,z	0.0937	0.0937	0.481	A,B,z	0.0963	0.0963	0.424	A,B,z	0.1	0.1
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				2.48		0	0	0.139		0	0	0.22		0	0
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				2.79		0	0	0.623		0	0	0.728		0	0
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				2.71		0	0	0.143		0	0	0.22		0	0
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				2.74		0	0	0.617		0	0	0.728		0	0
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				16.8		0.468	0.468	7.15		0.481	0.481	14.1		0.486	0.486
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				1.82		0.468	0.468	<0.481	U	0.481	0.481	0.167	,B,z	0.486	0.486
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				3.69		0.468	0.468	0.532		0.481	0.481	3		0.486	0.486
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				1.25		0.468	0.468	0.079	,B,z	0.481	0.481	0.0759	,B,z	0.486	0.486
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				0.804		0.468	0.468	<0.481	U	0.481	0.481	0.165		0.486	0.486
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				2.21		0.468	0.468	0.135	,B,z	0.481	0.481	<0.486	U	0.486	0.486
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				2.34		0.107	0.107	<0.125	U	0.125	0.125	<0.121	U	0.121	0.121
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				4.07		0.0937	0.0937	0.481	,B,z	0.0963	0.0963	0.871	,B,z	0.1	0.1
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB57B 8/17/2004 8-12		MDL	RL	54SB57C 8/17/2004 16-18		MDL	RL	54SB57C-DUP(DUP-1) 8/17/2004 16-18		MDL	RL	54SB58A [D] 8/17/2004 0-1		MDL	RL	54SB58B [D] 8/17/2004 9-10		MDL	RL	54SB58C [D] 8/17/2004 16-18		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U	0.246	1	<1	U	0.246	1	<1	U	0.246	1	<1	U	0.226	1	<1	U	0.246	1	<1	U	0.246	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.057	0.05	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0801	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.118	1	<1	U	0.118	1	<1	U	0.118	1	<1	U	0.109	1	<1	U	0.118	1	<1	U	0.118	1
Dinitrotoluene Mix				9.4E-01	4.2E+00		ND				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5	<0.5	U	0.0972	0.5	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0587	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5
Aminodinitrotoluenes				1.6E+01	2.0E+02		ND				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U,UJ,c	0.208	1	<1	U,UJ,c	0.208	1	<1	U,UJ,c	0.208	1	<1	U	0.19	1	<1	U,UJ,c	0.208	1	<1	U,UJ,c	0.208	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1.45	10	<10	U	1.45	10	<10	U	1.45	10	<10	U	1.33	10	<10	U	1.45	10	<10	U	1.45	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	83		0.1	0.1	82		0.1	0.1	82		0.1	0.1	89		0.1	0.1	85		0.1	0.1	83		0.1	0.1

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB58C-DUP(Dup-5) 1/10/2007 20.7-21.7		MDL	RL	54SB59A 8/18/2004 0-1		MDL	RL	54SB59B 8/18/2004 9-10		MDL	RL	54SB59C 8/18/2004 13-15		MDL	RL	54SB59C-DUP(DUP-2) 8/18/2004 13-15		MDL	RL	54SB60A 8/18/2004 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				9,570		4.2	50	5,620		4.2	50	9,760		4.2	50	8,760		4.2	50	11,600		4.2	50
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				0.058	J	0.0386	0.5	<0.5	U	0.0386	0.5	0.041	J	0.0386	0.5	<0.5	U	0.0386	0.5	0.63		0.0386	0.5
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				***0.79***		0.058	0.4	***0.38***	J	0.058	0.4	***0.58***		0.058	0.4	***0.52***		0.058	0.4	***2.3***		0.058	0.4
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				118		0.103	5	59		0.103	5	108		0.103	5	93		0.103	5	147		0.103	5
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	NT				0.4	J	0.0267	1	0.2	J	0.0267	1	0.4	J	0.0267	1	0.32	J	0.0267	1	0.083	J	0.0267	1
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				1.6		0.25	1	1		0.25	1	1.5		0.25	1	1.4		0.25	1	1.9		0.25	1
Calcium	7440-70-2	--	--	--	--	--	NT				1,720		17.5	250	949		17.5	250	1,520		17.5	250	1,380		17.5	250	4,240		17.5	250
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				***17***		0.998	5	***11***		0.998	5	***18***		0.998	5	***16***		0.998	5	***21***		0.998	5
Cobalt	7440-48-4	--	72.3	--	--	--	NT				7.6	,J,s	0.233	1	4.8	,J,s	0.233	1	7.7	,J,s	0.233	1	6.8	,J,s	0.233	1	12		0.233	1
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				8.8		0.516	5	4.3	J	0.516	5	7.8		0.516	5	7.5		0.516	5	19		0.516	5
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				17,000		0.731	10	10,500		0.731	10	15,600		0.731	10	14,300		0.731	10	37,700		0.731	10
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				20		0.0776	1	4.4		0.0776	1	7.9		0.0776	1	6.2		0.0776	1	175		1.94	25
Magnesium	7439-95-4	--	--	--	--	--	NT				2,530		7.67	250	1,800		7.67	250	2,690		7.67	250	2,460		7.67	250	3,600	,J,s	7.67	250
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				***515***		0.474	5	***224***		0.474	5	***398***		0.474	5	***354***		0.474	5	***1,300***		0.474	5
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT				0.021	J	0.0077	0.1	<0.1	U	0.0077	0.1	0.012	J	0.0077	0.1	0.012	J	0.0077	0.1	0.06	J	0.0077	0.1
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				11	,J,s	0.0775	0.5	6.9	,J,s	0.0775	0.5	10	,J,s	0.0775	0.5	9.6	,J,s	0.0775	0.5	11		0.0775	0.5
Potassium	7440-09-7	--	--	--	--	--	NT				962		7.79	100	881		7.79	100	1,120		7.79	100	1,060		7.79	100	1,460		7.79	100
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				<1	U	0.0486	1	<1	U	0.0486	1	<1	U	0.0486	1	<1	U	0.0486	1	0.21	J,B,p	0.0486	1
Silver	7440-22-4	N	--	39.11	511	1.551	NT				0.055	J	0.0178	3	0.32	J	0.0178	3	0.045	J	0.0178	3	0.04	J	0.0178	3	0.17	J	0.0178	3
Sodium	7440-23-5	--	--	--	--	--	NT				72	J,B,o	31.4	100	<100	U,UL,o	31.4	100	<100	U,UL,o	31.4	100	<100	U,UL,o	31.4	100	<100	U	31.4	100
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	NT				0.17	J	0.0733	0.5	<0.5	U	0.0733	0.5	0.12	J	0.0733	0.5	0.11	J	0.0733	0.5	0.48	J	0.0733	0.5
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				21		0.401	1.2	15		0.401	1.2	23		0.401	1.2	21		0.401	1.2	30		0.401	1.2
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				101	,J,s	0.789	4	39	,J,s	0.789	4	56	,J,s	0.789	4	48	,J,s	0.789	4	575		0.789	4
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				<20	U	2.44	20	<20	U	2.39	20	<20	U	2.48	20	<20	U	2.48	20	<20	U	2.48	20
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	NT				<20	U	2.52	20	<20	U	2.48	20	<20	U	2.57	20	<20	U	2.57	20	<20	U	2.57	20
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				<20	U	2.06	20	<20	U	2.03	20	<20	U	2.1	20	<20	U	2.1	20	<20	U	2.1	20
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				<20	U	2.37	20	<20	U	2.33	20	<20	U	2.41	20	<20	U	2.41	20	<20	U	2.41	20
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	NT				<20	U	2.5	20	<20	U	2.46	20	<20	U	2.54	20	<20	U	2.54	20	<20	U	2.54	20
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				<20	U	3.88	20	<20	U	3.81	20	<20	U	3.95	20	<20	U	3.95	20	<20	U	3.95	20
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				<20	U	1.8	20	<20	U	1.77	20	<20	U	1.83	20	<20	U	1.83	20	<20	U	1.83	20
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				<20	U	2.3	20	<20	U	2.26	20	<20	U	2.34	20	<20	U	2.34	20	<20	U	2.34	20
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				<20	U	1.82	20	<20	U	1.78	20	<20	U	1.85	20	<20	U	1.85	20	<20	U	1.85	20
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				<20	U	2.08	20	<20	U	2.05	20	<20	U	2.12	20	<20	U	2.12	20	<20	U	2.12	20
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				<20	U	2.88	20	<20	U	2.83	20	<20	U	2.93	20	<20	U	2.93	20	<20	U	2.93	20
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				<33	U	8.16	33	<33	U	7.48	33	<33	U	8.16	33	<33	U	8.16	33	18	J	8.16	33
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				<66	U	12.1	66	<66	U	11.1	66	<66	U	12.1	66	<66	U	12.1	66	<66	U	12.1	66
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB58C-DUP(Dup-5) 1/10/2007 20.7-21.7		MDL	RL	54SB59A 8/18/2004 0-1		MDL	RL	54SB59B 8/18/2004 9-10		MDL	RL	54SB59C 8/18/2004 13-15		MDL	RL	54SB59C-DUP(DUP-2) 8/18/2004 13-15		MDL	RL	54SB60A 8/18/2004 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	246		1	1	NT				NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	<1	U	1	1	NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	4.09	A	0.502	0.502	NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	0.137	A,B,z	0.502	0.502	NT				NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	<0.502	U	0.502	0.502	NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	<0.502	U	0.502	0.502	NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	<0.502	U	0.502	0.502	NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	<0.502	U	0.502	0.502	NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	<0.502	U	0.502	0.502	NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	0.255	A	0.502	0.502	NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	<0.502	U	0.502	0.502	NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	<0.502	U	0.502	0.502	NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	<0.502	U	0.502	0.502	NT				NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	<0.502	U	0.502	0.502	NT				NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	0.0703	A,B,z	0.502	0.502	NT				NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	<0.112	U	0.112	0.112	NT				NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	0.412	A,B,z	0.1	0.1	NT				NT				NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	0.204		0	0	NT				NT				NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	0.672		0	0	NT				NT				NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	0.204		0	0	NT				NT				NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	0.672		0	0	NT				NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	11.9		0.502	0.502	NT				NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	0.137	,B,z	0.502	0.502	NT				NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	2.15		0.502	0.502	NT				NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	0.112	,B,z	0.502	0.502	NT				NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	<0.502	U	0.502	0.502	NT				NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	0.161	,B,z	0.502	0.502	NT				NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	<0.112	U	0.112	0.112	NT				NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	0.827	,B,z	0.1	0.1	NT				NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB58C-DUP(Dup-5) 1/10/2007 20.7-21.7		MDL	RL	54SB59A 8/18/2004 0-1		MDL	RL	54SB59B 8/18/2004 9-10		MDL	RL	54SB59C 8/18/2004 13-15		MDL	RL	54SB59C-DUP(DUP-2) 8/18/2004 13-15		MDL	RL	54SB60A 8/18/2004 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT				<1	U	0.205	1	<1	U	0.226	1	<1	U	0.246	1	<1	U	0.246	1	<1	U	0.246	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT				<0.5	U	0.0513	0.5	<0.5	U	0.0564	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT				<0.5	U	0.0728	0.5	<0.5	U	0.0801	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	NT				<1	U	0.0987	1	<1	U	0.109	1	<1	U	0.118	1	<1	U	0.118	1	<1	U	0.118	1
Dinitrotoluene Mix				9.4E-01	4.2E+00		NT				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	NT				<0.5	U	0.0884	0.5	<0.5	U	0.0972	0.5	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT				<0.5	U	0.0534	0.5	<0.5	U	0.0587	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5
Aminodinitrotoluenes				1.6E+01	2.0E+02		NT				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT				<1	U	0.173	1	<1	U	0.19	1	<1	U	0.208	1	<1	U	0.208	1	<1	U	0.208	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				<10	U	1.45	10	<10	U	1.33	10	<10	U	1.45	10	<10	U	1.45	10	<10	U	1.45	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	NT				86		0.1	0.1	87		0.1	0.1	85		0.1	0.1	85		0.1	0.1	85		0.1	0.1

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB60B 8/18/2004 9-10		MDL	RL	54SB60C 8/18/2004 12-13.5		MDL	RL	54SB61A 8/17/2004 0-1		MDL	RL	54SB61B 8/17/2004 9-10		MDL	RL	54SB61C 8/17/2004 16-18		MDL	RL	54SB62A 8/19/2004 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	22,400		4.2	50	15,700		4.2	50	6,620		4.2	50	7,670		4.2	50	14,500		4.2	50	7,750		4.2	50
Antimony	7440-36-0	N	--	3.13	40.88	0.66	<0.5	U	0.0386	0.5	<0.5	U	0.0386	0.5	0.04	J	0.0386	0.5	0.069	J	0.0386	0.5	0.068	J	0.0386	0.5	<0.5	U	0.0386	0.5
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***1.7***		0.058	0.4	***1.9***		0.058	0.4	***0.67***		0.058	0.4	***0.64***		0.058	0.4	***0.94***		0.058	0.4	***0.63***		0.058	0.4
Barium	7440-39-3	N	209	1,564	20,440	300.8	247		0.103	5	184		0.103	5	119		0.103	5	95		0.103	5	161		0.103	5	125		0.103	5
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.63	J	0.0267	1	0.23	J	0.0267	1	0.23	J	0.0267	1	0.26	J	0.0267	1	0.47	J	0.0267	1	0.26	J	0.0267	1
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	***3.8***		0.25	1	2.5		0.25	1	1.3		0.25	1	1.4		0.25	1	1.5		0.25	1	1.1		0.25	1
Calcium	7440-70-2	--	--	--	--	--	2,140		17.5	250	1,870		17.5	250	1,140		17.5	250	1,270		17.5	250	2,060		17.5	250	1,580		17.5	250
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***29***		0.998	5	***23***		0.998	5	***12***		0.998	5	***13***		0.998	5	***22***		0.998	5	***16***		0.998	5
Cobalt	7440-48-4	--	72.3	--	--	--	16		0.233	1	13		0.233	1	6	,J,s	0.233	1	6.4	,J,s	0.233	1	11	,J,s	0.233	1	6.3	,J,s	0.233	1
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	23		0.516	5	18		0.516	5	7.6		0.516	5	7.3		0.516	5	14		0.516	5	7.4		0.516	5
Iron	7439-89-6	N	50,962	5,475	71,540	--	44,500		0.731	10	38,300		0.731	10	13,700		0.731	10	14,400		0.731	10	23,300		0.731	10	13,600		0.731	10
Lead [2]	7439-92-1	--	26.8	400	750	--	373		3.88	50	296		3.88	50	17		0.0776	1	6.9		0.0776	1	9.9		0.0776	1	14		0.0776	1
Magnesium	7439-95-4	--	--	--	--	--	4,400	,J,s	7.67	250	3,130	,J,s	7.67	250	2,040		7.67	250	2,290		7.67	250	3,570		7.67	250	2,140	,J,s	7.67	250
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***1,680***		0.474	5	***1,350***		0.474	5	***483***		0.474	5	***368***		0.474	5	***672***		0.474	5	***418***		0.474	5
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	0.055	J	0.0077	0.1	0.037	J	0.0077	0.1	0.017	J	0.0077	0.1	0.012	J	0.0077	0.1	0.02	J	0.0077	0.1	0.014	J	0.0077	0.1
Nickel	7440-02-0	N	62.8	156.4	2,044	--	15		0.0775	0.5	12		0.0775	0.5	8.6	,J,s	0.0775	0.5	9.6	,J,s	0.0775	0.5	15	,J,s	0.0775	0.5	9.2		0.0775	0.5
Potassium	7440-09-7	--	--	--	--	--	2,290		7.79	100	1,460		7.79	100	955		7.79	100	940		7.79	100	1,290		7.79	100	1,120		7.79	100
Selenium	7782-49-2	N	--	39.11	511	0.949	0.052	J,B,p	0.0486	1	0.13	J,B,p	0.0486	1	<1	U	0.0486	1	<1	U	0.0486	1	<1	U	0.0486	1	0.088	J	0.0486	1
Silver	7440-22-4	N	--	39.11	511	1.551	0.15	J	0.0178	3	0.12	J	0.0178	3	0.049	J	0.0178	3	0.047	J	0.0178	3	0.072	J	0.0178	3	0.043	J	0.0178	3
Sodium	7440-23-5	--	--	--	--	--	40	J	31.4	100	<100	U	31.4	100	69	J,B,o	31.4	100	72	J,B,o	31.4	100	79	J,B,o	31.4	100	40	J,L,o	31.4	100
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	***0.97***		0.0733	0.5	***0.93***		0.0733	0.5	0.12	J	0.0733	0.5	0.1	J	0.0733	0.5	***0.19***	J	0.0733	0.5	0.1	J	0.0733	0.5
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	***53***		0.401	1.2	***39***		0.401	1.2	16		0.401	1.2	18		0.401	1.2	32		0.401	1.2	19	,J,s	0.401	1.2
Zinc	7440-66-6	N	202	2,346	30,660	681.1	***1,390***		0.789	4	***934***		0.789	4	87	,J,s	0.789	4	51	,J,s	0.789	4	77	,J,s	0.789	4	68	,J,s	0.789	4
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<20	U	2.81	20	<20	U	2.6	20	<20	U	3.29	20	<20	U	2.44	20	<20	U	2.65	20	<20	U	3.29	20
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	<20	U	2.91	20	<20	U	2.7	20	<20	U	3.07	20	<20	U	2.52	20	<20	U	2.74	20	<20	U,UJ,c	3.07	20
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<20	U	2.39	20	<20	U	2.21	20	<20	U	2.56	20	<20	U	2.06	20	<20	U	2.24	20	<20	U	2.56	20
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<20	U	2.74	20	<20	U	2.54	20	<20	U	2.22	20	<20	U	2.37	20	<20	U	2.58	20	<20	U	2.22	20
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	<20	U	2.89	20	<20	U	2.67	20	<20	U	3.06	20	<20	U	2.5	20	<20	U	2.72	20	<20	U	3.06	20
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<20	U	4.48	20	<20	U	4.15	20	<20	U	2.47	20	<20	U	3.88	20	<20	U	4.21	20	<20	U	2.47	20
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<20	U	2.08	20	<20	U	1.93	20	<20	U	2.99	20	<20	U	1.8	20	<20	U	1.96	20	<20	U	2.99	20
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<20	U	2.66	20	<20	U	2.46	20	<20	U	2.6	20	<20	U	2.3	20	<20	U	2.5	20	<20	U	2.6	20
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<20	U	2.1	20	<20	U	1.94	20	<20	U	2.8	20	<20	U	1.82	20	<20	U	1.97	20	<20	U	2.8	20
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<20	U	2.41	20	<20	U	2.23	20	<20	U	3.94	20	<20	U	2.08	20	<20	U	2.26	20	<20	U	3.94	20
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U	3.33	20	<20	U	3.08	20	<20	U	5.32	20	<20	U	2.88	20	<20	U	3.13	20	<20	U	5.32	20
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<33	U	8.84	33	<33	U	8.84	33	<33	U	7.48	33	<33	U	8.16	33	<33	U	8.84	33	<33	U	7.48	33
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<66	U	13.1	66	<66	U	13.1	66	<66	U	11.1	66	<66	U	12.1	66	<66	U	13.1	66	<66	U	11.1	66
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB60B 8/18/2004 9-10		MDL	RL	54SB60C 8/18/2004 12-13.5		MDL	RL	54SB61A 8/17/2004 0-1		MDL	RL	54SB61B 8/17/2004 9-10		MDL	RL	54SB61C 8/17/2004 16-18		MDL	RL	54SB62A 8/19/2004 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB60B 8/18/2004 9-10		MDL	RL	54SB60C 8/18/2004 12-13.5		MDL	RL	54SB61A 8/17/2004 0-1		MDL	RL	54SB61B 8/17/2004 9-10		MDL	RL	54SB61C 8/17/2004 16-18		MDL	RL	54SB62A 8/19/2004 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U	0.267	1	<1	U	0.246	1	<1	U	0.226	1	<1	U	0.246	1	<1	U	0.267	1	<1	U	0.226	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<0.5	U	0.0667	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0564	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0667	0.5	<0.5	U	0.0564	0.5
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<0.5	U	0.0946	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0801	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0946	0.5	<0.5	U	0.0801	0.5
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.128	1	<1	U	0.118	1	<1	U	0.109	1	<1	U	0.118	1	<1	U	0.128	1	<1	U	0.109	1
Dinitrotoluene Mix				9.4E-01	4.2E+00		ND				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.115	0.5	<0.5	U	0.106	0.5	<0.5	U	0.0972	0.5	<0.5	U	0.106	0.5	<0.5	U	0.115	0.5	<0.5	U	0.0972	0.5
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.0694	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0587	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0694	0.5	<0.5	U	0.0587	0.5
Aminodinitrotoluenes				1.6E+01	2.0E+02		ND				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.225	1	<1	U	0.208	1	<1	U,UJ,c	0.19	1	<1	U	0.208	1	<1	U,UJ,c	0.225	1	<1	U	0.19	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1.57	10	<10	U	1.45	10	<10	U	1.33	10	<10	U	1.45	10	<10	U	1.57	10	<10	U	1.33	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	75		0.1	0.1	80		0.1	0.1	88		0.1	0.1	86		0.1	0.1	79		0.1	0.1	87		0.1	0.1

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB62B 8/19/2004 9-10		MDL	RL	54SB62B-DUP(DUP-6) 8/19/2004 9-10		MDL	RL	54SB62C 8/19/2004 15-16		MDL	RL	54SB63A 8/19/2004 0-1		MDL	RL	54SB63A-DUP(DUP-4) 8/19/2004 0-1		MDL	RL	54SB63B 8/19/2004 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	9,330		4.2	50	9,140		4.2	50	11,100		4.2	50	14,500		4.2	50	16,200		4.2	50	9,300		4.2	50
Antimony	7440-36-0	N	--	3.13	40.88	0.66	<0.5	U	0.0386	0.5	<0.5	U	0.0386	0.5	<0.5	U	0.0386	0.5	0.094	J	0.0386	0.5	0.13	J	0.0386	0.5	<0.5	U	0.0386	0.5
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***0.65***		0.058	0.4	***0.63***		0.058	0.4	***0.73***		0.058	0.4	***3.2***		0.116	0.4	***3.4***		0.116	0.4	***0.66***		0.058	0.4
Barium	7440-39-3	N	209	1,564	20,440	300.8	105		0.103	5	105		0.103	5	121		0.103	5	237		0.103	5	275		0.103	5	107		0.103	5
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.37	J	0.0267	1	0.29	J	0.0267	1	0.33	J	0.0267	1	0.29	J	0.0267	1	0.19	J	0.0267	1	0.3	J	0.0267	1
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	1.3		0.25	1	1.3		0.25	1	1.3		0.25	1	2.7		0.25	1	***3.3***		0.25	1	1.5		0.25	1
Calcium	7440-70-2	--	--	--	--	--	1,470		17.5	250	1,410		17.5	250	1,620		17.5	250	1,370		17.5	250	1,640		17.5	250	1,760		17.5	250
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***16***		0.998	5	***16***		0.998	5	***19***		0.998	5	***20***		0.998	5	***24***		0.998	5	***18***		0.998	5
Cobalt	7440-48-4	--	72.3	--	--	--	7	,J,s	0.233	1	7.1	,J,s	0.233	1	8.1	,J,s	0.233	1	13		0.233	1	16		0.233	1	7.2		0.233	1
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	7.6		0.516	5	8		0.516	5	8.7		0.516	5	18		0.516	5	22		0.516	5	7.4		0.516	5
Iron	7439-89-6	N	50,962	5,475	71,540	--	15,300		0.731	10	15,400		0.731	10	17,300		0.731	10	53,600		0.731	10	61,800		0.731	10	15,300		0.731	10
Lead [2]	7439-92-1	--	26.8	400	750	--	6.9		0.0776	1	6.7		0.0776	1	7.9		0.0776	1	326		3.88	50	318		3.88	50	72		0.776	10
Magnesium	7439-95-4	--	--	--	--	--	2,510	,J,s	7.67	250	2,550	,J,s	7.67	250	2,730	,J,s	7.67	250	2,360	,J,s	7.67	250	2,770	,J,s	7.67	250	2,380	,J,s	7.67	250
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***369***		0.474	5	***375***		0.474	5	***451***		0.474	5	***2,330***		0.474	5	***2,670***		0.474	5	***403***		0.474	5
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	<0.1	U	0.0077	0.1	<0.1	U	0.0077	0.1	0.0081	J	0.0077	0.1	0.056	J	0.0077	0.1	0.056	J	0.0077	0.1	0.016	J	0.0077	0.1
Nickel	7440-02-0	N	62.8	156.4	2,044	--	10		0.0775	0.5	9.6		0.0775	0.5	12		0.0775	0.5	13		0.155	0.5	14		0.155	0.5	10		0.0775	0.5
Potassium	7440-09-7	--	--	--	--	--	1,160		7.79	100	1,140		7.79	100	1,170		7.79	100	1,690		7.79	100	1,640		7.79	100	1,150		7.79	100
Selenium	7782-49-2	N	--	39.11	511	0.949	<1	U	0.0486	1	<1	U	0.0486	1	<1	U	0.0486	1	0.31	J	0.0972	1	0.32	J	0.0972	1	0.23	J,B,p	0.0486	1
Silver	7440-22-4	N	--	39.11	511	1.551	0.048	J	0.0178	3	0.05	J	0.0178	3	0.056	J	0.0178	3	0.14	J	0.0178	3	0.15	J	0.0178	3	0.049	J	0.0178	3
Sodium	7440-23-5	--	--	--	--	--	<100	U,UL,o	31.4	100	<100	U,UL,o	31.4	100	<100	U,UL,o	31.4	100	<100	U	31.4	100	32	J	31.4	100	39	J	31.4	100
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	0.12	J	0.0733	0.5	0.11	J	0.0733	0.5	0.14	J	0.0733	0.5	***1.5***		0.0733	0.5	***1.3***		0.0733	0.5	0.17	J	0.0733	0.5
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	21	,J,s	0.401	1.2	21	,J,s	0.401	1.2	24	,J,s	0.401	1.2	34		0.401	1.2	***41***		0.401	1.2	22		0.401	1.2
Zinc	7440-66-6	N	202	2,346	30,660	681.1	52	,J,s	0.789	4	53	,J,s	0.789	4	57	,J,s	0.789	4	***1,150***		0.789	4	***1,310***		0.789	4	128		0.789	4
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<20	U	3.46	20	<20	U	3.46	20	<20	U	3.46	20	<20	U	2.52	20	<20	U	2.52	20	<20	U	2.52	20
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	<20	U,UJ,c	3.23	20	<20	U,UJ,c	3.23	20	<20	U	3.23	20	<20	U	2.61	20	<20	U	2.61	20	<20	U	2.61	20
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<20	U	2.69	20	<20	U	2.69	20	<20	U	2.69	20	<20	U	2.14	20	<20	U	2.14	20	<20	U	2.14	20
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<20	U	2.33	20	<20	U	2.33	20	<20	U	2.33	20	<20	U	2.45	20	<20	U	2.45	20	<20	U	2.45	20
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	<20	U	3.22	20	<20	U	3.22	20	<20	U	3.22	20	<20	U	2.59	20	<20	U	2.59	20	<20	U	2.59	20
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<20	U	2.6	20	<20	U	2.6	20	<20	U	2.6	20	<20	U	4.01	20	<20	U	4.01	20	<20	U	4.01	20
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<20	U	3.14	20	<20	U	3.14	20	<20	U	3.14	20	<20	U	1.87	20	<20	U	1.87	20	<20	U	1.87	20
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<20	U	2.74	20	<20	U	2.74	20	<20	U	2.74	20	<20	U	2.38	20	<20	U	2.38	20	<20	U	2.38	20
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<20	U	2.95	20	<20	U	2.95	20	<20	U	2.95	20	<20	U	1.88	20	<20	U	1.88	20	<20	U	1.88	20
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<20	U	4.15	20	<20	U	4.15	20	<20	U	4.15	20	<20	U	2.15	20	<20	U	2.15	20	<20	U	2.15	20
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U	5.6	20	<20	U	5.6	20	<20	U	5.6	20	<20	U	2.98	20	<20	U	2.98	20	<20	U	2.98	20
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<33	U	8.16	33	<33	U	8.16	33	<33	U	8.16	33	<33	U	8.16	33	<33	U	8.16	33	<33	U	8.16	33
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<66	U	12.1	66	<66	U	12.1	66	<66	U	12.1	66	<66	U	12.1	66	<66	U	12.1	66	<66	U	12.1	66
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB62B 8/19/2004 9-10		MDL	RL	54SB62B-DUP(DUP-6) 8/19/2004 9-10		MDL	RL	54SB62C 8/19/2004 15-16		MDL	RL	54SB63A 8/19/2004 0-1		MDL	RL	54SB63A-DUP(DUP-4) 8/19/2004 0-1		MDL	RL	54SB63B 8/19/2004 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB62B 8/19/2004 9-10		MDL	RL	54SB62B-DUP(DUP-6) 8/19/2004 9-10		MDL	RL	54SB62C 8/19/2004 15-16		MDL	RL	54SB63A 8/19/2004 0-1		MDL	RL	54SB63A-DUP(DUP-4) 8/19/2004 0-1		MDL	RL	54SB63B 8/19/2004 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U	0.246	1	<1	U	0.246	1	<1	U	0.246	1	<1	U	0.246	1	<1	U	0.246	1	<1	U	0.246	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.118	1	<1	U	0.118	1	<1	U	0.118	1	<1	U	0.118	1	<1	U	0.118	1	<1	U	0.118	1
Dinitrotoluene Mix				9.4E-01	4.2E+00		ND				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5
Aminodinitrotoluenes				1.6E+01	2.0E+02		ND				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.208	1	<1	U	0.208	1	<1	U	0.208	1	<1	U	0.208	1	<1	U	0.208	1	<1	U	0.208	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1.45	10	<10	U	1.45	10	<10	U	1.45	10	<10	U	1.45	10	<10	U	1.45	10	<10	U	1.45	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	84		0.1	0.1	84		0.1	0.1	83		0.1	0.1	83		0.1	0.1	84		0.1	0.1	84		0.1	0.1

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB63C 8/19/2004 11-12		MDL	RL	54SB64A 8/18/2004 0-2		MDL	RL	54SB64B 8/18/2004 9-10		MDL	RL	54SB64C 8/18/2004 12.5-13.5		MDL	RL	54SB65A 8/19/2004 0-1		MDL	RL	54SB65B 8/19/2004 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	10,500		4.2	50	13,500		4.2	50	23,400		4.2	50	10,300		4.2	50	5,900		4.2	50	8,860		4.2	50
Antimony	7440-36-0	N	--	3.13	40.88	0.66	<0.5	U	0.0386	0.5	0.062	J	0.0386	0.5	<0.5	U	0.0386	0.5	<0.5	U	0.0386	0.5	<0.5	U	0.0386	0.5	<0.5	U	0.0386	0.5
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***0.8***		0.058	0.4	***2.1***		0.058	0.4	***1.5***		0.058	0.4	***1.3***		0.058	0.4	***0.53***		0.058	0.4	***0.62***		0.058	0.4
Barium	7440-39-3	N	209	1,564	20,440	300.8	113		0.103	5	157		0.103	5	234		0.103	5	113		0.103	5	74		0.103	5	93		0.103	5
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.27	J	0.0267	1	0.13	J	0.0267	1	0.56	J	0.0267	1	0.19	J	0.0267	1	0.18	J	0.0267	1	0.38	J	0.0267	1
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	1.7		0.25	1	2.3		0.25	1	***3.1***		0.25	1	1.9		0.25	1	0.87	J	0.25	1	1.2		0.25	1
Calcium	7440-70-2	--	--	--	--	--	1,700		17.5	250	2,070		17.5	250	2,120		17.5	250	1,810		17.5	250	1,110		17.5	250	1,400		17.5	250
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***21***		0.998	5	***22***		0.998	5	***30***		0.998	5	***20***		0.998	5	***13***		0.998	5	***16***		0.998	5
Cobalt	7440-48-4	--	72.3	--	--	--	8.1		0.233	1	13		0.233	1	15		0.233	1	8.6		0.233	1	4.9	,J,s	0.233	1	7	,J,s	0.233	1
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	10		0.516	5	21		0.516	5	22		0.516	5	13		0.516	5	5.4		0.516	5	7.7		0.516	5
Iron	7439-89-6	N	50,962	5,475	71,540	--	18,500		0.731	10	39,500		0.731	10	36,200		0.731	10	27,100		0.731	10	11,300		0.731	10	15,400		0.731	10
Lead [2]	7439-92-1	--	26.8	400	750	--	117		1.94	25	179		1.94	25	355		3.88	50	177		1.94	25	10		0.0776	1	6.5		0.0776	1
Magnesium	7439-95-4	--	--	--	--	--	2,590	,J,s	7.67	250	2,840	,J,s	7.67	250	4,340	,J,s	7.67	250	2,430	,J,s	7.67	250	1,860	,J,s	7.67	250	2,630	,J,s	7.67	250
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***527***		0.474	5	***1,280***		0.474	5	***1,350***		0.474	5	***827***		0.474	5	***268***		0.474	5	***360***		0.474	5
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	0.017	J	0.0077	0.1	0.056	J	0.0077	0.1	0.04	J	0.0077	0.1	0.03	J	0.0077	0.1	<0.1	U	0.0077	0.1	<0.1	U	0.0077	0.1
Nickel	7440-02-0	N	62.8	156.4	2,044	--	10		0.0775	0.5	12		0.0775	0.5	15		0.0775	0.5	9.2		0.0775	0.5	6.9		0.0775	0.5	10		0.0775	0.5
Potassium	7440-09-7	--	--	--	--	--	1,280		7.79	100	1,480		7.79	100	2,800		7.79	100	1,420		7.79	100	1,020		7.79	100	1,140		7.79	100
Selenium	7782-49-2	N	--	39.11	511	0.949	0.066	J,B,p	0.0486	1	0.21	J,B,p	0.0486	1	<1	U	0.0486	1	0.14	J,B,p	0.0486	1	0.053	J	0.0486	1	<1	U	0.0486	1
Silver	7440-22-4	N	--	39.11	511	1.551	0.06	J	0.0178	3	0.12	J	0.0178	3	0.14	J	0.0178	3	0.087	J	0.0178	3	0.037	J	0.0178	3	0.046	J	0.0178	3
Sodium	7440-23-5	--	--	--	--	--	36	J	31.4	100	<100	U	31.4	100	45	J	31.4	100	<100	U	31.4	100	<100	U	31.4	100	<100	U	31.4	100
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	***0.19***	J	0.0733	0.5	***0.46***	J	0.0733	0.5	***0.58***		0.0733	0.5	***0.36***	J	0.0733	0.5	0.086	J	0.0733	0.5	0.12	J	0.0733	0.5
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	26		0.401	1.2	33		0.401	1.2	***53***		0.401	1.2	27		0.401	1.2	15	,J,s	0.401	1.2	21	,J,s	0.401	1.2
Zinc	7440-66-6	N	202	2,346	30,660	681.1	262		0.789	4	599		0.789	4	***949***		0.789	4	507		0.789	4	53	,J,s	0.789	4	52	,J,s	0.789	4
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<20	U	2.52	20	<20	U	2.35	20	<20	U	2.6	20	<20	U	2.52	20	<20	U	3.29	20	<20	U	3.29	20
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	<20	U	2.61	20	<20	U	2.44	20	<20	U	2.7	20	<20	U	2.61	20	<20	U	3.07	20	<20	U	3.07	20
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<20	U	2.14	20	<20	U	1.99	20	<20	U	2.21	20	<20	U	2.14	20	<20	U	2.56	20	<20	U	2.56	20
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<20	U	2.45	20	<20	U	2.29	20	<20	U	2.54	20	<20	U	2.45	20	<20	U	2.22	20	<20	U	2.22	20
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	<20	U	2.59	20	<20	U	2.41	20	<20	U	2.67	20	<20	U	2.59	20	<20	U	3.06	20	<20	U	3.06	20
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<20	U	4.01	20	<20	U	3.75	20	<20	U	4.15	20	<20	U	4.01	20	<20	U	2.47	20	<20	U	2.47	20
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<20	U	1.87	20	<20	U	1.74	20	<20	U	1.93	20	<20	U	1.87	20	<20	U	2.99	20	<20	U	2.99	20
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<20	U	2.38	20	<20	U	2.22	20	<20	U	2.46	20	<20	U	2.38	20	<20	U	2.6	20	<20	U	2.6	20
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<20	U	1.88	20	<20	U	1.75	20	<20	U	1.94	20	<20	U	1.88	20	<20	U	2.8	20	<20	U	2.8	20
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<20	U	2.15	20	<20	U	2.01	20	<20	U	2.23	20	<20	U	2.15	20	<20	U	3.94	20	<20	U	3.94	20
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U	2.98	20	<20	U	2.78	20	<20	U	3.08	20	<20	U	2.98	20	<20	U	5.32	20	<20	U	5.32	20
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<33	U	8.16	33	12	J	8.16	33	<33	U	8.16	33	<33	U	8.16	33	<33	U	7.48	33	<33	U	7.48	33
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<66	U	12.1	66	<66	U	12.1	66	<66	U	12.1	66	<66	U	12.1	66	<66	U	11.1	66	<66	U	11.1	66
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB63C 8/19/2004 11-12		MDL	RL	54SB64A 8/18/2004 0-2		MDL	RL	54SB64B 8/18/2004 9-10		MDL	RL	54SB64C 8/18/2004 12.5-13.5		MDL	RL	54SB65A 8/19/2004 0-1		MDL	RL	54SB65B 8/19/2004 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB63C 8/19/2004 11-12		MDL	RL	54SB64A 8/18/2004 0-2		MDL	RL	54SB64B 8/18/2004 9-10		MDL	RL	54SB64C 8/18/2004 12.5-13.5		MDL	RL	54SB65A 8/19/2004 0-1		MDL	RL	54SB65B 8/19/2004 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U	0.246	1	<1	U	0.226	1	<1	U	0.246	1	<1	U	0.246	1	<1	U	0.226	1	<1	U	0.226	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<0.5	U	0.0616	0.5	<0.5	U	0.0564	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0564	0.5	<0.5	U	0.0564	0.5
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<0.5	U	0.0874	0.5	<0.5	U	0.0801	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0801	0.5	<0.5	U	0.0801	0.5
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.118	1	<1	U	0.109	1	<1	U	0.118	1	<1	U	0.118	1	<1	U	0.109	1	<1	U	0.109	1
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	ND				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.106	0.5	<0.5	U	0.0972	0.5	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5	<0.5	U	0.0972	0.5	<0.5	U	0.0972	0.5
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.0641	0.5	<0.5	U	0.0587	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0587	0.5	<0.5	U	0.0587	0.5
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.208	1	<1	U	0.19	1	<1	U	0.208	1	<1	U	0.208	1	<1	U	0.19	1	<1	U	0.19	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1.45	10	<10	U	1.33	10	<10	U	1.45	10	<10	U	1.45	10	<10	U	1.33	10	<10	U	1.33	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	83		0.1	0.1	89		0.1	0.1	81		0.1	0.1	84		0.1	0.1	88		0.1	0.1	87		0.1	0.1

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB65C 8/19/2004 15-17		MDL	RL	54SB66A 8/19/2004 0-1		MDL	RL	54SB66B 8/19/2004 9-10		MDL	RL	54SB66C 8/19/2004 11-12		MDL	RL	54SB67A 8/19/2004 0-1		MDL	RL	54SB67B 8/19/2004 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	12,900		4.2	50	16,100		4.2	50	18,500		4.2	50	18,100		4.2	50	13,100		4.2	50	12,000		4.2	50
Antimony	7440-36-0	N	--	3.13	40.88	0.66	0.051	J,B,p	0.0386	0.5	0.071	J	0.0386	0.5	<0.5	U	0.0386	0.5	0.27	J	0.0386	0.5	0.13	J	0.0386	0.5	0.14	J	0.0386	0.5
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***0.69***		0.058	0.4	***2.8***		0.058	0.4	***1.3***		0.058	0.4	***1.2***		0.058	0.4	***2***		0.058	0.4	***4.7***		0.116	0.4
Barium	7440-39-3	N	209	1,564	20,440	300.8	131		0.103	5	247		0.103	5	169		0.103	5	171		0.103	5	146		0.103	5	261		0.103	5
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.5	J	0.0267	1	0.2	J	0.0267	1	0.46	J	0.0267	1	0.54	J	0.0267	1	0.18	J	0.0267	1	0.073	J	0.0267	1
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	1.3		0.25	1	***2.9***		0.25	1	2.4		0.25	1	2		0.25	1	2		0.25	1	***3.4***		0.25	1
Calcium	7440-70-2	--	--	--	--	--	1,950		17.5	250	1,730		17.5	250	1,660		17.5	250	1,930		17.5	250	3,850		17.5	250	1,430		17.5	250
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***25***		0.998	5	***23***		0.998	5	***26***		0.998	5	***28***		0.998	5	***23***		0.998	5	***20***		0.998	5
Cobalt	7440-48-4	--	72.3	--	--	--	9.2	,J,s	0.233	1	16		0.233	1	12		0.233	1	12		0.233	1	13		0.233	1	16		0.233	1
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	10		0.516	5	22		0.516	5	22		0.516	5	17		0.516	5	19		0.516	5	19		0.516	5
Iron	7439-89-6	N	50,962	5,475	71,540	--	20,100		0.731	10	52,400		0.731	10	28,300		0.731	10	27,000		0.731	10	36,300		0.731	10	77,900		0.731	10
Lead [2]	7439-92-1	--	26.8	400	750	--	8.1		0.0776	1	297		3.88	50	304		3.88	50	241		3.88	50	152		1.94	25	502		7.76	100
Magnesium	7439-95-4	--	--	--	--	--	3,270	,J,s	7.67	250	2,720	,J,s	7.67	250	3,400	,J,s	7.67	250	3,450	,J,s	7.67	250	3,800	,J,s	7.67	250	2,060	,J,s	7.67	250
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***473***		0.474	5	***2,150***		0.474	5	***911***		0.474	5	***900***		0.474	5	***1,170***		0.474	5	***3,250***		0.474	5
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	0.01	J	0.0077	0.1	0.062	J	0.0077	0.1	0.032	J	0.0077	0.1	0.028	J	0.0077	0.1	0.059	J	0.0077	0.1	0.065	J	0.0077	0.1
Nickel	7440-02-0	N	62.8	156.4	2,044	--	13		0.0775	0.5	12		0.0775	0.5	14		0.0775	0.5	14		0.0775	0.5	12		0.0775	0.5	15		0.155	0.5
Potassium	7440-09-7	--	--	--	--	--	1,170		7.79	100	1,760		7.79	100	1,940		7.79	100	1,760		7.79	100	1,850		7.79	100	1,210		7.79	100
Selenium	7782-49-2	N	--	39.11	511	0.949	<1	U	0.0486	1	0.18	J,B,p	0.0486	1	<1	U	0.0486	1	0.049	J,B,p	0.0486	1	0.2	J,B,p	0.0486	1	0.3	J	0.0972	1
Silver	7440-22-4	N	--	39.11	511	1.551	0.057	J	0.0178	3	0.15	J	0.0178	3	0.12	J	0.0178	3	0.1	J	0.0178	3	0.12	J	0.0178	3	0.19	J	0.0178	3
Sodium	7440-23-5	--	--	--	--	--	<100	U	31.4	100	<100	U	31.4	100	<100	U	31.4	100	37	J	31.4	100	<100	U	31.4	100	<100	U	31.4	100
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	0.14	J	0.0733	0.5	1		0.0733	0.5	0.41	J	0.0733	0.5	***0.27***	J	0.0733	0.5	***0.47***	J	0.0733	0.5	***2.8***		0.0733	0.5
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	29	,J,s	0.401	1.2	***39***		0.401	1.2	***42***		0.401	1.2	***43***		0.401	1.2	32		0.401	1.2	35		0.401	1.2
Zinc	7440-66-6	N	202	2,346	30,660	681.1	64	,J,s	0.789	4	***921***		0.789	4	575		0.789	4	321		0.789	4	530		0.789	4	***1,870***		0.789	4
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<20	U	3.58	20	<20	U	2.48	20	<20	U	2.6	20	<20	U	2.86	20	<20	U	2.35	20	<20	U	2.39	20
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	<20	U,UJ,c	3.34	20	<20	U	2.57	20	<20	U	2.7	20	<20	U	2.96	20	<20	U	2.44	20	<20	U	2.48	20
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<20	U	2.78	20	<20	U	2.1	20	<20	U	2.21	20	<20	U	2.42	20	<20	U	1.99	20	<20	U	2.03	20
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<20	U	2.41	20	<20	U	2.41	20	<20	U	2.54	20	<20	U	2.78	20	<20	U	2.29	20	<20	U	2.33	20
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	<20	U	3.33	20	<20	U	2.54	20	<20	U	2.67	20	<20	U	2.93	20	<20	U	2.41	20	<20	U	2.46	20
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<20	U	2.69	20	<20	U	3.95	20	<20	U	4.15	20	<20	U	4.55	20	<20	U	3.75	20	<20	U	3.81	20
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<20	U	3.25	20	<20	U	1.83	20	<20	U	1.93	20	<20	U	2.11	20	<20	U	1.74	20	<20	U	1.77	20
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<20	U	2.83	20	<20	U	2.34	20	<20	U	2.46	20	<20	U	2.7	20	<20	U	2.22	20	<20	U	2.26	20
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<20	U	3.05	20	<20	U	1.85	20	<20	U	1.94	20	<20	U	2.13	20	<20	U	1.75	20	<20	U	1.78	20
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<20	U	4.29	20	<20	U	2.12	20	<20	U	2.23	20	<20	U	2.44	20	<20	U	2.01	20	<20	U	2.05	20
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U	5.78	20	<20	U	2.93	20	<20	U	3.08	20	<20	U	3.38	20	<20	U	2.78	20	<20	U	2.83	20
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<33	U	8.16	33	<33	U	8.16	33	<33	U	8.16	33	<33	U	9.52	33	13	J	7.48	33	<33	U	7.48	33
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<66	U	12.1	66	<66	U	12.1	66	<66	U	12.1	66	<66	U	14.1	66	<66	U	11.1	66	<66	U	11.1	66
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB65C 8/19/2004 15-17		MDL	RL	54SB66A 8/19/2004 0-1		MDL	RL	54SB66B 8/19/2004 9-10		MDL	RL	54SB66C 8/19/2004 11-12		MDL	RL	54SB67A 8/19/2004 0-1		MDL	RL	54SB67B 8/19/2004 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB65C 8/19/2004 15-17		MDL	RL	54SB66A 8/19/2004 0-1		MDL	RL	54SB66B 8/19/2004 9-10		MDL	RL	54SB66C 8/19/2004 11-12		MDL	RL	54SB67A 8/19/2004 0-1		MDL	RL	54SB67B 8/19/2004 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U	0.246	1	<1	U	0.246	1	<1	U	0.246	1	<1	U	0.287	1	<1	U	0.226	1	<1	U	0.226	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0718	0.5	<0.5	U	0.0564	0.5	<0.5	U	0.0564	0.5
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.102	0.5	<0.5	U	0.0801	0.5	<0.5	U	0.0801	0.5
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.118	1	<1	U	0.118	1	<1	U	0.118	1	<1	U	0.138	1	<1	U	0.109	1	<1	U	0.109	1
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	ND				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5	<0.5	U	0.124	0.5	<0.5	U	0.0972	0.5	<0.5	U	0.0972	0.5
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0748	0.5	<0.5	U	0.0587	0.5	<0.5	U	0.0587	0.5
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.208	1	<1	U	0.208	1	<1	U	0.208	1	<1	U	0.242	1	<1	U	0.19	1	<1	U	0.19	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1.45	10	<10	U	1.45	10	<10	U	1.45	10	<10	U	1.69	10	<10	U	1.45	10	<10	U	1.33	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	80		0.1	0.1	85		0.1	0.1	81		0.1	0.1	73		0.1	0.1	89		0.1	0.1	87		0.1	0.1

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB67C 8/19/2004 11-12.5		MDL	RL	54SB68A 8/19/2004 0-1		MDL	RL	54SB68B 8/19/2004 9-10		MDL	RL	54SB68C 8/19/2004 16-18		MDL	RL	54SB69A 8/19/2004 0-1		MDL	RL	54SB69B 8/19/2004 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	18,400		4.2	50	10,400		4.2	50	10,900		4.2	50	14,600		4.2	50	14,900		4.2	50	15,800		4.2	50
Antimony	7440-36-0	N	--	3.13	40.88	0.66	0.16	J	0.0386	0.5	0.062	J,B,p	0.0386	0.5	<0.5	U	0.0386	0.5	0.11	J,B,p	0.0386	0.5	0.12	J	0.0386	0.5	<0.5	U	0.0386	0.5
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***4***		0.116	0.4	***1***		0.058	0.4	***0.62***		0.058	0.4	***0.78***		0.058	0.4	***2.5***		0.058	0.4	***1.4***		0.058	0.4
Barium	7440-39-3	N	209	1,564	20,440	300.8	293		0.103	5	166		0.103	5	123		0.103	5	159		0.103	5	191		0.103	5	159		0.103	5
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.28	J	0.0267	1	0.33	J	0.0267	1	0.37	J	0.0267	1	0.64	J	0.0267	1	0.27	J	0.0267	1	0.47	J	0.0267	1
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	***4.5***		0.25	1	1.5		0.25	1	1.5		0.25	1	1.3		0.25	1	2.7		0.25	1	2.4		0.25	1
Calcium	7440-70-2	--	--	--	--	--	1,650		17.5	250	2,030		17.5	250	1,760		17.5	250	2,150		17.5	250	2,350		17.5	250	1,750		17.5	250
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***25***		0.998	5	***19***		0.998	5	***20***		0.998	5	***27***		0.998	5	***22***		0.998	5	***24***		0.998	5
Cobalt	7440-48-4	--	72.3	--	--	--	19		0.233	1	8.3	,J,s	0.233	1	8.3	,J,s	0.233	1	11	,J,s	0.233	1	20		0.233	1	12		0.233	1
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	27		0.516	5	9.4		0.516	5	9.2		0.516	5	12		0.516	5	22		0.516	5	18		0.516	5
Iron	7439-89-6	N	50,962	5,475	71,540	--	94,100		0.731	10	20,100		0.731	10	17,400		0.731	10	22,800		0.731	10	47,900		0.731	10	26,100		0.731	10
Lead [2]	7439-92-1	--	26.8	400	750	--	568		7.76	100	44		0.0776	1	8		0.0776	1	10		0.0776	1	210		1.94	25	247		3.88	50
Magnesium	7439-95-4	--	--	--	--	--	2,940	,J,s	7.67	250	2,610	,J,s	7.67	250	2,880	,J,s	7.67	250	3,850	,J,s	7.67	250	3,030	,J,s	7.67	250	3,610	,J,s	7.67	250
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***3,710***		0.474	5	***651***		0.474	5	***424***		0.474	5	***629***		0.474	5	***1,860***		0.474	5	***864***		0.474	5
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	0.085	J	0.0077	0.1	0.026	J	0.0077	0.1	<0.1	U	0.0077	0.1	0.015	J	0.0077	0.1	0.062	J	0.0077	0.1	0.03	J	0.0077	0.1
Nickel	7440-02-0	N	62.8	156.4	2,044	--	17		0.155	0.5	11		0.0775	0.5	12		0.0775	0.5	15		0.0775	0.5	12		0.0775	0.5	13		0.0775	0.5
Potassium	7440-09-7	--	--	--	--	--	1,830		7.79	100	1,180		7.79	100	1,110		7.79	100	1,110		7.79	100	1,540		7.79	100	1,970		7.79	100
Selenium	7782-49-2	N	--	39.11	511	0.949	0.38	J	0.0972	1	0.12	J	0.0486	1	<1	U	0.0486	1	<1	U	0.0486	1	0.16	J,B,p	0.0486	1	<1	U	0.0486	1
Silver	7440-22-4	N	--	39.11	511	1.551	0.27	J	0.0178	3	0.053	J	0.0178	3	0.046	J	0.0178	3	0.063	J	0.0178	3	0.14	J	0.0178	3	0.11	J	0.0178	3
Sodium	7440-23-5	--	--	--	--	--	38	J	31.4	100	34	J	31.4	100	37	J	31.4	100	41	J	31.4	100	42	J	31.4	100	<100	U	31.4	100
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	***4.1***		0.0733	0.5	***0.22***	J	0.0733	0.5	0.14	J	0.0733	0.5	0.15	J	0.0733	0.5	***0.77***		0.0733	0.5	***0.35***	J	0.0733	0.5
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	***49***		0.401	1.2	23	,J,s	0.401	1.2	25	,J,s	0.401	1.2	32	,J,s	0.401	1.2	36		0.401	1.2	***38***		0.401	1.2
Zinc	7440-66-6	N	202	2,346	30,660	681.1	***2,750***		0.789	4	152	,J,s	0.789	4	56	,J,s	0.789	4	72	,J,s	0.789	4	***711***		0.789	4	***748***		0.789	4
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<20	U	2.86	20	<20	U	3.46	20	<20	U	3.52	20	<20	U	3.75	20	<20	U	3.35	20	<20	U	2.56	20
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	<20	U	2.96	20	<20	U	3.23	20	<20	U	3.28	20	<20	U	3.5	20	<20	U	3.13	20	<20	U	2.65	20
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<20	U	2.42	20	<20	U	2.69	20	<20	U	2.74	20	<20	U	2.92	20	<20	U	2.61	20	<20	U	2.17	20
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<20	U	2.78	20	<20	U	2.33	20	<20	U	2.37	20	<20	U	2.53	20	<20	U	2.26	20	<20	U	2.49	20
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	<20	U	2.93	20	<20	U	3.22	20	<20	U	3.28	20	<20	U	3.49	20	<20	U	3.12	20	<20	U	2.63	20
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<20	U	4.55	20	<20	U	2.6	20	<20	U	2.65	20	<20	U	2.82	20	<20	U	2.52	20	<20	U	4.08	20
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<20	U	2.11	20	<20	U	3.14	20	<20	U	3.2	20	<20	U	3.41	20	<20	U	3.05	20	<20	U	1.9	20
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<20	U	2.7	20	<20	U	2.74	20	<20	U	2.79	20	<20	U	2.97	20	<20	U	2.66	20	<20	U	2.42	20
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<20	U	2.13	20	<20	U	2.95	20	<20	U	3	20	<20	U	3.2	20	<20	U	2.86	20	<20	U	1.91	20
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<20	U	2.44	20	<20	U	4.15	20	<20	U	4.22	20	<20	U	4.5	20	<20	U	4.02	20	<20	U	2.19	20
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U	3.38	20	<20	U	5.6	20	<20	U	5.69	20	<20	U	6.06	20	<20	U,UJ,c	5.42	20	<20	U	3.03	20
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<33	U	9.52	33	<33	U	8.16	33	<33	U	8.16	33	<33	U	8.84	33	15	J	8.16	33	<33	U	8.16	33
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<66	U	14.1	66	<66	U	12.1	66	<66	U	12.1	66	<66	U	13.1	66	<66	U	12.1	66	<66	U	13.1	66
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

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SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB67C 8/19/2004 11-12.5		MDL	RL	54SB68A 8/19/2004 0-1		MDL	RL	54SB68B 8/19/2004 9-10		MDL	RL	54SB68C 8/19/2004 16-18		MDL	RL	54SB69A 8/19/2004 0-1		MDL	RL	54SB69B 8/19/2004 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB67C 8/19/2004 11-12.5		MDL	RL	54SB68A 8/19/2004 0-1		MDL	RL	54SB68B 8/19/2004 9-10		MDL	RL	54SB68C 8/19/2004 16-18		MDL	RL	54SB69A 8/19/2004 0-1		MDL	RL	54SB69B 8/19/2004 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U	0.287	1	<1	U	0.246	1	<1	U	0.246	1	<1	U	0.267	1	<1	U	0.246	1	<1	U	0.246	1
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<0.5	U	0.0718	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0667	0.5	<0.5	U	0.0616	0.5	<0.5	U	0.0616	0.5
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<0.5	U	0.102	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0946	0.5	<0.5	U	0.0874	0.5	<0.5	U	0.0874	0.5
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.138	1	<1	U	0.118	1	<1	U	0.118	1	<1	U	0.128	1	<1	U	0.118	1	<1	U	0.118	1
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	ND				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.124	0.5	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5	<0.5	U	0.115	0.5	<0.5	U	0.106	0.5	<0.5	U	0.106	0.5
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.0748	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0694	0.5	<0.5	U	0.0641	0.5	<0.5	U	0.0641	0.5
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.242	1	<1	U	0.208	1	<1	U	0.208	1	<1	U	0.225	1	<1	U	0.208	1	<1	U	0.208	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1.69	10	<10	U	1.45	10	<10	U	1.45	10	<10	U	1.57	10	<10	U	1.45	10	<10	U	1.45	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	74		0.1	0.1	83		0.1	0.1	82		0.1	0.1	77		0.1	0.1	86		0.1	0.1	82		0.1	0.1

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
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Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB69B-DUP(DUP-5) 8/19/2004 9-10		MDL	RL	54SB69C 8/19/2004 12-14		MDL	RL	54SB70A 8/19/2004 0-1		MDL	RL	54SB70B 8/19/2004 9-10		MDL	RL	54SB70C 8/19/2004 12.5-14		MDL	RL	54SB81A 1/10/2007 0-0.5		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	16,600		4.2	50	16,700		4.2	50	17,100		4.2	50	9,110		4.2	50	4,720		4.2	50	NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	0.076	,J,B,p	0.0386	0.5	<0.5	U	0.0386	0.5	<0.5	U	0.0386	0.5	<0.5	U	0.0386	0.5	<0.5	U	0.0386	0.5	NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***1.3***		0.058	0.4	***1.2***		0.058	0.4	***1.3***		0.058	0.4	***0.58***		0.058	0.4	***1.5***		0.058	0.4	NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	161		0.103	5	163		0.103	5	159		0.103	5	74		0.103	5	44		0.103	5	NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	0.38	J	0.0267	1	0.52	J	0.0267	1	0.5	J	0.0267	1	0.4	J	0.0267	1	0.076	J	0.0267	1	NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	2.5		0.25	1	2.6		0.25	1	2.3		0.25	1	1.2		0.25	1	1.1		0.25	1	NT			
Calcium	7440-70-2	--	--	--	--	--	1,910		17.5	250	1,730		17.5	250	1,970		17.5	250	1,280		17.5	250	843		17.5	250	NT			
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***26***		0.998	5	***27***		0.998	5	***26***		0.998	5	***17***		0.998	5	***11***		0.998	5	NT			
Cobalt	7440-48-4	--	72.3	--	--	--	13	,J,s	0.233	1	13		0.233	1	12		0.233	1	7.6	,J,s	0.233	1	4.2	,J,s	0.233	1	NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	19		0.516	5	20		0.516	5	18		0.516	5	7.2		0.516	5	3.5	J	0.516	5	NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	28,100		0.731	10	27,700		0.731	10	25,200		0.731	10	15,700		0.731	10	10,200		0.731	10	NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	318		3.88	50	252		3.88	50	255		3.88	50	7.3		0.0776	1	12		0.0776	1	5.7	,J,s	0.041	0.2
Magnesium	7439-95-4	--	--	--	--	--	3,780	,J,s	7.67	250	3,580	,J,s	7.67	250	3,330	,J,s	7.67	250	2,380	,J,s	7.67	250	1,580	,J,s	7.67	250	NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***944***		0.474	5	***936***		0.474	5	***334***		0.474	5	***387***		0.474	5	***226***		0.474	5	NT			
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	0.028	J	0.0077	0.1	0.032	J	0.0077	0.1	0.031	J	0.0077	0.1	<0.1	U	0.0077	0.1	<0.1	U	0.0077	0.1	NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	14		0.0775	0.5	14		0.0775	0.5	14		0.0775	0.5	9		0.0775	0.5	5.7		0.0775	0.5	NT			
Potassium	7440-09-7	--	--	--	--	--	2,090		7.79	100	1,990		7.79	100	1,830		7.79	100	918		7.79	100	692		7.79	100	NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	0.13	J	0.0486	1	<1	U	0.0486	1	0.071	J,B,p	0.0486	1	0.064	J	0.0486	1	0.066	J	0.0486	1	NT			
Silver	7440-22-4	N	--	39.11	511	1.551	0.12	J	0.0178	3	0.11	J	0.0178	3	0.1	J	0.0178	3	0.094	J	0.0178	3	0.031	J	0.0178	3	NT			
Sodium	7440-23-5	--	--	--	--	--	33	J	31.4	100	<100	U	31.4	100	<100	U	31.4	100	35	J	31.4	100	<100	U	31.4	100	NT			
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	***0.35***	J	0.0733	0.5	***0.35***	J	0.0733	0.5	***0.28***	J	0.0733	0.5	0.11	J	0.0733	0.5	<0.5	U	0.0733	0.5	NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	***41***	,J,s	0.401	1.2	***41***		0.401	1.2	***41***		0.401	1.2	21	,J,s	0.401	1.2	12	,J,s	0.401	1.2	NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	***851***	,J,s	0.789	4	***719***		0.789	4	436		0.789	4	52	,J,s	0.789	4	41	,J,s	0.789	4	NT			
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<20	U	3.69	20	<20	U	4.15	20	<20	U	3.28	20	<20	U	3.29	20	<20	U	3.12	20	<3.8	U	1	3.8
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	<20	U	3.44	20	<20	U	3.87	20	<20	U	3.06	20	<20	U	3.07	20	<20	U	2.91	20	<3.8	U	1.2	3.8
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<20	U	2.87	20	<20	U	3.23	20	<20	U	2.55	20	<20	U	2.56	20	<20	U	2.42	20	<3.8	U	0.79	3.8
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<20	U	2.49	20	<20	U	2.8	20	<20	U	2.21	20	<20	U	2.22	20	<20	U	2.1	20	<3.8	U	1.1	3.8
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	<20	U	3.44	20	<20	U	3.87	20	<20	U	3.05	20	<20	U	3.06	20	<20	U	2.9	20	<3.8	U	1.2	3.8
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<20	U	2.78	20	<20	U	3.12	20	<20	U	2.47	20	<20	U	2.47	20	<20	U	2.34	20	<3.8	U	1.2	3.8
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<20	U	3.35	20	<20	U	3.77	20	<20	U	2.98	20	<20	U	2.99	20	<20	U	2.83	20	<2	U	0.75	2
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<20	U	2.92	20	<20	U	3.29	20	<20	U	2.6	20	<20	U	2.6	20	<20	U	2.47	20	<3.8	U	0.55	3.8
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<20	U	3.15	20	<20	U	3.54	20	<20	U	2.8	20	<20	U	2.8	20	<20	U	2.66	20	<7.8	U	1.4	7.8
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<20	U	4.43	20	<20	U	4.98	20	<20	U	3.93	20	<20	U	3.94	20	<20	U	3.74	20	<2	U	0.48	2
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U	5.97	20	<20	U	6.72	20	<20	U	5.3	20	<20	U	5.32	20	<20	U	5.04	20	<20	U	1.5	20
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<33	U	8.84	33	<33	U	9.52	33	<33	U	7.48	33	<33	U	7.48	33	<33	U	7.48	33	<38	U	7	38
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<66	U	13.1	66	<66	U	14.1	66	<66	U	11.1	66	<66	U	11.1	66	<66	U	11.1	66	<38	U	5.1	38
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB69B-DUP(DUP-5) 8/19/2004 9-10		MDL	RL	54SB69C 8/19/2004 12-14		MDL	RL	54SB70A 8/19/2004 0-1		MDL	RL	54SB70B 8/19/2004 9-10		MDL	RL	54SB70C 8/19/2004 12.5-14		MDL	RL	54SB81A 1/10/2007 0-0.5		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB69B-DUP(DUP-5) 8/19/2004 9-10		MDL	RL	54SB69C 8/19/2004 12-14		MDL	RL	54SB70A 8/19/2004 0-1		MDL	RL	54SB70B 8/19/2004 9-10		MDL	RL	54SB70C 8/19/2004 12.5-14		MDL	RL	54SB81A 1/10/2007 0-0.5		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U	0.267	1	<1	U	0.287	1	<1	U	0.226	1	<1	U	0.226	1	<1	U	0.226	1	NT			
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<0.5	U	0.0667	0.5	<0.5	U	0.0718	0.5	<0.5	U	0.0564	0.5	<0.5	U	0.0564	0.5	<0.5	U	0.0564	0.5	NT			
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<0.5	U	0.0946	0.5	<0.5	U	0.102	0.5	<0.5	U	0.0801	0.5	<0.5	U	0.0801	0.5	<0.5	U	0.0801	0.5	NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<1	U	0.128	1	<1	U	0.138	1	<1	U	0.109	1	<1	U	0.109	1	<1	U	0.109	1	NT			
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	ND				ND				ND				ND				ND				NT			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.115	0.5	<0.5	U	0.124	0.5	<0.5	U	0.0972	0.5	<0.5	U	0.0972	0.5	<0.5	U	0.0972	0.5	NT			
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<0.5	U	0.0694	0.5	<0.5	U	0.0748	0.5	<0.5	U	0.0587	0.5	<0.5	U	0.0587	0.5	<0.5	U	0.0587	0.5	NT			
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				ND				ND				ND				NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.225	1	<1	U	0.242	1	<1	U	0.19	1	<1	U	0.19	1	<1	U	0.19	1	NT			
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1.57	10	<10	U	1.69	10	<10	U	1.33	10	<10	U	1.33	10	<10	U	1.33	10	NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	78		0.1	0.1	69		0.1	0.1	88		0.1	0.1	87		0.1	0.1	93		0.1	0.1	86		0.1	0.1

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Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB81A-DUP(DUP3) 1/10/2007 0-0.5		MDL	RL	54SB81B 1/10/2007 9-10		MDL	RL	54SB81C 1/10/2007 19-20		MDL	RL	54SB82A 1/12/2007 0-0.5		MDL	RL	54SB82B 1/12/2007 9-10		MDL	RL	54SB82C 1/12/2007 18-19		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				NT				NT				NT				NT				NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				NT				NT				NT				NT				NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				NT				NT				NT				NT				NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				NT				NT				NT				NT				NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	NT				NT				NT				NT				NT				NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				NT				NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				NT				NT				NT				NT				NT			
Cobalt	7440-48-4	--	72.3	--	--	--	NT				NT				NT				NT				NT				NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				NT				NT				NT				NT				NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				NT				NT				NT				NT				NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	7.1	,J,s	0.041	0.2	4.9	,J,s	0.041	0.2	6.6	,J,s	0.041	0.2	NT				NT				NT			
Magnesium	7439-95-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				NT				NT				NT				NT				NT			
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT				NT				NT				NT				NT				NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				NT				NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				NT				NT				NT				NT				NT			
Silver	7440-22-4	N	--	39.11	511	1.551	NT				NT				NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	NT				NT				NT				NT				NT				NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				NT				NT				NT				NT				NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				NT				NT				NT				NT				NT			
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				<3.9	U	1	3.9	<4.1	U	1.1	4.1	<3.9	U	1.1	3.9	<4	U	1.1	4	<4.1	U	1.1	4.1
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	NT				<3.9	U	1.2	3.9	<4.1	U	1.3	4.1	<3.9	U	1.2	3.9	<4	U	1.3	4	<4.1	U	1.3	4.1
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				<3.9	U	0.79	3.9	<4.1	U	0.85	4.1	<3.9	U	0.8	3.9	<4	U	0.83	4	<4.1	U	0.85	4.1
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				<3.9	U	1.1	3.9	<4.1	U	1.2	4.1	<3.9	U	1.1	3.9	<4	U	1.1	4	<4.1	U	1.2	4.1
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	NT				<3.9	U	1.2	3.9	<4.1	U	1.2	4.1	<3.9	U	1.2	3.9	<4	U	1.2	4	<4.1	U	1.3	4.1
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				<3.9	U	1.2	3.9	<4.1	U	1.3	4.1	<3.9	U	1.2	3.9	<4	U	1.3	4	<4.1	U	1.3	4.1
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				<2	U	0.75	2	<2.1	U	0.8	2.1	<2	U	0.75	2	<2.1	U	0.78	2.1	<2.1	U	0.8	2.1
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				<3.9	U	0.55	3.9	<4.1	U	0.59	4.1	<3.9	U	0.55	3.9	<4	U	0.57	4	<4.1	U	0.59	4.1
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				<7.8	U	1.4	7.8	<8.4	U	1.5	8.4	<7.9	U	1.4	7.9	<8.2	U	1.5	8.2	<8.4	U	1.5	8.4
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				<2	U	0.48	2	<2.1	U	0.52	2.1	<2	U	0.49	2	<2.1	U	0.51	2.1	<2.1	U	0.52	2.1
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				<20	U	1.5	20	<21	U	1.6	21	<20	U	1.5	20	<21	U	1.6	21	<21	U	1.6	21
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				<39	U	7	39	<41	U	7.5	41	<39	U	7	39	<40	U	7.3	40	<41	U	7.5	41
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				<39	U	5.1	39	<41	U	5.5	41	<39	U	5.2	39	<40	U	5.4	40	<41	U	5.5	41
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

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							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				122		0.997	0.997	251	,J,m	0.949	0.949	364		1.14	1.14
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT				<0.997	U	0.997	0.997	<0.949	U	0.949	0.949	0.375	A	1.14	1.14
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				1.87	A,B,z	0.498	0.498	4	A	0.474	0.474	5.87		0.568	0.568
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				0.114	A	0.498	0.498	0.275	A	0.474	0.474	0.218	A	0.568	0.568
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				<0.498	U	0.498	0.498	<0.474	U	0.474	0.474	<0.568	U	0.568	0.568
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				<0.498	U	0.498	0.498	<0.474	U	0.474	0.474	0.109	A	0.568	0.568
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				<0.498	U	0.498	0.498	0.0531	A	0.474	0.474	<0.568	U	0.568	0.568
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				<0.498	U	0.498	0.498	0.123	A	0.474	0.474	0.154	A	0.568	0.568
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				<0.498	U	0.498	0.498	0.0436	A,J,w	0.474	0.474	<0.568	U	0.568	0.568
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				<0.498	U	0.498	0.498	0.184	A	0.474	0.474	<0.568	U	0.568	0.568
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				<0.498	U	0.498	0.498	0.0626	A	0.474	0.474	<0.568	U	0.568	0.568
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				<0.498	U	0.498	0.498	0.0683	A	0.474	0.474	0.0931	A,J,w	0.568	0.568
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				0.0738	A,B,z	0.498	0.498	0.0759	A,J,wz	0.474	0.474	0.104	A,J,w	0.568	0.568
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				<0.498	U	0.498	0.498	0.116	A	0.474	0.474	<0.568	U	0.568	0.568
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				0.0957	A,B,z	0.498	0.498	0.144	A,B,z	0.474	0.474	0.107	A,J,w	0.568	0.568
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				<0.0997	U	0.0997	0.0997	<0.0949	U	0.0949	0.0949	<0.136	U	0.136	0.136
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				0.463	A,B,z	0.0997	0.0997	0.414	A,B,z	0.0949	0.0949	0.454	A,B,z	0.116	0.116
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT				0.134		0	0	0.325		0	0	0.242		0	0
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				0.61		0	0	0.429		0	0	0.832		0	0
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT				0.134		0	0	0.339		0	0	0.397		0	0
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT				0.61		0	0	0.389		0	0	0.581		0	0
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				5.92		0.498	0.498	11.2		0.474	0.474	16.1		0.568	0.568
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				0.209		0.498	0.498	0.275		0.474	0.474	0.37		0.568	0.568
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				0.51		0.498	0.498	2.05		0.474	0.474	1.77		0.568	0.568
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				0.118		0.498	0.498	0.727		0.474	0.474	0.125		0.568	0.568
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				<0.498	U	0.498	0.498	0.675		0.474	0.474	<0.568	U	0.568	0.568
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				0.403	,B,z	0.498	0.498	1.12		0.474	0.474	<0.568	U	0.568	0.568
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				<0.0997	U	0.0997	0.0997	0.0949		0.0949	0.0949	<0.136	U	0.136	0.136
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				0.947	,B,z	0.0997	0.0997	1.64	,B,z	0.0949	0.0949	0.952	,B,z	0.116	0.116
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB81A-DUP(DUP3) 1/10/2007 0-0.5		MDL	RL	54SB81B 1/10/2007 9-10		MDL	RL	54SB81C 1/10/2007 19-20		MDL	RL	54SB82A 1/12/2007 0-0.5		MDL	RL	54SB82B 1/12/2007 9-10		MDL	RL	54SB82C 1/12/2007 18-19		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT				NT				NT				<2.5	U	0.2	2.5	<2.5	U	0.2	2.5	<2.5	U	0.2	2.5
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT				NT				NT				<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT				NT				NT				<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	NT				NT				NT				<2.5	U	0.099	2.5	<2.5	U	0.099	2.5	<2.5	U	0.099	2.5
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	NT				NT				NT				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				<2.5	U	0.088	2.5	<2.5	U	0.088	2.5	<2.5	U	0.088	2.5
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				<2.5	U	0.053	2.5	<2.5	U	0.053	2.5	<2.5	U	0.053	2.5
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT				NT				NT				<2.5	U	0.17	2.5	<2.5	U	0.17	2.5	<2.5	U	0.17	2.5
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				NT				NT				NT				NT				NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	NT				86		0.1	0.1	80		0.1	0.1	85		0.1	0.1	82		0.1	0.1	80		0.1	0.1

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB82C-DUP(Dup 7) 1/12/2007 18-19		MDL	RL	54SB82C-DUP(DUP4) 1/12/2007 18-19		MDL	RL	54SB83A 1/11/2007 0-0.5		MDL	RL	54SB83B 1/11/2007 9-10		MDL	RL	54SB83C 1/11/2007 21-22		MDL	RL	54SB83C-DUP(DUP-3) 1/11/2007 21-22		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				NT				NT				NT				NT				NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				NT				NT				NT				NT				NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				NT				NT				NT				NT				NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				NT				NT				NT				NT				NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	NT				NT				NT				NT				NT				NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				NT				NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				NT				NT				NT				NT				NT			
Cobalt	7440-48-4	--	72.3	--	--	--	NT				NT				NT				NT				NT				NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				NT				NT				NT				NT				NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				NT				NT				NT				NT				NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				NT				NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				NT				NT				NT				NT				NT			
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT				NT				NT				NT				NT				NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				NT				NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				NT				NT				NT				NT				NT			
Silver	7440-22-4	N	--	39.11	511	1.551	NT				NT				NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	NT				NT				NT				NT				NT				NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				NT				NT				NT				NT				NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				NT				NT				NT				NT				NT			
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				<4.4	U	1.2	4.4	<3.7	U	1	3.7	<4	U	1.1	4	<4.1	U	1.1	4.1	<4.1	U	1.1	4.1
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	NT				<4.4	U	1.4	4.4	<3.7	U	1.2	3.7	<4	U	1.2	4	<4.1	U	1.3	4.1	<4.1	U	1.3	4.1
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				<4.4	U	0.9	4.4	<3.7	U	0.77	3.7	<4	U	0.82	4	<4.1	U	0.83	4.1	<4.1	U	0.84	4.1
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				<4.4	U	1.2	4.4	<3.7	U	1.1	3.7	<4	U	1.1	4	<4.1	U	1.1	4.1	<4.1	U	1.2	4.1
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	NT				<4.4	U	1.3	4.4	<3.7	U	1.1	3.7	<4	U	1.2	4	<4.1	U	1.2	4.1	<4.1	U	1.2	4.1
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				<4.4	U	1.4	4.4	<3.7	U	1.2	3.7	<4	U	1.3	4	<4.1	U	1.3	4.1	<4.1	U	1.3	4.1
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				<2.2	U	0.85	2.2	<1.9	U	0.73	1.9	<2.1	U	0.77	2.1	<2.1	U	0.79	2.1	<2.1	U	0.79	2.1
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				<4.4	U	0.62	4.4	<3.7	U	0.53	3.7	<4	U	0.57	4	<4.1	U	0.58	4.1	<4.1	U	0.58	4.1
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				<8.9	U	1.6	8.9	<7.6	U	1.4	7.6	<8.1	U	1.5	8.1	<8.2	U	1.5	8.2	<8.3	U	1.5	8.3
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				<2.2	U	0.55	2.2	<1.9	U	0.47	1.9	<2.1	U	0.5	2.1	<2.1	U	0.51	2.1	<2.1	U	0.51	2.1
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				<22	U	1.7	22	<19	U	1.5	19	<21	U	1.6	21	<21	U	1.6	21	<21	U	1.6	21
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				<44	U	7.9	44	<37	U	6.8	37	<40	U	7.2	40	<41	U	7.4	41	<41	U	7.4	41
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				<44	U	5.8	44	<37	U	5	37	<40	U	5.3	40	<41	U	5.4	41	<41	U	5.4	41
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT				NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB82C-DUP(Dup 7) 1/12/2007 18-19		MDL	RL	54SB82C-DUP(DUP4) 1/12/2007 18-19		MDL	RL	54SB83A 1/11/2007 0-0.5		MDL	RL	54SB83B 1/11/2007 9-10		MDL	RL	54SB83C 1/11/2007 21-22		MDL	RL	54SB83C-DUP(DUP-3) 1/11/2007 21-22		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	405		1.01	1.01	NT				113		0.923	0.923	170		0.933	0.933	170		1.01	1.01	NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	<1.01	U	1.01	1.01	NT				<0.923	U	0.923	0.923	<0.933	U	0.933	0.933	<1.01	U	1.01	1.01	NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	5.49		0.506	0.506	NT				2.33	A	0.461	0.461	2.51	A	0.467	0.467	2.81	A	0.506	0.506	NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	0.233	A	0.506	0.506	NT				0.109	A,B,z	0.461	0.461	0.108	A,B,z	0.467	0.467	<0.506	U	0.506	0.506	NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	<0.506	U	0.506	0.506	NT				<0.461	U	0.461	0.461	<0.467	U	0.467	0.467	<0.506	U	0.506	0.506	NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	0.0749	A	0.506	0.506	NT				<0.461	U	0.461	0.461	<0.467	U	0.467	0.467	<0.506	U	0.506	0.506	NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	<0.506	U	0.506	0.506	NT				<0.461	U	0.461	0.461	<0.467	U	0.467	0.467	<0.506	U	0.506	0.506	NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	<0.506	U	0.506	0.506	NT				<0.461	U	0.461	0.461	<0.467	U	0.467	0.467	<0.506	U	0.506	0.506	NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	0.0567	A,J,w	0.506	0.506	NT				<0.461	U	0.461	0.461	<0.467	U	0.467	0.467	<0.506	U	0.506	0.506	NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	0.229	A	0.506	0.506	NT				<0.461	U	0.461	0.461	<0.467	U	0.467	0.467	<0.506	U	0.506	0.506	NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	0.085	A	0.506	0.506	NT				<0.461	U	0.461	0.461	<0.467	U	0.467	0.467	<0.506	U	0.506	0.506	NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	0.0789	A	0.506	0.506	NT				<0.461	U	0.461	0.461	<0.467	U	0.467	0.467	<0.506	U	0.506	0.506	NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	0.0728	A,J,w	0.506	0.506	NT				<0.461	U	0.461	0.461	<0.467	U	0.467	0.467	<0.506	U	0.506	0.506	NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	0.083	A	0.506	0.506	NT				<0.461	U	0.461	0.461	<0.467	U	0.467	0.467	<0.506	U	0.506	0.506	NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	0.115	A,B,z	0.506	0.506	NT				<0.461	U	0.461	0.461	0.0579	A,B,z	0.467	0.467	0.0809	,J,w	0.506	0.506	NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	<0.101	U	0.101	0.101	NT				<0.108	U	0.108	0.108	<0.116	U	0.116	0.116	<0.114	U	0.114	0.114	NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	0.425	A,B,z	0.108	0.108	NT				0.402	,B,z	0.0923	0.0923	0.498	,B,z	0.0933	0.0933	0.425	A,B,z	0.104	0.104	NT			
TEQ (ND=0)	--	--	--	--	--	--	0.382		0	0	NT				0.0985		0	0	0.144		0	0	0.122		0	0	NT			
TEQ (ND=1/2)	--	--	--	--	--	--	0.519		0	0	NT				0.623		0	0	0.608		0	0	0.697		0	0	NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	0.408		0	0	NT				0.0985		0	0	0.144		0	0	0.147		0	0	NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	0.462		0	0	NT				0.623		0	0	0.608		0	0	0.644		0	0	NT			
Total HpCDD	37871-00-4	--	--	--	--	--	16.3		0.506	0.506	NT				7.14		0.461	0.461	7.25		0.467	0.467	7.96		0.506	0.506	NT			
Total HpCDF	38998-75-3	--	--	--	--	--	0.233		0.506	0.506	NT				0.109	A,B,z	0.461	0.461	0.108	A,B,z	0.467	0.467	<0.506	U	0.506	0.506	NT			
Total HxCDD	34465-46-8	--	--	--	--	--	2.71		0.506	0.506	NT				0.498		0.461	0.461	0.87		0.467	0.467	1.01		0.506	0.506	NT			
Total HxCDF	55684-94-1	--	--	--	--	--	0.66		0.506	0.506	NT				0.0941	,B,z	0.461	0.461	0.0709	,B,z	0.467	0.467	<0.506	U	0.506	0.506	NT			
Total PeCDD	36088-22-9	--	--	--	--	--	0.544		0.506	0.506	NT				<0.461	U	0.461	0.461	<0.467	U	0.467	0.467	<0.506	U	0.506	0.506	NT			
Total PeCDF	30402-15-4	--	--	--	--	--	0.605	,B,z	0.506	0.506	NT				<0.461	U	0.461	0.461	0.0579	,B,z	0.467	0.467	0.0809	,B,z	0.506	0.506	NT			
Total TCDD	41903-57-5	--	--	--	--	--	0.0951		0.101	0.101	NT				<0.108	U	0.108	0.108	<0.116	U	0.116	0.116	<0.114	U	0.114	0.114	NT			
Total TCDF	55722-27-5	--	--	--	--	--	1.51	,B,z	0.108	0.108	NT				0.705	,B,z	0.0923	0.0923	0.933	,B,z	0.0933	0.0933	0.746	,B,z	0.104	0.104	NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB82C-DUP(Dup 7) 1/12/2007 18-19		MDL	RL	54SB82C-DUP(DUP4) 1/12/2007 18-19		MDL	RL	54SB83A 1/11/2007 0-0.5		MDL	RL	54SB83B 1/11/2007 9-10		MDL	RL	54SB83C 1/11/2007 21-22		MDL	RL	54SB83C-DUP(DUP-3) 1/11/2007 21-22		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT				<2.5	U	0.2	2.5	<2.5	U	0.2	2.5	<2.5	U	0.2	2.5	<2.5	U	0.2	2.5	<2.5	U	0.2	2.5
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT				<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT				<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	NT				<2.5	U	0.099	2.5	<2.5	U	0.099	2.5	<2.5	U	0.099	2.5	<2.5	U	0.099	2.5	<2.5	U	0.099	2.5
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	NT				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	NT				<2.5	U	0.088	2.5	<2.5	U	0.088	2.5	<2.5	U	0.088	2.5	<2.5	U	0.088	2.5	<2.5	U	0.088	2.5
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT				<2.5	U	0.053	2.5	<2.5	U	0.053	2.5	<2.5	U	0.053	2.5	<2.5	U	0.053	2.5	<2.5	U	0.053	2.5
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	NT				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT				<2.5	U	0.17	2.5	<2.5	U	0.17	2.5	<2.5	U	0.17	2.5	<2.5	U	0.17	2.5	<2.5	U	0.17	2.5
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				NT				NT				NT				NT				NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	NT				76		0.1	0.1	88		0.1	0.1	83		0.1	0.1	81		0.1	0.1	81		0.1	0.1

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB84A 1/11/2007 0-0.5		MDL	RL	54SB84B 1/11/2007 9-10		MDL	RL	54SB84C 1/11/2007 15-16		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																		
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				NT				NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				NT				NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				NT				NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				NT				NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.68	NT				NT				NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				NT				NT			
Calcium	7440-70-2	--	--	--	--	--	NT				NT				NT			
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				NT				NT			
Cobalt	7440-48-4	--	72.3	--	--	--	NT				NT				NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				NT				NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				NT				NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				NT				NT			
Magnesium	7439-95-4	--	--	--	--	--	NT				NT				NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				NT				NT			
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT				NT				NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				NT				NT			
Potassium	7440-09-7	--	--	--	--	--	NT				NT				NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				NT				NT			
Silver	7440-22-4	N	--	39.11	511	1.551	NT				NT				NT			
Sodium	7440-23-5	--	--	--	--	--	NT				NT				NT			
Thallium	7440-28-0	N	2.11	0.548	7.154	0.182	NT				NT				NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				NT				NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				NT				NT			
TCL Pesticides/PCBs (µg/kg)																		
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				NT			
4,4'-DDT	50-29-3	C	--	1.9E+03	8.4E+03	5.8E+01	NT				NT				NT			
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				NT			
Endosulfan Sulfate [6]	1031-07-8	N	--	4.7E+04	6.1E+05	--	NT				NT				NT			
Endrin aldehyde [7]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				NT			
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				NT			
Aroclor 1254 [8]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				NT			
TCL SVOCs (µg/kg)																		
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				NT				NT			
2-Nitroaniline	88-74-4	--	--	--	--	--	NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT			
Pyrene	129-00-0	N		2.3E+05	3.1E+06	3.4E+04	NT				NT				NT			
SVOC TICs (µg/kg)																		
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT			
13-Octadecenal	56554-90-6	--	--	--	--	--	NT				NT				NT			
Benzenamine, 2-Methyl-3,5-Dinitro-	35572-78-2	N	--	1.6E+04	2.0E+05	--	NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT			
Benzenamine, 3,5-Dinitro-	618-87-1	--	--	--	--	--	NT				NT				NT			
Benzene, 1-Methyl-2-Nitro-	88-72-2	N	--	7.8E+04	1.0E+06	--	NT				NT				NT			
Benzene, 1-Methyl-3-Nitro-	99-08-1	--	--	--	--	--	NT				NT				NT			
Benzene, 1-Methyl-4-Nitro-	99-99-0	--	--	--	--	--	NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT			
Benzene, 4-Methyl-1,2-Dinitro-	610-39-9	--	--	--	--	--	NT				NT				NT			
Benzo[e]pyrene	192-97-2	--	--	--	--	--	NT				NT				NT			
Benzo[k]fluoranthene	207-08-9	--	--	--	--	--	NT				NT				NT			
Cyclopropanenonanoic acid, 2-[(2-butylcy	10152-69-9	--	--	--	--	--	NT				NT				NT			
D:C-Friedooleanan-3-one	5945-53-9	--	--	--	--	--	NT				NT				NT			
Hexadecanoic Acid	57-10-3	--	--	--	--	--	NT				NT				NT			

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Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB84A 1/11/2007 0-0.5		MDL	RL	54SB84B 1/11/2007 9-10		MDL	RL	54SB84C 1/11/2007 15-16		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Oleic Acid	112-80-1	--	--	--	--	--	NT				NT				NT			
Phosphoric acid, triphenyl ester	115-86-6	--	--	--	--	--	NT				NT				NT			
Pyrene, hexadecahydro-	2435-85-0	--	--	--	--	--	NT				NT				NT			
Stigmast-4-en-3-one	1058-61-3	--	--	--	--	--	NT				NT				NT			
Sulfur, Mol. (S8)	10544-50-0	--	--	--	--	--	NT				NT				NT			
Dioxin/Furans (pg/g)																		
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	--	NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT			
TEQ (ND=0)	--	--	--	--	--	--	NT				NT				NT			
TEQ (ND=1/2)	--	--	--	--	--	--	NT				NT				NT			
TEQ EMPC (ND=0)	--	--	--	--	--	--	NT				NT				NT			
TEQ EMPC (ND=1/2)	--	--	--	--	--	--	NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT			
PAHs (µg/kg)																		
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT			
Acenaphthylene [9]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT			
Benzo(g,h,i)perylene [9]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT			
Phenanthrene [9]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT			
PCB Congeners (pg/g)																		
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT			
20-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT			
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT			

Table 4-1
Summary of Detected Chemicals in Soil Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB84A 1/11/2007 0-0.5		MDL	RL	54SB84B 1/11/2007 9-10		MDL	RL	54SB84C 1/11/2007 15-16		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT			
Explosives (mg/kg)																		
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<2.5	U	0.2	2.5	<2.5	U	0.2	2.5	<2.5	U	0.2	2.5
2,4,6-Trinitrotoluene [10]	118-96-7	N	--	3.9E+00	5.1E+01	--	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+00	1.0E+02	1.2E-02	<2.5	U	0.099	2.5	<2.5	U	0.099	2.5	<2.5	U	0.099	2.5
Dinitrotoluene Mix	--	--	--	9.4E-01	4.2E+00	--	ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	355-72-78-2	N	--	1.6E+01	2.0E+02	--	<2.5	U	0.088	2.5	<2.5	U	0.088	2.5	<2.5	U	0.088	2.5
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<2.5	U	0.053	2.5	<2.5	U	0.053	2.5	<2.5	U	0.053	2.5
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<2.5	U	0.17	2.5	<2.5	U	0.17	2.5	<2.5	U	0.17	2.5
Nitroglycerin (mg/kg)																		
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				NT				NT			
Percent Solids (%)																		
Percent Solids	--	--	--	--	--	--	NT				NT				NT			

Notes:

CAS = Chemical Abstracts Service
ft bgs = Feet Below Ground Surface
mg/kg = Milligram Per Kilogram
µg/kg = Microgram Per Kilogram
pg/g = Picogram Per Gram
TAL = Target Analyte List
TCL = Target Compound List
PCB = Polychlorinated Biphenyl
SVOC = Semivolatile Organic Compound
PAH = Polynuclear Aromatic Hydrocarbon
TIC = Tentatively Identified Compound
MDL = Method Detection Limit
RL = Reporting Limit
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code

[A] = Facility-Wide Background Point Estimate as Reported in the Facility-Wide Background Study Report (IT 2001a)
[B] = Sample analyzed for Pesticides/PCBs in January 2007.
[C] = Sample analyzed for Pesticides/PCBs and Dioxin/Furans in January 2007.
[D] = Sample analyzed for Dioxin/Furans in January 2007.
[E] = Sample analyzed for PCBs and PCB Congeners in January 2007.
RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
Adjusted RBCs = a Hazard Quotient (HQ) of 0.1 applied to non-carcinogens
C/N = Carcinogenic/Noncarcinogenic per EPA RBC Table (October 2007)
SSL DAF1 = Soil Screening Levels at a Dilution Attenuation Factor of 1
NT = Not Tested
NR = Not Reported
NI = Not Identified

[1] = Chromium VI RBC value was used
[2] = Lead criteria are Action Levels; see USEPA Region III guidance
[3] = Mercuric chloride soil RBC value used
[4] = Chlordane RBC value was used
[5] = Alpha-BHC RBC value was used
[6] = Endosulfan RBC value was used
[7] = Endrin RBC value was used
[8] = Noncarcinogenic Residential RBC value for Aroclor 1254 was used for screening
[9] = Pyrene RBC value was used
[10] = Noncarcinogenic Residential and Industrial RBC values for 2,4,6-Trinitrotoluene were used for screening

= Concentration Exceeds Adjusted Soil Residential RBC

= Concentration Exceeds Adjusted Soil Industrial RBC

underline = Concentration Exceeds Site Background Values

bold italic = Concentration Exceeds SSL DAF1

Laboratory Qualifiers

A	Amount detected is less than the Lower Calibration Limit.
B	Analyte found in associated blank as well as in the sample.
D	Discrepancies between the reported concentrations may be due to dilution of the sample or extract.
J	Estimated value.
E	Concentration exceeded the upper level of the calibration range of the instrument for that specific analysis. For TICs, compound not present in calibration standard, calculated using total peak areas ion chromatographs and response factor of
N	Presumptive evidence of a compound.
P	Greater than 40% difference for detected concentrations between the two GC or HPLC columns.
U	The compound was analyzed for but not detected. The reporting limit will be adjusted to reflect any dilution, and for soil, the percent moisture.

Validation Qualifiers

B	Not detected substantially above the level reported in laboratory or field blanks.
N	Tentative Identification. Consider present. Special methods may be needed to confirm its presence or absence in future sampling efforts.
J	Analyte present. Reported value may not be accurate or precise.
K	Analyte present. Reported value may be biased high. Actual value is expected to be lower.
L	Analyte present. Reported value may be biased low. Actual value is expected to be higher.
R	Unreliable result. Analyte may or may not be present in the sample. Supporting data necessary to confirm result.
U	Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
UJ	Not detected, quantitation limit may be inaccurate or imprecise.
UL	Not detected, quantitation limit is probably higher.

Reason Codes

GC/MS Organics

c	Calibration failure; poor (RRF) or unstable (%D) response
d	MS/MSD or LCS/LCSD RPD imprecision
i	Tuning Failure or poor mass spectrometer performance
l	MS/MSD recovery failure
q	Concentration exceeded the linear range
r	linearity (%RSD or r) failure in initial calibration
s	Surrogate failure
t	Tentatively identified Compound
w	Identification criteria failure
x	Field and/or equipment blank contamination
z	Method blank and/or storage blank contamination

Inorganics and Conventionals

f	Field duplicate imprecision
k	Laboratory duplicate imprecision
m	MS/MSD recovery failure
o	Calibration blank contamination
p	Preparation blank contamination
s	Serial dilution failure
w	Laboratory storage blank contamination
x	CRDL standard recovery failure

GC and HPLC Organics

c	Calibration failure; poor or unstable (%D) response
d	MS/MSD or LCS/LCSD RPD imprecision
g	Dual column confirmation imprecision
i	LCS recovery failure
l	MS/MSD recovery failure
q	linearity (%RSD or r) failure in initial calibration
r	Surrogate failure
s	No confirmation column
w	Field and/or equipment blank contamination
x	Trip blank contamination
z	Method blank and/or storage blank contamination

Note: 1. Source of Data Qualifier Codes: United States Environmental Protection Agency (USEPA) Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses, April 1993.
2. Source of Data Qualifier Codes: United States Environmental Protection Agency (USEPA) Region III Modifications to National Functional Guidelines for Organic Data Review Multimedia, Multi-Concentration (OLMO1.0-OLMO1.9), September 1994.

Table 4-2
Area A - Summary of Risk Screening Results for Soil
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

	CAS #	Facility Background	Adjusted R-RBC	C/N	Adjusted I-RBC	C/N	SSL DAF1	Minimum Detected Concentration	Maximum Detected Concentration	# of Samples that Exceed Adj. R-RBC[A]	# of Samples that Exceed Adj. I-RBC[A]	# of Samples that Exceed SSL[A]	# of Detections	# of Samples
TAL Metals (mg/kg)														
Aluminum	7429-90-5	40,041	7,821	N	102,200	N	--	4,720	23,400	0	0	--	89	89
Antimony	7440-36-0	--	3.1	N	40.9	N	0.66	0.04	4.8	**1**	0	**1**	44	82
Arsenic	7440-38-2	15.8	0.43	C	1.9	C	0.0013	0.29	4.7	0	0	0	88	89
Barium	7440-39-3	209	1,564	N	20,440	N	301	44	293	0	0	0	89	89
Beryllium	7440-41-7	1.02	15.6	N	204	N	58	0.073	1.1	0	0	0	89	89
Cadmium	7440-43-9	0.69	3.9	N	51.1	N	2.7	0.1	4.5	**1**	0	**6**	48	89
Calcium	7440-70-2	--	--	--	--	--	--	666	21,500	--	--	--	89	89
Chromium [1]	7440-47-3	65.3	23.5	N	307	N	2.1	9.7	30	0	0	0	89	89
Cobalt	7440-48-4	72.3	--	--	--	--	--	4.2	20	--	--	--	89	89
Copper	7440-50-8	53.5	313	N	4,088	N	526	2	84.1	0	0	0	89	89
Iron	7439-89-6	50,962	5,475	N	71,540	N	--	10,100	94,100	**4**	**2**	--	89	89
Lead [2]	7439-92-1	27	400	--	750	--	--	4.4	568	**4**	0	--	92	92
Magnesium	7439-95-4	--	--	--	--	--	--	1,580	7,465	--	--	--	89	89
Manganese	7439-96-5	2,543	156	N	2,044	N	47.6	220	3,710	**2**	**2**	**2**	89	89
Mercury [3]	7439-97-6	0.13	2.3	--	31	--	--	0.008	0.540	0	0	--	80	89
Nickel	7440-02-0	63	156	N	2,044	N	--	5.7	17	0	0	--	89	89
Potassium	7440-09-7	--	--	--	--	--	--	692	2,800	--	--	--	89	89
Selenium	7782-49-2	--	39.1	N	511	N	0.95	0.049	2	0	0	**11**	68	89
Silver	7440-22-4	--	39.1	N	511	N	1.6	0.031	0.32	0	0	0	45	89
Sodium	7440-23-5	--	--	--	--	--	--	23.850	525	--	--	--	67	89
Thallium	7440-28-0	2.1	0.55	N	7.2	N	0.18	0.086	4.1	**2**	0	**2**	43	70
Vanadium	7440-62-2	108	7.8	N	102	N	36.5	12	55.3	0	0	0	89	89
Zinc	7440-66-6	202	2,346	N	30,660	N	681	30.1	2,750	**1**	0	**11**	89	89
TCL Pesticides/PCBs (µg/kg)														
4,4'-DDE	72-55-9	--	1,879	C	8,416	C	1,761	4.8	4.8	0	0	0	1	75
4,4'-DDT	50-29-3	--	1,879	C	8,416	C	58	2.1	26	0	0	0	5	75
alpha-Chlordane [4]	5103-71-9	--	1,825	C	8,176	C	--	3.1	3.1	0	0	--	1	75
delta-BHC [5]	319-86-8	--	101	C	454	C	--	0.46	0.5	0	0	--	2	75
Endosulfan Sulfate [6]	1031-07-8	--	46,929	N	613,200	N	--	1.8	1.8	0	0	--	1	75
Endrin aldehyde [7]	7421-93-4	--	2,346	N	30,660	N	--	1.2	26	0	0	--	3	75
gamma-BHC (Lindane)	58-89-9	--	491	C	2,201	C	0.22	1.6	1.6	0	0	**1**	1	75
gamma-Chlordane [4]	5103-74-2	--	1,825	C	8,176	C	--	10	13	0	0	--	2	75
Heptachlor	76-44-8	--	142	C	636	C	42	1.1	4.8	0	0	0	2	75
Heptachlor epoxide	1024-57-3	--	70.2	C	314	C	1.2	1.9	290	**3**	0	**5**	5	75
Methoxychlor	72-43-5	--	39,107	N	511,000	N	15,252	6.3	7.4	0	0	0	2	75
Aroclor 1254 [8]	11097-69-1	--	156	N	1,431	C	54	12	200	**1**	0	**2**	7	75
Aroclor 1260	11096-82-5	--	319	C	1,431	C	--	78	78	0	0	--	1	75
TCL SVOCs (µg/kg)														
2-Nitroaniline	88-74-4	--	--	--	--	--	--	55	55	--	--	--	1	36
Bis(2-ethylhexyl)phthalate	117-81-7	--	45,623	C	204,400	C	144,470	29.5	2,600	0	0	0	25	36
Di-n-butylphthalate	84-74-2	--	782,143	N	10,220,000	N	248,200	37	800	0	0	0	10	36
Di-n-octylphthalate	117-84-0	--	--	--	--	--	--	31	385	--	--	--	12	36
Diethylphthalate	84-66-2	--	6,257,143	N	81,760,000	N	22,659	120	680	0	0	0	8	36
N-Nitrosodiphenylamine	86-30-6	--	130,352	C	584,000	C	38	66	1,200	0	0	**6**	6	36
PAHs (µg/kg)														
Acenaphthene	83-32-9	--	469,286	N	6,132,000	N	5,242	27	8,600	0	0	**1**	17	26
Acenaphthylene [9]	208-96-8	--	234,643	N	3,066,000	N	--	10	1,100	0	0	--	10	36
Anthracene	120-12-7	--	2,346,429	N	30,660,000	N	23,280	15	88.5	0	0	0	2	36
Benzo(a)anthracene	56-55-3	--	220	C	3,920	C	24	3.6	350	**1**	0	**6**	17	36
Benzo(a)pyrene	50-32-8	--	22	C	392	C	6.1	2	675	**4**	**1**	**10**	13	36
Benzo(b)fluoranthene	205-99-2	--	220	C	3,920	C	74	4.9	725	**1**	0	**3**	15	36
Benzo(g,h,i)perylene [9]	191-24-2	--	234,643	N	3,066,000	N	--	11	515	0	0	--	6	36
Benzo(k)fluoranthene	207-08-9	--	2,200	C	39,200	C	738	3.7	1,000	0	0	**1**	14	36
Chrysene	218-01-9	--	22,000	C	392,000	C	2,389	4.5	405	0	0	0	15	36
Dibenz(a,h)anthracene	53-70-3	--	22	C	392	C	23	16	681	**4**	**1**	**4**	6	36
Fluoranthene	206-44-0	--	312,857	N	4,088,000	N	312,732	4.8	1,110	0	0	0	27	36
Fluorene	86-73-7	--	312,857	N	4,088,000	N	6,765	26	26	0	0	0	1	20
Indeno(1,2,3-cd)pyrene	193-39-5	--	220	C	3,920	C	208	5.9	517	**2**	0	**2**	7	36
Naphthalene	91-20-3	--	156,429	N	2,044,000	N	7.7	23	9,400	0	0	**16**	16	23
Phenanthrene [9]	85-01-8	--	234,643	N	3,066,000	N	--	11	240	0	0	--	7	36
Pyrene	129-00-0	--	234,643	N	3,066,000	N	34,100	8.08	1,210	0	0	0	25	36

Table 4-2
Area A - Summary of Risk Screening Results for Soil
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

	CAS #	Facility Background	Adjusted R-RBC	C/N	Adjusted I-RBC	C/N	SSL DAF1	Minimum Detected Concentration	Maximum Detected Concentration	# of Samples that Exceed Adj. R-RBC[A]	# of Samples that Exceed Adj. I-RBC[A]	# of Samples that Exceed SSL[A]	# of Detections	# of Samples
Explosives (mg/kg)														
1,3,5-Trinitrobenzene	99-35-4	--	235	N	3,066	N	--	1.8	7.6	0	0	--	2	78
2,4,6-Trinitrotoluene[10]	118-96-7	--	3.9	N	51	N	--	0.23	130	**3**	**1**	--	9	103
2,4-Dinitrotoluene	121-14-2	--	16	N	204	N	0.029	0.4	17	**1**	0	**3**	3	103
2,6-Dinitrotoluene	606-20-2	--	7.8	N	102	N	0.012	1.1	11	**1**	0	**2**	2	103
DNT Mixture	--	--	0.94	C	4.2	C	--	0.495	28	**2**	**1**	--	3	103
2-Amino-4,6-Dinitrotoluene	355-72-78-2	--	16	N	204	N	--	0.170	5.7	0	0	--	7	103
4-Amino-2,6-Dinitrotoluene	1946-51-0	--	16	N	204	N	--	0.38	5.2	0	0	--	6	103
Aminodinitrotoluenes	--	--	16	N	204	N	--	0.20	10.9	0	0	--	7	102
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	--	391	N	5,110	N	--	6.8	6.8	0	0	--	1	103
Nitroglycerin (mg/kg)														
Nitroglycerin	55-63-0	--	0.78	N	10	N	--	32	32	**1**	**1**	--	1	89
Dioxin/Furans (pg/g)														
Total 2,3,7,8-TCDD TEQ[11]	--	--	4.3	C	19	C	8.6	0.0286	16.98	**3**	0	**1**	29	29

Notes:

CAS = Chemical Abstract Service
mg/kg = Milligram per Kilogram
µg/kg = Microgram per kilogram
pg/g = Picogram per Gram
TAL = Target Analyte List
TCL = Target Compound List
PCB = Polychlorinated Biphenyl
SVOC = Semivolatile Organic Compound
PAH = Polynuclear Aromatic Hydrocarbon
DNT = Dinitrotoluene
Facility Background = Facility-Wide Background Point Estimate as Reported in the Facility-Wide Background Study Report (IT 2001a)
RBC = USEPA Region III Risk-Based Concentration
(RBC) values from the October 11, 2007,
RBC Table and October 11, 2007, Alternate RBC Table
Adjusted RBCs = a Hazard Quotient (HQ) of 0.1 applied to non-carcinogens
R-RBC = Adjusted Residential RBC
I-RBC = Adjusted Industrial RBC
C/N = Carcinogenic/Noncarcinogenic per EPA RBC Table (October 2007)
SSL DAF1 = Soil Screening Levels at a Dilution Attenuation Factor of 1

-- = No screening value available
[A] = For inorganics, number of samples that exceed background (if available) and screening level
[1] = Chromium VI RBC value was used
[2] = Lead criteria are Action Levels; see USEPA Region III guidance
[3] = Mercuric chloride soil RBC value used
[4] = Chlordane RBC value was used
[5] = Alpha-BHC RBC value was used
[5] = alpha-BHC RBC value was used
[6] = Endosulfan RBC value was used
[7] = Endrin RBC value was used
[8] = Noncarcinogenic Residential RBC value for Aroclor 1254 was used for screening
[9] = Pyrene RBC value was used
[10] = Noncarcinogenic Residential and Industrial RBC values for 2,4,6-Trinitrotoluene were used for screening
[11] = See Table 6-3A for Total 2,3,7,8-TCDD TEQ Calculations

Table 4-3
Summary of Detected Chemicals in Direct Push Groundwater Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	Units	54DPW1 12/11/2002		MDL	RL	54DPW2 12/11/2002		MDL	RL	54DPW3 12/11/2002		MDL	RL	54GP77 10/13/2004		MDL	RL	54GP78 10/11/2004		MDL	RL	54GP78-DUP(DUP-1) 10/11/2004		MDL	RL	54GP79 10/11/2004		MDL	RL
						Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals																															
Aluminum	7429-90-5	N	3,650	--	ug/L	232		21.8	100	32,000		21.8	100	69.1	B,K,w	21.8	100	NT				NT				NT				NT			
Aluminum, Dissolved	7429-90-5	N	3,650	--	ug/L	38	B,K,w	21.8	100	<100	U	21.8	100	<100	U	21.8	100	NT				NT				NT				NT			
Arsenic	7440-38-2	C	0.0446	10	ug/L	<10	U	2.5	10	3.7	B	2.5	10	<10	U	2.5	10	NT				NT				NT				NT			
Barium	7440-39-3	N	730	2,000	ug/L	154		0.2	10	537		0.2	10	132		0.2	10	NT				NT				NT				NT			
Barium, Dissolved	7440-39-3	N	730	2,000	ug/L	165		0.2	10	154		0.2	10	138		0.2	10	NT				NT				NT				NT			
Beryllium	7440-41-7	N	7.3	4	ug/L	<5	U	0.1	5	2.2	B	0.1	5	<5	U	0.1	5	NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	ug/L	80,700		9.6	1,000	72,700		9.6	1,000	82,800		9.6	1,000	NT				NT				NT				NT			
Calcium, Dissolved	7440-70-2	--	--	--	ug/L	86,400		9.6	1,000	75,600		9.6	1,000	88,300		9.6	1,000	NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	10.95	100	ug/L	2.1	B	0.6	5	231		0.6	5	0.95	B	0.6	5	NT				NT				NT				NT			
Chromium, Dissolved [1]	7440-47-3	N	10.95	100	ug/L	<5	U	0.6	5	1.1	B	0.6	5	<5	U	0.6	5	NT				NT				NT				NT			
Cobalt	7440-48-4	--	--	--	ug/L	0.97	B	0.6	5	11.6		0.6	5	2.1	B	0.6	5	NT				NT				NT				NT			
Cobalt, Dissolved	7440-48-4	--	--	--	ug/L	1.7	B	0.6	5	2.1	B	0.6	5	1.9	B	0.6	5	NT				NT				NT				NT			
Copper	7440-50-8	N	146	1,300	ug/L	<5	U	1.4	5	33.4		1.4	5	<5	U	1.4	5	NT				NT				NT				NT			
Iron	7439-89-6	N	2,555	--	ug/L	376		13.7	100	41,900		13.7	100	674		13.7	100	NT				NT				NT				NT			
Iron, Dissolved	7439-89-6	N	2,555	--	ug/L	369		13.7	100	24.3	B	13.7	100	649		13.7	100	NT				NT				NT				NT			
Lead [2]	7439-92-1	--	15	--	ug/L	2.7	B,K,w	2.3	3	19.4		2.3	3	3.4	K,w	2.3	3	NT				NT				NT				NT			
Lead, Dissolved [2]	7439-92-1	--	15	--	ug/L	<3	U	2.3	3	<3	U	2.3	3	<3	U	2.3	3	NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	ug/L	29,300		6.1	1,000	34,500		6.1	1,000	29,900		6.1	1,000	NT				NT				NT				NT			
Magnesium, Dissolved	7439-95-4	--	--	--	ug/L	31,100		6.1	1,000	28,600		6.1	1,000	31,600		6.1	1,000	NT				NT				NT				NT			
Manganese	7439-96-5	N	73	--	ug/L	46.6		0.2	10	340		0.2	10	763		0.2	10	NT				NT				NT				NT			
Manganese, Dissolved	7439-96-5	N	73	--	ug/L	54.2		0.2	10	47.5		0.2	10	778		0.2	10	NT				NT				NT				NT			
Mercury [3]	7439-97-6	--	--	2	ug/L	<0.2	U	0.1	0.2	0.16	B	0.1	0.2	<0.2	U	0.1	0.2	NT				NT				NT				NT			
Mercury, Dissolved [3]	7439-97-6	--	--	2	ug/L	<0.2	U	0.1	0.2	<0.2	U	0.1	0.2	<0.2	U	0.1	0.2	NT				NT				NT				NT			
Nickel	7440-02-0	N	73	--	ug/L	7.5		1	5	37		1	5	10.2		1	5	NT				NT				NT				NT			
Nickel, Dissolved	7440-02-0	N	73	--	ug/L	22		1	5	3	B	1	5	9.9		1	5	NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	ug/L	1,350		118	1,000	4,920		118	1,000	1,160		118	1,000	NT				NT				NT				NT			
Potassium, Dissolved	7440-09-7	--	--	--	ug/L	1,450	K,w	118	1,000	1,390	K,w	118	1,000	1,410	K,w	118	1,000	NT				NT				NT				NT			
Selenium	7782-49-2	N	18.25	50	ug/L	<5	U	3.3	5	4.1	B,K,w	3.3	5	<5	U	3.3	5	NT				NT				NT				NT			
Selenium, Dissolved	7782-49-2	N	18.25	50	ug/L	8.1	L,w	3.3	5	7.1	L,w	3.3	5	6.7	L,w	3.3	5	NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	ug/L	4,900		248.7	2,000	8,310		248.7	2,000	4,420		248.7	2,000	NT				NT				NT				NT			
Sodium, Dissolved	7440-23-5	--	--	--	ug/L	5,190		248.7	2,000	8,750		248.7	2,000	4,600		248.7	2,000	NT				NT				NT				NT			
Vanadium	7440-62-2	N	3.65	--	ug/L	1.3	B	0.7	20	52.6		0.7	20	<20	U	0.7	20	NT				NT				NT				NT			
Vanadium, Dissolved	7440-62-2	N	3.65	--	ug/L	1.4	B	0.7	20	<20	U	0.7	20	<20	U	0.7	20	NT				NT				NT				NT			
Zinc	7440-66-6	N	1,095	--	ug/L	26.5		1	20	178		1	20	28.3		1	20	NT				NT				NT				NT			
Zinc, Dissolved	7440-66-6	N	1,095	--	ug/L	79.6	E,J,s	1	20	21.2	E,J,s	1	20	27.1	E,J,s	1	20	NT				NT				NT				NT			
TCL SVOCs																															
2,4-Dinitrotoluene	121-14-2	N	7.3	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
SVOC TICs																															
Benzene, 2-methyl-1,3,5-trinitro-	118-96-7	N	18.3	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Explosives					ug/L																										
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	ug/L	<7.2	U,R,l	1.2	7.2	<3.3	U,R,l	0.56	3.3	<2.1	U,R,l	0.36	2.1	NT				NT				NT				NT			
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	ug/L	<7.2	U,R,l	0.73	7.2	1.5	JB,B,z	0.33	3.3	<2.1	U,R,l	0.21	2.1	NT				NT				NT				NT			
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	ug/L	<9.6	U,R,l	1	9.6	<4.4	U,R,l	0.47	4.4	<2.8	U,R,l	0.3	2.8	NT				NT				NT				NT			
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	ug/L	<9.6	U,R,l	0.94	9.6	<4.4	U,R,l	0.43	4.4	<2.8	U,R,l	0.27	2.8	NT				NT				NT				NT			
4-Nitrotoluene	99-99-0	C	4.19	--	ug/L	<7.2	U,R,l	1.6	7.2	<3.3	U,R,l	0.72	3.3	<2.1	U,R,l	0.46	2.1	NT				NT				NT				NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	182.5	--	ug/L	2.6	J,J,l	1.3	9.6	<4.4	U,R,l	0.59	4.4	<2.8	U,R,l	0.37	2.8	NT				NT				NT				NT			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	0.609	--	ug/L	<7.2	U,R,l	1	7.2	<3.3	U,R,l	0.48	3.3	<2.1	U,R,l	0.31	2.1	NT				NT				NT				NT			
Perchlorate																															
Perchlorate	14797-73-0	N	2.56	24.5	ug/L	5.5		0.54	1	27.7		0.54	1	2		0.54	1	3.5		0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1

Table 4-3
Summary of Detected Chemicals in Direct Push Groundwater Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	Units	54GP80 10/13/2004		MDL	RL	54GP81 10/11/2004		MDL	RL	54GP82 10/11/2004		MDL	RL	54GP83 10/11/2004		MDL	RL	54GP84 10/13/2004		MDL	RL	54GP85 10/14/2004		MDL	RL	54GP86 10/13/2004		MDL	RL
						Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals																															
Aluminum	7429-90-5	N	3,650	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Aluminum, Dissolved	7429-90-5	N	3,650	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Arsenic	7440-38-2	C	0.0446	10	ug/L	NT				NT				NT				NT				NT				NT				NT			
Barium	7440-39-3	N	730	2,000	ug/L	NT				NT				NT				NT				NT				NT				NT			
Barium, Dissolved	7440-39-3	N	730	2,000	ug/L	NT				NT				NT				NT				NT				NT				NT			
Beryllium	7440-41-7	N	7.3	4	ug/L	NT				NT				NT				NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Calcium, Dissolved	7440-70-2	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	10.95	100	ug/L	NT				NT				NT				NT				NT				NT				NT			
Chromium, Dissolved [1]	7440-47-3	N	10.95	100	ug/L	NT				NT				NT				NT				NT				NT				NT			
Cobalt	7440-48-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Cobalt, Dissolved	7440-48-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Copper	7440-50-8	N	146	1,300	ug/L	NT				NT				NT				NT				NT				NT				NT			
Iron	7439-89-6	N	2,555	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Iron, Dissolved	7439-89-6	N	2,555	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Lead [2]	7439-92-1	--	15	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Lead, Dissolved [2]	7439-92-1	--	15	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Magnesium, Dissolved	7439-95-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Manganese	7439-96-5	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Manganese, Dissolved	7439-96-5	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Mercury [3]	7439-97-6	--	--	2	ug/L	NT				NT				NT				NT				NT				NT				NT			
Mercury, Dissolved [3]	7439-97-6	--	--	2	ug/L	NT				NT				NT				NT				NT				NT				NT			
Nickel	7440-02-0	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Nickel, Dissolved	7440-02-0	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Potassium, Dissolved	7440-09-7	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Selenium	7782-49-2	N	18.25	50	ug/L	NT				NT				NT				NT				NT				NT				NT			
Selenium, Dissolved	7782-49-2	N	18.25	50	ug/L	NT				NT				NT				NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Sodium, Dissolved	7440-23-5	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Vanadium	7440-62-2	N	3.65	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Vanadium, Dissolved	7440-62-2	N	3.65	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Zinc	7440-66-6	N	1,095	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Zinc, Dissolved	7440-66-6	N	1,095	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
TCL SVOCs																															
2,4-Dinitrotoluene	121-14-2	N	7.3	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
SVOC TICs																															
Benzene, 2-methyl-1,3,5-trinitro-	118-96-7	N	18.3	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Explosives					ug/L																										
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
4-Nitrotoluene	99-99-0	C	4.19	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	182.5	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	0.609	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Perchlorate																															
Perchlorate	14797-73-0	N	2.56	24.5	ug/L	<1	U	0.1	1	1		0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1

Table 4-3
Summary of Detected Chemicals in Direct Push Groundwater Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	Units	54GP87 10/14/2004		MDL	RL	54GW56 8/18/2004		MDL	RL	54GW57 8/17/2004		MDL	RL	54GW58 8/24/2004		MDL	RL	54GW59 8/18/2004		MDL	RL	54GW59-DUP(DUP-3) 8/18/2004		MDL	RL	54GW60 8/24/2004		MDL	RL
						Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals																															
Aluminum	7429-90-5	N	3,650	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Aluminum, Dissolved	7429-90-5	N	3,650	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Arsenic	7440-38-2	C	0.0446	10	ug/L	NT				NT				NT				NT				NT				NT				NT			
Barium	7440-39-3	N	730	2,000	ug/L	NT				NT				NT				NT				NT				NT				NT			
Barium, Dissolved	7440-39-3	N	730	2,000	ug/L	NT				NT				NT				NT				NT				NT				NT			
Beryllium	7440-41-7	N	7.3	4	ug/L	NT				NT				NT				NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Calcium, Dissolved	7440-70-2	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	10.95	100	ug/L	NT				NT				NT				NT				NT				NT				NT			
Chromium, Dissolved [1]	7440-47-3	N	10.95	100	ug/L	NT				NT				NT				NT				NT				NT				NT			
Cobalt	7440-48-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Cobalt, Dissolved	7440-48-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Copper	7440-50-8	N	146	1,300	ug/L	NT				NT				NT				NT				NT				NT				NT			
Iron	7439-89-6	N	2,555	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Iron, Dissolved	7439-89-6	N	2,555	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Lead [2]	7439-92-1	--	15	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Lead, Dissolved [2]	7439-92-1	--	15	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Magnesium, Dissolved	7439-95-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Manganese	7439-96-5	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Manganese, Dissolved	7439-96-5	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Mercury [3]	7439-97-6	--	--	2	ug/L	NT				NT				NT				NT				NT				NT				NT			
Mercury, Dissolved [3]	7439-97-6	--	--	2	ug/L	NT				NT				NT				NT				NT				NT				NT			
Nickel	7440-02-0	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Nickel, Dissolved	7440-02-0	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Potassium, Dissolved	7440-09-7	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Selenium	7782-49-2	N	18.25	50	ug/L	NT				NT				NT				NT				NT				NT				NT			
Selenium, Dissolved	7782-49-2	N	18.25	50	ug/L	NT				NT				NT				NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Sodium, Dissolved	7440-23-5	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Vanadium	7440-62-2	N	3.65	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Vanadium, Dissolved	7440-62-2	N	3.65	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Zinc	7440-66-6	N	1,095	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Zinc, Dissolved	7440-66-6	N	1,095	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
TCL SVOCs																															
2,4-Dinitrotoluene	121-14-2	N	7.3	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
SVOC TICs																															
Benzene, 2-methyl-1,3,5-trinitro-	118-96-7	N	18.3	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Explosives					ug/L																												
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	ug/L	NT				32		0.158	0.65	<0.65	U	0.158	0.65	9.2		0.158	0.65	<0.65	U	0.158	0.65	<0.65	U	0.158	0.65	<0.65	U	0.158	0.65
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	ug/L	NT				160		0.15	1.3	1.7	,J,g	0.0749	0.65	15		0.0749	0.65	4.2	,L,f	0.0749	0.65	11	,J,g	0.0749	0.65	9.3		0.0749	0.65
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	ug/L	NT				8.7		0.2	1	<1	U	0.2	1	7.5		0.2	1	1.4		0.2	1	3		0.2	1	3.8		0.2	1
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	ug/L	NT				<2	U	0.628	2	<1	U	0.314	1	<1	U	0.314	1	<1	U,UL,f	0.314	1	3.6		0.314	1	<1	U	0.314	1
4-Nitrotoluene	99-99-0	C	4.19	--	ug/L	NT				<2	U	0.146	2	<2	U	0.146	2	<2	U	0.146	2	<2	U	0.146	2	<2	U	0.146	2	<2	U	0.146	2
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	182.5	--	ug/L	NT				9.4		0.25	1	4.3		0.25	1	9.5		0.25	1	1.1	,L,f	0.25	1	4.1		0.25	1	4.6		0.25	1
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	0.609	--	ug/L	NT				35	,J,g	0.164	0.65	0.69		0.164	0.65	3.7		0.164	0.65	1		0.164	0.65	1.7		0.164	0.65	0.8		0.164	0.65
Perchlorate																																	
Perchlorate	14797-73-0	N	2.56	24.5	ug/L	<1	U	0.1	1	13.5		0.1	1	2		0.1	1	25.8		0.1	1	4		0.1	1	3.6		0.1	1	1.7		0.1	1

Table 4-3
Summary of Detected Chemicals in Direct Push Groundwater Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	Units	54GW61 8/24/2004		MDL	RL	54GW62 8/23/2004		MDL	RL	54GW63 8/23/2004		MDL	RL	54GW64 8/23/2004		MDL	RL	54GW64-DUP(DUP-9) 8/23/2004		MDL	RL	54GW65 8/20/2004		MDL	RL	54GW66 8/20/2004		MDL	RL
						Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals																															
Aluminum	7429-90-5	N	3,650	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Aluminum, Dissolved	7429-90-5	N	3,650	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Arsenic	7440-38-2	C	0.0446	10	ug/L	NT				NT				NT				NT				NT				NT				NT			
Barium	7440-39-3	N	730	2,000	ug/L	NT				NT				NT				NT				NT				NT				NT			
Barium, Dissolved	7440-39-3	N	730	2,000	ug/L	NT				NT				NT				NT				NT				NT				NT			
Beryllium	7440-41-7	N	7.3	4	ug/L	NT				NT				NT				NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Calcium, Dissolved	7440-70-2	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	10.95	100	ug/L	NT				NT				NT				NT				NT				NT				NT			
Chromium, Dissolved [1]	7440-47-3	N	10.95	100	ug/L	NT				NT				NT				NT				NT				NT				NT			
Cobalt	7440-48-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Cobalt, Dissolved	7440-48-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Copper	7440-50-8	N	146	1,300	ug/L	NT				NT				NT				NT				NT				NT				NT			
Iron	7439-89-6	N	2,555	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Iron, Dissolved	7439-89-6	N	2,555	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Lead [2]	7439-92-1	--	15	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Lead, Dissolved [2]	7439-92-1	--	15	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Magnesium, Dissolved	7439-95-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Manganese	7439-96-5	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Manganese, Dissolved	7439-96-5	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Mercury [3]	7439-97-6	--	--	2	ug/L	NT				NT				NT				NT				NT				NT				NT			
Mercury, Dissolved [3]	7439-97-6	--	--	2	ug/L	NT				NT				NT				NT				NT				NT				NT			
Nickel	7440-02-0	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Nickel, Dissolved	7440-02-0	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Potassium, Dissolved	7440-09-7	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Selenium	7782-49-2	N	18.25	50	ug/L	NT				NT				NT				NT				NT				NT				NT			
Selenium, Dissolved	7782-49-2	N	18.25	50	ug/L	NT				NT				NT				NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Sodium, Dissolved	7440-23-5	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Vanadium	7440-62-2	N	3.65	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Vanadium, Dissolved	7440-62-2	N	3.65	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Zinc	7440-66-6	N	1,095	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Zinc, Dissolved	7440-66-6	N	1,095	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
TCL SVOCs																															
2,4-Dinitrotoluene	121-14-2	N	7.3	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
SVOC TICs																															
Benzene, 2-methyl-1,3,5-trinitro-	118-96-7	N	18.3	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Explosives					ug/L																										
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	ug/L	3.4		0.158	0.65	2.2	,J,g	0.158	0.65	<0.65	U	0.158	0.65	<0.65	U	0.158	0.65	<0.65	U	0.158	0.65	<0.65	U	0.158	0.65	NT			
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	ug/L	74		0.0749	0.65	9		0.0749	0.65	<0.65	U	0.0749	0.65	0.82	,J,g	0.0749	0.65	0.76	,J,g	0.0749	0.65	3		0.0749	0.65	NT			
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	ug/L	7.1		0.2	1	3.2		0.2	1	<1	U	0.2	1	0.4	J	0.2	1	0.47	J,J,g	0.2	1	1.3		0.2	1	NT			
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	ug/L	<1	U	0.314	1	<1	U	0.314	1	<1	U	0.314	1	<1	U	0.314	1	<1	U	0.314	1	<1	U	0.314	1	NT			
4-Nitrotoluene	99-99-0	C	4.19	--	ug/L	<2	U	0.146	2	<2	U	0.146	2	0.34	J,J,g	0.146	2	<2	U	0.146	2	<2	U	0.146	2	<2	U	0.146	2	NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	182.5	--	ug/L	9.7		0.25	1	6.6		0.25	1	1		0.25	1	5.5		0.25	1	5.6		0.25	1	6.1		0.25	1	NT			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	0.609	--	ug/L	<0.65	U	0.164	0.65	1.6		0.164	0.65	<0.65	U	0.164	0.65	0.75	,J,g	0.164	0.65	0.73	,J,g	0.164	0.65	0.7		0.164	0.65	NT			
Perchlorate																															
Perchlorate	14797-73-0	N	2.56	24.5	ug/L	3		0.1	1	5.3		0.1	1	<1	U	0.1	1	1.1		0.1	1	0.97	B	0.1	1	1.7		0.1	1	0.94	B,J,m	0.1	1

Table 4-3
Summary of Detected Chemicals in Direct Push Groundwater Analytical Samples at Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	Units	54GW66 8/23/2004		MDL	RL	54GW67 8/20/2004		MDL	RL	54GW67 8/23/2004		MDL	RL	54GW68 8/20/2004		MDL	RL	54GW69 8/20/2004		MDL	RL	54GW69 8/23/2004		MDL	RL	54GW70 8/20/2004		MDL	RL
						Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals																															
Aluminum	7429-90-5	N	3,650	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Aluminum, Dissolved	7429-90-5	N	3,650	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Arsenic	7440-38-2	C	0.0446	10	ug/L	NT				NT				NT				NT				NT				NT				NT			
Barium	7440-39-3	N	730	2,000	ug/L	NT				NT				NT				NT				NT				NT				NT			
Barium, Dissolved	7440-39-3	N	730	2,000	ug/L	NT				NT				NT				NT				NT				NT				NT			
Beryllium	7440-41-7	N	7.3	4	ug/L	NT				NT				NT				NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Calcium, Dissolved	7440-70-2	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	10.95	100	ug/L	NT				NT				NT				NT				NT				NT				NT			
Chromium, Dissolved [1]	7440-47-3	N	10.95	100	ug/L	NT				NT				NT				NT				NT				NT				NT			
Cobalt	7440-48-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Cobalt, Dissolved	7440-48-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Copper	7440-50-8	N	146	1,300	ug/L	NT				NT				NT				NT				NT				NT				NT			
Iron	7439-89-6	N	2,555	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Iron, Dissolved	7439-89-6	N	2,555	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Lead [2]	7439-92-1	--	15	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Lead, Dissolved [2]	7439-92-1	--	15	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Magnesium, Dissolved	7439-95-4	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Manganese	7439-96-5	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Manganese, Dissolved	7439-96-5	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Mercury [3]	7439-97-6	--	--	2	ug/L	NT				NT				NT				NT				NT				NT				NT			
Mercury, Dissolved [3]	7439-97-6	--	--	2	ug/L	NT				NT				NT				NT				NT				NT				NT			
Nickel	7440-02-0	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Nickel, Dissolved	7440-02-0	N	73	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Potassium, Dissolved	7440-09-7	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Selenium	7782-49-2	N	18.25	50	ug/L	NT				NT				NT				NT				NT				NT				NT			
Selenium, Dissolved	7782-49-2	N	18.25	50	ug/L	NT				NT				NT				NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Sodium, Dissolved	7440-23-5	--	--	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Vanadium	7440-62-2	N	3.65	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Vanadium, Dissolved	7440-62-2	N	3.65	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Zinc	7440-66-6	N	1,095	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Zinc, Dissolved	7440-66-6	N	1,095	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
TCL SVOCs																															
2,4-Dinitrotoluene	121-14-2	N	7.3	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
SVOC TICs																															
Benzene, 2-methyl-1,3,5-trinitro-	118-96-7	N	18.3	--	ug/L	NT				NT				NT				NT				NT				NT				NT			
Explosives					ug/L																										
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	ug/L	<0.65	U	0.158	0.65	NT				<0.65	U	0.158	0.65	<0.65	U	0.158	0.65	NT				<0.65	U	0.158	0.65	<0.65	U	0.158	0.65
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	ug/L	<0.65	U	0.0749	0.65	NT				<0.65	U	0.0749	0.65	2.6	,J,g	0.0749	0.65	NT				1.4		0.0749	0.65	<0.65	U	0.0749	0.65
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	ug/L	<1	U	0.2	1	NT				<1	U	0.2	1	0.78	J	0.2	1	NT				0.66	J	0.2	1	<1	U	0.2	1
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	ug/L	<1	U	0.314	1	NT				<1	U	0.314	1	<1	U	0.314	1	NT				<1	U	0.314	1	<1	U	0.314	1
4-Nitrotoluene	99-99-0	C	4.19	--	ug/L	<2	U	0.146	2	NT				<2	U	0.146	2	<2	U	0.146	2	NT				<2	U	0.146	2	<2	U	0.146	2
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	182.5	--	ug/L	2.5		0.25	1	NT				3.7		0.25	1	5.1		0.25	1	NT				5.2		0.25	1	9.7		0.25	1
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	0.609	--	ug/L	<0.65	U	0.164	0.65	NT				<0.65	U	0.164	0.65	<0.65	U	0.164	0.65	NT				0.51	J	0.164	0.65	<0.65	U	0.164	0.65
Perchlorate																															
Perchlorate	14797-73-0	N	2.56	24.5	ug/L	NT				0.59	B,J,m	0.1	1	NT				<1	U	0.1	1	0.65	B,J,m	0.1	1	NT				0.76	B	0.1	1

Notes:

CAS = Chemical Abstracts Service
µg/L = Microgram Per Liter
TAL = Target Analyte List
TCL = Target Compound List
SVOC = Semivolatile Organic Compound
TIC = Tentatively Identified Compound
MDL = Method Detection Limit
RL = Reporting Limit
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code
NI = Not Identified
NT = Not Tested

RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
C = Carcinogenic per EPA RBC Table (October 2007)
N = Noncarcinogenic per EPA RBC Table (October 2007)
MCL = Maximum Contaminant Level

=Exceeds MCL

=Exceeds Adjusted T-RBC

Data Qualifiers:
B = Not detected substantially above the level reported in laboratory or field blanks.
E = Concentration exceeded the upper level of the calibration range of the instrument for that specific analysis. For TICs, compound not present in calibration standard, calculated using total peak areas ion chromatographs and response factor of 1.
J = Analyte present. Reported value may not be accurate or precise.
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
N = Sample spike recovery is outside of control limits.
P = Greater than 40% difference for detected concentrations between the two GC or HPLC columns.
U = Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation limit may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
g = Dual column confirmation imprecision
l = LCS recovery failure
m = MS/MSD recovery failure.
o = Calibration blank contamination
p = Preparation blank contamination
s = Serial dilution failure
w = Field and/or equipment blank contamination
x = Trip blank contamination
z = Method blank and/or storage blank contamination

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Table 4-4
Sample Assemblages Groundwater - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Area A			
Sampling Date	**Monitoring Wells Sampled**	**Sampled Analytes**	**Detected Analyte Classes Used in COPC Screening for HHRA**
March 2003	54MW2 (D), 54MW3 (D), and 54MW5 (U)	TAL metals and mercury (total and dissolved), TCL SVOCs, PAHs, explosives, nitroglycerin, and perchlorate	TCL SVOCs, PAHs, and TAL metals and mercury (total and dissolved)
December 2004	54MW8 (D), 54MW9 (D), and 54MW10 (D)	Manganese (total and dissolved), explosives, nitroglycerin, and perchlorate	Manganese (total and dissolved)
December 2006	54MW1 (U), 54MW2 (D), 54MW3 (D), 54MW5 (U), 54MW8 (D), 54MW9 (D), and 54MW10 (D)	Explosives, perchlorate, pesticides, PCBs, and dioxin/furans[1]	Dioxin/furans
March 2007	54MW1 (U), 54MW2 (D), 54MW3 (D), 54MW5 (U), 54MW8 (D), 54MW9 (D), and 54MW10 (D)	Explosives and perchlorate	None[2]
June 2007	54MW1 (U), 54MW2 (D), 54MW3 (D), 54MW5 (U), 54MW8 (D), 54MW9 (D), and 54MW10 (D)	Explosives and perchlorate	Explosives and perchlorate[3]

Notes:

(U) = Upgradient Well

(D) = Downgradient Well

[1] = Dioxin/furans samples collected at 54MW1, 54MW2, and 54MW3

[2] = Most recent data for explosives, perchlorate, and dioxin/furans used for COPC screening
Data used in nature and extents assessment to demonstrate trends

[3] = Most recent data for explosives and perchlorate used for COPC screening

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Table 4-5
Summary of Detected Chemicals in Groundwater Analytical Samples at Area A
March 2003 and December 2004
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	Units	54MW2 3/4/2003		MDL	RL	54MW3 3/4/2003		MDL	RL	54MW5 3/4/2003		MDL	RL	54MW-8 12/21/2004		MDL	RL	54MW-9 12/21/2004		MDL	RL	54MW-10 12/21/2004		MDL	RL	54MW10-DUP(DUP-1) 12/21/2004		MDL	RL
						Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals																															
Aluminum	7429-90-5	N	3,650	--	ug/L	59	B	29.5	100	<100	U	29.5	100	221		29.5	100	NT				NT				NT				NT			
Aluminum, Dissolved	7429-90-5	N	3,650	--	ug/L	<100	U	11.8	100	<100	U	11.8	100	<100	U	11.8	100	NT				NT				NT				NT			
Arsenic	7440-38-2	C	0.0446	10	ug/L	<10	U	3.6	10	<10	U	3.6	10	<10	U	3.6	10	NT				NT				NT				NT			
Barium	7440-39-3	N	730	2,000	ug/L	137		0.2	10	184		0.2	10	149		0.2	10	NT				NT				NT				NT			
Barium, Dissolved	7440-39-3	N	730	2,000	ug/L	139		0.2	10	190		0.2	10	146		0.2	10	NT				NT				NT				NT			
Beryllium	7440-41-7	N	7.3	4	ug/L	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5	NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	ug/L	49,300		26.2	1,000	79,300		26.2	1,000	88,300		26.2	1,000	NT				NT				NT				NT			
Calcium, Dissolved	7440-70-2	--	--	--	ug/L	51,800		7.9	1,000	82,700		7.9	1,000	90,900		7.9	1,000	NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	10.95	100	ug/L	3	B	0.7	5	2.9	B	0.7	5	5.2		0.7	5	NT				NT				NT				NT			
Chromium, Dissolved [1]	7440-47-3	N	10.95	100	ug/L	1.1	B	0.6	5	1.6	B	0.6	5	0.6	B	0.6	5	NT				NT				NT				NT			
Cobalt	7440-48-4	--	--	--	ug/L	<5	U	0.9	5	<5	U	0.9	5	2.5	B	0.9	5	NT				NT				NT				NT			
Cobalt, Dissolved	7440-48-4	--	--	--	ug/L	<5	U,UL,o	0.5	5	<5	U,UL,o	0.5	5	2.4	B,B,x	0.5	5	NT				NT				NT				NT			
Copper	7440-50-8	N	146	1,300	ug/L	<5	U	1.2	5	<5	U	1.2	5	<5	U	1.2	5	NT				NT				NT				NT			
Iron	7439-89-6	N	2,555	--	ug/L	51.9	B,B,o	15	100	17.6	B,B,o	15	100	267		15	100	NT				NT				NT				NT			
Iron, Dissolved	7439-89-6	N	2,555	--	ug/L	<100	U,UL,p	8.7	100	<100	U,UL,p	8.7	100	<100	U,UL,p	8.7	100	NT				NT				NT				NT			
Lead [2]	7439-92-1	--	15	--	ug/L	<3	U,UL,w	1.3	3	<3	U,UL,w	1.3	3	<3	U,UL,w	1.3	3	NT				NT				NT				NT			
Lead, Dissolved [2]	7439-92-1	--	15	--	ug/L	<3	U	1.1	3	<3	U	1.1	3	<3	U	1.1	3	NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	ug/L	21,100		7.4	1,000	29,900		7.4	1,000	27,500		7.4	1,000	NT				NT				NT				NT			
Magnesium, Dissolved	7439-95-4	--	--	--	ug/L	20,700		5.3	1,000	29,800		5.3	1,000	27,300		5.3	1,000	NT				NT				NT				NT			
Manganese	7439-96-5	N	73	--	ug/L	7.9	B	0.2	10	0.67	B,B,o	0.2	10	157		0.2	10	20		1.68	10	65		1.68	10	190		1.68	10	191		1.68	10
Manganese, Dissolved	7439-96-5	N	73	--	ug/L	2.6	B	0.2	10	0.29	B,B,o	0.2	10	160		0.2	10	20		1.68	10	63		1.68	10	190		1.68	10	180		1.68	10
Mercury [3]	7439-97-6	--	--	2	ug/L	<0.2	U	0.1	0.2	<0.2	U	0.1	0.2	<0.2	U	0.1	0.2	NT				NT				NT				NT			
Mercury, Dissolved [3]	7439-97-6	--	--	2	ug/L	<0.2	U	0.1	0.2	<0.2	U	0.1	0.2	<0.2	U	0.1	0.2	NT				NT				NT				NT			
Nickel	7440-02-0	N	73	--	ug/L	2.7	B	1.2	5	1.7	B	1.2	5	5.9		1.2	5	NT				NT				NT				NT			
Nickel, Dissolved	7440-02-0	N	73	--	ug/L	2.8	B,B,x	1	5	2.1	B,B,x	1	5	4.4	B,B,x	1	5	NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	ug/L	439	B,L,w	30.6	1,000	1,180	L,w	30.6	1,000	1,310	L,w	30.6	1,000	NT				NT				NT				NT			
Potassium, Dissolved	7440-09-7	--	--	--	ug/L	805	B,K,w	68.4	1,000	2,080		68.4	1,000	2,210		68.4	1,000	NT				NT				NT				NT			
Selenium	7782-49-2	N	18.25	50	ug/L	<5	UN	2.1	5	5.1	N,B,p	2.1	5	<5	UN	2.1	5	NT				NT				NT				NT			
Selenium, Dissolved	7782-49-2	N	18.25	50	ug/L	6.1	B,o	2.6	5	7.4	B,o	2.6	5	5	K,w	2.6	5	NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	ug/L	4,560		235	2,000	16,600		235	2,000	6,820		235	2,000	NT				NT				NT				NT			
Sodium, Dissolved	7440-23-5	--	--	--	ug/L	3,140	E,L,w	99.3	2,000	14,900	E,J,s	99.3	2,000	5,310	E,J,s	99.3	2,000	NT				NT				NT				NT			
Vanadium	7440-62-2	N	3.65	--	ug/L	<20	U	0.7	20	<20	U	0.7	20	<20	U	0.7	20	NT				NT				NT				NT			
Vanadium, Dissolved	7440-62-2	N	3.65	--	ug/L	<20	U	0.4	20	<20	U	0.4	20	0.46	B,B,o	0.4	20	NT				NT				NT				NT			
Zinc	7440-66-6	N	1,095	--	ug/L	18	B,L,w	0.6	20	27.6	L,w	0.6	20	4.1	B,L,w	0.6	20	NT				NT				NT				NT			
Zinc, Dissolved	7440-66-6	N	1,095	--	ug/L	21.1		1	20	28.9		1	20	4	B,B,p	1	20	NT				--				NT				NT			
TCL SVOCs																															
2,4-Dinitrotoluene	121-14-2	N	7.3	--	ug/L	2	J	1	10	3	J	1	10	<10	U	1	10	NT				NT				NT				NT			
SVOC TICs																															
Benzene, 2-methyl-1,3,5-trinitro-	118-96-7	N	18.3	--	ug/L	NI				15	NJ,NJ,t	0	0	NI				NT				NT				NT				NT			
Explosives					ug/L																										
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	ug/L	<3.6	U	0.616	3.6	2.2	J	0.616	3.6	<4.2	U	0.72	4.2	<0.65	U	0.158	0.65	<0.65	U	0.158	0.65	12		0.158	0.65	12		0.158	0.65
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	ug/L	<3.6	U	0.365	3.6	38		0.365	3.6	<4.2	U	0.43	4.2	<0.65	U	0.0749	0.65	<0.65	U	0.0749	0.65	62		0.15	1.3	65		0.15	1.3
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	ug/L	2	J	0.515	4.8	4	J	0.515	4.8	<5.6	U	0.6	5.6	<1	U	0.2	1	<1	U	0.2	1	5.6		0.2	1	5.8		0.2	1
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	ug/L	2.8	JP,J,g	0.469	4.8	8.6	P,J,g	0.469	4.8	<5.6	U	0.55	5.6	<1	U	0.314	1	<1	U	0.314	1	<1	U	0.314	1	<1	U	0.314	1
4-Nitrotoluene	99-99-0	C	4.19	--	ug/L	<3.6	U	0.785	3.6	<3.6	U	0.785	3.6	<4.2	U	0.92	4.2	<2	U	0.146	2	<2	U	0.146	2	<2	U	0.146	2	<2	U	0.146	2
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	182.5	--	ug/L	<4.8	U	0.644	4.8	<4.8	U	0.644	4.8	3	J,J,m	0.75	5.6	3		0.25	1	3.4		0.25	1	6.8		0.25	1	7.2		0.25	1
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	0.609	--	ug/L	<3.6	U	0.526	3.6	32		0.526	3.6	<4.2	U	0.61	4.2	0.2	J,J,g	0.164	0.65	1.1	J,J,g	0.164	0.65	28		0.164	0.65	29		0.164	0.65
Perchlorate																															
Perchlorate	14797-73-0	N	2.56	24.5	ug/L	12		0.54	1	59.2		0.54	1	1.6		0.54	1	0.22	B	0.1	1	0.21	B	0.1	1	9.8		0.1	1	9.1		0.1	1
Field Parameters																															
Dissolved Oxygen	--	--	--	--	mg/L	6.97				5.18				2.88				0.25				2.56				1.25				1.25			
Oxidation Reduction Potential	--	--	--	--	mV	159.5				119.0				95.1				215				234				208				208			
pH	--	--	--	--	SU	6.37				6.65				7.00				7.20				7.53				7.06				7.06			
Conductivity	--	--	--	--	mS	0.191				0.341				0.310				0.627				0.706				0.760				0.760			
Temperature	--	--	--	--	°C	16.24				15.97				12.91				13.6				13.2				13.8				13.8			
Turbidity	--	--	--	--	NTU	0.80				1.93				12.0				4.17				4.13				3.52				3.52			

Notes:

CAS = Chemical Abstracts Service
µg/L = Microgram Per Liter
TAL = Target Analyte List
TCL = Target Compound List
SVOC = Semivolatile Organic Compound
TIC = Tentatively Identified Compound
MDL = Method Detection Limit
RL = Reporting Limit
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code
NI = Not Identified
NT = Not Tested
mV = millivolt

SU = Standard Units
mS = milliSiemen
°C = degrees Celcius
NTU = Nephelometric Turbidity
RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
C = Carcinogenic per EPA RBC Table (October 2007)
N = Noncarcinogenic per EPA RBC Table (October 2007)
MCL = Maximum Contaminant Level

=Exceeds MCL

=Exceeds Adjusted T-RBC

Data Qualifiers:
B = Not detected substantially above the level reported in laboratory or field blanks.
E = Concentration exceeded the upper level of the calibration range of the instrument for that specific analysis. For TICs, compound not present in calibration standard, calculated using total peak areas ion chromatographs and response factor of 1.
J = Analyte present. Reported value may not be accurate or precise.
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
N = Sample spike recovery is outside of control limits.
P = Greater than 40% difference for detected concentrations between the two GC or HPLC columns.
U = Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation limit may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.

g = Dual column confirmation imprecision
l = LCS recovery failure
m = MS/MSD recovery failure.
o = Calibration blank contamination
p = Preparation blank contamination
s = Serial dilution failure
w = Field and/or equipment blank contamination
x = Trip blank contamination
z = Method blank and/or storage blank contamination

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Table 4-6
Area A Quarterly Groundwater Monitoring Results Summary
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

First Quarter - November/December 2006

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	54MW1 11/29/2006		MDL	RL	54MW2 11/29/2006		MDL	RL	54MW3 12/5/2006		MDL	RL	54MW5 11/29/2006		MDL	RL	54MW8 12/1/2006		MDL	RL	54MW9 12/1/2006		MDL	RL	54MW10 12/1/2006		MDL	RL
					Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Explosives (ug/L)																																
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	<5	U	0.16	5	0.63	J	0.16	5	0.26	J	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	0.84	J	0.16	5
1,3-Dinitrobenzene	99-65-0	N	0.37	--	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	<5	U	0.075	5	5.6		0.075	5	0.85	J	0.075	5	0.29	J	0.075	5	<5	U	0.075	5	<5	U	0.075	5	2.1	J	0.075	5
2,4-Dinitrotoluene	121-14-2	N	7.3	--	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5
2,6-Dinitrotoluene	606-20-2	N	3.65	--	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5
Dinitrotoluene Mixture	--	C	0.098	--	<5				<5				<5				<5				<5				<5				<5			
2-Nitrotoluene	88-72-2	N	6.08	--	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5
3-Nitrotoluene	99-08-1	--	--	--	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	<5	U	0.2	5	3.6	J	0.2	5	0.8	J	0.2	5	0.92	J	0.2	5	<5	U	0.2	5	<5	U	0.2	5	2.1	J	0.2	5
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	<5	U	0.31	5	3.1	J	0.31	5	1	J	0.31	5	1.1	J	0.31	5	0.42	J	0.31	5	0.36	J	0.31	5	2	J	0.31	5
Aminodinitrotoluenes	--	N	7.3	--	<5				6.7				1.8				2.02				0.52				0.46				4.1			
4-Nitrotoluene	99-99-0	C	4.19	--	<5	U	0.15	5	<5	U	0.15	5	0.69	J	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
HMX	2691-41-0	N	182.5	--	<5	U	0.25	5	9.3	,J,m	0.25	5	3.6	J	0.25	5	4.2	J	0.25	5	2.9	J	0.25	5	2	J	0.25	5	1.6	J	0.25	5
Nitrobenzene	98-95-3	N	0.353	--	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5
RDX	121-82-4	C	0.609	--	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	3.3	J	0.16	5
Tetryl	479-45-8	N	14.6	--	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5	0.38	J	0.18	5	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5
Dioxin/Furans (ng/L)																																
Total 2,3,7,8-TCDD Equivalents	--	C	4.47E-04	--	ND		--	--	3.00E-04		--	--	6.51E-07		--	--	NT				NT				NT				NT			
Perchlorate (ug/L)																																
Perchlorate	14797-73-0	N	2.56	24.5	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10
Field Parameters																																
Dissolved Oxygen (mg/L)	--	--	--	--	11.95				10.29				11.94				10.1				8.94				8.51				8.13			
Oxidation Reduction Potential (mV)	--	--	--	--	153				159				171				231				32				53				36			
pH (SU)	--	--	--	--	7.86				7.15				7.26				7.2				7.53				7.65				7.39			
Conductivity (mS)	--	--	--	--	0.44				0.533				0.580				0.557				0.605				0.790				0.733			
Temperature (°C)	--	--	--	--	18.6				17.7				18.3				18.5				17.1				19.1				16.3			
Turbidity (NTU)	--	--	--	--	4.47				1.16				0.07				16.6				11.83				23.5				10.31			

Second Quarter - March 2007

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	54MW-1 3/28/2007		MDL	RL	54MW-2 3/28/2007		MDL	RL	54MW-3 3/28/2007		MDL	RL	54MW-5 3/28/2007		MDL	RL	54MW-8 3/27/2007		MDL	RL	54MW-9 3/27/2007		MDL	RL	54MW10 DUP AVG 3/27/2007		MDL	RL
					Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Explosives (ug/L)																																
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	<5	U	0.045	5	0.22	J	0.045	5	<5	U	0.045	5	0.19	J	0.045	5	4.6	J	0.045	5	<5	U	0.045	5	1.96	J	0.045	5
1,3-Dinitrobenzene	99-65-0	N	0.37	--	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	<5	U	0.1	5	0.25	J,J,d	0.1	5	<5	U	0.1	5	0.84	J,J,g	0.1	5	14		0.1	5	<5	U	0.1	5	6.018		0.1	5
2,4-Dinitrotoluene	121-14-2	N	7.3	--	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	0.158	J,J,g	0.092	5
2,6-Dinitrotoluene	606-20-2	N	3.65	--	<5	U	0.16	5	1.1	J,J,m	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	0.74	J,J,g	0.16	5
Dinitrotoluene Mixture	--	C	0.098	--	<5				1.146				<5				<5				<5				<5				0.898			
2-Nitrotoluene	88-72-2	N	6.08	--	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5
3-Nitrotoluene	99-08-1	--	--	--	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	<5	U	0.24	5	0.93	J,J,g	0.24	5	<5	U	0.24	5	0.71	J	0.24	5	2.6	J	0.24	5	<5	U	0.24	5	1.26	J	0.24	5
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	<5	U	0.22	5	0.57	J,J,g	0.22	5	<5	U	0.22	5	0.65	J,J,g	0.22	5	2.3	J	0.22	5	<5	U	0.22	5	1.105	J	0.22	5
Aminodinitrotoluenes	--	N	7.3	--	<5				1.5				<5				1.36				4.9				<5				2.31			
4-Nitrotoluene	99-99-0	C	4.19	--	<5	U	0.49	5	0.94	J	0.49	5	<5	U	0.49	5	0.63	J,J,g	0.49	5	0.85	J,J,g	0.49	5	<5	U	0.49	5	<5	U	0.49	5
HMX	2691-41-0	N	182.5	--	<5	U,UJ,l	0.2	5	6.7	,J,l	0.2	5	1.9	J,J,l	0.2	5	2.7	J,J,l	0.2	5	12	,J,l	0.2	5	2.5	J,J,l	0.2	5	5.95	,J,l	0.2	5
Nitrobenzene	98-95-3	N	0.353	--	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	0.3	J	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
RDX	121-82-4	C	0.609	--	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	8.1		0.092	5	<5	U	0.092	5	3.87		0.092	5
Tetryl	479-45-8	N	14.6	--	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	0.68	J	0.15	5	<5	U	0.15	5	<5	U	0.15	5
Perchlorate (ug/L)																																
Perchlorate	14797-73-0	N	2.56	24.5	<0.2	U	0.036	0.2	3.6		0.036	0.2	<0.2	U	0.036	0.2	0.52		0.036	0.2	0.26		0.036	0.2	0.24		0.036	0.2	2.9		0.036	0.2
Field Parameters																																
Dissolved Oxygen (mg/L)	--	--	--	--	8.06				7.75				6.12				8.38				6.68				6.51				8			
Oxidation Reduction Potential (mV)	--	--	--	--	-5				44				-11				53				-17				-10				11			
pH (SU)	--	--	--	--	7.63				6.45				6.94				6.51				7.05				7.18				6.88			
Conductivity (mS)	--	--	--	--	0.199				0.183				0.311				0.167				0.267				0.960				0.334			
Temperature (°C)	--	--	--	--	13.44				15.8				15.22				12.73				13.92				14.43				15.95			
Turbidity (NTU)	--	--	--	--	1.82				0.37				2.13				1.22				13.96				7.71				3.64			

Table 4-6
Area A Quarterly Groundwater Monitoring Results Summary
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Third Quarter - June 2007

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	54MW-1 6/5/2007		MDL	RL	54MW-2 6/5/2007		MDL	RL	54MW-3 6/5/2007		MDL	RL	54MW-5 6/5/2007		MDL	RL	54MW-8 6/5/2007		MDL	RL	54MW-9 6/5/2007		MDL	RL	54MW-10 6/5/2007		MDL	RL
					Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Explosives (ug/L)																																
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	<5	U	0.045	5	2.9	J	0.045	5	0.28	J,J,g	0.045	5	<5	U	0.045	5	<5	U	0.045	5	<5	U	0.045	5	0.75	J	0.045	5
1,3-Dinitrobenzene	99-65-0	N	0.37	--	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	<5	U	0.1	5	3.9	J	0.1	5	1	J	0.1	5	0.49	J	0.1	5	<5	U	0.1	5	<5	U	0.1	5	2.4	J	0.1	5
2,4-Dinitrotoluene	121-14-2	N	7.3	--	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5
2,6-Dinitrotoluene	606-20-2	N	3.65	--	<5	U,UJ,c	0.16	5	<5	U,UJ,c	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	0.42	J	0.16	5	<5	U	0.16	5
Dinitrotoluene Mixture	--	C	0.098	--	ND				ND				ND				ND				ND				0.466				ND			
2-Nitrotoluene	88-72-2	N	6.08	--	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5
3-Nitrotoluene	99-08-1	--	--	--	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	<5	U	0.24	5	4.1	J	0.24	5	0.83	J	0.24	5	0.43	J	0.24	5	<5	U	0.24	5	<5	U	0.24	5	<5	U	0.24	5
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	<5	U	0.22	5	2.2	J	0.22	5	1.3	J	0.22	5	0.82	J,J,g	0.22	5	<5	U	0.22	5	0.82	U	0.22	5	<5	U	0.22	5
Aminodinitrotoluenes	--	N	7.3	--	ND				6.3				2.13				1.25				ND				0.94				ND			
4-Nitrotoluene	99-99-0	C	4.19	--	<5	U	0.49	5	<5	U	0.49	5	1	J	0.49	5	<5	U	0.49	5	<5	U	0.49	5	<5	U	0.49	5	<5	U	0.49	5
HMX	2691-41-0	N	182.5	--	<5	U	0.2	5	30	,J,g	0.2	5	15		0.2	5	6		0.2	5	<5	U	0.2	5	4.1	J	0.2	5	<5	U	0.2	5
Nitrobenzene	98-95-3	N	0.353	--	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
RDX	121-82-4	C	0.609	--	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	6.3		0.092	5	<5	U	0.092	5	1.6	J	0.092	5
Tetryl	479-45-8	N	14.6	--	<5	U,UJ,c	0.15	5	<5	U,UJ,c	0.15	5	<5	U,UJ,c	0.15	5	<5	U,UJ,c	0.15	5	<5	U,UJ,c	0.15	5	<5	U,UJ,c	0.15	5	<5	U,UJ,c	0.15	5
Perchlorate (ug/L)																																
Perchlorate	14797-73-0	N	2.56	24.5	<0.2	U	0.08	0.2	2		0.08	0.2	0.88		0.08	0.2	0.58		0.08	0.2	0.7		0.08	0.2	0.23		0.08	0.2	0.37		0.08	0.2
Field Parameters																																
Dissolved Oxygen (mg/L)	--	--	--	--	7.57				8.46				5.06				8.44				8.82				5.21				7.35			
Oxidation Reduction Potential (mV)	--	--	--	--	297				268				109				236				285				94				187			
pH (SU)	--	--	--	--	7.33				6.78				6.2				6.24				6.9				6.25				6.87			
Conductivity (mS)	--	--	--	--	0.192				0.225				0.003				0.163				0.245				0.003				0.353			
Temperature (°C)	--	--	--	--	13.58				13.48				15.66				21.68				13.4				15.44				14.51			
Turbidity (NTU)	--	--	--	--	0.48				0.29				0.36				0.67				0.06				1.67				9.37			

Fourth Quarter - September 2007

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	54MW-1 9/19/2007		MDL	RL	54MW-2 9/19/2007		MDL	RL	54MW-3 9/19/2007		MDL	RL	54MW-5 9/19/2007		MDL	RL	54MW-8 9/18/2007		MDL	RL	54MW-9 9/18/2007		MDL	RL	54MW-10 9/18/2007		MDL	RL
					Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Explosives (ug/L)																																
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	<5	U	0.045	5	0.65	J	0.045	5	0.17	J	0.045	5	<5	U	0.045	5	<5	U	0.045	5	<5	U	0.045	5	6.5		0.045	5
1,3-Dinitrobenzene	99-65-0	N	0.37	--	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	<5	U	0.1	5	0.78	J	0.1	5	1.2	J	0.1	5	0.38	J,J,g	0.1	5	<5	U	0.1	5	<5	U	0.1	5	17		0.1	5
2,4-Dinitrotoluene	121-14-2	N	7.3	--	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	0.65	J	0.092	5
2,6-Dinitrotoluene	606-20-2	N	3.65	--	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
Dinitrotoluene Mixture	--	C	0.098	--	ND				ND				ND				ND				ND				ND				0.696			
2-Nitrotoluene	88-72-2	N	6.08	--	<5	U	0.28	5	0.82	J,J,g	0.28	5	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5
3-Nitrotoluene	99-08-1	--	--	--	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	<5	U	0.24	5	1	J	0.24	5	0.76	J	0.24	5	0.46	J	0.24	5	<5	U	0.24	5	<5	U	0.24	5	2.2	J	0.24	5
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	<5	U	0.22	5	0.69	J	0.22	5	0.88	J	0.22	5	0.53	J	0.22	5	0.42	J	0.22	5	<5	U	0.22	5	1.8	J	0.22	5
Aminodinitrotoluenes	--	N	7.3	--	ND				1.69				1.64				0.99				0.54				ND				4			
4-Nitrotoluene	99-99-0	C	4.19	--	<5	U	0.49	5	<5	U	0.49	5	<5	U	0.49	5	<5	U	0.49	5	<5	U	0.49	5	<5	U	0.49	5	<5	U	0.49	5
HMX	2691-41-0	N	182.5	--	<5	U	0.2	5	8.2	,J,m	0.2	5	10		0.2	5	10		0.2	5	6.6		0.2	5	<5	U	0.2	5	5.8		0.2	5
Nitrobenzene	98-95-3	N	0.353	--	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
RDX	121-82-4	C	0.609	--	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5	8		0.092	5
Tetryl	479-45-8	N	14.6	--	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
Perchlorate (ug/L)																																
Perchlorate	14797-73-0	N	2.56	24.5	<0.2	U	0.08	0.2	0.57		0.08	0.2	0.31		0.08	0.2	0.34		0.08	0.2	0.37		0.08	0.2	<0.2	U	0.08	0.2	2.9		0.08	0.2
Field Parameters																																
Dissolved Oxygen (mg/L)	--	--	--	--	4.03				2.37				6.34				5.53				4.06				3.78				3.89			
Oxidation Reduction Potential (mV)	--	--	--	--	233				172				205				228				288				237				239			
pH (SU)	--	--	--	--	8.2				7.01				5.67				6.89				6.82				7.11				6.76			
Conductivity (mS)	--	--	--	--	0.487				0.637				0.57				0.647				0.711				0.833				0.844			
Temperature (°C)	--	--	--	--	19.79				15.91				15.6				17.36				14.41				18.05				17.27			
Turbidity (NTU)	--	--	--	--	0.79				2.19				2.02				1.62				0.43				2.19				7.19			

Notes:

CAS = Chemical Abstracts Service
ug/L = Microgram Per Liter
ng/L = Nanograms Per Liter
MDL = Method Detection Limit
RL = Reporting Limit
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code

ND = Not Detected
NT = Not Tested
mV = millivolt
SU = Standard Units
mS = milliSiemen
°C = degrees Celcius
NTU = Nephelometric Turbidity

RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
C = Carcinogenic per EPA RBC Table (October 2007)
N = Noncarcinogenic per EPA RBC Table (October 2007)
MCL = Maximum Contaminant Level

=Exceeds Adjusted T-RBC

=Exceeds MCL

Data Qualifiers:
J = Analyte present. Reported value may not be accurate or precise.
U = Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation limit may be inaccurate or imprecise.
c = Calibration failure
d = MS/MSD or LCS/LCSD RPD imprecision
g = Dual column confirmation imprecision
l = LCS recovery failure
m = MS/MSD recovery failure.

Table 4-7
Area A - Summary of Risk Screening Results for Groundwater
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

	CAS #	Adjusted T-TBC	C/N	MCL	Minimum Detected Concentration	Maximum Detected Concentration	# Samples that Exceed Adj. T-RBC	# Samples that Exceed MCL	# of Detections	# of Samples
TAL Metals (ug/L)										
Aluminum	7429-90-5	3,650	N	--	59	221	0	--	2	3
Barium	7440-39-3	730	N	2000	137	184	0	0	3	3
Barium, Dissolved	7440-39-3	730	N	2000	139	190	0	0	3	3
Calcium	7440-70-2	--	--	--	49,300	88,300	--	--	3	3
Calcium, Dissolved	7440-70-2	--	--	--	51,800	90,900	--	--	3	3
Chromium [1]	7440-47-3	10.95	N	100	2.9	5.2	0	0	3	3
Chromium, Dissolved [1]	7440-47-3	10.95	N	100	0.6	1.6	0	0	3	3
Cobalt	7440-48-4	--	--	--	2.5	2.5	--	--	1	3
Cobalt, Dissolved	7440-48-4	--	--	--	2.4	2.4	--	--	1	3
Iron	7439-89-6	2,555	N	--	17.6	267	0	--	3	3
Magnesium	7439-95-4	--	--	--	21,100	29,900	--	--	3	3
Magnesium, Dissolved	7439-95-4	--	--	--	20,700	29,800	--	--	3	3
Manganese	7439-96-5	73	N	--	0.67	190.5	**2**	--	6	6
Manganese, Dissolved	7439-96-5	73	N	--	0.29	185	**2**	--	6	6
Nickel	7440-02-0	73	N	--	1.7	5.9	0	--	3	3
Nickel, Dissolved	7440-02-0	73	N	--	2.1	4.4	0	--	3	3
Potassium	7440-09-7	--	--	--	439	1310	--	--	3	3
Potassium, Dissolved	7440-09-7	--	--	--	805	2210	--	--	3	3
Selenium	7782-49-2	18.25	N	50	5.1	5.1	0	0	1	3
Selenium, Dissolved	7782-49-2	18.25	N	50	5	7.4	0	0	3	3
Sodium	7440-23-5	--	--	--	4,560	16,600	--	--	3	3
Sodium, Dissolved	7440-23-5	--	--	--	3,140	14,900	--	--	3	3
Vanadium, Dissolved	7440-62-2	3.65	N	--	0.46	0.46	0	--	1	3
Zinc	7440-66-6	1,095	N	--	4.1	27.6	0	--	3	3
Zinc, Dissolved	7440-66-6	1,095	N	--	4	28.9	0	--	3	3
Explosives (ug/L)										
1,3,5-Trinitrobenzene	99-35-4	109.5	N	--	0.17	6.5	0	--	3	6
2,4,6-Trinitrotoluene [2]	118-96-7	1.83	N	--	0.38	17	**1**	--	4	6
2,4-Dinitrotoluene	121-14-2	7.3	N	--	0.65	0.65	0	--	1	6
2,6-Dinitrotoluene	606-20-2	3.65	N	--	ND	ND	0	--	0	6
DNT Mixture	--	0.098	C	--	0.65	0.65	**1**	--	1	6
2-Nitrotoluene	88-72-2	6.08	N	--	0.82	0.82	0	--	1	6
2-Amino-4,6-dinitrotoluene	35572-78-2	7.3	N	--	0.46	2.2	0	--	4	6
4-Amino-2,6-dinitrotoluene	1946-51-0	7.3	N	--	0.42	1.8	0	--	5	6
Aminodinitrotoluenes	--	7.3	N	--	0.42	4	0	--	5	6
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5	2691-41-0	182.5	N	--	5.8	10	0	--	5	6
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	0.609	C	--	8	8	**1**	--	1	6

Table 4-7
Area A - Summary of Risk Screening Results for Groundwater
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

	CAS #	Adjusted T-TBC	C/N	MCL	Minimum Detected Concentration	Maximum Detected Concentration	# Samples that Exceed Adj. T-RBC	# Samples that Exceed MCL	# of Detections	# of Samples
Dioxin/Furans (ng/L)										
Total 2,3,7,8-TCDD TEQ[3]	--	4.46E-04	C	0.03	6.51E-07	3.00E-04	0	0	2	4
Perchlorate (ug/L)										
Perchlorate	14797-73-0	2.56	N	24.5	0.31	3	**1**	0	5	6

Notes:
CAS = Chemical Abstract Service
TAL = Target Analyte List
ug/L = Microgram Per Liter
ng/L = Nanogram Per Liter
RBC = USEPA Region III Risk-Based Concentration
(RBC) values from the October 11, 2007,
RBC Table and October 11, 2007, Alternate RBC Table
Adjusted RBCs = a Hazard Quotient (HQ) of 0.1 applied to non-carcinogens
T-RBC = Adjusted Tap Water RBC
C/N = Carcinogenic/Noncarcinogenic per EPA RBC Table (October 2007)
MCL = Maximum Contaminant Level
DNT = Dinitrotoluene
[1] = Chromium VI RBC value was used
[2] = Noncarcinogenic Residential and Industrial RBC values for 2,4,6-Trinitrotoluene were used for screening
[3] See Table 6.3B for Calculation of Total 2,3,7,8-TCDD TEQ

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB39A[D] 12/10/2002 0-1		MDL	RL	54SB39B[D] 12/10/2002 9-10		MDL	RL	54SB39C 1/8/2007 15-16		MDL	RL	54SB40A[D] 12/10/2002 0-1		MDL	RL	54SB40B[D] 12/10/2002 9-10		MDL	RL	54SB40C 1/8/2007 11-12		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	17,300		6.8	12	10,300		5.6	9.9	NT				13,600		6.4	11.3	13,100		6	10.6	NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	0.44	BN,B,p	0.14	1.2	0.33	BN,B,p	0.12	0.99	NT				0.46	BN,B,p	0.14	1.1	0.39	BN,B,p	0.13	1.1	NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***1.7***		0.36	1.2	***1.4***		0.3	0.99	NT				***1.7***		0.34	1.1	***1.3***		0.32	1.1	NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	112	*	0.04	1.2	81.5	*	0.03	0.99	NT				103	*	0.03	1.1	98.4	*	0.03	1.1	NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	0.82		0.02	0.6	0.54		0.02	0.49	NT				0.68		0.02	0.56	0.67		0.02	0.53	NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.6	U	0.04	0.6	<0.49	U	0.03	0.49	NT				<0.56	U	0.03	0.56	<0.53	U	0.03	0.53	NT			
Calcium	7440-70-2	--	--	--	--	--	1,290		1.8	120	1,200		1.5	98.5	NT				1,220		1.7	113	1,100		1.6	106	NT			
Chromium[1]	7440-47-3	N	65.3	23.46	306.6	2.102	***24.1***		0.1	0.6	***16***		0.08	0.49	NT				***20.8***		0.09	0.56	***21.8***		0.09	0.53	NT			
Cobalt	7440-48-4	--	72.3	--	--	--	12		0.08	0.6	7		0.07	0.49	NT				8.5		0.08	0.56	7.2		0.07	0.53	NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	11.3		0.18	0.6	9.7		0.15	0.49	NT				13		0.17	0.56	10.9		0.16	0.53	NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	25,200		1.5	12	17,400		1.2	9.9	NT				21,100		1.4	11.3	19,900		1.3	10.6	NT			
Lead[2]	7439-92-1	--	26.8	400	750	--	10		0.14	0.36	6.2		0.12	0.3	NT				18.5		0.14	0.34	7.3		0.13	0.32	NT			
Magnesium	7439-95-4	--	--	--	--	--	4,470		1.5	120	3,380		1.2	98.5	NT				4,010		1.4	113	3,350		1.3	106	NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***442***		0.02	1.2	***284***		0.02	0.99	NT				***400***		0.02	1.1	***302***		0.02	1.1	NT			
Mercury[3]	7439-97-6	--	0.13	2.35	30.66	--	0.02	B	0.018	0.037	<0.035	U	0.018	0.035	NT				0.023	B	0.02	0.04	0.021	B	0.017	0.033	NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	14.1	E,J,s	0.12	0.6	10	E,J,s	0.1	0.49	NT				12.4	E,J,s	0.11	0.56	12.1	E,J,s	0.11	0.53	NT			
Potassium	7440-09-7	--	--	--	--	--	1,760	E,J,s	4.8	120	1,320	E,J,s	3.9	98.5	NT				1,810	E,J,s	4.5	113	1,630	E,J,s	4.3	106	NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	***0.97***	B,x	0.36	0.6	0.52	B,x	0.3	0.49	NT				0.73	B,x	0.34	0.56	0.67	B,x	0.32	0.53	NT			
Silver	7440-22-4	N	--	39.11	511	1.551	<0.6	U	0.1	0.6	<0.49	U	0.08	0.49	NT				<0.56	U	0.09	0.56	<0.53	U	0.09	0.53	NT			
Sodium	7440-23-5	--	--	--	--	--	70	B,K,w	36.6	240	94	B,K,w	30	197	NT				67.6	B,K,w	34.3	225	92.7	B,K,w	32.4	213	NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	***45.9***		0.08	2.4	29		0.07	2	NT				36.3		0.08	2.3	35.7		0.07	2.1	NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	63.5		0.13	2.4	39.5		0.11	2	NT				63.6		0.12	2.3	49.9		0.12	2.1	NT			
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				NT				NT				NT				NT			
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	NT				NT				NT				NT				NT				NT			
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	NT				NT				NT				NT				NT				NT			
alpha-Chlordane[4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	NT				NT				NT				NT				NT				NT			
delta-BHC[5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				NT				NT				NT				NT			
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	NT				NT				NT				NT				NT				NT			
Endrin aldehyde[6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
Endrin ketone[6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				NT				NT				NT				NT			
gamma-Chlordane[4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				NT				NT				NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				NT				NT				NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				NT				NT				NT				NT			
Aroclor 1254[7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				NT				NT				NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				NT				NT				NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<400	U	20	400	<350	U	20	350	NT				<410	U	20	410	<380	U	20	380	NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<400	U	21	400	<350	U	21	350	NT				<410	U	21	410	<380	U	21	380	NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				ND				NT				ND				ND				NT			
Acenaphthylene[8]	208-96-8	N	--	2.3E+05	3.1E+06	--	<400	U	17	400	<350	U	17	350	NT				<410	U	17	410	<380	U	17	380	NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<400	U	25	400	<350	U	25	350	NT				<410	U	25	410	<380	U	25	380	NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<400	U	29	400	<350	U	29	350	NT				<410	U	29	410	<380	U	29	380	NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<400	U	23	400	<350	U	23	350	NT				<410	U	23	410	<380	U	23	380	NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<400	U	36	400	<350	U	36	350	NT				<410	U	36	410	<380	U	36	380	NT			
Benzo(g,h,i)perylene[8]	191-24-2	N	--	2.3E+05	3.1E+06	--	<400	U	23	400	<350	U	23	350	NT				<410	U	23	410	<380	U	23	380	NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<400	U	29	400	<350	U	29	350	NT				<410	U	29	410	<380	U	29	380	NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	<400	U	32	400	<350	U	32	350	NT				180	J	32	410	<380	U	32	380	NT			
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	<400	U	29	400	<350	U	29	350	NT				<410	U	29	410	<380	U	29	380	NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<400	U	28	400	<350	U	28	350	NT				<410	U	28	410	<380	U	28	380	NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	<400	U	400	400	<350	U	350	350	NT				<410	U	410	410	<380	U	380	380	NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	<400	U	400	400	<350	U	350	350	NT				<410	U	410	410	<380	U	380	380	NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<400	U	21	400	<350	U	21	350	NT				<410	U	21	410	<380	U	21	380	NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	<400	U	400	400	<350	U	350	350	NT				<410	U	410	410	<380	U	380	380	NT			
Dimethylphthalate	131-11-3	--	--	--	--	--	<400	U	400	400	<350	U	350	350	NT				<410	U	410	410	<380	U	380	380	NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<400	U	18	400	<350	U	18	350	NT				<410	U	18	410	<380	U	18	380	NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<400	U	18	400	<350	U	18	350	NT				<410	U	18	410	<380	U	18	380	NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<400	U	20	400	<350	U	20	350	NT				<410	U	20	410	<380	U	20	380	NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<400	U	400	400	<350	U	350	350	NT				<410	U	410	410	<380	U	380	380	NT			
Phenanthrene[8]	85-01-8	N	--	2.3E+05	3.1E+06	--	<400	U	24	400	<350	U	24	350	NT				<410	U	24	410	<380	U	24	380	NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	<400	U	24	400	<350	U	24	350	NT				<410	U	24	410	<380	U	24	380	NT			
SVOC TICs (ug/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
16-Octadecenal	56554-87-1	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
17-Octadecenal	56554-86-0	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NI				NI				NT				NI				NI				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				NI				NT				NI				NI				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB39A [D] 12/10/2002 0-1		MDL	RL	54SB39B [D] 12/10/2002 9-10		MDL	RL	54SB39C 1/8/2007 15-16		MDL	RL	54SB40A [D] 12/10/2002 0-1		MDL	RL	54SB40B [D] 12/10/2002 9-10		MDL	RL	54SB40C 1/8/2007 11-12		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Camphene	79-92-5	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Cholesterol	57-88-5	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Pentadecanal-	24055	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Testosterone	58-22-0	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NI				NI				NT				NI				NI				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	68.4	A	11.9	11.9	116		10.2	10.2	55.7	A	11.1	11.1	234	,J,i	0.979	0.979	164		0.824	0.824	24.6		0.869	0.869
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	<11.9	U	11.9	11.9	<10.2	U	10.2	10.2	<11.1	U	11.1	11.1	6.96	A,J,i	0.979	0.979	0.341	,J,w	0.824	0.824	0.0643	A	0.869	0.869
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	4.01	A	5.96	5.96	<5.12	U	5.12	5.12	4.56	A	5.56	5.56	10.1		0.49	0.49	3.41	A	0.412	0.412	0.786	A	0.435	0.435
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	<5.96	U	5.96	5.96	0.614	A,J,w	5.12	5.12	<5.56	U	5.56	5.56	2.88	A	0.49	0.49	0.394	A	0.412	0.412	0.165	A,J,w	0.435	0.435
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	<5.96	U	5.96	5.96	<5.12	U	5.12	5.12	<5.56	U	5.56	5.56	<0.49	U	0.49	0.49	<0.412	U	0.412	0.412	<0.435	U	0.435	0.435
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	<5.96	U	5.96	5.96	<5.12	U	5.12	5.12	<5.56	U	5.56	5.56	0.198	A	0.49	0.49	<0.412	U	0.412	0.412	<0.435	U	0.435	0.435
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	<5.96	U	5.96	5.96	<5.12	U	5.12	5.12	<5.56	U	5.56	5.56	0.407	A	0.49	0.49	0.114	A,J,w	0.412	0.412	<0.435	U	0.435	0.435
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	<5.96	U	5.96	5.96	<5.12	U	5.12	5.12	<5.56	U	5.56	5.56	0.46	A	0.49	0.49	0.234	A,J,w	0.412	0.412	<0.435	U	0.435	0.435
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	<5.96	U	5.96	5.96	<5.12	U	5.12	5.12	<5.56	U	5.56	5.56	0.372	A	0.49	0.49	0.12	A	0.412	0.412	<0.435	U	0.435	0.435
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	<5.96	U	5.96	5.96	<5.12	U	5.12	5.12	<5.56	U	5.56	5.56	0.453	A	0.49	0.49	0.221	A,J,w	0.412	0.412	<0.435	U	0.435	0.435
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	<5.96	U	5.96	5.96	<5.12	U	5.12	5.12	<5.56	U	5.56	5.56	<0.49	U	0.49	0.49	<0.412	U	0.412	0.412	<0.435	U	0.435	0.435
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	<5.96	U	5.96	5.96	<5.12	U	5.12	5.12	<5.56	U	5.56	5.56	<0.49	U	0.49	0.49	<0.412	U	0.412	0.412	<0.435	U	0.435	0.435
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	1.05	A	5.96	5.96	<5.12	U	5.12	5.12	1.09	A	5.56	5.56	0.231	A	0.49	0.49	0.0874	A	0.412	0.412	<0.435	U	0.435	0.435
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	<5.96	U	5.96	5.96	<5.12	U	5.12	5.12	<5.56	U	5.56	5.56	0.646	A,J,w	0.49	0.49	0.223	A	0.412	0.412	<0.435	U	0.435	0.435
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	0.858	A	5.96	5.96	1.11	A	5.12	5.12	1.09	A	5.56	5.56	0.474	A	0.49	0.49	0.153	A	0.412	0.412	<0.435	U	0.435	0.435
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	<1.19	U	1.19	1.19	<1.02	U	1.02	1.02	<1.11	U	1.11	1.11	***0.733***	A	0.147	0.147	<0.0824	U	0.0824	0.0824	<0.0869	U	0.0869	0.0869
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	6.1	A	1.19	1.19	5.18	A	1.02	1.02	6.1	A	1.11	1.11	0.57	A,B,z	0.224	0.224	0.265	A,B,z	0.0997	0.0997	<0.0869	U	0.0869	0.0869
Total HpCDD	37871-00-4	--	--	--	--	--	4.01		5.96	5.96	6.96		5.12	5.12	12.4		5.56	5.56	35.2		0.49	0.49	12.6		0.412	0.412	0.786		0.435	0.435
Total HpCDF	38998-75-3	--	--	--	--	--	<5.96	U	5.96	5.96	0.655		5.12	5.12	<5.56	U	5.56	5.56	6.92		0.49	0.49	0.394		0.412	0.412	<0.435	U	0.435	0.435
Total HxCDD	34465-46-8	--	--	--	--	--	<5.96	U	5.96	5.96	<5.12	U	5.12	5.12	2.54		5.56	5.56	2.61		0.49	0.49	1.07		0.412	0.412	<0.435	U	0.435	0.435
Total HxCDF	55684-94-1	--	--	--	--	--	0.691		5.96	5.96	<5.12	U	5.12	5.12	<5.56	U	5.56	5.56	2.69		0.49	0.49	0.61		0.412	0.412	<0.435	U	0.435	0.435
Total PeCDD	36088-22-9	--	--	--	--	--	<5.96	U	5.96	5.96	<5.12	U	5.12	5.12	1.11		5.56	5.56	1.99		0.49	0.49	1.48		0.412	0.412	<0.435	U	0.435	0.435
Total PeCDF	30402-15-4	--	--	--	--	--	2.46		5.96	5.96	1.76		5.12	5.12	2.43		5.56	5.56	2.99		0.49	0.49	0.745		0.412	0.412	<0.435	U	0.435	0.435
Total TCDD	41903-57-5	--	--	--	--	--	<1.19	U	1.19	1.19	<1.02	U	1.02	1.02	<1.11	U	1.11	1.11	1.69		0.147	0.147	0.204		0.0824	0.0824	<0.0869	U	0.0869	0.0869
Total TCDF	55722-27-5	--	--	--	--	--	9.63		1.19	1.19	8.15		1.02	1.02	9.48		1.11	1.11	3.38		0.224	0.224	1.12	,B,z	0.0997	0.0997	<0.0869	U	0.0869	0.0869
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	<51	U	5.8	51	<45	U	5.8	45	NT				34	JP,J,g	5.8	52	<48	U	5.8	48	NT			
Acenaphthylene [B]	208-96-8	N	--	2.3E+05	3.1E+06	--	<51	U	5.9	51	<45	U	5.9	45	NT				<52	U	5.9	52	<48	U	5.9	48	NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<51	U	5.4	51	<45	U	5.4	45	NT				<52	U	5.4	52	<48	U	5.4	48	NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<10	U	2.2	10	<8.8	U	2.2	8.8	NT				<10	U	2.2	10	<9.4	U	2.2	9.4	NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<10	U	1.6	10	<8.8	U	1.6	8.8	NT				<10	U	1.6	10	<9.4	U	1.6	9.4	NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<10	U	1.7	10	<8.8	U	1.7	8.8	NT				<10	U	1.7	10	<9.4	U	1.7	9.4	NT			
Benzo(g,h,i)perylene [B]	191-24-2	N	--	2.3E+05	3.1E+06	--	<10	U	3.6	10	<8.8	U	3.6	8.8	NT				<10	U	3.6	10	<9.4	U	3.6	9.4	NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<10	U	1.4	10	<8.8	U	1.4	8.8	NT				<10	U	1.4	10	<9.4	U	1.4	9.4	NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<10	U	2.4	10	<8.8	U	2.4	8.8	NT				<10	U	2.4	10	<9.4	U	2.4	9.4	NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<10	U	4.2	10	<8.8	U	4.2	8.8	NT				<10	U	4.2	10	<9.4	U	4.2	9.4	NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<21	U	2.1	21	<18	U	2.1	18	NT				<21	U	2.1	21	<19	U	2.1	19	NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<51	U	14	51	<45	U	14	45	NT				<52	U	14	52	<48	U	14	48	NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<10	U	2.5	10	<8.8	U	2.5	8.8	NT				<10	U	2.5	10	<9.4	U	2.5	9.4	NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	<51	U	14	51	<45	U	14	45	NT				<52	U	14	52	<48	U	14	48	NT			
Phenanthrene [B]	85-01-8	N	--	2.3E+05	3.1E+06	--	<51	U	8.5	51	<45	U	8.5	45	NT				<52	U	8.5	52	<48	U	8.5	48	NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	<21	U	4.3	21	<18	U	4.3	18	NT				<21	U	4.3	21	<19	U	4.3	19	NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
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Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB39A [D] 12/10/2002 0-1		MDL	RL	54SB39B [D] 12/10/2002 9-10		MDL	RL	54SB39C 1/8/2007 15-16		MDL	RL	54SB40A [D] 12/10/2002 0-1		MDL	RL	54SB40B [D] 12/10/2002 9-10		MDL	RL	54SB40C 1/8/2007 11-12		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	NT				<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	NT			
2,4,6-Trinitrotoluene[B]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	<1	U	0.16	1	NT				<1	U	0.16	1	<1	U	0.16	1	NT			
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	<1	U	0.12	1	NT				<1	U	0.12	1	<1	U	0.12	1	NT			
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	ND				ND				NT				ND				ND				NT			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	<1	U	0.1	1	NT				<1	U	0.1	1	<1	U	0.1	1	NT			
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	<1	U	0.095	1	NT				<1	U	0.095	1	<1	U	0.095	1	NT			
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				NT				ND				ND				NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	<1	U	0.1	1	NT				<1	U	0.1	1	<1	U	0.1	1	NT			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	<1	U	0.28	1	<1	U	0.28	1	NT				<1	U	0.28	1	<1	U	0.28	1	NT			
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	0.1	10	<10	U	0.1	10	NT				<10	U	0.1	10	<10	U	0.1	10	NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				NT				--				--				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB41A[D] 12/10/2002 0-1		MDL	RL	54SB41B[D] 12/10/2002 9-10		MDL	RL	54SB41C 1/9/2007 14-15		MDL	RL	54SB42A[C] 12/10/2002 0-1		MDL	RL	54SB42A-DUP(D-14)(Dup-1)[C] 12/10/2002 0-1		MDL	RL	54SB42B[C] 12/10/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	13,000		2.9	13.2	15,700		2.4	10.9	NT				13,700		6.2	11	12,300		6.5	11.5	12,900		6.6	11.6
Antimony	7440-36-0	N	--	3.13	40.88	0.66	<1.3	UN,UL,m	0.49	1.3	<1.1	UN,UJ,m	0.4	1.1	NT				***1.4***	N,L,m	0.13	1.1	***1.9***	N,L,m	0.14	1.1	0.42	B,B,p	0.14	1.2
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***1.4***	N,L,m	0.33	1.3	***1.7***	N,L,m	0.27	1.1	NT				***2.8***		0.33	1.1	***2.9***		0.34	1.1	***1.5***		0.35	1.2
Barium	7440-39-3	N	209	1,564	20,440	300.8	184	*E,J,s	0.03	1.3	155	*E,J,s	0.02	1.1	NT				158	*	0.03	1.1	146	*	0.03	1.1	95.7	*	0.03	1.2
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	0.88	E,J,s	0.01	0.66	0.77	E,J,s	0.01	0.55	NT				0.77		0.02	0.55	0.76		0.02	0.57	0.63		0.02	0.58
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.66	U	0.05	0.66	<0.55	U	0.04	0.55	NT				0.33	B	0.03	0.55	0.37	B	0.03	0.57	<0.58	U	0.03	0.58
Calcium	7440-70-2	--	--	--	--	--	1,610	E,J,s	1.3	132	1,270	E,J,s	1.1	109	NT				4,770		1.6	110	5,880		1.7	115	1,290		1.7	116
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***20.7***	E,J,s	0.08	0.66	***24.1***	E,J,s	0.07	0.55	NT				***23***		0.09	0.55	***22.1***		0.09	0.57	***19.4***		0.09	0.58
Cobalt	7440-48-4	--	72.3	--	--	--	9.9	E,J,s	0.08	0.66	10.2	E,J,s	0.07	0.55	NT				9.7		0.08	0.55	8.5		0.08	0.57	7.5		0.08	0.58
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	17	E,J,s	0.19	0.66	3.9	E,J,s	0.15	0.55	NT				63.3		0.16	0.55	60.6		0.17	0.57	12		0.17	0.58
Iron	7439-89-6	N	50,962	5,475	71,540	--	19,600	E,J,s	1.8	13.2	24,800	E,J,s	1.5	10.9	NT				23,600		1.4	11	23,800		1.4	11.5	20,600		1.4	11.6
Lead [2]	7439-92-1	--	26.8	400	750	--	50.8	*E,J,k	0.3	0.4	10.6	*E,J,k	0.25	0.33	NT				1,940		0.13	0.33	1,270		0.14	0.34	12.7		0.14	0.35
Magnesium	7439-95-4	--	--	--	--	--	1,830	E,J,s	0.81	132	4,080	E,J,s	0.67	109	NT				3,860		1.3	110	4,890		1.4	115	4,080		1.4	116
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***767***	E,J,s	0.03	1.3	***534***	E,J,s	0.02	1.1	NT				***785***		0.02	1.1	***982***		0.02	1.1	***315***		0.02	1.2
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	0.043	B	0.022	0.044	0.033	B	0.018	0.036	NT				0.43		0.017	0.035	0.65		0.018	0.035	<0.038	U	0.019	0.038
Nickel	7440-02-0	N	62.8	156.4	2,044	--	11	E,J,s	0.13	0.66	12.8	E,J,s	0.11	0.55	NT				13.1	E,J,s	0.11	0.55	14	E,J,s	0.11	0.57	11.8	E,J,s	0.12	0.58
Potassium	7440-09-7	--	--	--	--	--	1,270	E,J,s	15.7	132	2,360	E,J,s	13	109	NT				1,340	E,J,s	4.4	110	1,330	E,J,s	4.6	115	2,910	E,J,s	4.6	116
Selenium	7782-49-2	N	--	39.11	511	0.949	***1.7***	N,B,x	0.44	0.66	***1.6***	N,B,x	0.36	0.55	NT				***1.2***	B,x	0.33	0.55	***1.3***	B,x	0.34	0.57	0.6	B,x	0.35	0.58
Silver	7440-22-4	N	--	39.11	511	1.551	<0.66	U	0.09	0.66	<0.55	U	0.08	0.55	NT				<0.55	U	0.09	0.55	<0.57	U	0.09	0.57	<0.58	U	0.09	0.58
Sodium	7440-23-5	--	--	--	--	--	202	B,L,w	32.9	265	197	B,L,w	27.2	219	NT				<219	U	33.4	219	<230	U	35	230	132	B,K,w	35.2	231
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	***36.9***	E,J,s	0.09	2.6	***38.6***	E,J,s	0.08	2.2	NT				31.4		0.08	2.2	29.1		0.08	2.3	36.2		0.08	2.3
Zinc	7440-66-6	N	202	2,346	30,660	681.1	71.8	N*E,J,k	0.13	2.6	70.7	N*E,J,k	0.11	2.2	NT				371		0.12	2.2	405		0.13	2.3	53.7		0.13	2.3
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				NT				<4	U	1.1	4	<4	U	1.1	4	<4	U	1.1	4
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	NT				NT				NT				<2.1	U	0.66	2.1	<2.1	U	0.66	2.1	<2	U	0.65	2
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	NT				NT				NT				<2.1	U	0.42	2.1	<2.1	U	0.43	2.1	<2	U	0.42	2
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				<4	U	0.82	4	<4	U	0.82	4	<4	U	0.81	4
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	NT				NT				NT				<4	U	0.81	4	<4	U	0.82	4	<4	U	0.81	4
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				NT				<4	U	1.1	4	<4	U	1.1	4	<4	U	1.1	4
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	NT				NT				NT				<4	U	0.56	4	<4	U	0.56	4	<4	U	0.55	4
Endrin aldehyde [6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				<4	U	1.3	4	<4	U	1.3	4	<4	U	1.2	4
Endrin ketone [6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				<4	U	1.2	4	<4	U	1.2	4	<4	U	1.2	4
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				NT				<2.1	U	0.77	2.1	<2.1	U	0.78	2.1	<2	U	0.77	2
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				<4	U	0.57	4	<4	U	0.57	4	<4	U	0.56	4
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				NT				<8.1	U	1.5	8.1	<8.1	U	1.5	8.1	<8	U	1.5	8
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				NT				<2.1	U	0.5	2.1	<2.1	U	0.5	2.1	<2	U	0.5	2
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				NT				<21	U	1.6	21	<21	U	1.6	21	<20	U	1.5	20
Aroclor 1254 [7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				NT				40	J,J,g	7.2	40	37	J	7.3	40	***140***		7.2	40
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				NT				29	J	5.3	40	19	J	5.3	40	140		5.3	40
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<430	U	20	430	<360	U	20	360	NT				***12,000***		20	1,600	***170***	J,L,s	20	390	***33***	J	20	390
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<430	U	21	430	<360	U	21	360	NT				***830***	J	21	1,600	***37***	J,L,s	21	390	<390	U	21	390
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				ND				NT				12,830		21	1,600	207	J,L,s	21	390	33	J	21	390
Acenaphthylene [8]	208-96-8	N	--	2.3E+05	3.1E+06	--	<430	U	17	430	<360	U	17	360	NT				<1,600	U	17	1,600	<390	U,UL,s	17	390	<390	U	17	390
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<430	U	25	430	<360	U	25	360	NT				<1,600	U	25	1,600	<390	U,UL,s	25	390	<390	U	25	390
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<430	U	29	430	<360	U	29	360	NT				<1,600	U	29	1,600	<390	U,UL,s	29	390	<390	U	29	390
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<430	U	23	430	<360	U	23	360	NT				<1,600	U	23	1,600	<390	U,UL,s	23	390	<390	U	23	390
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<430	U	36	430	<360	U	36	360	NT				<1,600	U	36	1,600	<390	U,UL,s	36	390	<390	U	36	390
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	<430	U	23	430	<360	U	23	360	NT				<1,600	U	23	1,600	<390	U,UL,s	23	390	<390	U	23	390
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<430	U	29	430	<360	U	29	360	NT				<1,600	U	29	1,600	<390	U,UL,s	29	390	<390	U	29	390
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	50	J	32	430	<360	U	32	360	NT				490	J	32	1,600	250	J,L,s	32	390	68	J	32	390
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	<430	U	29	430	<360	U	29	360	NT				<1,600	U	29	1,600	<390	U,UL,s	29	390	<390	U	29	390
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<430	U	28	430	<360	U	28	360	NT				<1,600	U	28	1,600	<390	U,UL,s	28	390	<390	U	28	390
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	<430	U	430	430	<360	U	360	360	NT				12,000		1,600	1,600	750	L,s	390	390	120	J	390	390
Di-n-octylphthalate	117-84-0	--	--	--	--	--	<430	U	430	430	<360	U	360	360	NT				<1,600	U	1,600	1,600	<390	U,UL,s	390	390	<390	U	390	390
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<430	U	21	430	<360	U	21	360	NT				<1,600	U	21	1,600	<390	U,UL,s	21	390	<390	U	21	390
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	<430	U	430	430	<360	U	360	360	NT				4,900		1,600	1,600	2,000	L,s	390	390	100	J	390	390
Dimethylphthalate	131-11-3	--	--	--	--	--	<430	U	430	430	<360	U	360	360	NT				<1,600	U	1,600	1,600	<390	U,UL,s	390	390	84	J	390	390
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<430	J	18	430	<360	U	18	360	NT				<1,600	U	18	1,600	<390	U,UL,s	18	390	<390	U	18	390
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<430	U	18	430	<360	U	18	360	NT				<1,600	U	18	1,600	<390	U,UL,s	18	390	<390	U	18	390
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<430	U	20	430	<360	U	20	360	NT				<1,600	U	20	1,600	<390	U,UL,s	20	390	<390	U	20	390
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<430	U	430	430	<360	U	360	360	NT				***1,400***	J	1,600	1,600	***210***	J,L,s	390	390	29	J	390	390
Phenanthrene [8]	85-01-8	N	--	2.3E+05	3.1E+06	--	<430	U	24	430	<360	U	24	360	NT				<1,600	U	24	1,600	<390	U,UL,s	24	390	<390	U	24	390
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	<430	U	24	430	<360	U	24	360	NT				<1,600	U	24	1,600	<390	U,UL,s	24	390	<390	U	24	390
SVOC TICs (ug/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
16-Octadecenal	56554-87-1	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
17-Octadecenal	56554-86-0	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NI				NI				NT				NI				NI				NI			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				NI				NT				NI				430	NJ,NJ,t	0	0	NI			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				NI				NT				NI				NI				NI			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
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Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB41A[D] 12/10/2002 0-1		MDL	RL	54SB41B[D] 12/10/2002 9-10		MDL	RL	54SB41C 1/9/2007 14-15		MDL	RL	54SB42A[C] 12/10/2002 0-1		MDL	RL	54SB42A-DUP(D-14)(Dup-1)[C] 12/10/2002 0-1		MDL	RL	54SB42B[C] 12/10/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r					Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
Camphene	79-92-5	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
Cholesterol	57-88-5	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NI				650	NJ,NJ,t	0	0	NT				NI				NI				NI			
Pentadecanal-	24055	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
Testosterone	58-22-0	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NI				NI				NT				NI				NI				NI			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	440		0.991	0.991	2.17	A,B,z	0.888	0.888	49.5		0.985	0.985	3,630		10.8	10.8	3,890		1.4	1.4	1,050		1.29	1.29
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	<0.92	U	0.92	0.92	<0.888	U	0.888	0.888	<0.985	U	0.985	0.985	20.5	A	10.8	10.8	26.4		0.902	0.902	69.5		1	1
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	10		0.46	0.46	0.547	A,J,w	0.444	0.444	1.47	A	0.493	0.493	60.7		5.39	5.39	73.2		0.718	0.718	113		0.508	0.508
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	1.01	A	0.46	0.46	<0.444	U	0.444	0.444	<0.493	U	0.493	0.493	9.46	A	5.39	5.39	12.2		0.451	0.451	28		0.501	0.501
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	<0.46	U	0.46	0.46	<0.444	U	0.444	0.444	<0.493	U	0.493	0.493	<5.39	U	5.39	5.39	0.908	A	0.451	0.451	3.2	A	0.501	0.501
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	0.291	A,J,w	0.46	0.46	<0.444	U	0.444	0.444	<0.493	U	0.493	0.493	<5.39	U	5.39	5.39	0.606	A	0.451	0.451	1.94	A	0.501	0.501
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	0.154	A,J,w	0.46	0.46	<0.444	U	0.444	0.444	<0.493	U	0.493	0.493	1.96	A	5.39	5.39	1.82	A	0.451	0.451	8.26		0.501	0.501
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	<0.46	U	0.46	0.46	<0.444	U	0.444	0.444	<0.493	U	0.493	0.493	1.7	A	5.39	5.39	1.77	A	0.451	0.451	4.72	A	0.501	0.501
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	0.162	A,J,w	0.46	0.46	<0.444	U	0.444	0.444	<0.493	U	0.493	0.493	1.12	A	5.39	5.39	1.33	A	0.451	0.451	7.05		0.501	0.501
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	0.36	A	0.46	0.46	<0.444	U	0.444	0.444	0.323	A	0.493	0.493	<5.39	U	5.39	5.39	1.45	A	0.451	0.451	4.41	A	0.501	0.501
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	<0.46	U	0.46	0.46	<0.444	U	0.444	0.444	<0.493	U	0.493	0.493	<5.39	U	5.39	5.39	0.491	A	0.451	0.451	2.55	A	0.501	0.501
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	<0.46	U	0.46	0.46	<0.444	U	0.444	0.444	<0.493	U	0.493	0.493	<5.39	U	5.39	5.39	0.42	A,J,w	0.451	0.451	2.36	A	0.501	0.501
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	0.143	A,J,w	0.46	0.46	<0.444	U	0.444	0.444	<0.493	U	0.493	0.493	<5.39	U	5.39	5.39	0.489	A	0.451	0.451	7.4		0.501	0.501
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	0.232	A,B,z	0.46	0.46	<0.444	U	0.444	0.444	<0.493	U	0.493	0.493	0.733	A,J,w	5.39	5.39	1.87	A	0.451	0.451	5.49		0.501	0.501
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	0.241	A,B,z	0.46	0.46	0.071	A	0.444	0.444	0.067	A,J,w	0.493	0.493	1.64	A	5.39	5.39	1.25	A	0.451	0.451	8.62		0.501	0.501
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	***1.26***		0.132	0.132	<0.0888	U	0.0888	0.0888	<0.103	U	0.103	0.103	<1.08	U	1.08	1.08	0.179	A,J,w	0.0902	0.0902	***0.8***	A	0.133	0.133
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	<0.217	U	0.217	0.217	0.236	A,B,z	0.0909	0.0909	0.262	A,B,z	0.0985	0.0985	5.91	A,J,f	1.14	1.14	0.863	A,J,f	0.194	0.194	6.66		0.439	0.439
Total HpCDD	37871-00-4	--	--	--	--	--	35.1		0.544	0.544	0.577		0.444	0.444	4.31		0.493	0.493	214		5.39	5.39	248		1.02	1.02	247		0.725	0.725
Total HpCDF	38998-75-3	--	--	--	--	--	1.83		0.46	0.46	<0.444	U	0.444	0.444	<0.493	U	0.493	0.493	27.6		5.39	5.39	33.2		0.451	0.451	77.7		0.501	0.501
Total HxCDD	34465-46-8	--	--	--	--	--	2.78		0.46	0.46	<0.444	U	0.444	0.444	1.06		0.493	0.493	13.1		5.39	5.39	14.5		0.451	0.451	35.9		0.501	0.501
Total HxCDF	55684-94-1	--	--	--	--	--	0.868	,B,z	0.46	0.46	0.105		0.444	0.444	0.0532		0.493	0.493	11.1		5.39	5.39	16.6		0.451	0.451	56.4		0.501	0.501
Total PeCDD	36088-22-9	--	--	--	--	--	1.16		0.46	0.46	0.277		0.444	0.444	0.402		0.493	0.493	1.51		5.39	5.39	3.37		0.451	0.451	19.6		0.501	0.501
Total PeCDF	30402-15-4	--	--	--	--	--	0.791		0.46	0.46	0.176		0.444	0.444	<0.493	U	0.493	0.493	4.05		5.39	5.39	7.88		0.451	0.451	55.7		0.501	0.501
Total TCDD	41903-57-5	--	--	--	--	--	1.26		0.132	0.132	<0.0888	U	0.0888	0.0888	<0.103	U	0.103	0.103	<1.08	U	1.08	1.08	0.17		0.0902	0.0902	9.74		0.133	0.133
Total TCDF	55722-27-5	--	--	--	--	--	0.82		0.217	0.217	0.437	,B,z	0.0909	0.0909	0.402	,B,z	0.0985	0.0985	9.31		1.14	1.14	7.69		0.194	0.194	83.6		0.439	0.439
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	96	P,J,d	5.9	55	<46	U	5.9	46	NT				<50	U	5.9	50	<50	U	5.9	50	<50	U	5.8	50
Acenaphthylene[B]	208-96-8	N	--	2.3E+05	3.1E+06	--	<55	U	5.9	55	<46	U	5.9	46	NT				<50	U	5.9	50	<50	U	5.9	50	<50	U	5.9	50
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<55	U	5.4	55	<46	U	5.4	46	NT				<50	U	5.4	50	<50	U	5.4	50	<50	U	5.4	50
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<11	U	2.2	11	<9.1	U	2.2	9.1	NT				<9.9	U	2.2	9.9	<9.9	U	2.2	9.9	<9.9	U	2.2	9.9
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	***6.9***	J	1.6	11	<9.1	U	1.6	9.1	NT				<9.9	U	1.6	9.9	<9.9	U	1.6	9.9	<9.9	U	1.6	9.9
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<11	U	1.7	11	<9.1	U	1.7	9.1	NT				***92***	P,J,g	1.7	9.9	<9.9	U	1.7	9.9	<9.9	U	1.7	9.9
Benzo(g,h,i)perylene[B]	191-24-2	N	--	2.3E+05	3.1E+06	--	<11	U	3.6	11	<9.1	U	3.6	9.1	NT				<9.9	U	3.6	9.9	<9.9	U	3.6	9.9	<9.9	U	3.6	9.9
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<11	U	1.4	11	<9.1	U	1.4	9.1	NT				<9.9	U	1.4	9.9	<9.9	U	1.4	9.9	<9.9	U	1.4	9.9
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<11	U	2.4	11	<9.1	U	2.4	9.1	NT				<9.9	U	2.4	9.9	<9.9	U	2.4	9.9	<9.9	U	2.4	9.9
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<11	U	4.2	11	<9.1	U	4.2	9.1	NT				<9.9	U	4.2	9.9	<9.9	U	4.2	9.9	<9.9	U	4.2	9.9
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	9.2	J	2.1	22	<19	U	2.1	19	NT				<20	U	2.1	20	<20	U	2.1	20	<20	U	2.1	20
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<55	U	14	55	<46	U	14	46	NT				<50	U	14	50	<50	U	14	50	<50	U	14	50
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<11	U	2.5	11	<9.1	U	2.5	9.1	NT				<9.9	U	2.5	9.9	<9.9	U	2.5	9.9	<9.9	U	2.5	9.9
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	***89***	P,J,g	14	55	<46	U	14	46	NT				***660***		14	50	<50	U	14	50	***150***	P,J,g	14	50
Phenanthrene[B]	85-01-8	N	--	2.3E+05	3.1E+06	--	<55	U	8.5	55	<46	U	8.5	46	NT				<50	U	8.5	50	<50	U	8.5	50	<50	U	8.5	50
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	<22	U	4.3	22	25	P,J,g	4.3	19	NT				<20	U	4.3	20	<20	U	4.3	20	<20	U	4.3	20
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB41A [D] 12/10/2002 0-1		MDL	RL	54SB41B [D] 12/10/2002 9-10		MDL	RL	54SB41C 1/9/2007 14-15		MDL	RL	54SB42A [C] 12/10/2002 0-1		MDL	RL	54SB42A-DUP(D-14)(Dup-1)[C] 12/10/2002 0-1		MDL	RL	54SB42B [C] 12/10/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	NT				<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1
2,4,6-Trinitrotoluene[B]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	<1	U	0.16	1	NT				<1	U	0.16	1	0.82	J,J,c	0.16	1	<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	<1	U	0.12	1	NT				***0.7***	J,J,c	0.12	1	<1	U	0.12	1	<1	U	0.12	1
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	ND				ND				NT				0.7	J,J,c	0.12	1	ND				ND			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	<1	U	0.1	1	NT				<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	<1	U	0.095	1	NT				<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				NT				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	<1	U	0.1	1	NT				<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	<1	U	0.28	1	<1	U	0.28	1	NT				<1	U	0.28	1	<1	U	0.28	1	<1	U	0.28	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	<10	U	1	10	NT				<10	U	0.1	10	190		0.1	10	<10	U	0.1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				NT				--				--				--			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB42C 1/8/2007 13.5-14.5		MDL	RL	54SB43A [D] 12/4/2002 0.5-1		MDL	RL	54SB43B [D] 12/4/2002 8-9		MDL	RL	54SB43C [D] 12/4/2002 10-11		MDL	RL	54SB44A 12/4/2002 0-1		MDL	RL	54SB44B 12/4/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				13,800		2.5	11.6	9,180		2.4	11.2	7,080		2.6	11.8	8,690		2.3	10.7	19,000		2.5	11.6
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				<1.2	UN*,R,m	0.43	1.2	<1.1	UN*,R,m	0.41	1.1	<1.2	UN*,R,m	0.44	1.2	<1.1	UN*,R,m	0.4	1.1	<1.2	UN*,R,m	0.43	1.2
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				***1.2***	N,K,w	0.29	1.2	***0.6***	BN,K,w	0.28	1.1	***0.35***	BN,K,w	0.3	1.2	***1.1***	N,K,w	0.27	1.1	***2.1***	N,K,w	0.29	1.2
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				118	E,J,s	0.02	1.2	89.3	E,J,s	0.02	1.1	73.5	E,J,s	0.02	1.2	141	E,J,s	0.02	1.1	140	E,J,s	0.02	1.2
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	NT				0.63		0.01	0.58	0.52	B	0.01	0.56	0.43	B	0.01	0.59	0.69		0.01	0.53	0.89		0.01	0.58
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				0.05	B	0.05	0.58	<0.56	U	0.04	0.56	<0.59	U	0.05	0.59	<0.53	U	0.04	0.53	<0.58	U	0.05	0.58
Calcium	7440-70-2	--	--	--	--	--	NT				1,610	E,J,s	1.1	116	905	E,J,s	1.1	112	791	E,J,s	1.1	118	636	E,J,s	1	107	1,320	E,J,s	1.1	116
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				***17.6***	N,L,m	0.07	0.58	***15.7***	N,L,m	0.07	0.56	***12.3***	N,L,m	0.07	0.59	***14.8***	N,L,m	0.06	0.53	***23.5***	N,L,m	0.07	0.58
Cobalt	7440-48-4	--	72.3	--	--	--	NT				6.8	E,J,s	0.07	0.58	6.3	E	0.07	0.56	4.8	E	0.07	0.59	7.6	E,J,s	0.06	0.53	10.7	E	0.07	0.58
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				22.8	N*E,J,k	0.16	0.58	<0.56	UN*E,R,m	0.16	0.56	<0.59	UN*E,R,m	0.17	0.59	8.3	N*E,J,k	0.15	0.53	11.8	N*E,J,k	0.16	0.58
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				17,900	E,J,s	1.6	11.6	15,000	E,J,s	1.5	11.2	12,300	E,J,s	1.6	11.8	13,200	E,J,s	1.5	10.7	28,400	E,J,s	1.6	11.6
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				249	*E,J,k	0.27	0.35	7.2	*E,J,k	0.26	0.34	5.5	*E,J,k	0.27	0.35	16.7	*E,J,k	0.25	0.32	12.1	*E,J,k	0.27	0.35
Magnesium	7439-95-4	--	--	--	--	--	NT				2,420	E,J,s	0.71	116	2,510	E,J,s	0.68	112	2,300	E,J,s	0.72	118	1,120	E,J,s	0.65	107	4,860	E,J,s	0.71	116
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				***480***	E,J,s	0.02	1.2	***274***	E,J,s	0.02	1.1	***247***	E,J,s	0.02	1.2	***620***	E,J,s	0.02	1.1	***494***	E,J,s	0.02	1.2
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT				0.15	N*,J,k	0.019	0.038	<0.038	UN*,UJ,k	0.019	0.038	0.022	BN*,J,k	0.018	0.036	0.031	BN*,J,k	0.019	0.038	0.041	N*,J,k	0.02	0.039
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				9.6	E,J,s	0.12	0.58	9.1	E,J,s	0.11	0.56	7.3	E,J,s	0.12	0.59	7	E,J,s	0.11	0.53	15.6	E,J,s	0.12	0.58
Potassium	7440-09-7	--	--	--	--	--	NT				1,610	E,J,s	13.7	116	1,490	E,J,s	13.3	112	1,370	E,J,s	14	118	749	E,J,s	12.7	107	2,720	E,J,s	13.8	116
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				***1.3***	N,L,m	0.38	0.58	0.91	N,L,m	0.37	0.56	0.79	N,L,m	0.39	0.59	***1.1***	N,L,m	0.35	0.53	***1.6***	N,L,m	0.38	0.58
Silver	7440-22-4	N	--	39.11	511	1.551	NT				<0.58	U	0.08	0.58	<0.56	U	0.08	0.56	<0.59	U	0.08	0.59	<0.53	U	0.07	0.53	<0.58	U	0.08	0.58
Sodium	7440-23-5	--	--	--	--	--	NT				286	L,w	28.8	232	176	B,L,w	27.8	224	170	B,L,w	29.4	236	150	B,L,w	26.6	214	208	B,L,w	28.9	232
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				28.1	E,J,s	0.08	2.3	25.5	E,J,s	0.08	2.2	19.5	E,J,s	0.08	2.4	25	E,J,s	0.07	2.1	***46.1***	E,J,s	0.08	2.3
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				147	N*E,J,k	0.12	2.3	40.4	N*E,J,k	0.11	2.2	33.3	N*E,J,k	0.12	2.4	52.6	N*E,J,k	0.11	2.1	63.8	N*E,J,k	0.12	2.3
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<3.9	U	1.1	3.9	NT				NT				NT				NT				NT			
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	<2	U	0.65	2	NT				NT				NT				NT				NT			
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	<2	U	0.42	2	NT				NT				NT				NT				NT			
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<3.9	U	0.81	3.9	NT				NT				NT				NT				NT			
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	<3.9	U	0.8	3.9	NT				NT				NT				NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<3.9	U	1.1	3.9	NT				NT				NT				NT				NT			
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	<3.9	U	0.55	3.9	NT				NT				NT				NT				NT			
Endrin aldehyde [6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<3.9	U	1.2	3.9	NT				NT				NT				NT				NT			
Endrin ketone [6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	<3.9	U	1.2	3.9	NT				NT				NT				NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<2	U	0.76	2	NT				NT				NT				NT				NT			
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<3.9	U	0.56	3.9	NT				NT				NT				NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<8	U	1.4	8	NT				NT				NT				NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<2	U	0.49	2	NT				NT				NT				NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U	1.5	20	NT				NT				NT				NT				NT			
Aroclor 1254 [7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<39	U	7.1	39	NT				NT				NT				NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<39	U	5.2	39	NT				NT				NT				NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				***150***	J,J,r	20	400	<380	U	20	380	<400	U	20	400	<380	U	20	380	<390	U	20	390
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				***25***	J	21	400	<380	U	21	380	<400	U	21	400	<380	U	21	380	<390	U	21	390
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	NT				175	J	21	400	ND				ND				ND				ND			
Acenaphthylene [8]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				<400	U	17	400	<380	U	17	380	<400	U	17	400	<380	U	17	380	<390	U	17	390
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				<400	U	25	400	<380	U	25	380	<400	U	25	400	<380	U	25	380	<390	U	25	390
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				<400	U	29	400	<380	U	29	380	<400	U	29	400	<380	U	39	380	<390	U	29	390
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				<400	U	23	400	<380	U	23	380	<400	U	23	400	<380	U	23	380	<390	U	23	390
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				<400	U	36	400	<380	U	36	380	<400	U	36	400	<380	U	36	380	<390	U	36	390
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				<400	U	23	400	<380	U	23	380	<400	U	23	400	<380	U	23	380	<390	U	23	390
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				<400	U	29	400	<380	U	29	380	<400	U	29	400	<380	U	29	380	<390	U	29	390
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				670		32	400	<380	U	32	380	<400	U	32	400	<380	U	32	380	<390	U	32	390
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	NT				<400	U	29	400	<380	U	29	380	<400	U	29	400	<380	U	29	380	<390	U	29	390
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				<400	U	28	400	<380	U	28	380	<400	U	28	400	<380	U	28	380	<390	U	28	390
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				970		400	400	<380	U	380	380	<400	U	400	400	<380	U	380	380	<390	U	390	390
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				<400	U	400	400	<380	U	380	380	<400	U	400	400	<380	U	380	380	<390	U	390	390
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				<400	U	21	400	<380	U	21	380	<400	U	21	400	<380	U	21	380	<390	U	21	390
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				720		400	400	<380	U	380	380	<400	U	400	400	74	J	380	380	<390	U	390	390
Dimethylphthalate	131-11-3	--	--	--	--	--	NT				1,200		400	400	<380	U	380	380	<400	U	400	400	<380	U	380	380	<390	U	390	390
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				<400	U	18	400	<380	U	18	380	<400	U	18	400	<380	U	18	380	<390	U	18	390
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				<400	U	18	400	<380	U	18	380	<400	U	18	400	<380	U	18	380	<390	U	18	390
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				<400	U	20	400	<380	U	20	380	<400	U	20	400	<380	U	20	380	<390	U	20	390
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				***160***	J,J,r	400	400	<380	U	380	380	<400	U	400	400	<380	U	380	380	<390	U	390	390
Phenanthrene [8]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				<400	U	24	400	<380	U	24	380	<400	U	24	400	<380	U	24	380	<390	U	24	390
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				<400	U	24	400	<380	U	24	380	<400	U	24	400	<380	U	24	380	<390	U	24	390
SVOC TICs (ug/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NT				NI				NI				NI				260	NJ,NJ,t	0	0	NI			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NT				NI				160	NJ,NJ,t	0	0	NI				NI				NI			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NT				NI				NI				NI				500	NJ,NJ,t	0	0	NI			
16-Octadecenal	56554-87-1	--	--	--	--	--	NT				NI				NI				NI				160	NJ,NJ,t	0	0	NI			
17-Octadecenal	56554-86-0	--	--	--	--	--	NT				NI				NI				NI				540	NJ,NJ,t	0	0	NI			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NI				NI				NI				NI				NI			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				850	NJ,NJ,t	0	0	NI				NI				NI				NI			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NI				NI				NI				NI				NI			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB42C 1/8/2007 13.5-14.5		MDL	RL	54SB43A [D] 12/4/2002 0.5-1		MDL	RL	54SB43B [D] 12/4/2002 8-9		MDL	RL	54SB43C [D] 12/4/2002 10-11		MDL	RL	54SB44A 12/4/2002 0-1		MDL	RL	54SB44B 12/4/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NT				NI				NI				NI				170	NJ,NJ,t	0	0	NI			
Camphene	79-92-5	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Cholesterol	57-88-5	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NT				NI				NI				NI				NI				NI			
Pentadecanal-	24055	--	--	--	--	--	NT				530	NJ,NJ,t	0	0	NI				NI				NI				NI			
Testosterone	58-22-0	--	--	--	--	--	NT				200	NJ,NJ,t	0	0	NI				NI				NI				NI			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NT				170	NJ,NJ,t	0	0	NI				NI				NI				NI			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	18.7	,B,z	0.889	0.889	1,860		1.05	1.05	120		1.02	1.02	733		0.965	0.965	NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	0.407	A	0.889	0.889	216		0.98	0.98	<1.02	U	1.02	1.02	64.6		0.955	0.955	NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	1.08	A	0.445	0.445	210		0.633	0.633	2.2	A,J,w	0.509	0.509	53.8		0.477	0.477	NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	0.79	A	0.445	0.445	86.9		0.49	0.49	0.216	A,J,w	0.509	0.509	14.3		0.477	0.477	NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	<0.445	U	0.445	0.445	6.24		0.49	0.49	<0.509	U	0.509	0.509	0.825	A	0.477	0.477	NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	<0.445	U	0.445	0.445	3.22	A	0.49	0.49	<0.509	U	0.509	0.509	0.489	A	0.477	0.477	NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	<0.445	U	0.445	0.445	10.7		0.49	0.49	<0.509	U	0.509	0.509	0.974	A,J,w	0.477	0.477	NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	<0.445	U	0.445	0.445	8.89		0.49	0.49	<0.509	U	0.509	0.509	1.28	A	0.477	0.477	NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	<0.445	U	0.445	0.445	8.08		0.49	0.49	<0.509	U	0.509	0.509	0.819	A	0.477	0.477	NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	0.164	A	0.445	0.445	8.34		0.49	0.49	<0.509	U	0.509	0.509	<0.477	U	0.477	0.477	NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	<0.445	U	0.445	0.445	2.51	A	0.49	0.49	<0.509	U	0.509	0.509	0.206	A,J,w	0.477	0.477	NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	0.135	A	0.445	0.445	<0.49	U	0.49	0.49	0.12	A	0.509	0.509	<0.477	U	0.477	0.477	NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	0.237	A	0.445	0.445	6.49		0.49	0.49	0.0713	A,J,w	0.509	0.509	0.537	A,J,w	0.477	0.477	NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	0.302	A	0.445	0.445	8.97		0.49	0.49	<0.509	U	0.509	0.509	0.745	A,J,w	0.477	0.477	NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	0.466	A	0.445	0.445	7.69		0.49	0.49	0.106	A	0.509	0.509	0.64	A,J,w	0.477	0.477	NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	<0.0889	U	0.0889	0.0889	***1.05***		0.098	0.098	<0.102	U	0.102	0.102	0.405	A	0.0955	0.0955	NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	0.459	A,J,w	0.145	0.145	9.85		0.0998	0.0998	<0.106	U	0.106	0.106	0.9	A	0.182	0.182	NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	3.03		0.445	0.445	448		0.903	0.903	5.95		0.509	0.509	127		0.578	0.578	NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	0.79		0.445	0.445	241		0.49	0.49	<0.509	U	0.509	0.509	42.6		0.477	0.477	NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	0.706		0.445	0.445	71.3		0.49	0.49	0.285		0.509	0.509	8.5		0.477	0.477	NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	0.74		0.445	0.445	101		0.49	0.49	0.0631		0.509	0.509	8.68		0.477	0.477	NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	1.11		0.445	0.445	23.2		0.49	0.49	0.481		0.509	0.509	1.85		0.477	0.477	NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	2.05		0.445	0.445	60.3		0.884	0.884	0.106		0.509	0.509	3.18		0.477	0.477	NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	<0.0889	U	0.0889	0.0889	11.7		0.098	0.098	<0.102	U	0.102	0.102	0.707		0.0955	0.0955	NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	1.6		0.145	0.145	110		0.0998	0.0998	0.275	,B,z	0.106	0.106	7.08		0.182	0.182	NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				3,500	EP,J,g	5.9	50	<47	U	5.9	47	<51	U	5.9	51	<49	U	5.9	49	***20,000***	EP,L,s	5.9	49
Acenaphthylene[B]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				<50	U	5.9	50	<47	U	5.9	47	<51	U	5.9	51	<49	U	5.9	49	340	P,L,s	5.9	49
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				<50	U	5.4	50	<47	U	5.4	47	<51	U	5.4	51	<49	U	5.4	49	7.2	J,L,s	5.4	49
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				5.6	J	2.2	9.9	<9.3	U	2.2	9.3	<10	U	2.2	10	<9.6	U	2.2	9.6	***25***	P,L,s	2.2	9.8
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				***26***	P,J,g	1.6	9.9	<9.3	U	1.6	9.3	5.8	J	1.6	10	<9.6	U	1.6	9.6	***34***	P,L,s	1.6	9.8
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				50	P,J,g	1.7	9.9	<9.3	U	1.7	9.3	6.7	J	1.7	10	<9.6	U	1.7	9.6	***87***	P,L,s	1.7	9.8
Benzo(g,h,i)perylene[B]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				6.5	J	3.6	9.9	<9.3	U	3.6	9.3	<10	U	3.6	10	<9.6	U	3.6	9.6	14	P,L,s	3.6	9.8
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				7.9	JP,J,g	1.4	9.9	<9.3	U	1.4	9.3	9	JP,J,g	1.4	10	<9.6	U	1.4	9.6	44	P,J,c	1.4	9.8
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				18	P,J,g	2.4	9.9	<9.3	U	2.4	9.3	<10	U	2.4	10	<9.6	U	2.4	9.6	49	P,L,s	2.4	9.8
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				8.9	J	4.2	9.9	<9.3	U	4.2	9.3	<10	U	4.2	10	<9.6	U	4.2	9.6	<9.8	U,UL,s	4.2	9.8
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				29	P,J,g	2.1	20	<19	U	2.1	19	<20	U	2.1	20	11	JP,J,g	2.1	20	64	P,L,s	2.1	20
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				<50	U	14	50	<47	U	14	47	<51	U	14	51	<49	U	14	49	73	P,L,s	14	49
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				35	P,J,g	2.5	9.9	<9.3	U	2.5	9.3	5.1	J	2.5	10	<9.6	U	2.5	9.6	35	P,L,s	2.5	9.8
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				***450***		14	50	<47	U	14	47	<51	U	14	51	<49	U	14	49	***830***	L,s	14	49
Phenanthrene[B]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				<50	U	8.5	50	<47	U	8.5	47	<51	U	8.5	51	<49	U	8.5	49	48	J,L,s	8.5	49
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				17	J	4.3	20	<19	U	4.3	19	<20	U	4.3	20	<20	U	4.3	20	57	L,s	4.3	20
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB42C 1/8/2007 13.5-14.5		MDL	RL	54SB43A [D] 12/4/2002 0.5-1		MDL	RL	54SB43B [D] 12/4/2002 8-9		MDL	RL	54SB43C [D] 12/4/2002 10-11		MDL	RL	54SB44A 12/4/2002 0-1		MDL	RL	54SB44B 12/4/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r				Result	LQ, VQ, r				Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT					NT					NT			
Explosives (mg/kg)																																
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT				<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1		<1	U,R,l	0.079	1		<1	U,R,l	0.079	1
2,4,6-Trinitrotoluene[B]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT				<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1		<1	U	0.16	1		<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT				<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1		<1	U	0.12	1		<1	U	0.12	1
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	NT				ND				ND				ND					ND					ND			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	NT				<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1		<1	U	0.1	1		<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT				<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1		<1	U	0.095	1		<1	U	0.095	1
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	NT				ND				ND				ND					ND					ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT				<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1		<1	U	0.1	1		<1	U	0.1	1
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	NT				<1	U	0.28	1	<1	U	0.28	1	<1	U	0.28	1		<1	U	0.28	1		<1	U	0.28	1
Nitroglycerin (mg/kg)																																
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				<10	U	1	10	<10	U	1	10	<10	U	1	10		<10	U	1	10		<10	U	1	10
Percent Solids (%)																																
Percent Solids	--	--	--	--	--	--	84		0.1	0.1	--				--				--					--					--			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB44C 12/4/2002 17-18		MDL	RL	54SB44C-DUP (D-11) 12/4/2002 17-18		MDL	RL	54SB45A[D] 12/2/2002 0-1		MDL	RL	54SB45B[D] 12/2/2002 9-10		MDL	RL	54SB45C 1/9/2007 12-13		MDL	RL	54SB46A[E] 12/4/2002 0.5-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	15,500		2.6	11.9	14,300		2.4	11.1	12,600		2.4	11.2	11,300		2.5	11.4	NT				14,300		2.6	11.7
Antimony	7440-36-0	N	--	3.13	40.88	0.66	<1.2	UN*,R,m	0.44	1.2	<1.1	UN*,R,m	0.41	1.1	<1.1	UN,UL,m	0.41	1.1	<1.1	UN,UL,m	0.42	1.1	NT				***1.9***	N*,K,w	0.43	1.2
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***2.4***	N,L,m	0.3	1.2	***2.2***	N,K,w	0.28	1.1	***0.44***	BN,L,w	0.28	1.1	***1.1***	BN,L,w	0.28	1.1	NT				***5.1***	N,L,m	0.29	1.2
Barium	7440-39-3	N	209	1,564	20,440	300.8	137	E,J,s	0.02	1.2	137	E,J,s	0.02	1.1	91.9	*E,J,s	0.02	1.1	74.8	*E,J,s	0.02	1.1	NT				228	E,J,s	0.02	1.2
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	0.81		0.01	0.6	0.69		0.01	0.56	0.61	E,J,s	0.01	0.56	0.54	BE,J,s	0.01	0.57	NT				0.66		0.01	0.59
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.6	U	0.05	0.6	<0.56	U	0.04	0.56	<0.56	U	0.04	0.56	<0.57	U	0.05	0.57	NT				0.64		0.05	0.59
Calcium	7440-70-2	--	--	--	--	--	1,780	E,J,s	1.1	119	1,620	E,J,s	1.1	111	820	E,J,s	1.1	112	1,150	E,J,s	1.1	114	NT				14,900	E,J,s	1.1	117
Chromium[1]	7440-47-3	N	65.3	23.46	306.6	2.102	***21***	N,L,m	0.07	0.6	***20.4***	N,L,m	0.07	0.56	***19.2***	E,J,s	0.07	0.56	***16***	E,J,s	0.07	0.57	NT				***31.9***	N,L,m	0.07	0.59
Cobalt	7440-48-4	--	72.3	--	--	--	8.5	E	0.07	0.6	8.3	E,J,s	0.07	0.56	7.9	E,J,s	0.07	0.56	7.4	E,J,s	0.07	0.57	NT				6.5	E,J,s	0.07	0.59
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	12.3	N*E,J,k	0.17	0.6	13.3	N*E,J,k	0.16	0.56	3.3	E,J,s	0.16	0.56	7	E,J,s	0.16	0.57	NT				195	N*E,J,k	0.16	0.59
Iron	7439-89-6	N	50,962	5,475	71,540	--	22,900	E	1.6	11.9	21,700	E,J,s	1.5	11.1	19,200	E,J,s	1.5	11.2	18,500	E,J,s	1.6	11.4	NT				23,300	E,J,s	1.6	11.7
Lead[2]	7439-92-1	--	26.8	400	750	--	8.4	*E,J,k	0.27	0.36	9	*E,J,k	0.26	0.33	7.4	*E,J,k	0.26	0.33	6.7	*E,J,k	0.26	0.34	NT				3,610	*E,J,k	0.27	0.35
Magnesium	7439-95-4	--	--	--	--	--	4,670	E,J,s	0.73	119	4,200	E,J,s	0.68	111	3,450	E,J,s	0.68	112	3,160	E,J,s	0.69	114	NT				9,040	E,J,s	0.72	117
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***338***	E,J,s	0.02	1.2	***347***	E,J,s	0.02	1.1	***370***	E,J,s	0.02	1.1	***321***	E,J,s	0.02	1.1	NT				***406***	E,J,s	0.02	1.2
Mercury[3]	7439-97-6	--	0.13	2.35	30.66	--	<0.036	UN*,UJ,k	0.018	0.036	<0.039	UN*,UJ,k	0.02	0.039	0.029	B	0.018	0.036	0.022	B	0.017	0.035	NT				0.77	N*,J,k	0.019	0.037
Nickel	7440-02-0	N	62.8	156.4	2,044	--	13.1	E,J,s	0.12	0.6	12.3	E,J,s	0.11	0.56	11.2	E,J,s	0.11	0.56	10	E,J,s	0.11	0.57	NT				16.6	E,J,s	0.12	0.59
Potassium	7440-09-7	--	--	--	--	--	2,410	E,J,s	14.1	119	2,270	E,J,s	13.2	111	2,220	E,J,s	13.2	112	1,640	E,J,s	13.5	114	NT				1,390	E,J,s	13.9	117
Selenium	7782-49-2	N	--	39.11	511	0.949	***0.99***	N,L,m	0.39	0.6	***1***	N,L,m	0.37	0.56	***1***	N,B,x	0.37	0.56	***1.2***	N,B,x	0.37	0.57	NT				***1.9***	N,L,m	0.39	0.59
Silver	7440-22-4	N	--	39.11	511	1.551	<0.6	U	0.08	0.6	<0.56	U	0.08	0.56	<0.56	U	0.08	0.56	<0.57	U	0.08	0.57	NT				0.11	B	0.08	0.59
Sodium	7440-23-5	--	--	--	--	--	187	B,L,w	29.6	238	184	B,L,w	27.7	223	182	B,L,w	27.8	223	158	B,L,w	28.3	227	NT				746		29.2	235
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	***38.3***	E,J,s	0.08	2.4	36.4	E,J,s	0.08	2.2	33.4	E,J,s	0.08	2.2	30.8	E,J,s	0.08	2.3	NT				***37.4***	E,J,s	0.08	2.3
Zinc	7440-66-6	N	202	2,346	30,660	681.1	47	N*E,J,k	0.12	2.4	46.6	N*E,J,k	0.11	2.2	54.4	N*E,J,k	0.11	2.2	41	N*E,J,k	0.11	2.3	NT				555	N*E,J,k	0.12	2.3
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				NT				NT				NT				60	PD,J,g	0.4	20
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	NT				NT				NT				NT				NT				<1	U	0.17	1
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	NT				NT				NT				NT				NT				<1	U	0.26	1
alpha-Chlordane[4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				62	D	0.22	20
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	NT				NT				NT				NT				NT				<2	U	0.28	2
delta-BHC[5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				NT				NT				NT				<1	U	0.15	1
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	NT				NT				NT				NT				NT				***11***		0.43	2
Endrin aldehyde[6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				<4	U	0.35	4
Endrin ketone[6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				<10	U	0.39	10
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				NT				NT				NT				<1	U	0.22	1
gamma-Chlordane[4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				55	D	0.35	10
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				NT				NT				NT				1.3		0.34	1
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				NT				NT				NT				***21***	PD,J,g	0.26	10
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				NT				NT				NT				<10	U	1.4	10
Aroclor 1254[7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				NT				NT				NT				***2,800***		73	400
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				NT				NT				NT				380	,J,g	5.4	40
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<390	U	20	390	***430***	J,r	20	400	<380	U	20	380	<380	U	20	380	NT				***14,000***	D,J,r	20	6,000
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<390	U	21	390	***29***	J	21	400	<380	U	21	380	<380	U	21	380	NT				***2,100***	JD	21	6,000
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				459	J	21	400	ND				ND				NT				16,100	D,J,r	21	6,000
Acenaphthylene[8]	208-96-8	N	--	2.3E+05	3.1E+06	--	<390	U	17	390	<400	U	17	400	<380	U	17	380	<380	U	17	380	NT				<6,000	U	17	6,000
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<390	U	25	390	<400	U	25	400	<380	U	25	380	<380	U	25	380	NT				<6,000	U	25	6,000
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<390	U	29	390	<400	U	29	400	<380	U	29	380	<380	U	29	380	NT				<6,000	U	29	6,000
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<390	U	23	390	<400	U	23	400	<380	U	23	380	<380	U	23	380	NT				<6,000	U	23	6,000
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<390	U	36	390	<400	U	36	400	<380	U	36	380	<380	U	36	380	NT				<6,000	U	36	6,000
Benzo(g,h,i)perylene[8]	191-24-2	N	--	2.3E+05	3.1E+06	--	<390	U	23	390	<400	U	23	400	<380	U	23	380	<380	U	23	380	NT				<6,000	U	23	6,000
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<390	U	29	390	<400	U	29	400	<380	U	29	380	<380	U	29	380	NT				<6,000	U	29	6,000
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	<390	U	32	390	<400	U	32	400	<380	U	32	380	<380	U	32	380	NT				1,400	JD	32	6,000
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	<390	U	29	390	<400	U	29	400	<380	U	29	380	<380	U	29	380	NT				<6,000	U	29	6,000
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<390	U	28	390	<400	U	28	400	<380	U	28	380	<380	U	28	380	NT				<6,000	U	28	6,000
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	<390	U	390	390	1,100		400	400	<380	U	380	380	<380	U	380	380	NT				11,000	D	6,000	6,000
Di-n-octylphthalate	117-84-0	--	--	--	--	--	<390	U	390	390	<400	U	400	400	<380	U	380	380	<380	U	380	380	NT				<6,000	U	6,000	6,000
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<390	U	21	390	<400	U	21	400	<380	U	21	380	<380	U	21	380	NT				<6,000	U	21	6,000
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	130	J	390	390	<400	U	400	400	<380	U	380	380	<380	U	380	380	NT				***96,000***	D	6,000	6,000
Dimethylphthalate	131-11-3	--	--	--	--	--	<390	U	390	390	<400	U	400	400	<380	U	380	380	<380	U	380	380	NT				1,900	JD	6,000	6,000
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<390	U	18	390	<400	U	18	400	<380	U	18	380	<380	U	18	380	NT				<6,000	U	18	6,000
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<390	U	18	390	<400	U	18	400	<380	U	18	380	<380	U	18	380	NT				<6,000	U	18	6,000
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<390	U	20	390	<400	U	20	400	<380	U	20	380	<380	U	20	380	NT				<6,000	U	20	6,000
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<390	U	390	390	***87***	J,J,r	400	400	<380	U	380	380	<380	U	380	380	NT				***1,800***	JD,J,r	6,000	6,000
Phenanthrene[8]	85-01-8	N	--	2.3E+05	3.1E+06	--	<390	U	24	390	<400	U	24	400	<380	U	24	380	<380	U	24	380	NT				<6,000	U	24	6,000
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	<390	U	24	390	<400	U	24	400	<380	U	24	380	<380	U	24	380	NT				<6,000	U	24	6,000
SVOC TICs (µg/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NI				NI				380	NJ,NJ,t	0	0	NI				NT				NI			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
16-Octadecenal	56554-87-1	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
17-Octadecenal	56554-86-0	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NI				NI				NI				NI				NT				NI			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				NI				NI				NI				NT				40,000	NJ,NJ,t	0	0
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				NI				NI				NI				NT				8,500	NJ,NJ,t	0	0

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB44C 12/4/2002 17-18		MDL	RL	54SB44C-DUP (D-11) 12/4/2002 17-18		MDL	RL	54SB45A[D] 12/2/2002 0-1		MDL	RL	54SB45B[D] 12/2/2002 9-10		MDL	RL	54SB45C 1/9/2007 12-13		MDL	RL	54SB46A[E] 12/4/2002 0.5-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
Camphene	79-92-5	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
Cholesterol	57-88-5	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NI				NI				NI				540	NJ,NJ,t	0	0	NT				NI			
Pentadecanal-	24055	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
Testosterone	58-22-0	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NI				NI				NI				NI				NT				NI			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				70		0.795	0.795	47.8		0.913	0.913	29.2		0.984	0.984	17,790		9.5	99.9
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	NT				NT				0.382	A,B,z	0.795	0.795	0.575	A,B,z	0.913	0.913	<0.984	U	0.984	0.984	2,060	J,c	1.8	10
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				1.83	A	0.403	0.403	2.04	A	0.637	0.637	1.15	A	0.492	0.492	3,090		11.6	49.9
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				0.223	A,J,w	0.397	0.397	0.888	A	0.457	0.457	0.148	A	0.492	0.492	1,030		0.7	5
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				<0.397	U	0.397	0.397	<0.457	U	0.457	0.457	<0.492	U	0.492	0.492	54.9		1	5
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				<0.494	U	0.494	0.494	<0.592	U	0.592	0.592	<0.492	U	0.492	0.492	62.7		0.8	5
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				<0.397	U	0.397	0.397	0.142	A	0.457	0.457	<0.492	U	0.492	0.492	116		0.5	5
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				<0.505	U	0.505	0.505	<0.605	U	0.605	0.605	<0.492	U	0.492	0.492	154		0.8	5
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				<0.397	U	0.397	0.397	0.139	A	0.457	0.457	<0.492	U	0.492	0.492	57		0.5	5
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				<0.545	U	0.545	0.545	<0.653	U	0.653	0.653	<0.492	U	0.492	0.492	163		0.8	5
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				<0.397	U	0.397	0.397	<0.457	U	0.457	0.457	<0.492	U	0.492	0.492	3.3	J	0.6	5
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				<0.397	U	0.397	0.397	<0.457	U	0.457	0.457	<0.492	U	0.492	0.492	34.5	J,c	0.5	5
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				<0.397	U	0.397	0.397	0.141	A	0.457	0.457	<0.492	U	0.492	0.492	<5		0.4	5
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				<0.397	U	0.397	0.397	0.413	A	0.457	0.457	<0.492	U	0.492	0.492	57		0.5	5
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				<0.397	U	0.397	0.397	0.225	A,B,z	0.457	0.457	<0.492	U	0.492	0.492	29.6		0.4	5
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				<0.0795	U	0.0795	0.0795	<0.0913	U	0.0913	0.0913	<0.0984	U	0.0984	0.0984	***5.9***		0.4	1
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				0.221	A	0.0795	0.0795	0.298	A	0.109	0.109	0.274	A,B,z	0.0984	0.0984	43		0.3	1
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				7.02		0.575	0.575	6.29		0.908	0.908	3.26		0.492	0.492	5,340		11.6	49.9
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				0.235	,B,z	0.397	0.397	0.888		0.457	0.457	0.148		0.492	0.492	3,220	MX,J,w	0.8	5
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				<0.545	U	0.545	0.545	0.866		0.653	0.653	0.793		0.492	0.492	1,090		0.8	5
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				0.0811		0.397	0.397	1.39		0.457	0.457	0.12		0.492	0.492	2,670	MX,J,w	0.5	5
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				<0.397	U	0.397	0.397	1.32		0.457	0.457	0.356		0.492	0.492	170	M,J,c	0.5	5
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				<0.397	U	0.397	0.397	1.4		0.457	0.457	0.0276		0.492	0.492	1,400	MX,J,w	0.4	5
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				<0.0795	U	0.0795	0.0795	<0.0913	U	0.0913	0.0913	<0.0984	U	0.0984	0.0984	86.4	M	0.4	1
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				0.356		0.0795	0.0795	1.34		0.109	0.109	0.425	,B,z	0.0984	0.0984	1,130	MX,J,w	0.4	1
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	<50	U	5.9	50	<51	U	5.9	51	<48	U	5.9	48	<49	U	5.9	49	NT				<51	U	5.9	51
Acenaphthylene[B]	208-96-8	N	--	2.3E+05	3.1E+06	--	<50	U	5.9	50	<51	U	5.9	51	<48	U	5.9	48	<49	U	5.9	49	NT				<51	U	5.9	51
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<50	U	5.4	50	<51	U	5.4	51	<48	U	5.4	48	<49	U	5.4	49	NT				<51	U	5.4	51
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<9.9	U	2.2	9.9	<10	U	2.2	10	<9.5	U	2.2	9.5	<9.6	U	2.2	9.6	NT				<10	U	2.2	10
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<9.9	U	1.6	9.9	<10	U	1.6	10	<9.5	U	1.6	9.5	<9.6	U	1.6	9.6	NT				<10	U	1.6	10
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<9.9	U	1.7	9.9	<10	U	1.7	10	<9.5	U	1.7	9.5	<9.6	U	1.7	9.6	NT				<10	U	1.7	10
Benzo(g,h,i)perylene[B]	191-24-2	N	--	2.3E+05	3.1E+06	--	<9.9	U	3.6	9.9	<10	U	3.6	10	<9.5	U	3.6	9.5	<9.6	U	3.6	9.6	NT				<10	U	3.6	10
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<9.9	U	1.4	9.9	<10	U	1.4	10	<9.5	U	1.4	9.5	<9.6	U	1.4	9.6	NT				<10	U	1.4	10
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<9.9	U	2.4	9.9	<10	U	2.4	10	<9.5	U	2.4	9.5	<9.6	U	2.4	9.6	NT				<10	U	2.4	10
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<9.9	U	4.2	9.9	<10	U	4.2	10	<9.5	U	4.2	9.5	<9.6	U	4.2	9.6	NT				<10	U	4.2	10
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<20	U	2.1	20	<21	U	2.1	21	<20	U	2.1	20	<20	U	2.1	20	NT				<20	U	2.1	20
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<50	U	14	50	<51	U	14	51	<48	U	14	48	<49	U	14	49	NT				<51	U	14	51
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<9.9	U	2.5	9.9	<10	U	2.5	10	<9.5	U	2.5	9.5	<9.6	U	2.5	9.6	NT				<10	U	2.5	10
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	<50	U	14	50	<51	U	14	51	<48	U	14	48	<49	U	14	49	NT				<51	U	14	51
Phenanthrene[B]	85-01-8	N	--	2.3E+05	3.1E+06	--	<50	U	8.5	50	<51	U	8.5	51	<48	U	8.5	48	<49	U	8.5	49	NT				<51	U	8.5	51
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	<20	U	4.3	20	<21	U	4.3	21	14	JP,J,g	4.3	20	21	P,J,g	4.3	20	NT				<20	U	4.3	20
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				353	,J,i	8.13	8.13
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				2,160	,J,n	16.3	16.3
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				2,120	,J,n	16.3	16.3
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				2,540	,J,n	8.13	8.13
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				1,090	,J,n	8.13	8.13
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				49,100	E,J,q	24.4	24.4
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				25,300		16.3	16.3
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				137,000	E,J,q	8.13	8.13
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				8,190		8.13	8.13
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				2,890		8.13	8.13
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				73,300	E,J,q	32.5	32.5
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				21,400		8.13	8.13
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				2,750		8.13	8.13
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				<8.13	U	8.13	8.13
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				165,000	E,J,q	48.8	48.8
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				221,000	E,J,q	24.4	24.4
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				180,000	E,J,q	8.13	8.13
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				89,200	E,J,q	8.13	8.13
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				67,100	E,J,q	8.13	8.13
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				3,170		8.13	8.13
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				123,000	E,J,q	8.13	8.13
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				2,350		8.13	8.13
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				612		8.13	8.13
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				50,300	E,J,q	16.3	16.3
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				318,000	E,J,q	24.4	24.4
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				107,000	E,J,q	8.13	8.13
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				76,100	E,J,q	16.3	16.3
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				32,300		8.13	8.13
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				222,000	E,J,q	16.3	16.3
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				37,000	E,J,q	16.3	16.3

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB44C 12/4/2002 17-18		MDL	RL	54SB44C-DUP (D-11) 12/4/2002 17-18		MDL	RL	54SB45A [D] 12/2/2002 0-1		MDL	RL	54SB45B [D] 12/2/2002 9-10		MDL	RL	54SB45C 1/9/2007 12-13		MDL	RL	54SB46A [E] 12/4/2002 0.5-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				26,400		8.13	8.13
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				11,900		8.13	8.13
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				45,900	E,J,n	8.13	8.13
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				19,500	,J,n	8.13	8.13
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				79,100	E,J,n	16.3	16.3
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				21,000	,J,n	16.3	16.3
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				29,600	,J,n	8.13	8.13
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				1,660	,J,n	8.13	8.13
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				19,300	,J,n	8.13	8.13
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				8,080	,J,n	8.13	8.13
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				9,560	,J,n	8.13	8.13
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				1,830	,J,n	8.13	8.13
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				9,330	,J,n	8.13	8.13
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				4,160	,J,n	8.13	8.13
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT				NT				9,050		8.13	8.13
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	NT				<1	U,R,l	0.079	1
2,4,6-Trinitrotoluene [B]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	NT				59	Z,J,c	0.16	10
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	NT				***11***		0.12	1
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	ND				ND				ND				ND				NT				11		0.12	1
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	NT				9.6	JZ	0.1	10
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	NT				14	Z	0.095	10
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				ND				ND				NT				23.6	Z	0.1	10
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	NT				<1	U	0.1	1
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	<1	U	0.28	1	<1	U	0.28	1	<1	U	0.28	1	<1	U	0.28	1	NT				<1	U	0.28	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	NT				400	P,J,s	1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				--				--				NT				--			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB46B 12/4/2002 7.5-9		MDL	RL	54SB46C[F] 12/4/2002 11-12		MDL	RL	54SB47A[D] 12/9/2002 0-1		MDL	RL	54SB47A-DUP (D-13) 12/9/2002 0-1		MDL	RL	54SB47B[D] 12/9/2002 9-10		MDL	RL	54SB47C 1/9/2007 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	10,000		2.5	11.3	10,400		2.4	11.1	14,500		2.6	12	17,000		2.5	11.6	6,910		2.2	10.1	NT				
Antimony	7440-36-0	N	--	3.13	40.88	0.66	***20.7***	N*,J,k	0.42	1.1	<1.1	UN*,R,m	0.41	1.1	<1.2	UN,UL,m	0.45	1.2	<1.2	UN,UL,m	0.43	1.2	<1	UN,UL,m	0.37	1	NT				
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***4.2***	N,L,m	0.28	1.1	***0.58***	BN,K,w	0.28	1.1	***0.99***	BN,L,w	0.3	1.2	***1.4***	N,L,m	0.29	1.2	<1	UN,UL,w	0.25	1	NT				
Barium	7440-39-3	N	209	1,564	20,440	300.8	245	E,J,s	0.02	1.1	103	E,J,s	0.02	1.1	171	*E,J,s	0.02	1.2	182	*E,J,s	0.02	1.2	60	*E,J,s	0.02	1	NT				
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	0.58		0.01	0.57	0.58		0.01	0.56	0.92	E,J,s	0.01	0.6	1	E,J,s	0.01	0.58	0.42	BE,J,s	0.01	0.5	NT				
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	0.74		0.05	0.57	<0.56	U	0.04	0.56	<0.6	U	0.05	0.6	<0.58	U	0.05	0.58	<0.5	U	0.04	0.5	NT				
Calcium	7440-70-2	--	--	--	--	--	33,900	E,J,s	1.1	113	967	E,J,s	1.1	111	1,580	E,J,s	1.2	120	1,780	E,J,s	1.1	116	919	E,J,s	0.97	101	NT				
Chromium[1]	7440-47-3	N	65.3	23.46	306.6	2.102	***38.5***	N,L,m	0.07	0.57	***17.2***	N,L,m	0.07	0.56	***22.1***	E,J,s	0.07	0.6	***25.3***	E,J,s	0.07	0.58	***11.6***	E,J,s	0.06	0.5	NT				
Cobalt	7440-48-4	--	72.3	--	--	--	6.6	E,J,s	0.07	0.57	7.3	E,J,s	0.07	0.56	9.2	E,J,s	0.07	0.6	9.6	E,J,s	0.07	0.58	4.9	E,J,s	0.06	0.5	NT				
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	320	N*E,J,k	0.16	0.57	2.5	N*E,J,k	0.16	0.56	15.4	E,J,s	0.17	0.6	18.4	E,J,s	0.16	0.58	0.39	BE,B,x	0.14	0.5	NT				
Iron	7439-89-6	N	50,962	5,475	71,540	--	22,800	E,J,s	1.6	11.3	17,200	E,J,s	1.5	11.1	21,000	E,J,s	1.7	12	24,600	E,J,s	1.6	11.6	11,600	E,J,s	1.4	10.1	NT				
Lead[2]	7439-92-1	--	26.8	400	750	--	3,070	*E,J,k	0.26	0.34	8.4	*E,J,k	0.26	0.33	24.9	*E,J,k	0.28	0.36	36.6	*E,J,k	0.27	0.35	4.5	*E,J,k	0.23	0.3	NT				
Magnesium	7439-95-4	--	--	--	--	--	18,500	E,J,s	0.69	113	3,070	E,J,s	0.68	111	2,950	E,J,s	0.73	120	3,260	E,J,s	0.71	116	1,830	E,J,s	0.61	101	NT				
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***475***	E	0.02	1.1	***290***	E,J,s	0.02	1.1	***658***	E,J,s	0.02	1.2	***726***	E,J,s	0.02	1.2	***217***	E,J,s	0.02	1	NT				
Mercury[3]	7439-97-6	--	0.13	2.35	30.66	--	0.8	N*,J,k	0.019	0.038	0.019	BN*,J,k	0.018	0.036	0.043		0.02	0.04	0.042		0.02	0.041	0.019	B	0.017	0.035	NT				
Nickel	7440-02-0	N	62.8	156.4	2,044	--	21.6	E,J,s	0.11	0.57	9.9	E,J,s	0.11	0.56	13.5	E,J,s	0.12	0.6	15.1	E,J,s	0.12	0.58	7.2	E,J,s	0.1	0.5	NT				
Potassium	7440-09-7	--	--	--	--	--	1,570	E,J,s	13.4	113	2,060	E,J,s	13.2	111	1,520	E,J,s	14.3	120	1,690	E,J,s	13.7	116	997	E,J,s	11.9	101	NT				
Selenium	7782-49-2	N	--	39.11	511	0.949	***1.5***	N,L,m	0.37	0.57	***0.99***	N,L,m	0.37	0.56	***1.5***	N,B,x	0.4	0.6	***1.6***	N,B,x	0.38	0.58	0.73	N,B,x	0.33	0.5	NT				
Silver	7440-22-4	N	--	39.11	511	1.551	0.2	B	0.08	0.57	<0.56	U	0.08	0.56	<0.6	U	0.08	0.6	<0.58	U	0.08	0.58	<0.5	U	0.07	0.5	NT				
Sodium	7440-23-5	--	--	--	--	--	1,020		28.2	227	212	B,L,w	27.6	222	220	B,L,w	30	241	262		28.8	231	136	B,L,w	25.1	202	NT				
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	25.7	E,J,s	0.08	2.3	29.3	E	0.08	2.2	30.6	E,J,s	0.08	2.4	36.2	E,J,s	0.08	2.3	18.8	E,J,s	0.07	2	NT				
Zinc	7440-66-6	N	202	2,346	30,660	681.1	***762***	N*E,J,k	0.11	2.3	45.2	N*E,J,k	0.11	2.2	100	N*E,J,k	0.12	2.4	127	N*E,J,k	0.12	2.3	31.7	N*E,J,k	0.1	2	NT				
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	25	EP,J,s	0.4	2	NT				NT				NT				NT				NT				
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	***4.4***	P,J,c	0.17	1	NT				NT				NT				NT				NT				
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	<1	U	0.26	1	NT				NT				NT				NT				NT				
alpha-Chlordane[4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	490	PD,J,g	0.22	200	NT				NT				NT				NT				NT				
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	<2	U	0.28	2	NT				NT				NT				NT				NT				
delta-BHC[5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<1	U	0.15	1	NT				NT				NT				NT				NT				
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	<2	U	0.43	2	NT				NT				NT				NT				NT				
Endrin aldehyde[6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<4	U	0.35	4	NT				NT				NT				NT				NT				
Endrin ketone[6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	<10	U	0.39	10	NT				NT				NT				NT				NT				
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<1	U	0.22	1	NT				NT				NT				NT				NT				
gamma-Chlordane[4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	63	EP,J,s	0.35	1	NT				NT				NT				NT				NT				
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	2.8	P,J,s	0.34	1	NT				NT				NT				NT				NT				
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	***530***	D	0.26	100	NT				NT				NT				NT				NT				
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<10	U	1.4	10	NT				NT				NT				NT				NT				
Aroclor 1254[7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	***760***		9	110	***2,600***		75	410	NT				NT				NT				NT				
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	260		9.2	160	510	,J,g	5.5	41	NT				NT				NT				NT				
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	***4,700***	L,h	20	400	<380	U,R,s	20	380	<400	U	20	400	<400	U	20	400	<360	U	20	360	NT				
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	***750***	L,h	21	400	<380	U,R,s	21	380	<400	U	21	400	<400	U	21	400	<360	U	21	360	NT				
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	5,450	L,h	21	400	ND				ND				ND				ND				NT				
Acenaphthylene[8]	208-96-8	N	--	2.3E+05	3.1E+06	--	30	J,L,h	17	400	<380	U,R,s	17	380	<400	U	17	400	<400	U	17	400	<360	U	17	360	NT				
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	58	J,L,h	25	400	<380	U,R,s	25	380	<400	U	25	400	<400	U	25	400	<360	U	25	360	NT				
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	***180***	J,L,h	29	400	<380	U,R,s	29	380	<400	U	29	400	<400	U	29	400	<360	U	29	360	NT				
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	***190***	J,L,h	23	400	<380	U,R,s	23	380	<400	U	23	400	<400	U	23	400	<360	U	23	360	NT				
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	***290***	J,L,h	36	400	<380	U,R,s	36	380	<400	U	36	400	<400	U	36	400	<360	U	36	360	NT				
Benzo(g,h,i)perylene[8]	191-24-2	N	--	2.3E+05	3.1E+06	--	150	J,L,h	23	400	<380	U,R,s	23	380	<400	U	23	400	<400	U	23	400	<360	U	23	360	NT				
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	220	J,L,h	29	400	<380	U,R,s	29	380	<400	U	29	400	<400	U	29	400	<360	U	29	360	NT				
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	1,900	L,h	32	400	120	J,L,s	32	380	<400	U	32	400	<400	U	32	400	<360	U	32	360	NT				
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	***42***	J,L,h	29	400	<380	U,R,s	29	380	<400	U	29	400	<400	U	29	400	<360	U	29	360	NT				
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	220	J,L,h	28	400	<380	U,R,s	28	380	<400	U	28	400	<400	U	28	400	<360	U	28	360	NT				
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	3,100	L,h	400	400	<380	U,R,s	380	380	<400	U	400	400	<400	U	400	400	<360	U	360	360	NT				
Di-n-octylphthalate	117-84-0	--	--	--	--	--	<400	U,UL,h	400	400	640	L,s	380	380	<400	U	400	400	<400	U	400	400	<360	U	360	360	NT				
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	***73***	J,L,h	21	400	<380	U,R,s	21	380	<400	U	21	400	<400	U	21	400	<360	U	21	360	NT				
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	18,000	D,L,s	2,000	2,000	<380	U,R,s	380	380	<400	U	400	400	<400	U	400	400	<360	U	360	360	NT				
Dimethylphthalate	131-11-3	--	--	--	--	--	1,000	L,h	400	400	<380	U,R,s	380	380	<400	U	400	400	<400	U	400	400	<360	U	360	360	NT				
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	400	J,L,h	18	400	<380	U,R,s	18	380	<400	U	18	400	<400	U	18	400	<360	U	18	360	NT				
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	43	J,L,h	18	400	<380	U,R,s	18	380	<400	U	18	400	<400	U	18	400	<360	U	18	360	NT				
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	160	J,L,h	20	400	<380	U,R,s	20	380	<400	U	20	400	<400	U	20	400	<360	U	20	360	NT				
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	***500***	L,h	400	400	<380	U,R,s	380	380	<400	U	400	400	<400	U	400	400	<360	U	360	360	NT				
Phenanthrene[8]	85-01-8	N	--	2.3E+05	3.1E+06	--	250	J,L,h	24	400	<380	U,R,s	24	380	<400	U	24	400	<400	U	24	400	<360	U	24	360	NT				
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	380		24	400	<380	U,R,s	24	380	<400	U	24	400	<400	U	24	400	<360	U	24	360	NT				
SVOC TICs (µg/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NI				NI				160	NJ,NJ,t	0	0	NI				NI				NT				
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NI				180	NJ,NJ,t	0	0	NI				NI				NT				
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				720	NJ,NJ,t	0	0	NI				NI				NI				NT				
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NI				NI				NI				NI				NI				NT				
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NI				NI				NI				NI				NI				NT				
1-Heptadecanol	1454-85-9	--	--	--	--	--	NI				NI				NI				NI				NI				NT				
1-Nonadecanol	1454-84-8	--	--	--	--	--	NI				NI				NI				NI				NI				NT				
16-Octadecenal	56554-87-1	--	--	--	--	--	NI				NI				NI				NI				NI				NT				
17-Octadecenal	56554-86-0	--	--	--	--	--	NI				NI				NI				NI				NI				NT				
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	***250***	NJ,NJ,t	0	0	NI				NI				NI				NI				NT				
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	5,800	NJ,NJ,t	0	0	NI				NI				NI				NI				NT				
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	4,600	NJ,NJ,t	0	0	NI				NI				NI				NI				NT				

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB46B 12/4/2002 7.5-9		MDL	RL	54SB46C[F] 12/4/2002 11-12		MDL	RL	54SB47A[D] 12/9/2002 0-1		MDL	RL	54SB47A-DUP (D-13) 12/9/2002 0-1		MDL	RL	54SB47B[D] 12/9/2002 9-10		MDL	RL	54SB47C 1/9/2007 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NI				NI				NI				NI				NI				NT			
Camphene	79-92-5	--	--	--	--	--	NI				NI				NI				NI				NI				NT			
Cholesterol	57-88-5	--	--	--	--	--	NI				NI				NI				NI				NI				NT			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NI				NI				NI				NI				600	NJ,NJ,t	0	0	NT			
Pentadecanal-	24055	--	--	--	--	--	NI				NI				NI				NI				NI				NT			
Testosterone	58-22-0	--	--	--	--	--	NI				NI				NI				NI				NI				NT			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NI				NI				NI				NI				NI				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	5,320		6.3	100	8,600	E,J,q	1.01	1.01	2,440		1.01	1.01	NT				78.3		0.954	0.954	59.2		0.922	0.922
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	1,400	J,c	2	10	965		1.01	1.01	1.36	A,B,z	1.01	1.01	NT				<0.954	U	0.954	0.954	<0.922	U	0.922	0.922
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	1,070		1.4	5	687		0.505	0.505	24.8		0.506	0.506	NT				1.71	A	0.477	0.477	1.5	A	0.461	0.461
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	417		0.7	5	276		1.24	1.24	0.937		0.506	0.506	NT				0.225	A,J,w	0.477	0.477	0.17	A,B,z	0.461	0.461
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	43.4		0.9	5	16.9		1.55	1.55	<0.506	U	0.506	0.506	NT				<0.477	U	0.477	0.477	<0.461	U	0.461	0.461
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	14.2		0.7	5	8.57		0.505	0.505	0.281	A	0.506	0.506	NT				<0.477	U	0.477	0.477	<0.461	U	0.461	0.461
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	60.7		0.5	5	15.3		1.87	1.87	<0.506	U	0.506	0.506	NT				0.0592		0.477	0.477	<0.461	U	0.461	0.461
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	40.1		0.7	5	27.4		0.505	0.505	0.423	A	0.506	0.506	NT				<0.477	U	0.477	0.477	<0.461	U	0.461	0.461
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	27		0.4	5	10.1		1.79	1.79	0.123	A,B,z	0.506	0.506	NT				<0.477	U	0.477	0.477	0.0442	A,J,w	0.461	0.461
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	35.5		0.7	5	20.5		0.505	0.505	0.747	A	0.506	0.506	NT				<0.477	U	0.477	0.477	<0.461	U	0.461	0.461
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	2.3	J	0.6	5	2.99	A	2.1	2.1	<0.506	U	0.506	0.506	NT				<0.477	U	0.477	0.477	<0.461	U	0.461	0.461
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	6.8	M,J,c	0.5	5	4.87	A,J,w	0.505	0.505	<0.506	U	0.506	0.506	NT				<0.477	U	0.477	0.477	0.0922	A	0.461	0.461
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	<5		0.3	5	4.39	A	0.505	0.505	0.105	A	0.506	0.506	NT				<0.477	U	0.477	0.477	0.0627	A,J,w	0.461	0.461
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	27.2		0.5	5	13.2		1.85	1.85	0.168	A,B,z	0.506	0.506	NT				<0.477	U	0.477	0.477	0.133	A,J,w	0.461	0.461
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	14.6		0.3	5	6.06		0.505	0.505	0.152	A,B,z	0.506	0.506	NT				<0.477	U	0.477	0.477	0.12	A,J,w	0.461	0.461
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	***2.7***		0.3	1	***0.765***	A	0.101	0.101	<0.101	U	0.101	0.101	NT				<0.0954	U	0.0954	0.0954	<0.112	U	0.112	0.112
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	21		0.2	1	6.12		0.101	0.101	0.293	A	0.101	0.101	NT				<0.115	U	0.115	0.115	0.247	A	0.177	0.177
Total HpCDD	37871-00-4	--	--	--	--	--	1,830		1.4	5	1,130		0.505	0.505	61		0.506	0.506	NT				5.63		0.477	0.477	4.98		0.461	0.461
Total HpCDF	38998-75-3	--	--	--	--	--	1,440	MX,J,w	0.8	5	967		1.55	1.55	1.69		0.506	0.506	NT				<0.477	U	0.477	0.477	0.17	,B,z	0.461	0.461
Total HxCDD	34465-46-8	--	--	--	--	--	334	M	0.7	5	161		0.505	0.505	6.54		0.506	0.506	NT				0.21		0.477	0.477	0.182		0.461	0.461
Total HxCDF	55684-94-1	--	--	--	--	--	1,060	MX,J,w	0.5	5	301		2.1	2.1	1.64		0.506	0.506	NT				0.594	A,B,z	0.477	0.477	0.28	,B,z	0.461	0.461
Total PeCDD	36088-22-9	--	--	--	--	--	41.3	M,J,c	0.5	5	23.8		0.505	0.505	1.2		0.506	0.506	NT				<0.477	U	0.477	0.477	0.907		0.461	0.461
Total PeCDF	30402-15-4	--	--	--	--	--	728	MX,J,w	0.3	5	80.6		0.505	0.505	1.63		0.506	0.506	NT				<0.477	U	0.477	0.477	0.306	,B,z	0.461	0.461
Total TCDD	41903-57-5	--	--	--	--	--	47.6	MQ	0.3	1	11.2		0.101	0.101	<0.101	U	0.101	0.101	NT				<0.0954	U	0.0954	0.0954	<0.112	U	0.112	0.112
Total TCDF	55722-27-5	--	--	--	--	--	795	MX,J,w	0.3	1	73.9		0.101	0.101	1.27		0.101	0.101	NT				<0.115	U	0.115	0.115	0.507		0.177	0.177
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	***16,000***	EP,J,g	5.9	51	<49	U	5.9	49	<51	U	5.9	51	<51	U	5.9	51	<46	U	5.9	46	NT			
Acenaphthylene[B]	208-96-8	N	--	2.3E+05	3.1E+06	--	16	JP,J,g	5.9	51	<49	U	5.9	49	<51	U	5.9	51	<51	U	5.9	51	<46	U	5.9	46	NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	26	J	5.4	51	<49	U	5.4	49	<51	U	5.4	51	<51	U	5.4	51	<46	U	5.4	46	NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	***55***		2.2	10	<9.6	U	2.2	9.6	<10	U	2.2	10	<10	U	2.2	10	<9.1	U	2.2	9.1	NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	***68***		1.6	10	<9.6	U	1.6	9.6	<10	U	1.6	10	<10	U	1.6	10	<9.1	U	1.6	9.1	NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	51	P,J,g	1.7	10	<9.6	U	1.7	9.6	<10	U	1.7	10	<10	U	1.7	10	<9.1	U	1.7	9.1	NT			
Benzo(g,h,i)perylene[B]	191-24-2	N	--	2.3E+05	3.1E+06	--	51	P,J,g	3.6	10	<9.6	U	3.6	9.6	<10	U	3.6	10	<10	U	3.6	10	<9.1	U	3.6	9.1	NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	140	P,J,c	1.4	10	<9.6	U	1.4	9.6	<10	U	1.4	10	<10	U	1.4	10	<9.1	U	1.4	9.1	NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	61		2.4	10	<9.6	U	2.4	9.6	<10	U	2.4	10	<10	U	2.4	10	<9.1	U	2.4	9.1	NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	18	P,J,g	4.2	10	<9.6	U	4.2	9.6	<10	U	4.2	10	<10	U	4.2	10	<9.1	U	4.2	9.1	NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	160	P,J,g	2.1	20	<20	U	2.1	20	<20	U	2.1	20	<21	U	2.1	21	<19	U	2.1	19	NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	13	JP,J,g	14	51	<49	U	14	49	<51	U	14	51	<51	U	14	51	<46	U	14	46	NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	100	P,J,g	2.5	10	<9.6	U	2.5	9.6	<10	U	2.5	10	<10	U	2.5	10	<9.1	U	2.5	9.1	NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	***650***	P,J,g	14	51	<49	U	14	49	<51	U	14	51	<51	U	14	51	<46	U	14	46	NT			
Phenanthrene[B]	85-01-8	N	--	2.3E+05	3.1E+06	--	94		8.5	51	<49	U	8.5	49	<51	U	8.5	51	<51	U	8.5	51	<46	U	8.5	46	NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	160		4.3	20	<20	U	4.3	20	13	JP,J,g	4.3	20	34	P,J,g	4.3	21	7.6	J	4.3	19	NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				215		8.32	8.32	NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				2,550		16.6	16.6	NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				3,300		16.6	16.6	NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				3,280		8.32	8.32	NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				1,190		8.32	8.32	NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				43,100	E,J,q	25	25	NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				22,100		16.6	16.6	NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				114,000	E,J,q	8.32	8.32	NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				8,040		8.32	8.32	NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				4,130		8.32	8.32	NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				84,900	E,J,q	33.3	33.3	NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				22,700		8.32	8.32	NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				2,510		8.32	8.32	NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				171	,J,w	8.32	8.32	NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				113,000	E,J,q	49.9	49.9	NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				212,000	E,J,q	25	25	NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				155,000	E,J,q	8.32	8.32	NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				84,800	E,J,q	8.32	8.32	NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				76,100	E,J,q	8.32	8.32	NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				4,560		8.32	8.32	NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				140,000	E,J,q	8.32	8.32	NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				2,880		8.32	8.32	NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				655		8.32	8.32	NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				42,900	E,J,q	16.6	16.6	NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				254,000	E,J,q	25	25	NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				82,500	E,J,q	8.32	8.32	NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				57,400	E,J,q	16.6	16.6	NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				23,000		8.32	8.32	NT				NT				NT				NT			
153,168-HxCB	35065-27-1	--	--	--	--	--	NT				164,000	E,J,q	16.6	16.6	NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				31,200		16.6	16.6	NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB46B 12/4/2002 7.5-9		MDL	RL	54SB46C [F] 12/4/2002 11-12		MDL	RL	54SB47A [D] 12/9/2002 0-1		MDL	RL	54SB47A-DUP (D-13) 12/9/2002 0-1		MDL	RL	54SB47B [D] 12/9/2002 9-10		MDL	RL	54SB47C 1/9/2007 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				24,400		8.32	8.32	NT				NT				NT				NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				9,150		8.32	8.32	NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				36,200	E,J,q	8.32	8.32	NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				15,700		8.32	8.32	NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				62,400	E,J,q	16.6	16.6	NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				21,000		16.6	16.6	NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				29,700		8.32	8.32	NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				1,350		8.32	8.32	NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				14,200		8.32	8.32	NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				5,350		8.32	8.32	NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				8,130		8.32	8.32	NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				1,840		8.32	8.32	NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				8,840		8.32	8.32	NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				6,390		8.32	8.32	NT				NT				NT				NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				2,210		8.32	8.32	NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	NT			
2,4,6-Trinitrotoluene [B]	118-96-7	N	--	3.9E+00	5.1E+01	--	68	Z,J,c	0.16	10	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	NT			
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	***160***	Z	0.12	10	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	NT			
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	160		0.16	10	ND				ND				ND				ND				NT			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	35	Z	0.1	10	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	NT			
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	31	Z	0.095	10	<1	U,UJ,c	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	NT			
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	66	Z	0.1	10	ND				ND				ND				ND				NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	110	E,J,q	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	NT			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	<1	U	0.28	1	<1	U	0.28	1	<1	U	0.28	1	<1	U	0.28	1	<1	U	0.28	1	NT			
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				--				--				--				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB48A 12/9/2002 0-1		MDL	RL	54SB48B 12/9/2002 9-10		MDL	RL	54SB49A 12/4/2002 1-2		MDL	RL	54SB49B 12/4/2002 9-10		MDL	RL	54SB49C 12/4/2002 13.5-14.5		MDL	RL	54SB50A [D] 12/9/2002 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r				Result	LQ, VQ, r				Result	LQ, VQ, r		
TAL Metals (mg/kg)																																
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	12,700		2.4	11.2	14,300		2.3	10.6	22,600		4	18.3	11,700		2.4	11	10,700		2.5	11.7	14,800		2.6	12.1
Antimony	7440-36-0	N	--	3.13	40.88	0.66	<1.1	UN,UL,m	0.41	1.1	<1.1	UN,UL,m	0.39	1.1	***1.9***	N*,K,w	0.68	1.8	<1.1	UN*,R,m	0.41	1.1	<1.2	UN,UL,m	0.43	1.2	<1.2	UN,UL,m	0.45	1.2
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***0.84***	BN,L,w	0.28	1.1	***0.95***	BN,L,w	0.27	1.1	***2.5***	N,K,w	0.46	1.8	***0.57***	BN,K,w	0.28	1.1	***0.71***	BN,L,w	0.29	1.2	***0.97***	BN,L,w	0.3	1.2
Barium	7440-39-3	N	209	1,564	20,440	300.8	98.4	*E,J,s	0.02	1.1	88.4	*E,J,s	0.02	1.1	206	E,J,s	0.04	1.8	103	E,J,s	0.02	1.1	102	*E,J,s	0.02	1.2	155	*E,J,s	0.02	1.2
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	0.65	E,J,s	0.01	0.56	0.65	E,J,s	0.01	0.53	1.1		0.02	0.92	0.62		0.01	0.55	0.5	BE,J,s	0.01	0.58	0.86	E,J,s	0.01	0.6
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.56	U	0.04	0.56	<0.53	U	0.04	0.53	<0.92	U	0.07	0.92	<0.55	U	0.04	0.55	<0.58	U	0.05	0.58	<0.6	U	0.05	0.6
Calcium	7440-70-2	--	--	--	--	--	1,140	E,J,s	1.1	112	1,000	E,J,s	1	106	2,510	E,J,s	1.8	183	1,160	E,J,s	1.1	110	1,440	E,J,s	1.1	117	1,490	E,J,s	1.2	121
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***19.8***	E,J,s	0.07	0.56	***18.8***	E,J,s	0.06	0.53	***41.6***	N,L,m	0.11	0.92	***18.1***	N,L,m	0.07	0.55	***22.5***	E,J,s	0.07	0.58	***22.3***	E,J,s	0.07	0.6
Cobalt	7440-48-4	--	72.3	--	--	--	7.5	E,J,s	0.07	0.56	8.6	E,J,s	0.06	0.53	12.2	E,J,s	0.11	0.92	7.1	E,J,s	0.07	0.55	5.7	E,J,s	0.07	0.58	11.6	E,J,s	0.07	0.6
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	7.9	E,J,s	0.16	0.56	15.1	E,J,s	0.15	0.53	83.1	N*E,J,k	0.26	0.92	4.4	N*E,J,k	0.15	0.55	0.79	E,L,w	0.16	0.58	9.3	E,J,s	0.17	0.6
Iron	7439-89-6	N	50,962	5,475	71,540	--	19,300	E,J,s	1.5	11.2	21,100	E,J,s	1.5	10.6	35,100	E,J,s	2.5	18.3	18,300	E,J,s	1.5	11	15,400	E	1.6	11.7	21,300	E,J,s	1.7	12.1
Lead [2]	7439-92-1	--	26.8	400	750	--	55.1	*E,J,k	0.26	0.33	7.8	*E,J,k	0.24	0.32	257	*E,J,k	0.42	0.55	7.2	*E,J,k	0.25	0.33	6.1	*E,J,k	0.27	0.35	10.5	*E,J,k	0.28	0.36
Magnesium	7439-95-4	--	--	--	--	--	3,280	E,J,s	0.68	112	3,990	E,J,s	0.65	106	5,260	E,J,s	1.1	183	3,380	E,J,s	0.67	110	3,280	E,J,s	0.71	117	3,140	E,J,s	0.74	121
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***369***	E,J,s	0.02	1.1	***364***	E,J,s	0.02	1.1	***536***	E,J,s	0.04	1.8	***297***	E,J,s	0.02	1.1	***159***	E,J,s	0.02	1.2	***701***	E,J,s	0.02	1.2
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	0.1		0.018	0.036	0.042		0.019	0.037	0.23	N*,J,k	0.031	0.061	0.018	BN*,J,k	0.018	0.036	0.03	B	0.018	0.036	0.062		0.018	0.037
Nickel	7440-02-0	N	62.8	156.4	2,044	--	11.6	E,J,s	0.11	0.56	12.2	E,J,s	0.11	0.53	19.3	E,J,s	0.18	0.92	10.9	E,J,s	0.11	0.55	9.3	E,J,s	0.12	0.58	13.6	E,J,s	0.12	0.6
Potassium	7440-09-7	--	--	--	--	--	2,090	E,J,s	13.2	112	1,790	E,J,s	12.6	106	2,880	E,J,s	21.7	183	1,690	E,J,s	13.1	110	1,490	E,J,s	13.8	117	1,560	E,J,s	14.3	121
Selenium	7782-49-2	N	--	39.11	511	0.949	***1.2***	N,B,x	0.37	0.56	***1***	N,B,x	0.35	0.53	***2.6***	N,L,m	0.6	0.92	***1.1***	N,L,m	0.36	0.55	***1.1***	N,L,m	0.38	0.58	***1.6***	N,B,x	0.4	0.6
Silver	7440-22-4	N	--	39.11	511	1.551	<0.56	U	0.08	0.56	<0.53	U	0.07	0.53	<0.92	U	0.13	0.92	<0.55	U	0.08	0.55	<0.58	U	0.08	0.58	<0.6	U	0.08	0.6
Sodium	7440-23-5	--	--	--	--	--	198	B,L,w	27.7	223	189	B,L,w	26.4	213	1,270		45.5	366	233	L,w	27.5	221	169	B,L,w	29	233	203	B,L,w	30	241
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	33.8	E,J,s	0.08	2.2	36.1	E,J,s	0.07	2.1	***58.9***	E,J,s	0.13	3.7	31.1	E,J,s	0.08	2.2	25.3	E,J,s	0.08	2.3	32.7	E,J,s	0.08	2.4
Zinc	7440-66-6	N	202	2,346	30,660	681.1	65.9	N*E,J,k	0.11	2.2	49.6	N*E,J,k	0.11	2.1	180	N*E,J,k	0.18	3.7	46.1	N*E,J,k	0.11	2.2	38.2	N*E,J,k	0.12	2.3	66.7	N*E,J,k	0.12	2.4
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<2	U	0.4	2	<2	U	0.4	2	7.6	P,J,m	0.4	2.2	<2	U	0.4	2	NT				NT			
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	<0.99	U	0.17	0.99	<0.97	U	0.17	0.97	<1.1	U	0.17	1.1	<0.95	U	0.17	0.95	NT				NT			
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	<0.99	U	0.26	0.99	***0.83***	J	0.26	0.97	<1.1	U	0.26	1.1	<0.95	U	0.26	0.95	NT				NT			
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<2	U	0.22	2	<2	U	0.22	2	<2.2	U	0.22	2.2	<2	U	0.22	2	NT				NT			
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	<2	U	0.28	2	***3.5***	P,J,q	0.28	2	<2.2	U,UJ,m	0.28	2.2	<2	U	0.28	2	NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<0.99	U	0.15	0.99	1.2	J,c	0.15	0.97	6	P,J,c	0.15	1.1	<0.95	U	0.15	0.95	NT				NT			
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	<2	U	0.43	2	<2	U	0.43	2	<2.2	U	0.43	2.2	<2	U	0.43	2	NT				NT			
Endrin aldehyde [6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<3.9	U	0.35	3.9	<3.8	U	0.35	3.8	<4.2	U	0.35	4.2	<3.8	U	0.35	3.8	NT				NT			
Endrin ketone [6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	<9.9	U	0.39	9.9	<9.7	U	0.39	9.7	7.5	J	0.39	11	<9.5	U	0.39	9.5	NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<0.99	U	0.22	0.99	***1.1***	P,J,c	0.22	0.97	<1.1	U	0.22	1.1	<0.95	U	0.22	0.95	NT				NT			
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<0.99	U	0.35	0.99	<0.97	U	0.35	0.97	<1.1	U	0.35	1.1	<0.95	U	0.35	0.95	NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<0.99	U	0.34	0.99	<0.97	U	0.34	0.97	<1.1	U	0.34	1.1	<0.95	U	0.34	0.95	NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<0.99	U	0.26	0.99	<0.97	U	0.26	0.97	<11	U	0.26	11	***2.6***		0.26	0.95	NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<9.9	U	1.4	9.9	<9.7	U	1.4	9.7	3	J	1.4	11	<9.5	U	1.4	9.5	NT				NT			
Aroclor 1254 [7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<54	U	9	54	<52	U	9	52	***230***		9	57	<52	U	9	52	NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<77	U	9.2	77	<76	U	9.2	76	<82	U	9.2	82	<75	U	9.2	75	NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<390	U	20	390	<380	U	20	380	***510***	J,r	20	420	<380	U	20	380	<430	U	20	430	<420	U	20	420
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<390	U	21	390	<380	U	21	380	***310***	J	21	420	<380	U	21	380	<430	U	21	430	<420	U	21	420
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				ND				820		21	420	ND				ND				ND			
Acenaphthylene [8]	208-96-8	N	--	2.3E+05	3.1E+06	--	<390	U	17	390	<380	U	17	380	<420	U	17	420	<380	U	17	380	<430	U	17	430	<420	U	17	420
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<390	U	25	390	<380	U	25	380	<420	U	25	420	<380	U	25	380	<430	U	25	430	<420	U	25	420
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<390	U	29	390	<380	U	29	380	<420	U	29	420	<380	U	29	380	<430	U	29	430	<420	U	29	420
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<390	U	23	390	<380	U	23	380	<420	U	23	420	<380	U	23	380	<430	U	23	430	<420	U	23	420
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<390	U	36	390	<380	U	36	380	<420	U	36	420	<380	U	36	380	<430	U	36	430	<420	U	36	420
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	<390	U	23	390	<380	U	23	380	<420	U	23	420	<380	U	23	380	<430	U	23	430	<420	U	23	420
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<390	U	29	390	<380	U	29	380	<420	U	29	420	<380	U	29	380	<430	U	29	430	<420	U	29	420
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	86	J	32	390	<380	U	32	380	480		32	420	<380	U	32	380	88	J	32	430	200	J	32	420
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	<390	U	29	390	<380	U	29	380	<420	U	29	420	<380	U	29	380	<430	U	29	430	<420	U	29	420
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<390	U	28	390	<380	U	28	380	<420	U	28	420	<380	U	28	380	<430	U	28	430	<420	U	28	420
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	44	J	390	390	<380	U	380	380	150	J	420	420	<380	U	380	380	<430	U	430	430	<420	U	420	420
Di-n-octylphthalate	117-84-0	--	--	--	--	--	<390	U	390	390	<380	U	380	380	<420	U	420	420	<380	U	380	380	<430	U	430	430	<420	U	420	420
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<390	U	21	390	<380	U	21	380	<420	U	21	420	<380	U	21	380	<430	U	21	430	<420	U	21	420
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	220	J	390	390	<380	U	380	380	1,900		420	420	<380	U	380	380	<430	U	430	430	<420	U	420	420
Dimethylphthalate	131-11-3	--	--	--	--	--	<390	U	390	390	<380	U	380	380	<420	U	420	420	<380	U	380	380	<430	U	430	430	<420	U	420	420
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<390	U	18	390	<380	U	18	380	<420	U	18	420	<380	U	18	380	<430	U	18	430	<420	U	18	420
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<390	U	18	390	<380	U	18	380	<420	U	18	420	<380	U	18	380	<430	U	18	430	<420	U	18	420
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<390	U	20	390	<380	U	20	380	<420	U	20	420	<380	U	20	380	<430	U	20	430	<420	U	20	420
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<390	U	390	390	<380	U	380	380	***110***	J,J,r	420	420	<380	U	380	380	<430	U	430	430	<420	U	420	420
Phenanthrene [8]	85-01-8	N	--	2.3E+05	3.1E+06	--	<390	U	24	390	<380	U	24	380	<420	U	24	420	<380	U	24	380	<430	U	24	430	<420	U	24	420
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	<390	U	24	390	<380	U	24	380	<420	U	24	420	<380	U	24	380	<430	U	24	430	<420	U	24	420
SVOC TICs (ug/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
16-Octadecenal	56554-87-1	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
17-Octadecenal	56554-86-0	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NI				NI				NI				NI				NI				NI			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				NI				560	NJ,NJ,t	0	0	NI				NI				NI			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				NI				18,000	NJ,NJ,t	0	0	NI				NI				NI			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB48A 12/9/2002 0-1		MDL	RL	54SB48B 12/9/2002 9-10		MDL	RL	54SB49A 12/4/2002 1-2		MDL	RL	54SB49B 12/4/2002 9-10		MDL	RL	54SB49C 12/4/2002 13.5-14.5		MDL	RL	54SB50A[D] 12/9/2002 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Camphene	79-92-5	--	--	--	--	--	NI				NI				NI				NI				NI				260	NJ,NJ,t	0	0
Cholesterol	57-88-5	--	--	--	--	--	NI				NI				NI				NI				NI				660	NJ,NJ,t	0	0
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Pentadecanal-	24055	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Testosterone	58-22-0	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NI				NI				NI				NI				NI				NI			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	4,230	E,J,c	1	9.9	56.2		1.7	9.9	5,700	J,i	4	99.8	23.4	J,c	1	10	NT				656		1.2	1.2
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	435	J,c	0.8	9.9	<9.9		1.2	9.9	1,060	J,c	0	10	<10		0.8	10	NT				8.16	A	1.16	1.16
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	495		0.5	5	2.4	J	0.8	5	1,560	J,i	7	49.9	<5		0.5	5	NT				21.6		0.58	0.58
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	147		0.2	5	<5		0.4	5	870		0.9	5	<5		0.3	5	NT				4.16	A	0.58	0.58
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	14.1		0.3	5	<5		0.5	5	47.4		1.2	5	<5		0.3	5	NT				0.309	A	0.58	0.58
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	7.6		0.2	5	<5		0.4	5	43.6		0.9	5	<5		0.2	5	NT				0.311	A	0.58	0.58
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	26.3		0.1	5	<5		0.2	5	197		0.6	5	<5		0.2	5	NT				0.408	A	0.58	0.58
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	18.8		0.2	5	<5		0.4	5	153		0.8	5	<5		0.2	5	NT				0.643	A	0.58	0.58
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	11.4		0.1	5	<5		0.2	5	87.5		0.6	5	<5		0.1	5	NT				0.318	A,B,z	0.58	0.58
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	21		0.2	5	<5		0.3	5	147		0.8	5	<5		0.2	5	NT				0.821	A,J,w	0.58	0.58
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	<5		0.2	5	<5		0.3	5	5.5		0.7	5	<5		0.2	5	NT				0.123	A,B,z	0.58	0.58
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	5		0.2	5	<5		0.3	5	36.9	J,c	0.4	5	<5		0.2	5	NT				<0.58	U	0.58	0.58
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	7.4		0.1	5	<5		0.2	5	<5		0.3	5	<5		0.1	5	NT				0.2	A	0.58	0.58
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	12.3		0.1	5	<5		0.3	5	89.6		0.6	5	<5		0.2	5	NT				0.429	A,J,w	0.58	0.58
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	11.9		0.1	5	<5		0.2	5	82.3		0.3	5	<5		0.1	5	NT				0.306	A,J,w	0.58	0.58
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	***1.3***		0.1	1	<1		0.3	1	***10***		0.3	1	<1		0.1	1	NT				<0.154	U	0.154	0.154
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	9.6		0.2	1	<1		0.2	1	125	J,i	0.2	1	<1		0.1	1	NT				0.61	A	0.213	0.213
Total HpCDD	37871-00-4	--	--	--	--	--	881		0.5	5	5.7		0.8	5	2,760	J,i	7	49.9	2.4		0.5	5	NT				59.7		0.759	0.759
Total HpCDF	38998-75-3	--	--	--	--	--	478	M	0.3	5	<5		0.5	5	2,320	MX,J,w	1	5	<5		0.3	5	NT				10.7		0.58	0.58
Total HxCDD	34465-46-8	--	--	--	--	--	146		0.2	5	1.1	M	0.4	5	1,330		0.8	5	0.5		0.2	5	NT				6.11		0.58	0.58
Total HxCDF	55684-94-1	--	--	--	--	--	270	MX,J,w	0.1	5	<5		0.3	5	2,390	MX,J,w	0.6	5	<5		0.2	5	NT				3.96		0.58	0.58
Total PeCDD	36088-22-9	--	--	--	--	--	35.7	M	0.2	5	<5		0.3	5	239	J,c	0.4	5	<5		0.2	5	NT				1.59		0.58	0.58
Total PeCDF	30402-15-4	--	--	--	--	--	241	MX,J,w	0.1	5	<5		0.2	5	1,460	MX,J,w	0.3	5	0.33		0.1	5	NT				1.16		0.58	0.58
Total TCDD	41903-57-5	--	--	--	--	--	31.5	M	0.1	1	<1		0.3	1	215	M	0.3	1	<1		0.1	1	NT				0.206		0.154	0.154
Total TCDF	55722-27-5	--	--	--	--	--	287	M	0.08	1	<1		0.2	1	1,790	MX,J,w	0.3	1	<1		0.1	1	NT				2.04		0.213	0.213
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	<50	U	5.9	50	<49	U	5.9	49	2,400	EP,J,m	5.9	53	<48	U	5.9	48	<55	U	5.9	55	<53	U	5.9	53
Acenaphthylene[B]	208-96-8	N	--	2.3E+05	3.1E+06	--	<50	U	5.9	50	<49	U	5.9	49	240	P,J,m	5.9	53	<48	U	5.9	48	<55	U	5.9	55	<53	U	5.9	53
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<50	U	5.4	50	<49	U	5.4	49	<53	U	5.4	53	<48	U	5.4	48	<55	U	5.4	55	<53	U	5.4	53
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<9.9	U	2.2	9.9	<9.6	U	2.2	9.6	15	J,m	2.2	10	<9.5	U	2.2	9.5	<11	U	2.2	11	13	P,J,g	2.2	10
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<9.9	U	1.6	9.9	<9.6	U	1.6	9.6	***57***	P,J,m	1.6	10	<9.5	U	1.6	9.5	<11	U	1.6	11	<10	U	1.6	10
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	19		1.7	9.9	<9.6	U	1.7	9.6	***100***	J,m	1.7	10	<9.5	U	1.7	9.5	<11	U	1.7	11	32	P,J,g	1.7	10
Benzo(g,h,i)perylene[B]	191-24-2	N	--	2.3E+05	3.1E+06	--	<9.9	U	3.6	9.9	<9.6	U	3.6	9.6	<10	U	3.6	10	<9.5	U	3.6	9.5	<11	U	3.6	11	84	P,J,g	3.6	10
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<9.9	U	1.4	9.9	<9.6	U	1.4	9.6	32	P,J,d	1.4	10	<9.5	U	1.4	9.5	<11	U	1.4	11	<10	U	1.4	10
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<9.9	U	2.4	9.9	<9.6	U	2.4	9.6	42	P,J,m	2.4	10	<9.5	U	2.4	9.5	<11	U	2.4	11	13	P,J,g	2.4	10
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<9.9	U	4.2	9.9	<9.6	U	4.2	9.6	<10	U	4.2	10	<9.5	U	4.2	9.5	<11	U	4.2	11	<10	U	4.2	10
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	4.3	J	2.1	20	<20	U	2.1	20	72	J,d	2.1	22	<20	U	2.1	20	<22	U	2.1	22	7.2	JP,J,g	2.1	22
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<50	U	14	50	<49	U	14	49	<53	U	14	53	<48	U	14	48	<55	U	14	55	<53	U	14	53
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<9.9	U	2.5	9.9	<9.6	U	2.5	9.6	<10	U	2.5	10	<9.5	U	2.5	9.5	<11	U	2.5	11	<10	U	2.5	10
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	***140***	P,J,g	14	50	<49	U	14	49	***8,600***	EP,J,g	14	53	<48	U	14	48	<55	U	14	55	<53	U	14	53
Phenanthrene[B]	85-01-8	N	--	2.3E+05	3.1E+06	--	<50	U	8.5	50	<49	U	8.5	49	25	J,J,d	8.5	53	<48	U	8.5	48	<55	U	8.5	55	<53	U	8.5	53
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	10	J	4.3	20	16	JP,J,g	4.3	20	35		4.3	22	<20	U	4.3	20	10	J	4.3	22	65	P,J,g	4.3	22
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB48A 12/9/2002 0-1		MDL	RL	54SB48B 12/9/2002 9-10		MDL	RL	54SB49A 12/4/2002 1-2		MDL	RL	54SB49B 12/4/2002 9-10		MDL	RL	54SB49C 12/4/2002 13.5-14.5		MDL	RL	54SB50A[D] 12/9/2002 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	1.9	JPZ,J,l	0.079	10	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1
2,4,6-Trinitrotoluene[B]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	<1	U	0.16	1	80	E,J,c	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	ND				ND				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	<1	U	0.1	1	<1	U,UJ,m	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U,UJ,c	0.095	1	<1	U	0.095	1	<1	U	0.095	1
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	<1	U	0.1	1	<1	U,UJ,m	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	<1	U	0.28	1	<1	U	0.28	1	8.2	JZ	0.28	10	<1	U	0.28	1	<1	U	0.28	1	<1	U	0.28	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				--				--				--				--			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB50B[D] 12/9/2002 9-10		MDL	RL	54SB50C 1/9/2007 11.5-12.5		MDL	RL	54SB51A 12/4/2002 0-1		MDL	RL	54SB51B 12/4/2002 9-10		MDL	RL	54SB51C 12/4/2002 16-17		MDL	RL	54SB52A 12/10/2002 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	8,920		2.4	11.2	NT				15,000		2.5	11.6	15,200		2.5	11.6	13,500		2.5	11.4	16,900		7.1	12.6
Antimony	7440-36-0	N	--	3.13	40.88	0.66	<1.1	UN,UL,m	0.41	1.1	NT				<1.2	UN,UL,m	0.43	1.2	<1.2	UN,UL,m	0.43	1.2	<1.1	UN,UL,m	0.42	1.1	0.57	BN,B,p	0.15	1.3
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***0.43***	BN,L,w	0.28	1.1	NT				***0.94***	BN,L,w	0.29	1.2	***1.7***	N,L,m	0.29	1.2	***1.2***	N,L,m	0.28	1.1	***2***		0.38	1.3
Barium	7440-39-3	N	209	1,564	20,440	300.8	84.4	*E,J,s	0.02	1.1	NT				241	*E,J,s	0.02	1.2	123	*E,J,s	0.02	1.2	116	*E,J,s	0.02	1.1	92.7	*	0.04	1.3
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	0.53	BE,J,s	0.01	0.56	NT				1.1	E,J,s	0.01	0.58	0.68	E,J,s	0.01	0.58	0.62	E,J,s	0.01	0.57	0.8		0.03	0.63
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.56	U	0.04	0.56	NT				<0.58	U	0.05	0.58	<0.58	U	0.05	0.58	<0.57	U	0.05	0.57	<0.63	U	0.04	0.63
Calcium	7440-70-2	--	--	--	--	--	1,170	E,J,s	1.1	112	NT				1,410	E,J,s	1.1	116	1,200	E,J,s	1.1	116	1,190	E,J,s	1.1	114	719		1.9	126
Chromium[1]	7440-47-3	N	65.3	23.46	306.6	2.102	***14.1***	E,J,s	0.07	0.56	NT				***20***	E,J,s	0.07	0.58	***18.7***	E,J,s	0.07	0.58	***23.9***	E,J,s	0.07	0.57	***22.2***		0.1	0.63
Cobalt	7440-48-4	--	72.3	--	--	--	6.3	E,J,s	0.07	0.56	NT				8.6	E,J,s	0.07	0.58	9.1	E,J,s	0.07	0.58	8.7	E,J,s	0.07	0.57	10.7		0.09	0.63
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	1.8	E,J,s	0.16	0.56	NT				20.6	E,J,s	0.16	0.58	21	E,J,s	0.16	0.58	10.5	E,J,s	0.16	0.57	11.1		0.19	0.63
Iron	7439-89-6	N	50,962	5,475	71,540	--	14,500	E,J,s	1.5	11.2	NT				17,900	E,J,s	1.6	11.6	23,000	E,J,s	1.6	11.6	21,000	E,J,s	1.6	11.4	26,000		1.6	12.6
Lead[2]	7439-92-1	--	26.8	400	750	--	5.7	*E,J,k	0.26	0.34	NT				11.8	*E,J,k	0.27	0.35	8.4	*E,J,k	0.27	0.35	8	*E,J,k	0.26	0.34	10.5		0.15	0.38
Magnesium	7439-95-4	--	--	--	--	--	2,350	E,J,s	0.68	112	NT				2,340	E,J,s	0.71	116	4,010	E,J,s	0.71	116	3,690	E,J,s	0.69	114	2,140		1.5	126
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***318***	E,J,s	0.02	1.1	NT				***751***	E,J,s	0.02	1.2	***417***	E,J,s	0.02	1.2	***428***	E,J,s	0.02	1.1	***393***		0.03	1.3
Mercury[3]	7439-97-6	--	0.13	2.35	30.66	--	0.041		0.018	0.037	NT				0.049		0.019	0.039	0.04		0.019	0.038	0.044		0.019	0.038	0.039	B	0.021	0.042
Nickel	7440-02-0	N	62.8	156.4	2,044	--	8.9	E,J,s	0.11	0.56	NT				12.7	E,J,s	0.12	0.58	12.9	E,J,s	0.12	0.58	12.1	E,J,s	0.11	0.57	11.9	E,J,s	0.13	0.63
Potassium	7440-09-7	--	--	--	--	--	1,190	E,J,s	13.3	112	NT				1,770	E,J,s	13.7	116	2,250	E,J,s	13.8	116	2,100	E,J,s	13.5	114	1,320	E,J,s	5	126
Selenium	7782-49-2	N	--	39.11	511	0.949	0.93	N,B,x	0.37	0.56	NT				***1.8***	N,L,m	0.38	0.58	***1.2***	N,L,m	0.38	0.58	***1.3***	N,L,m	0.38	0.57	0.73	B,x	0.38	0.63
Silver	7440-22-4	N	--	39.11	511	1.551	<0.56	U	0.08	0.56	NT				<0.58	U	0.08	0.58	<0.58	U	0.08	0.58	<0.57	U	0.08	0.57	<0.63	U	0.1	0.63
Sodium	7440-23-5	--	--	--	--	--	173	B,L,w	27.9	224	NT				196	B,L,w	28.8	232	183	B,L,w	29	233	188	B,L,w	28.3	227	244	B,K,w	38.3	252
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	22.9	E,J,s	0.08	2.2	NT				29.7	E,J,s	0.08	2.3	36.2	E,J,s	0.08	2.3	33.5	E,J,s	0.08	2.3	***54.6***		0.09	2.5
Zinc	7440-66-6	N	202	2,346	30,660	681.1	42.4	N*E,J,k	0.11	2.2	NT				72.8	N*E,J,k	0.12	2.3	52.2	N*E,J,k	0.12	2.3	49.7	N*E,J,k	0.11	2.3	47.1		0.14	2.5
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				NT				NT				NT				NT			
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	NT				NT				NT				NT				NT				NT			
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	NT				NT				NT				NT				NT				NT			
alpha-Chlordane[4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	NT				NT				NT				NT				NT				NT			
delta-BHC[5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				NT				NT				NT				NT			
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	NT				NT				NT				NT				NT				NT			
Endrin aldehyde[6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
Endrin ketone[6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				NT				NT				NT				NT			
gamma-Chlordane[4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				NT				NT				NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				NT				NT				NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				NT				NT				NT				NT			
Aroclor 1254[7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				NT				NT				NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				NT				NT				NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<380	U	20	380	NT				<410	U	20	410	<380	U	20	380	<400	U	20	400	<420	U	20	420
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<380	U	21	380	NT				<410	U	21	410	<380	U	21	380	<400	U	21	400	<420	U	21	420
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				NT				ND				ND				ND				ND			
Acenaphthylene[8]	208-96-8	N	--	2.3E+05	3.1E+06	--	<380	U	17	380	NT				<410	U	17	410	<380	U	17	380	<400	U	17	400	<420	U	17	420
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<380	U	25	380	NT				<410	U	25	410	<380	U	25	380	<400	U	25	400	<420	U	25	420
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<380	U	29	380	NT				<410	U	29	410	<380	U	29	380	<400	U	29	400	<420	U	29	420
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<380	U	23	380	NT				<410	U	23	410	<380	U	23	380	<400	U	23	400	<420	U	23	420
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<380	U	36	380	NT				<410	U	36	410	<380	U	36	380	<400	U	36	400	<420	U	36	420
Benzo(g,h,i)perylene[8]	191-24-2	N	--	2.3E+05	3.1E+06	--	<380	U	23	380	NT				<410	U	23	410	<380	U	23	380	<400	U	23	400	<420	U	23	420
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<380	U	29	380	NT				<410	U	29	410	<380	U	29	380	<400	U	29	400	<420	U	29	420
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	<380	U	32	380	NT				<410	U	32	410	<380	U	32	380	<400	U	32	400	<420	U	32	420
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	<380	U	29	380	NT				<410	U	29	410	<380	U	29	380	<400	U	29	400	<420	U	29	420
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<380	U	28	380	NT				<410	U	28	410	<380	U	28	380	<400	U	28	400	<420	U	28	420
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	<380	U	380	380	NT				<410	U	410	410	<380	U	380	380	<400	U	400	400	<420	U	420	420
Di-n-octylphthalate	117-84-0	--	--	--	--	--	<380	U	380	380	NT				<410	U	410	410	<380	U	380	380	<400	U	400	400	<420	U	420	420
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<380	U	21	380	NT				<410	U	21	410	<380	U	21	380	<400	U	21	400	<420	U	21	420
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	<380	U	380	380	NT				36	J	410	410	<380	U	380	380	<400	U	400	400	<420	U	420	420
Dimethylphthalate	131-11-3	--	--	--	--	--	<380	U	380	380	NT				<410	U	410	410	<380	U	380	380	<400	U	400	400	<420	U	420	420
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<380	U	18	380	NT				<410	U	18	410	<380	U	18	380	<400	U	18	400	<420	U	18	420
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<380	U	18	380	NT				<410	U	18	410	<380	U	18	380	<400	U	18	400	<420	U	18	420
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<380	U	20	380	NT				<410	U	20	410	<380	U	20	380	<400	U	20	400	<420	U	20	420
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<380	U	380	380	NT				<410	U	410	410	<380	U	380	380	<400	U	400	400	<420	U	420	420
Phenanthrene[8]	85-01-8	N	--	2.3E+05	3.1E+06	--	<380	U	24	380	NT				<410	U	24	410	<380	U	24	380	<400	U	24	400	<420	U	24	420
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	<380	U	24	380	NT				<410	U	24	410	<380	U	24	380	<400	U	24	400	<420	U	24	420
SVOC TICs (ug/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
16-Octadecenal	56554-87-1	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
17-Octadecenal	56554-86-0	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NI				NT				NI				NI				NI				NI			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				NT				NI				NI				NI				NI			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB50B [D] 12/9/2002 9-10		MDL	RL	54SB50C 1/9/2007 11.5-12.5		MDL	RL	54SB51A 12/4/2002 0-1		MDL	RL	54SB51B 12/4/2002 9-10		MDL	RL	54SB51C 12/4/2002 16-17		MDL	RL	54SB52A 12/10/2002 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
Camphene	79-92-5	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
Cholesterol	57-88-5	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
Pentadecanal-	24055	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
Testosterone	58-22-0	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NI				NT				NI				NI				NI				NI			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	73.1		0.932	0.932	56.6		0.982	0.982	NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	<0.932	U	0.932	0.932	<0.982	U	0.982	0.982	NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	2.07	A	0.466	0.466	1.41	A	0.491	0.491	NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	0.261	A	0.466	0.466	0.157	A	0.491	0.491	NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	<0.466	U	0.466	0.466	<0.491	U	0.491	0.491	NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	<0.466	U	0.466	0.466	<0.491	U	0.491	0.491	NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	<0.466	U	0.466	0.466	<0.491	U	0.491	0.491	NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	<0.466	U	0.466	0.466	<0.491	U	0.491	0.491	NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	<0.466	U	0.466	0.466	0.0668	A	0.491	0.491	NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	0.103	A	0.466	0.466	<0.491	U	0.491	0.491	NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	<0.466	U	0.466	0.466	<0.491	U	0.491	0.491	NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	<0.466	U	0.466	0.466	<0.491	U	0.491	0.491	NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	0.106	A,J,w	0.466	0.466	0.106	A,J,w	0.491	0.491	NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	0.0932	A	0.466	0.466	<0.491	U	0.491	0.491	NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	0.125	A,J,w	0.466	0.466	0.116	A	0.491	0.491	NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	<0.117	U	0.117	0.117	<0.0982	U	0.0982	0.0982	NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	0.578	A,B,z	0.175	0.175	0.542	A,B,z	0.15	0.15	NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	6.59		0.466	0.466	5.33		0.491	0.491	NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	0.576		0.466	0.466	0.157		0.491	0.491	NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	0.158		0.466	0.466	0.466		0.491	0.491	NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	0.222		0.466	0.466	0.116		0.491	0.491	NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	0.6		0.466	0.466	<0.491	U	0.491	0.491	NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	0.158		0.466	0.466	0.149		0.491	0.491	NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	<0.117	U	0.117	0.117	<0.0982	U	0.0982	0.0982	NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	1.04	,B,z	0.175	0.175	0.914	,B,z	0.15	0.15	NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	<48	U	5.9	48	NT				<52	U	5.9	52	<49	U	5.9	49	<51	U	5.9	51	<52	U	5.8	52
Acenaphthylene [B]	208-96-8	N	--	2.3E+05	3.1E+06	--	<48	U	5.9	48	NT				<52	U	5.9	52	<49	U	5.9	49	<51	U	5.9	51	<52	U	5.9	52
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<48	U	5.4	48	NT				<52	U	5.4	52	<49	U	5.4	49	<51	U	5.4	51	<52	U	5.4	52
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<9.5	U	2.2	9.5	NT				<10	U	2.2	10	<9.6	U	2.2	9.6	<10	U	2.2	10	<10	U	2.2	10
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<9.5	U	1.6	9.5	NT				<10	U	1.6	10	<9.6	U	1.6	9.6	<10	U	1.6	10	<10	U	1.6	10
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<9.5	U	1.7	9.5	NT				<10	U	1.7	10	<9.6	U	1.7	9.6	<10	U	1.7	10	<10	U	1.7	10
Benzo(g,h,i)perylene [B]	191-24-2	N	--	2.3E+05	3.1E+06	--	<9.5	U	3.6	9.5	NT				<10	U	3.6	10	<9.6	U	3.6	9.6	<10	U	3.6	10	<10	U	3.6	10
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<9.5	U	1.4	9.5	NT				<10	U	1.4	10	<9.6	U	1.4	9.6	<10	U	1.4	10	<10	U	1.4	10
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<9.5	U	2.4	9.5	NT				<10	U	2.4	10	<9.6	U	2.4	9.6	<10	U	2.4	10	<10	U	2.4	10
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<9.5	U	4.2	9.5	NT				<10	U	4.2	10	<9.6	U	4.2	9.6	<10	U	4.2	10	<10	U	4.2	10
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<20	U	2.1	20	NT				12	JP,J,g	2.1	21	<20	U	2.1	20	<20	U	2.1	20	<21	U	2.1	21
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<48	U	14	48	NT				<52	U	14	52	<49	U	14	49	<51	U	14	51	<52	U	14	52
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<9.5	U	2.5	9.5	NT				<10	U	2.5	10	<9.6	U	2.5	9.6	<10	U	2.5	10	<10	U	2.5	10
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	<48	U	14	48	NT				<52	U	14	52	<49	U	14	49	<51	U	14	51	<52	U,UJ,m	14	52
Phenanthrene [B]	85-01-8	N	--	2.3E+05	3.1E+06	--	<48	U	8.5	48	NT				<52	U	8.5	52	<49	U	8.5	49	<51	U	8.5	51	<52	U	8.5	52
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	8.7	J	4.3	20	NT				17	JP,J,g	4.3	21	<20	U	4.3	20	<20	U	4.3	20	<21	U	4.3	21
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB50B [D] 12/9/2002 9-10		MDL	RL	54SB50C 1/9/2007 11.5-12.5		MDL	RL	54SB51A 12/4/2002 0-1		MDL	RL	54SB51B 12/4/2002 9-10		MDL	RL	54SB51C 12/4/2002 16-17		MDL	RL	54SB52A 12/10/2002 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U,R,l	0.079	1	NT				<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1
2,4,6-Trinitrotoluene[B]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	NT				<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	NT				<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	ND				NT				ND				ND				ND				ND			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	NT				<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	NT				<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				NT				ND				ND				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	NT				<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	<1	U	0.28	1	NT				<1	U	0.28	1	<1	U	0.28	1	<1	U	0.28	1	<1	U	0.28	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	1	10	NT				<10	U	1	10	<10	U	1	10	<10	U	1	10	<10	U	0.1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				NT				--				--				--				--			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB52B 12/10/2002 9-10		MDL	RL	54SB53A [D] 12/10/2002 0-1		MDL	RL	54SB53B [D] 12/10/2002 9-10		MDL	RL	54SB53C 1/9/2007 12-13		MDL	RL	54SB54A [D] 12/9/2002 0-1		MDL	RL	54SB54B [D] 12/9/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	10,000		6.3	11.1	12,800		6.5	11.4	10,700		6.2	10.9	NT				9,520		2.5	11.6	12,200		2.6	11.7
Antimony	7440-36-0	N	--	3.13	40.88	0.66	0.35	BN,B,p	0.13	1.1	0.53	BN,B,p	0.14	1.1	0.41	BN,B,p	0.13	1.1	NT				<1.2	UN,UL,m	0.43	1.2	<1.2	UN,UL,m	0.43	1.2
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	***1.1***	B	0.33	1.1	***1.5***		0.34	1.1	***0.99***	B	0.33	1.1	NT				***0.63***	BN,L,w	0.29	1.2	***1.5***	N,L,m	0.29	1.2
Barium	7440-39-3	N	209	1,564	20,440	300.8	50.4	*	0.03	1.1	132	*	0.03	1.1	96.4	*	0.03	1.1	NT				119	*E,J,s	0.02	1.2	102	*E,J,s	0.02	1.2
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	0.52	B	0.02	0.55	0.75		0.02	0.57	0.63		0.02	0.55	NT				0.61	E,J,s	0.01	0.58	0.6	E,J,s	0.01	0.59
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	<0.55	U	0.03	0.55	<0.57	U	0.03	0.57	<0.55	U	0.03	0.55	NT				<0.58	U	0.05	0.58	<0.59	U	0.05	0.59
Calcium	7440-70-2	--	--	--	--	--	313		1.7	111	1,380		1.7	114	1,280		1.6	109	NT				949	E,J,s	1.1	116	1,040	E,J,s	1.1	117
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	***10.9***		0.09	0.55	***20.7***		0.09	0.57	***17.4***		0.09	0.55	NT				***15.7***	E,J,s	0.07	0.58	***17.8***	E,J,s	0.07	0.59
Cobalt	7440-48-4	--	72.3	--	--	--	4.5		0.08	0.55	8.3		0.08	0.57	7.6		0.08	0.55	NT				6.5	E,J,s	0.07	0.58	8.1	E,J,s	0.07	0.59
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	6		0.17	0.55	20.9		0.17	0.57	9		0.16	0.55	NT				4.1	E,J,s	0.16	0.58	7.8	E,J,s	0.16	0.59
Iron	7439-89-6	N	50,962	5,475	71,540	--	14,900		1.4	11.1	19,500		1.4	11.4	16,900		1.4	10.9	NT				14,300	E,J,s	1.6	11.6	20,200	E,J,s	1.6	11.7
Lead [2]	7439-92-1	--	26.8	400	750	--	4		0.13	0.33	75.7		0.14	0.34	6.1		0.13	0.33	NT				29.8	*E,J,k	0.27	0.35	7.3	*E,J,k	0.27	0.35
Magnesium	7439-95-4	--	--	--	--	--	1,490		1.4	111	3,550		1.4	114	3,070		1.3	109	NT				2,210	E,J,s	0.71	116	3,740	E,J,s	0.72	117
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	***215***		0.02	1.1	***469***		0.02	1.1	***316***		0.02	1.1	NT				***540***	E,J,s	0.02	1.2	***362***	E,J,s	0.02	1.2
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	<0.033	U	0.016	0.033	0.12		0.018	0.036	<0.039	U	0.02	0.039	NT				0.032	B	0.018	0.036	0.02	B	0.018	0.035
Nickel	7440-02-0	N	62.8	156.4	2,044	--	7.6	E,J,s	0.11	0.55	12.6	E,J,s	0.11	0.57	10.8	E,J,s	0.11	0.55	NT				9.3	E,J,s	0.12	0.58	11	E,J,s	0.12	0.59
Potassium	7440-09-7	--	--	--	--	--	627	E,J,s	4.4	111	1,670	E,J,s	4.6	114	1,280	E,J,s	4.4	109	NT				1,340	E,J,s	13.8	116	1,850	E,J,s	13.9	117
Selenium	7782-49-2	N	--	39.11	511	0.949	0.73	B,x	0.33	0.55	0.56	B,B,x	0.34	0.57	0.64	B,x	0.33	0.55	NT				***1.1***	N,B,x	0.38	0.58	***1***	N,B,x	0.39	0.59
Silver	7440-22-4	N	--	39.11	511	1.551	<0.55	U	0.09	0.55	<0.57	U	0.09	0.57	<0.55	U	0.09	0.55	NT				<0.58	U	0.08	0.58	<0.59	U	0.08	0.59
Sodium	7440-23-5	--	--	--	--	--	119	B,K,w	33.7	222	128	B,K,w	34.8	228	93.7	B,K,w	33.3	219	NT				182	B,L,w	28.9	233	180	B,L,w	29.2	235
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	24.9		0.08	2.2	32.6		0.08	2.3	28.5		0.08	2.2	NT				23	E,J,s	0.08	2.3	32.3	E,J,s	0.08	2.3
Zinc	7440-66-6	N	202	2,346	30,660	681.1	26.5		0.12	2.2	85.9		0.13	2.3	45.3		0.12	2.2	NT				66.2	N*E,J,k	0.12	2.3	46.7	N*E,J,k	0.12	2.3
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				NT				NT				NT				NT			
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	NT				NT				NT				NT				NT				NT			
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	NT				NT				NT				NT				NT				NT			
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	NT				NT				NT				NT				NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				NT				NT				NT				NT			
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	NT				NT				NT				NT				NT				NT			
Endrin aldehyde [6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
Endrin ketone [6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				NT				NT				NT				NT			
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				NT				NT				NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				NT				NT				NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				NT				NT				NT				NT			
Aroclor 1254 [7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				NT				NT				NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				NT				NT				NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	<380	U	20	380	<390	U	20	390	<390	U	20	390	NT				<400	U	20	400	<390	U	20	390
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	<380	U	21	380	<390	U	21	390	<390	U	21	390	NT				<400	U	21	400	<390	U	21	390
Dinitrotoluene Mix	--	--	--	9.4E+02	4.2E+03	--	ND				ND				ND				NT				ND				ND			
Acenaphthylene [8]	208-96-8	N	--	2.3E+05	3.1E+06	--	<380	U	17	380	<390	U	17	390	<390	U	17	390	NT				<400	U	17	400	<390	U	17	390
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<380	U	25	380	<390	U	25	390	<390	U	25	390	NT				<400	U	25	400	<390	U	25	390
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	<380	U	29	380	<390	U	29	390	<390	U	29	390	NT				<400	U	29	400	<390	U	29	390
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	<380	U	23	380	<390	U	23	390	<390	U	23	390	NT				<400	U	23	400	<390	U	23	390
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	<380	U	36	380	<390	U	36	390	<390	U	36	390	NT				<400	U	36	400	<390	U	36	390
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	<380	U	23	380	<390	U	23	390	<390	U	23	390	NT				<400	U	23	400	<390	U	23	390
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<380	U	29	380	<390	U	29	390	<390	U	29	390	NT				<400	U	29	400	<390	U	29	390
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	46	J	32	380	320	J	32	390	40	J	32	390	NT				120	J	32	400	<390	U	32	390
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	<380	U	29	380	<390	U	29	390	<390	U	29	390	NT				<400	U	29	400	<390	U	29	390
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	<380	U	28	380	<390	U	28	390	<390	U	28	390	NT				<400	U	28	400	<390	U	28	390
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	<380	U	380	380	60	J	390	390	<390	U	390	390	NT				<400	U	400	400	<390	U	390	390
Di-n-octylphthalate	117-84-0	--	--	--	--	--	<380	U	380	380	<390	U	390	390	<390	U	390	390	NT				<400	U	400	400	<390	U	390	390
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<380	U	21	380	<390	U	21	390	<390	U	21	390	NT				<400	U	21	400	<390	U	21	390
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	<380	U	380	380	1,500		390	390	120	J	390	390	NT				94	J	400	400	<390	U	390	390
Dimethylphthalate	131-11-3	--	--	--	--	--	<380	U	380	380	<390	U	390	390	<390	U	390	390	NT				<400	U	400	400	<390	U	390	390
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	<380	U	18	380	<390	U	18	390	<390	U	18	390	NT				<400	U	18	400	<390	U	18	390
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<380	U	18	380	<390	U	18	390	<390	U	18	390	NT				<400	U	18	400	<390	U	18	390
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	<380	U	20	380	<390	U	20	390	<390	U	20	390	NT				<400	U	20	400	<390	U	20	390
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	<380	U	380	380	<390	U	390	390	<390	U	390	390	NT				<400	U	400	400	<390	U	390	390
Phenanthrene [8]	85-01-8	N	--	2.3E+05	3.1E+06	--	<380	U	24	380	<390	U	24	390	<390	U	24	390	NT				<400	U	24	400	<390	U	24	390
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	<380	U	24	380	<390	U	24	390	<390	U	24	390	NT				<400	U	24	400	<390	U	24	390
SVOC TICs (ug/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
16-Octadecenal	56554-87-1	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
17-Octadecenal	56554-86-0	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NI				NI				NI				NT				NI				NI			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NI				390	NJ,NJ,t	0	0	NI				NT				NI				NI			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NI				NI				NI				NT				NI				NI			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB52B 12/10/2002 9-10		MDL	RL	54SB53A [D] 12/10/2002 0-1		MDL	RL	54SB53B [D] 12/10/2002 9-10		MDL	RL	54SB53C 1/9/2007 12-13		MDL	RL	54SB54A [D] 12/9/2002 0-1		MDL	RL	54SB54B [D] 12/9/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Camphene	79-92-5	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Cholesterol	57-88-5	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Pentadecanal-	24055	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Testosterone	58-22-0	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NI				NI				NI				NT				NI				NI			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				651		0.939	0.939	86.7		0.872	0.872	83.9		0.932	0.932	122		1.04	1.04	67.1		0.963	0.963
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	NT				222		0.905	0.905	<0.872	U	0.872	0.872	0.22	A,B,z	0.932	0.932	<1.04	U	1.04	1.04	0.3	A,B,z	0.963	0.963
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				58		0.453	0.453	1.6	A	0.436	0.436	1.93	A	0.466	0.466	2.94	A	0.538	0.538	2.15	A	0.482	0.482
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				79.6		0.453	0.453	0.0715	,B,z	0.436	0.436	0.155	A,B,z	0.466	0.466	0.376	A,J,w	0.522	0.522	0.222	A,B,z	0.482	0.482
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				10.5		0.453	0.453	<0.436	U	0.436	0.436	<0.466	U	0.466	0.466	<0.522	U	0.522	0.522	<0.482	U	0.482	0.482
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				0.835	A	0.453	0.453	<0.436	U	0.436	0.436	<0.466	U	0.466	0.466	<0.615	U	0.615	0.615	<0.482	U	0.482	0.482
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				8.34		0.453	0.453	<0.436	U	0.436	0.436	<0.466	U	0.466	0.466	<0.522	U	0.522	0.522	<0.482	U	0.482	0.482
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				2.41	A	0.453	0.453	<0.436	U	0.436	0.436	<0.466	U	0.466	0.466	<0.628	U	0.628	0.628	<0.482	U	0.482	0.482
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				4.64		0.453	0.453	<0.436	U	0.436	0.436	<0.466	U	0.466	0.466	<0.522	U	0.522	0.522	<0.482	U	0.482	0.482
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				2.33	A	0.453	0.453	<0.436	U	0.436	0.436	<0.466	U	0.466	0.466	<0.678	U	0.678	0.678	<0.482	U	0.482	0.482
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				2.39	A	0.453	0.453	<0.436	U	0.436	0.436	<0.466	U	0.466	0.466	<0.522	U	0.522	0.522	<0.482	U	0.482	0.482
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				<0.453	U	0.453	0.453	<0.436	U	0.436	0.436	<0.466	U	0.466	0.466	<0.522	U	0.522	0.522	<0.482	U	0.482	0.482
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				1.18	A	0.453	0.453	<0.436	U	0.436	0.436	<0.466	U	0.466	0.466	<0.522	U	0.522	0.522	<0.482	U	0.482	0.482
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				3.5	A	0.453	0.453	<0.436	U	0.436	0.436	<0.466	U	0.466	0.466	<0.522	U	0.522	0.522	<0.482	U	0.482	0.482
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				1.55	A	0.453	0.453	<0.436	U	0.436	0.436	0.069	A,B,z	0.466	0.466	0.071	A,B,z	0.522	0.522	<0.482	U	0.482	0.482
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				***0.454***	A	0.101	0.101	<0.0872	U	0.0872	0.0872	<0.0932	U	0.0932	0.0932	<0.104	U	0.104	0.104	<0.0963	U	0.0963	0.0963
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				1.28		0.158	0.158	<0.103	U	0.103	0.103	0.272	A,J,w	0.0932	0.0932	0.265	A	0.104	0.104	0.277	A,J,w	0.0963	0.0963
Total HpCDD	37871-00-4	--	--	--	--	--	NT				133		0.611	0.611	5.94		0.436	0.436	5.43		0.466	0.466	12.3		0.768	0.768	6.77		0.482	0.482
Total HpCDF	38998-75-3	--	--	--	--	--	NT				140		0.453	0.453	0.0715	A,B,z	0.436	0.436	0.282	,B,z	0.466	0.466	<0.522	U	0.522	0.522	0.222	,B,z	0.482	0.482
Total HxCDD	34465-46-8	--	--	--	--	--	NT				18.2		0.453	0.453	0.235		0.436	0.436	0.578		0.466	0.466	<0.678	U	0.678	0.678	0.898		0.482	0.482
Total HxCDF	55684-94-1	--	--	--	--	--	NT				42.1		0.453	0.453	<0.436	U	0.436	0.436	0.162	,B,z	0.466	0.466	0.278		0.522	0.522	0.0539		0.482	0.482
Total PeCDD	36088-22-9	--	--	--	--	--	NT				5.09		0.453	0.453	<0.436	U	0.436	0.436	<0.466	U	0.466	0.466	<0.522	U	0.522	0.522	0.302		0.482	0.482
Total PeCDF	30402-15-4	--	--	--	--	--	NT				10.3		0.453	0.453	<0.436	U	0.436	0.436	0.201	,B,z	0.466	0.466	0.14	,B,z	0.522	0.522	<0.482	U	0.482	0.482
Total TCDD	41903-57-5	--	--	--	--	--	NT				2.52		0.101	0.101	<0.0872	U	0.0872	0.0872	<0.0932	U	0.0932	0.0932	<0.104	U	0.104	0.104	<0.0963	U	0.0963	0.0963
Total TCDF	55722-27-5	--	--	--	--	--	NT				10.2		0.158	0.158	<0.103	U	0.103	0.103	0.211		0.0932	0.0932	0.551		0.104	0.104	<0.0963	U	0.0963	0.0963
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	1,600	EP,J,g	5.8	47	3,000	EP,J,g	5.8	50	<49	U	5.8	49	NT				<51	U	5.9	51	26	JP,J,g	5.9	50
Acenaphthylene [B]	208-96-8	N	--	2.3E+05	3.1E+06	--	<47	U	5.9	47	<50	U	5.9	50	<49	U	5.9	49	NT				<51	U	5.9	51	<50	U	5.9	50
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	<47	U	5.4	47	<50	U	5.4	50	<49	U	5.4	49	NT				<51	U	5.4	51	13	J	5.4	50
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	6.6	JP,J,g	2.2	9.3	<9.9	U	2.2	9.9	<9.8	U	2.2	9.8	NT				<10	U	2.2	10	12		2.2	9.9
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	***74***	P,J,g	1.6	9.3	<9.9	U	1.6	9.9	<9.8	U	1.6	9.8	NT				<10	U	1.6	10	***11***		1.6	9.9
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	54	P,J,g	1.7	9.3	72	P,J,g	1.7	9.9	<9.8	U	1.7	9.8	NT				<10	U	1.7	10	14		1.7	9.9
Benzo(g,h,i)perylene [B]	191-24-2	N	--	2.3E+05	3.1E+06	--	<9.3	U	3.6	9.3	<9.9	U	3.6	9.9	<9.8	U	3.6	9.8	NT				<10	U	3.6	10	12		3.6	9.9
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	<9.3	U	1.4	9.3	6.7	J,J,c	1.4	9.9	<9.8	U	1.4	9.8	NT				<10	U	1.4	10	15		1.4	9.9
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	9	JP,J,g	2.4	9.3	<9.9	U	2.4	9.9	<9.8	U	2.4	9.8	NT				<10	U	2.4	10	13		2.4	9.9
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	<9.3	U	4.2	9.3	<9.9	U	4.2	9.9	<9.8	U	4.2	9.8	NT				<10	U	4.2	10	11		4.2	9.9
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	54	P,J,g	2.1	19	28	P,J,g	2.1	20	<20	U	2.1	20	NT				<20	U	2.1	20	13	J	2.1	20
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	<47	U	14	47	<50	U	14	50	21	J	14	49	NT				<51	U	14	51	<50	U	14	50
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	15	P,J,g	2.5	9.3	<9.9	U	2.5	9.9	<9.8	U	2.5	9.8	NT				<10	U	2.5	10	14		2.5	9.9
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	***750***		14	47	<50	U	14	50	<49	U	14	49	NT				<51	U	14	51	<50	U	14	50
Phenanthrene [B]	85-01-8	N	--	2.3E+05	3.1E+06	--	<47	U	8.5	47	21	JP,J,g	8.5	50	<49	U	8.5	49	NT				<51	U	8.5	51	12	J	8.5	50
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	10	JP,J,g	4.3	19	11	J	4.3	20	<20	U	4.3	20	NT				<20	U	4.3	20	20	JP,J,g	4.3	20
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB52B 12/10/2002 9-10		MDL	RL	54SB53A [D] 12/10/2002 0-1		MDL	RL	54SB53B [D] 12/10/2002 9-10		MDL	RL	54SB53C 1/9/2007 12-13		MDL	RL	54SB54A [D] 12/9/2002 0-1		MDL	RL	54SB54B [D] 12/9/2002 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	<1	U,R,l	0.079	1	NT				<1	U,R,l	0.079	1	<1	U,R,l	0.079	1
2,4,6-Trinitrotoluene [B]	118-96-7	N	--	3.9E+00	5.1E+01	--	<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	NT				<1	U	0.16	1	<1	U	0.16	1
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	NT				<1	U	0.12	1	<1	U	0.12	1
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	ND				ND				ND				NT				ND				ND			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	NT				<1	U	0.1	1	<1	U	0.1	1
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	NT				<1	U	0.095	1	<1	U	0.095	1
Aminodinitrotoluenes	--	N	--	1.6E+01	2.0E+02	--	ND				ND				ND				NT				ND				ND			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	NT				<1	U	0.1	1	<1	U	0.1	1
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	<1	U	0.28	1	<1	U	0.28	1	<1	U	0.28	1	NT				<1	U	0.28	1	<1	U	0.28	1
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	<10	U	0.1	10	<10	U	0.1	10	<10	U	0.1	10	NT				<10	U	1	10	<10	U	1	10
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	--				--				--				NT				--				--			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB54B-DUP(Dup-2) 1/9/2007 9-10		MDL	RL	54SB54C 1/9/2007 12-13		MDL	RL	54SB55A 12/9/2002 0-1		MDL	RL	54SB55B 12/9/2002 9-10		MDL	RL	54SB55B-DUP (D-12) 12/9/2002 9-10		MDL	RL	54SB71A 8/20/2004 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				NT				17,600		2.6	12.1	12,100		2.5	11.3	11,200		2.5	11.4	NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				NT				<1.2	UN,UL,m	0.45	1.2	<1.1	UN,UL,m	0.42	1.1	<1.1	UN,UL,m	0.42	1.1	NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				NT				***0.54***	BN,L,w	0.3	1.2	***1.3***	N,L,m	0.28	1.1	***0.34***	BN,L,w	0.29	1.1	NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				NT				121	*E,J,s	0.02	1.2	80.4	*E,J,s	0.02	1.1	119	*E,J,s	0.02	1.1	NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	NT				NT				0.65	E,J,s	0.01	0.6	0.59	E,J,s	0.01	0.57	0.66	E,J,s	0.01	0.57	NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				NT				<0.6	U	0.05	0.6	<0.57	U	0.05	0.57	<0.57	U	0.05	0.57	NT			
Calcium	7440-70-2	--	--	--	--	--	NT				NT				1,060	E,J,s	1.2	121	1,290	E,J,s	1.1	113	1,040	E,J,s	1.1	114	NT			
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				NT				***22.1***	E,J,s	0.07	0.6	***18.1***	E,J,s	0.07	0.57	***19.6***	E,J,s	0.07	0.57	NT			
Cobalt	7440-48-4	--	72.3	--	--	--	NT				NT				6.1	E,J,s	0.07	0.6	8.2	E,J,s	0.07	0.57	6.6	E,J,s	0.07	0.57	NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				NT				10.2	E,J,s	0.17	0.6	7.8	E,J,s	0.16	0.57	6	E,J,s	0.16	0.57	NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				NT				17,900	E,J,s	1.7	12.1	19,900	E,J,s	1.5	11.3	17,000	E,J,s	1.6	11.4	NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				NT				16.5	*E,J,k	0.28	0.36	7.3	*E,J,k	0.26	0.34	13.4	*E,J,k	0.26	0.34	NT			
Magnesium	7439-95-4	--	--	--	--	--	NT				NT				2,970	E,J,s	0.74	121	3,900	E,J,s	0.69	113	2,750	E,J,s	0.7	114	NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				NT				***296***	E,J,s	0.02	1.2	***327***	E,J,s	0.02	1.1	***380***	E,J,s	0.02	1.1	NT			
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT				NT				0.15		0.02	0.04	0.039		0.019	0.038	0.057		0.02	0.039	NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				NT				11.1	E,J,s	0.12	0.6	11.7	E,J,s	0.11	0.57	10.4	E,J,s	0.11	0.57	NT			
Potassium	7440-09-7	--	--	--	--	--	NT				NT				2,140	E,J,s	14.3	121	2,300	E,J,s	13.4	113	1,920	E,J,s	13.5	114	NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				NT				***1.3***	N,B,x	0.4	0.6	***1.3***	N,B,x	0.37	0.57	***1.1***	N,B,x	0.38	0.57	NT			
Silver	7440-22-4	N	--	39.11	511	1.551	NT				NT				<0.6	U	0.08	0.6	<0.57	U	0.08	0.57	<0.57	U	0.08	0.57	NT			
Sodium	7440-23-5	--	--	--	--	--	NT				NT				220	B,L,w	30	241	206	B,L,w	28.1	226	183	B,L,w	28.4	228	NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				NT				30.3	E,J,s	0.08	2.4	31.7	E,J,s	0.08	2.3	27.2	E,J,s	0.08	2.3	NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				NT				61.9	N*E,J,k	0.12	2.4	49.2	N*E,J,k	0.11	2.3	56.7	N*E,J,k	0.11	2.3	NT			
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				<2	U	0.4	2	<1.9	U	0.4	1.9	<2	U	0.4	2	<20	U	3.92	20
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	NT				NT				<1	U	0.17	1	<0.94	U	0.17	0.94	<1	U	0.17	1	<20	U	3.06	20
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	NT				NT				<1	U	0.26	1	<0.94	U	0.26	0.94	<1	U	0.26	1	<20	U	3.43	20
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				<2	U	0.22	2	<1.9	U	0.22	1.9	<2	U	0.22	2	<20	U	3.05	20
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	NT				NT				<2	U	0.28	2	<1.9	U	0.28	1.9	<2	U	0.28	2	<20	U	4.26	20
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				<1	U	0.15	1	<0.94	U	0.15	0.94	<1	U	0.15	1	<20	U	2.65	20
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	NT				NT				<2	U	0.43	2	<1.9	U	0.43	1.9	<2	U	0.43	2	<20	U	3.2	20
Endrin aldehyde [6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				<4	U	0.35	4	<3.8	U	0.35	3.8	<4	U	0.35	4	<20	U	2.95	20
Endrin ketone [6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	NT				NT				<10	U	0.39	10	<9.4	U	0.39	9.4	<10	U	0.39	10	<20	U	3.11	20
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				<1	U	0.22	1	<0.94	U	0.22	0.94	<1	U	0.22	1	<20	U	3.56	20
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				<1	U	0.35	1	<0.94	U	0.35	0.94	<1	U	0.35	1	<20	U	3.11	20
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				<1	U	0.34	1	<0.94	U	0.34	0.94	<1	U	0.34	1	<20	U	3.35	20
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				***5.9***		0.26	1	***3.3***	P,J,g	0.26	0.94	***4.8***		0.26	1	<20	U	4.71	20
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				<10	U	1.4	10	<9.4	U	1.4	9.4	<10	U	1.4	10	<20	U	6.34	20
Aroclor 1254 [7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				<54	U	9	54	<51	U	9	51	<54	U	9	54	15	J,J,c	9.52	33
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				<78	U	9.2	78	<74	U	9.2	74	<78	U	9.2	78	<66	U	14.1	66
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				<400	U	20	400	<380	U	20	380	<400	U	20	400	NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				<400	U	21	400	<380	U	21	380	<400	U	21	400	NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	2.4E+03	--	NT				NT				ND				ND				ND				NT			
Acenaphthylene [8]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				<400	U	17	400	<380	U	17	380	<400	U	17	400	NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				<400	U	25	400	<380	U	25	380	<400	U	25	400	NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				<400	U	29	400	<380	U	29	380	<400	U	29	400	NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				<400	U	23	400	<380	U	23	380	<400	U	23	400	NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				<400	U	36	400	<380	U	36	380	<400	U	36	400	NT			
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				<400	U	23	400	<380	U	23	380	<400	U	23	400	NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				<400	U	29	400	<380	U	29	380	<400	U	29	400	NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				<400	U	32	400	<380	U	32	380	<400	U	32	400	NT			
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	NT				NT				<400	U	29	400	<380	U	29	380	<400	U	29	400	NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				<400	U	28	400	<380	U	28	380	<400	U	28	400	NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				<400	U	400	400	<380	U	380	380	<400	U	400	400	NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				<400	U	400	400	<380	U	380	380	<400	U	400	400	NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				<400	U	21	400	<380	U	21	380	<400	U	21	400	NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				<400	U	400	400	<380	U	380	380	<400	U	400	400	NT			
Dimethylphthalate	131-11-3	--	--	--	--	--	NT				NT				<400	U	400	400	<380	U	380	380	<400	U	400	400	NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				<400	U	18	400	<380	U	18	380	<400	U	18	400	NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				<400	U	18	400	<380	U	18	380	<400	U	18	400	NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				<400	U	20	400	<380	U	20	380	<400	U	20	400	NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				<400	U	400	400	<380	U	380	380	<400	U	400	400	NT			
Phenanthrene [8]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				<400	U	24	400	<380	U	24	380	<400	U	24	400	NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				<400	U	24	400	<380	U	24	380	<400	U	24	400	NT			
SVOC TICs (µg/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
16-Octadecenal	56554-87-1	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
17-Octadecenal	56554-86-0	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NI				NI				NI				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NI				NI				NI				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB54B-DUP(Dup-2) 1/9/2007 9-10		MDL	RL	54SB54C 1/9/2007 12-13		MDL	RL	54SB55A 12/9/2002 0-1		MDL	RL	54SB55B 12/9/2002 9-10		MDL	RL	54SB55B-DUP (D-12) 12/9/2002 9-10		MDL	RL	54SB71A 8/20/2004 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
Camphene	79-92-5	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
Cholesterol	57-88-5	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
Pentadecanal-	24055	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
Testosterone	58-22-0	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NT				NT				NI				NI				NI				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	65.7		0.968	0.968	57.4	A,B,z	0.971	0.971	1,210	J,c	3.1	10	40.8		2.9	9.9	NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	<0.968	U	0.968	0.968	1	A	0.971	0.971	211	J,c	3.4	10	<9.9		2.1	9.9	NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	2.06	A	0.484	0.484	2.09	A	0.486	0.486	204		2.4	5	<5		1.4	5	NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	0.174	A,J,w	0.484	0.484	0.427	A	0.486	0.486	125		2.1	5	<5		0.7	5	NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	<0.484	U	0.484	0.484	<0.486	U	0.486	0.486	16.1		3	5	<5		0.9	5	NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	<0.484	U	0.484	0.484	<0.486	U	0.486	0.486	8.5		1.2	5	<5		0.6	5	NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	<0.484	U	0.484	0.484	<0.486	U	0.486	0.486	91.6		1.2	5	<5		0.4	5	NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	<0.484	U	0.484	0.484	<0.486	U	0.486	0.486	14.3		1.2	5	<5		0.6	5	NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	<0.484	U	0.484	0.484	<0.486	U	0.486	0.486	40.4		1.2	5	<5		0.4	5	NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	<0.484	U	0.484	0.484	<0.486	U	0.486	0.486	22.7		1.2	5	<5		0.6	5	NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	<0.484	U	0.484	0.484	<0.486	U	0.486	0.486	5.7		1.6	5	<5		0.5	5	NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	<0.484	U	0.484	0.484	<0.486	U	0.486	0.486	9.9		0.3	5	<5		0.4	5	NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	<0.484	U	0.484	0.484	<0.486	U	0.486	0.486	37.5		0.3	5	<5		0.3	5	NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	<0.484	U	0.484	0.484	<0.486	U	0.486	0.486	38.6		1.2	5	<5		0.4	5	NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	<0.484	U	0.484	0.484	0.0894	A	0.486	0.486	56.7		0.3	5	<5		0.3	5	NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	<0.0968	U	0.0968	0.0968	<0.129	U	0.129	0.129	***2.7***		0.2	1	<1		0.4	1	NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	0.327	A,B,z	0.0968	0.0968	0.282	A	0.114	0.114	28.5		0.3	1	<1		0.3	1	NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	6.69		0.484	0.484	6.83		0.552	0.552	391		2.4	5	<5		1.4	5	NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	<0.484	U	0.484	0.484	0.954		0.486	0.486	274		2.5	5	<5		0.8	5	NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	1.23		0.484	0.484	0.69		0.486	0.486	181		1.2	5	<5		0.6	5	NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	<0.484	U	0.484	0.484	<0.486	U	0.486	0.486	439	M	1.3	5	<5		0.4	5	NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	<0.484	U	0.484	0.484	<0.486	U	0.486	0.486	154	M	0.3	5	<5		0.4	5	NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	<0.484	U	0.484	0.484	0.134		0.486	0.486	692	M	0.3	5	<5		0.3	5	NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	<0.0968	U	0.0968	0.0968	<0.129	U	0.129	0.129	147	M	0.2	1	<1		0.4	1	NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	0.509	,B,z	0.0968	0.0968	0.282		0.114	0.114	951	M	0.2	1	<1		0.3	1	NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				<51	U	5.9	51	<48	U	5.9	48	160	P,J,g	5.9	51	NT			
Acenaphthylene[B]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				<51	U	5.9	51	<48	U	5.9	48	<51	U	5.9	51	NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				<51	U	5.4	51	<48	U	5.4	48	<51	U	5.4	51	NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				<10	U	2.2	10	<9.4	U	2.2	9.4	<10	U	2.2	10	NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				<10	U	1.6	10	<9.4	U	1.6	9.4	<10	U	1.6	10	NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				5	JP,J,g	1.7	10	<9.4	U	1.7	9.4	<10	U	1.7	10	NT			
Benzo(g,h,i)perylene[B]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				<10	U	3.6	10	<9.4	U	3.6	9.4	<10	U	3.6	10	NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				<10	U	1.4	10	<9.4	U	1.4	9.4	<10	U	1.4	10	NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				<10	U	2.4	10	<9.4	U	2.4	9.4	<10	U	2.4	10	NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				<10	U	4.2	10	<9.4	U	4.2	9.4	<10	U	4.2	10	NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				<20	U	2.1	20	<19	U	2.1	19	<20	U	2.1	20	NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				<51	U	14	51	<48	U	14	48	<51	U	14	51	NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				<10	U	2.5	10	<9.4	U	2.5	9.4	<10	U	2.5	10	NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				***410***		14	51	<48	U	14	48	***160***	P,J,g	14	51	NT			
Phenanthrene[B]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				<51	U	8.5	51	<48	U	8.5	48	<51	U	8.5	51	NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				<20	U	4.3	20	<19	U	4.3	19	13	J	4.3	20	NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB54B-DUP(Dup-2) 1/9/2007 9-10		MDL	RL	54SB54C 1/9/2007 12-13		MDL	RL	54SB55A 12/9/2002 0-1		MDL	RL	54SB55B 12/9/2002 9-10		MDL	RL	54SB55B-DUP (D-12) 12/9/2002 9-10		MDL	RL	54SB71A 8/20/2004 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT				NT				<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	<1	U,R,I	0.079	1	NT			
2,4,6-Trinitrotoluene[B]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT				NT				<1	U	0.16	1	<1	U	0.16	1	<1	U	0.16	1	NT			
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT				NT				<1	U	0.12	1	<1	U	0.12	1	<1	U	0.12	1	NT			
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	NT				NT				ND				ND				ND				NT			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	NT				NT				<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	NT			
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT				NT				<1	U	0.095	1	<1	U	0.095	1	<1	U	0.095	1	NT			
Aminodinitrotoluenes	--	N	--	15.643	204.4	--	NT				NT				ND				ND				ND				NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT				NT				<1	U	0.1	1	<1	U	0.1	1	<1	U	0.1	1	NT			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	NT				NT				<1	U	0.28	1	<1	U	0.28	1	<1	U	0.28	1	NT			
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				NT				<10	U	1	10	<10	U	1	10	<10	U	1	10	NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	NT				NT				--				--				--				74		0.1	0.1

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB71B 8/20/2004 9-10		MDL	RL	54SB71C 8/20/2004 12-12.8		MDL	RL	54SB72A 8/20/2004 0-1		MDL	RL	54SB72B 8/20/2004 9-10		MDL	RL	54SB72C 8/20/2004 10.3-10.7		MDL	RL	54SB73A 8/20/2004 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				NT				NT				NT				NT				NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				NT				NT				NT				NT				NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				NT				NT				NT				NT				NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				NT				NT				NT				NT				NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	NT				NT				NT				NT				NT				NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				NT				NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				NT				NT				NT				NT				NT			
Cobalt	7440-48-4	--	72.3	--	--	--	NT				NT				NT				NT				NT				NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				NT				NT				NT				NT				NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				NT				NT				NT				NT				NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				NT				NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				NT				NT				NT				NT				NT			
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT				NT				NT				NT				NT				NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				NT				NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				NT				NT				NT				NT				NT			
Silver	7440-22-4	N	--	39.11	511	1.551	NT				NT				NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				NT				NT				NT				NT				NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				NT				NT				NT				NT				NT			
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<20	U	3.92	20	<20	U	4.1	20	<20	U	3.29	20	<20	U	3.64	20	<20	U	3.46	20	<20	U	3.46	20
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	<20	U	3.06	20	<20	U	3.2	20	<20	U	2.57	20	<20	U	2.84	20	<20	U	2.7	20	<20	U	2.7	20
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	<20	U	3.43	20	<20	U	3.59	20	<20	U	2.88	20	<20	U	3.18	20	<20	U	3.03	20	<20	U	3.03	20
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<20	U	3.05	20	<20	U	3.19	20	<20	U	2.56	20	<20	U	2.83	20	<20	U	2.69	20	<20	U	2.69	20
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	<20	U	4.26	20	<20	U	4.45	20	<20	U	3.57	20	<20	U	3.95	20	<20	U	3.76	20	<20	U	3.76	20
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<20	U	2.65	20	<20	U	2.76	20	<20	U	2.22	20	<20	U	2.45	20	<20	U	2.33	20	<20	U	2.33	20
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	<20	U	3.2	20	<20	U	3.34	20	<20	U	2.68	20	<20	U	2.97	20	<20	U	2.83	20	<20	U	2.83	20
Endrin aldehyde [6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<20	U	2.95	20	<20	U	3.08	20	<20	U	2.47	20	<20	U	2.73	20	<20	U	2.6	20	4.4	J,J,g	2.6	20
Endrin ketone [6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	<20	U	3.11	20	<20	U	3.24	20	<20	U	2.6	20	<20	U	2.88	20	<20	U	2.74	20	<20	U	2.74	20
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<20	U	3.56	20	<20	U	3.72	20	<20	U	2.99	20	<20	U	3.3	20	<20	U	3.14	20	<20	U	3.14	20
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<20	U	3.11	20	<20	U	3.24	20	<20	U	2.6	20	<20	U	2.88	20	<20	U	2.74	20	<20	U	2.74	20
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<20	U	3.35	20	<20	U	3.49	20	<20	U	2.8	20	<20	U	3.1	20	<20	U	2.95	20	<20	U	2.95	20
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<20	U	4.71	20	<20	U	4.91	20	<20	U	3.94	20	<20	U	4.36	20	<20	U	4.15	20	<20	U	4.15	20
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U	6.34	20	<20	U	6.62	20	<20	U	5.32	20	<20	U	5.88	20	<20	U	5.6	20	<20	U	5.6	20
Aroclor 1254 [7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<33	U	9.52	33	<33	U	9.52	33	19	J,J,c	7.48	33	<33	U	8.84	33	<33	U	8.16	33	<33	U	8.16	33
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<66	U	14.1	66	<66	U	14.1	66	<66	U	11.1	66	<66	U	13.1	66	<66	U	12.1	66	<66	U	12.1	66
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	2.4E+03	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [8]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Dimethylphthalate	131-11-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [8]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
16-Octadecenal	56554-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
17-Octadecenal	56554-86-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB71B 8/20/2004 9-10		MDL	RL	54SB71C 8/20/2004 12-12.8		MDL	RL	54SB72A 8/20/2004 0-1		MDL	RL	54SB72B 8/20/2004 9-10		MDL	RL	54SB72C 8/20/2004 10.3-10.7		MDL	RL	54SB73A 8/20/2004 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Camphene	79-92-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cholesterol	57-88-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pentadecanal-	24055	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Testosterone	58-22-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene[B]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene[B]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene[B]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB71B 8/20/2004 9-10		MDL	RL	54SB71C 8/20/2004 12-12.8		MDL	RL	54SB72A 8/20/2004 0-1		MDL	RL	54SB72B 8/20/2004 9-10		MDL	RL	54SB72C 8/20/2004 10.3-10.7		MDL	RL	54SB73A 8/20/2004 0-1		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT				NT				NT				NT				NT				NT			
2,4,6-Trinitrotoluene[B]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT				NT				NT				NT				NT				NT			
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	NT				NT				NT				NT				NT				NT			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				NT				NT				NT			
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				NT				NT				NT			
Aminodinitrotoluenes	--	N	--	15.643	204.4	--	NT				NT				NT				NT				NT				NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT				NT				NT				NT				NT				NT			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	NT				NT				NT				NT				NT				NT			
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				NT				NT				NT				NT				NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	74		0.1	0.1	70		0.1	0.1	87		0.1	0.1	79		0.1	0.1	83		0.1	0.1	83		0.1	0.1

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
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Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB73B 8/20/2004 9-10		MDL	RL	54SB73C 8/20/2004 10-11		MDL	RL	54SB74A 8/20/2004 0-1		MDL	RL	54SB74A-DUP(DUP-8) 8/20/2004 0-1		MDL	RL	54SB74B 8/20/2004 9-10		MDL	RL	54SB74C 8/20/2004 12-12.5		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				NT				NT				NT				NT				NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				NT				NT				NT				NT				NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				NT				NT				NT				NT				NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				NT				NT				NT				NT				NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	NT				NT				NT				NT				NT				NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				NT				NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				NT				NT				NT				NT				NT			
Cobalt	7440-48-4	--	72.3	--	--	--	NT				NT				NT				NT				NT				NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				NT				NT				NT				NT				NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				NT				NT				NT				NT				NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				NT				NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				NT				NT				NT				NT				NT			
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT				NT				NT				NT				NT				NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				NT				NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				NT				NT				NT				NT				NT			
Silver	7440-22-4	N	--	39.11	511	1.551	NT				NT				NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				NT				NT				NT				NT				NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				NT				NT				NT				NT				NT			
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<20	U	3.29	20	<20	U	3.35	20	<20	U	3.29	20	<20	U	3.29	20	<20	U	3.92	20	<20	U	3.64	20
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	<20	U	2.57	20	<20	U	2.61	20	<20	U	2.57	20	<20	U	2.57	20	<20	U	3.06	20	<20	U	2.84	20
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	<20	U	2.88	20	<20	U	2.93	20	<20	U	2.88	20	<20	U	2.88	20	<20	U	3.43	20	<20	U	3.18	20
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<20	U	2.56	20	<20	U	2.6	20	<20	U	2.56	20	<20	U	2.56	20	<20	U	3.05	20	<20	U	2.83	20
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	<20	U	3.57	20	<20	U	3.64	20	<20	U	3.57	20	<20	U	3.57	20	<20	U	4.26	20	<20	U	3.95	20
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<20	U	2.22	20	<20	U	2.26	20	<20	U	2.22	20	<20	U	2.22	20	<20	U	2.65	20	<20	U	2.45	20
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	<20	U	2.68	20	<20	U	2.73	20	<20	U	2.68	20	<20	U	2.68	20	<20	U	3.2	20	<20	U	2.97	20
Endrin aldehyde [6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	5.6	J	2.47	20	<20	U	2.52	20	<20	U	2.47	20	<20	U	2.47	20	<20	U	2.95	20	<20	U	2.73	20
Endrin ketone [6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	<20	U	2.6	20	<20	U	2.65	20	<20	U	2.6	20	<20	U	2.6	20	<20	U	3.11	20	<20	U	2.88	20
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<20	U	2.99	20	<20	U	3.04	20	<20	U	2.99	20	<20	U	2.99	20	<20	U	3.56	20	<20	U	3.3	20
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<20	U	2.6	20	<20	U	2.65	20	<20	U	2.6	20	<20	U	2.6	20	<20	U	3.11	20	<20	U	2.88	20
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<20	U	2.8	20	<20	U	2.85	20	<20	U	2.8	20	<20	U	2.8	20	<20	U	3.35	20	<20	U	3.1	20
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<20	U	3.94	20	<20	U	4.01	20	<20	U	3.94	20	<20	U	3.94	20	<20	U	4.71	20	<20	U	4.36	20
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U	5.32	20	<20	U	5.41	20	<20	U	5.32	20	<20	U	5.32	20	<20	U	6.34	20	<20	U	5.88	20
Aroclor 1254 [7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<33	U	6.8	33	<33	U	8.16	33	<33	U	7.48	33	<33	U	7.48	33	<33	U	9.52	33	<33	U	8.84	33
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<66	U	10.1	66	<66	U	12.1	66	<66	U	11.1	66	<66	U	11.1	66	<66	U	14.1	66	<66	U	13.1	66
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	2.4E+03	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [8]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Dimethylphthalate	131-11-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [8]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
16-Octadecenal	56554-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
17-Octadecenal	56554-86-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
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Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB73B 8/20/2004 9-10		MDL	RL	54SB73C 8/20/2004 10-11		MDL	RL	54SB74A 8/20/2004 0-1		MDL	RL	54SB74A-DUP(DUP-8) 8/20/2004 0-1		MDL	RL	54SB74B 8/20/2004 9-10		MDL	RL	54SB74C 8/20/2004 12-12.5		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Camphene	79-92-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cholesterol	57-88-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pentadecanal-	24055	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Testosterone	58-22-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				NT				NT			
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene[B]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene[B]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene[B]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-8
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SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB73B 8/20/2004 9-10		MDL	RL	54SB73C 8/20/2004 10-11		MDL	RL	54SB74A 8/20/2004 0-1		MDL	RL	54SB74A-DUP(DUP-8) 8/20/2004 0-1		MDL	RL	54SB74B 8/20/2004 9-10		MDL	RL	54SB74C 8/20/2004 12-12.5		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT				NT				NT				NT				NT				NT			
2,4,6-Trinitrotoluene[B]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT				NT				NT				NT				NT				NT			
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	NT				NT				NT				NT				NT				NT			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				NT				NT				NT			
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				NT				NT				NT			
Aminodinitrotoluenes	--	N	--	15.643	204.4	--	NT				NT				NT				NT				NT				NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT				NT				NT				NT				NT				NT			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	NT				NT				NT				NT				NT				NT			
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				NT				NT				NT				NT				NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	87		0.1	0.1	86		0.1	0.1	87		0.1	0.1	87		0.1	0.1	73		0.1	0.1	79		0.1	0.1

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB75A 8/20/2004 0-1		MDL	RL	54SB75B 8/20/2004 9-10		MDL	RL	54SB75C 8/20/2004 13-14.5		MDL	RL	54SB76C 8/20/2004 10-11		MDL	RL	54SB76C-DUP(DUP-7) 8/20/2004 10-11		MDL	RL	54SB77A 1/9/2007 0-0.5		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				NT				NT				NT				NT				NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				NT				NT				NT				NT				NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				NT				NT				NT				NT				NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				NT				NT				NT				NT				NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	NT				NT				NT				NT				NT				NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				NT				NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				NT				NT				NT				NT				NT			
Cobalt	7440-48-4	--	72.3	--	--	--	NT				NT				NT				NT				NT				NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				NT				NT				NT				NT				NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				NT				NT				NT				NT				NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				NT				NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				NT				NT				NT				NT				NT			
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT				NT				NT				NT				NT				NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				NT				NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				NT				NT				NT				NT				NT			
Silver	7440-22-4	N	--	39.11	511	1.551	NT				NT				NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				NT				NT				NT				NT				NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				NT				NT				NT				NT				NT			
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	<20	U	3.23	20	<20	U	3.35	20	<20	U	3.17	20	<20	U	3.4	20	<20	U	3.4	20	NT			
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	<20	U	2.52	20	<20	U	2.61	20	<20	U	2.48	20	<20	U	2.66	20	<20	U	2.66	20	NT			
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	<20	U	2.83	20	<20	U	2.93	20	<20	U	2.78	20	<20	U	2.98	20	<20	U	2.98	20	NT			
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	<20	U	2.51	20	<20	U	2.6	20	<20	U	2.47	20	<20	U	2.65	20	<20	U	2.65	20	NT			
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	<20	U	3.51	20	<20	U	3.64	20	<20	U	3.45	20	<20	U	3.7	20	<20	U	3.7	20	NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	<20	U	2.18	20	<20	U	2.26	20	<20	U	2.14	20	<20	U	2.3	20	<20	U	2.3	20	NT			
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	<20	U	2.64	20	<20	U	2.73	20	<20	U	2.59	20	<20	U	2.78	20	<20	U	2.78	20	NT			
Endrin aldehyde [6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	<20	U	2.43	20	<20	U	2.52	20	<20	U	2.39	20	4.2	J	2.56	20	<20	U	2.56	20	NT			
Endrin ketone [6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	<20	U	2.56	20	<20	U	2.65	20	<20	U	2.51	20	<20	U	2.7	20	<20	U	2.7	20	NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	<20	U	2.93	20	<20	U	3.04	20	<20	U	2.88	20	<20	U	3.09	20	<20	U	3.09	20	NT			
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	<20	U	2.56	20	<20	U	2.65	20	<20	U	2.51	20	<20	U	2.7	20	<20	U	2.7	20	NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	<20	U	2.76	20	<20	U	2.85	20	<20	U	2.71	20	<20	U	2.9	20	<20	U	2.9	20	NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	<20	U	3.88	20	<20	U	4.01	20	<20	U	3.81	20	<20	U	4.08	20	<20	U	4.08	20	NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	<20	U	5.22	20	<20	U	5.41	20	<20	U	5.13	20	<20	U	5.5	20	<20	U	5.5	20	NT			
Aroclor 1254 [7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	<33	U	7.48	33	<33	U	8.16	33	<33	U	7.48	33	<33	U	8.16	33	12	J	8.16	33	NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	<66	U	11.1	66	<66	U	12.1	66	<66	U	11.1	66	<66	U	12.1	66	<66	U	12.1	66	NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	2.4E+03	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [8]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Dimethylphthalate	131-11-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [8]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
16-Octadecenal	56554-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
17-Octadecenal	56554-86-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB75A 8/20/2004 0-1		MDL	RL	54SB75B 8/20/2004 9-10		MDL	RL	54SB75C 8/20/2004 13-14.5		MDL	RL	54SB76C 8/20/2004 10-11		MDL	RL	54SB76C-DUP(DUP-7) 8/20/2004 10-11		MDL	RL	54SB77A 1/9/2007 0-0.5		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Camphene	79-92-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cholesterol	57-88-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pentadecanal-	24055	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Testosterone	58-22-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	NT				NT				NT				NT				NT				120		0.897	0.897
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	NT				NT				NT				NT				NT				2	A	0.823	0.823
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				5.76		0.412	0.412
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	NT				NT				NT				NT				NT				1.19	A	0.412	0.412
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	NT				NT				NT				NT				NT				<0.412	U	0.412	0.412
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	NT				NT				NT				NT				NT				<0.412	U	0.412	0.412
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	NT				NT				NT				NT				NT				0.183	A,J,w	0.412	0.412
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	NT				NT				NT				NT				NT				<0.412	U	0.412	0.412
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	NT				NT				NT				NT				NT				0.135	A,J,w	0.412	0.412
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	NT				NT				NT				NT				NT				<0.412	U	0.412	0.412
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	NT				NT				NT				NT				NT				<0.412	U	0.412	0.412
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	NT				NT				NT				NT				NT				<0.412	U	0.412	0.412
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	NT				NT				NT				NT				NT				0.135	A	0.412	0.412
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	NT				NT				NT				NT				NT				0.147	A	0.412	0.412
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	NT				NT				NT				NT				NT				0.193	A	0.412	0.412
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	NT				NT				NT				NT				NT				***1.34***		0.0884	0.0884
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				0.39	A,J,w	0.138	0.138
Total HpCDD	37871-00-4	--	--	--	--	--	NT				NT				NT				NT				NT				19.1		0.412	0.412
Total HpCDF	38998-75-3	--	--	--	--	--	NT				NT				NT				NT				NT				2.3		0.412	0.412
Total HxCDD	34465-46-8	--	--	--	--	--	NT				NT				NT				NT				NT				2.41		0.412	0.412
Total HxCDF	55684-94-1	--	--	--	--	--	NT				NT				NT				NT				NT				1.14		0.412	0.412
Total PeCDD	36088-22-9	--	--	--	--	--	NT				NT				NT				NT				NT				0.655		0.412	0.412
Total PeCDF	30402-15-4	--	--	--	--	--	NT				NT				NT				NT				NT				0.897		0.412	0.412
Total TCDD	41903-57-5	--	--	--	--	--	NT				NT				NT				NT				NT				1.34		0.0884	0.0884
Total TCDF	55722-27-5	--	--	--	--	--	NT				NT				NT				NT				NT				1.23		0.138	0.138
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene[B]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene[B]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene[B]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB75A 8/20/2004 0-1		MDL	RL	54SB75B 8/20/2004 9-10		MDL	RL	54SB75C 8/20/2004 13-14.5		MDL	RL	54SB76C 8/20/2004 10-11		MDL	RL	54SB76C-DUP(DUP-7) 8/20/2004 10-11		MDL	RL	54SB77A 1/9/2007 0-0.5		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT				NT				NT				NT				NT				NT			
2,4,6-Trinitrotoluene[B]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT				NT				NT				NT				NT				NT			
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	NT				NT				NT				NT				NT				NT			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				NT				NT				NT			
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				NT				NT				NT			
Aminodinitrotoluenes	--	N	--	15.643	204.4	--	NT				NT				NT				NT				NT				NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT				NT				NT				NT				NT				NT			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	NT				NT				NT				NT				NT				NT			
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				NT				NT				NT				NT				NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	89		0.1	0.1	86		0.1	0.1	91		0.1	0.1	85		0.1	0.1	85		0.1	0.1	NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB77B 1/9/2007 7-8		MDL	RL	54SB77C 1/9/2007 10-11		MDL	RL	54SB77C-DUP(Dup-4) 1/9/2007 10-11		MDL	RL	54SB78A 1/9/2007 0-0.5		MDL	RL	54SB78B 1/9/2007 9-10		MDL	RL	54SB78B-DUP(Dup-3) 1/9/2007 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				NT				NT				NT				NT				NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				NT				NT				NT				NT				NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				NT				NT				NT				NT				NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				NT				NT				NT				NT				NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	NT				NT				NT				NT				NT				NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				NT				NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				NT				NT				NT				NT				NT			
Cobalt	7440-48-4	--	72.3	--	--	--	NT				NT				NT				NT				NT				NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				NT				NT				NT				NT				NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				NT				NT				NT				NT				NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				NT				NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				NT				NT				NT				NT				NT			
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT				NT				NT				NT				NT				NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				NT				NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				NT				NT				NT				NT				NT			
Silver	7440-22-4	N	--	39.11	511	1.551	NT				NT				NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				NT				NT				NT				NT				NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				NT				NT				NT				NT				NT			
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				NT				NT				NT				NT			
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	NT				NT				NT				NT				NT				NT			
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	NT				NT				NT				NT				NT				NT			
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	NT				NT				NT				NT				NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				NT				NT				NT				NT			
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	NT				NT				NT				NT				NT				NT			
Endrin aldehyde [6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
Endrin ketone [6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				NT				NT				NT				NT			
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				NT				NT				NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				NT				NT				NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				NT				NT				NT				NT			
Aroclor 1254 [7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				NT				NT				NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				NT				NT				NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	2.4E+03	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [8]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Dimethylphthalate	131-11-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [8]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
16-Octadecenal	56554-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
17-Octadecenal	56554-86-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB77B 1/9/2007 7-8		MDL	RL	54SB77C 1/9/2007 10-11		MDL	RL	54SB77C-DUP(Dup-4) 1/9/2007 10-11		MDL	RL	54SB78A 1/9/2007 0-0.5		MDL	RL	54SB78B 1/9/2007 9-10		MDL	RL	54SB78B-DUP(Dup-3) 1/9/2007 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Camphene	79-92-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cholesterol	57-88-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pentadecanal-	24055	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Testosterone	58-22-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	32.3		0.972	0.972	29.8		0.967	0.967	40.2		0.966	0.966	109		0.936	0.936	34.7		0.943	0.943	48.9		0.986	0.986
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	<0.972	U	0.972	0.972	<0.967	U	0.967	0.967	<0.966	U	0.966	0.966	1.25	A,B,z	0.936	0.936	<0.943	U	0.943	0.943	<0.986	U	0.986	0.986
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	1.01	A	0.486	0.486	1.06	A	0.483	0.483	1.3	A	0.483	0.483	5.5		0.468	0.468	1.22	A	0.471	0.471	1.62	A	0.493	0.493
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	0.187	A	0.486	0.486	0.12	A,J,w	0.483	0.483	<0.483	U	0.483	0.483	1.08	A	0.468	0.468	<0.471	U	0.471	0.471	0.181	A,B,z	0.493	0.493
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	<0.486	U	0.486	0.486	<0.483	U	0.483	0.483	<0.483	U	0.483	0.483	<0.468	U	0.468	0.468	<0.471	U	0.471	0.471	<0.493	U	0.493	0.493
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	<0.486	U	0.486	0.486	<0.483	U	0.483	0.483	<0.483	U	0.483	0.483	0.159	A	0.468	0.468	<0.471	U	0.471	0.471	<0.493	U	0.493	0.493
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	<0.486	U	0.486	0.486	<0.483	U	0.483	0.483	<0.483	U	0.483	0.483	<0.468	U	0.468	0.468	<0.471	U	0.471	0.471	<0.493	U	0.493	0.493
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	<0.486	U	0.486	0.486	<0.483	U	0.483	0.483	<0.483	U	0.483	0.483	0.271	A	0.468	0.468	<0.471	U	0.471	0.471	<0.493	U	0.493	0.493
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	<0.486	U	0.486	0.486	<0.483	U	0.483	0.483	<0.483	U	0.483	0.483	<0.468	U	0.468	0.468	<0.471	U	0.471	0.471	<0.493	U	0.493	0.493
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	<0.486	U	0.486	0.486	<0.483	U	0.483	0.483	<0.483	U	0.483	0.483	<0.468	U	0.468	0.468	<0.471	U	0.471	0.471	<0.493	U	0.493	0.493
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	<0.486	U	0.486	0.486	<0.483	U	0.483	0.483	<0.483	U	0.483	0.483	<0.468	U	0.468	0.468	<0.471	U	0.471	0.471	<0.493	U	0.493	0.493
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	<0.486	U	0.486	0.486	<0.483	U	0.483	0.483	<0.483	U	0.483	0.483	<0.468	U	0.468	0.468	<0.471	U	0.471	0.471	<0.493	U	0.493	0.493
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	<0.486	U	0.486	0.486	<0.483	U	0.483	0.483	<0.483	U	0.483	0.483	0.14	A	0.468	0.468	<0.471	U	0.471	0.471	<0.493	U	0.493	0.493
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	<0.486	U	0.486	0.486	<0.483	U	0.483	0.483	<0.483	U	0.483	0.483	<0.468	U	0.468	0.468	<0.471	U	0.471	0.471	<0.493	U	0.493	0.493
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	<0.486	U	0.486	0.486	0.0696	A,J,w	0.483	0.483	<0.483	U	0.483	0.483	0.212	A,B,z	0.468	0.468	<0.471	U	0.471	0.471	0.0848	A,J,w	0.493	0.493
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	<0.0972	U	0.0972	0.0972	<0.0967	U	0.0967	0.0967	<0.0966	U	0.0966	0.0966	***1.76***		0.108	0.108	<0.103	U	0.103	0.103	<0.0994	U	0.0994	0.0994
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	0.29	A,J,w	0.0972	0.0972	0.248	A,B,z	0.1	0.1	0.224	A,J,w	0.0966	0.0966	0.5	A	0.207	0.207	<0.104	U	0.104	0.104	0.276	A	0.102	0.102
Total HpCDD	37871-00-4	--	--	--	--	--	3.32		0.486	0.486	3.39		0.483	0.483	4.37		0.483	0.483	17.6		0.468	0.468	4.05		0.471	0.471	5.68		0.493	0.493
Total HpCDF	38998-75-3	--	--	--	--	--	0.187		0.486	0.486	<0.483	U	0.483	0.483	<0.483	U	0.483	0.483	1.94		0.468	0.468	0.164	,B,z	0.471	0.471	0.29	,B,z	0.493	0.493
Total HxCDD	34465-46-8	--	--	--	--	--	0.383		0.486	0.486	0.364		0.483	0.483	0.299		0.483	0.483	2.86		0.468	0.468	0.504		0.471	0.471	0.692		0.493	0.493
Total HxCDF	55684-94-1	--	--	--	--	--	<0.486	U	0.486	0.486	<0.483	U	0.483	0.483	0.0367		0.483	0.483	0.388	,B,z	0.468	0.468	<0.471	U	0.471	0.471	<0.493	U	0.493	0.493
Total PeCDD	36088-22-9	--	--	--	--	--	<0.486	U	0.486	0.486	<0.483	U	0.483	0.483	0.137		0.483	0.483	0.44		0.468	0.468	<0.471	U	0.471	0.471	<0.493	U	0.493	0.493
Total PeCDF	30402-15-4	--	--	--	--	--	<0.486	U	0.486	0.486	0.0851		0.483	0.483	<0.483	U	0.483	0.483	0.964		0.468	0.468	<0.471	U	0.471	0.471	0.0355	,B,z	0.493	0.493
Total TCDD	41903-57-5	--	--	--	--	--	<0.0972	U	0.0972	0.0972	<0.0967	U	0.0967	0.0967	<0.0966	U	0.0966	0.0966	1.76		0.108	0.108	<0.103	U	0.103	0.103	<0.0994	U	0.0994	0.0994
Total TCDF	55722-27-5	--	--	--	--	--	0.194	,B,z	0.0972	0.0972	0.391	,B,z	0.1	0.1	0.212	,B,z	0.0966	0.0966	1.83		0.207	0.207	0.234	,J,f	0.104	0.104	0.461	,J,f	0.102	0.102
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene[8]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene[8]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene[8]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB77B 1/9/2007 7-8		MDL	RL	54SB77C 1/9/2007 10-11		MDL	RL	54SB77C-DUP(Dup-4) 1/9/2007 10-11		MDL	RL	54SB78A 1/9/2007 0-0.5		MDL	RL	54SB78B 1/9/2007 9-10		MDL	RL	54SB78B-DUP(Dup-3) 1/9/2007 9-10		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT				NT				NT				NT				NT				NT			
2,4,6-Trinitrotoluene[B]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT				NT				NT				NT				NT				NT			
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	NT				NT				NT				NT				NT				NT			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				NT				NT				NT			
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				NT				NT				NT			
Aminodinitrotoluenes	--	N	--	15.643	204.4	--	NT				NT				NT				NT				NT				NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT				NT				NT				NT				NT				NT			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	NT				NT				NT				NT				NT				NT			
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				NT				NT				NT				NT				NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB78C 1/9/2007 13.5-14.5		MDL	RL	54SB79A 1/9/2007 0-0.5		MDL	RL	54SB79B 1/9/2007 7-8		MDL	RL	54SB79C 1/9/2007 9.5-10.5		MDL	RL	54SB80A 1/9/2007 0-0.5		MDL	RL	54SB80B 1/9/2007 5-6		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																														
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT				NT				NT				NT				NT				NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT				NT				NT				NT				NT				NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT				NT				NT				NT				NT				NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT				NT				NT				NT				NT				NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	NT				NT				NT				NT				NT				NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT				NT				NT				NT				NT				NT			
Calcium	7440-70-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT				NT				NT				NT				NT				NT			
Cobalt	7440-48-4	--	72.3	--	--	--	NT				NT				NT				NT				NT				NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT				NT				NT				NT				NT				NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT				NT				NT				NT				NT				NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	NT				NT				NT				NT				NT				NT			
Magnesium	7439-95-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT				NT				NT				NT				NT				NT			
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT				NT				NT				NT				NT				NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT				NT				NT				NT				NT				NT			
Potassium	7440-09-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	NT				NT				NT				NT				NT				NT			
Silver	7440-22-4	N	--	39.11	511	1.551	NT				NT				NT				NT				NT				NT			
Sodium	7440-23-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT				NT				NT				NT				NT				NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT				NT				NT				NT				NT				NT			
TCL Pesticides/PCBs (µg/kg)																														
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT				NT				NT				NT				NT				NT			
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	NT				NT				NT				NT				NT				NT			
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	NT				NT				NT				NT				NT				NT			
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	NT				NT				NT				NT				NT				NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT				NT				NT				NT				NT				NT			
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	NT				NT				NT				NT				NT				NT			
Endrin aldehyde [6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
Endrin ketone [6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	NT				NT				NT				NT				NT				NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT				NT				NT				NT				NT				NT			
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT				NT				NT				NT				NT				NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT				NT				NT				NT				NT				NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT				NT				NT				NT				NT				NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT				NT				NT				NT				NT				NT			
Aroclor 1254 [7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT				NT				NT				NT				NT				NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT				NT				NT				NT				NT				NT			
TCL SVOCs (µg/kg)																														
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	2.4E+03	--	NT				NT				NT				NT				NT				NT			
Acenaphthylene [8]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT				NT				NT				NT				NT				NT			
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT				NT				NT				NT				NT				NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Dimethylphthalate	131-11-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT				NT				NT				NT				NT				NT			
Phenanthrene [8]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
SVOC TICs (µg/kg)																														
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
16-Octadecenal	56554-87-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
17-Octadecenal	56554-86-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT				NT				NT				NT				NT				NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB78C 1/9/2007 13.5-14.5		MDL	RL	54SB79A 1/9/2007 0-0.5		MDL	RL	54SB79B 1/9/2007 7-8		MDL	RL	54SB79C 1/9/2007 9.5-10.5		MDL	RL	54SB80A 1/9/2007 0-0.5		MDL	RL	54SB80B 1/9/2007 5-6		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Camphene	79-92-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Cholesterol	57-88-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Pentadecanal-	24055	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Testosterone	58-22-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Dioxin/Furans (pg/g)																														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	38.6		0.927	0.927	66.3		1.03	1.03	18	,B,z	0.875	0.875	45.2		0.958	0.958	369		1.03	1.03	167		0.964	0.964
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	0.171	A	0.927	0.927	0.558	A	1.03	1.03	0.145	A,J,w	0.875	0.875	<0.958	U	0.958	0.958	0.766	A	1.03	1.03	<0.964	U	0.964	0.964
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	1.38	A	0.463	0.463	2.39	A	0.517	0.517	0.689	A	0.437	0.437	1.57	A	0.479	0.479	8.82		0.516	0.516	3.22	A	0.482	0.482
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	<0.463	U	0.463	0.463	0.335	A	0.517	0.517	0.0857	A	0.437	0.437	0.151	A,J,w	0.479	0.479	0.557	A	0.516	0.516	<0.482	U	0.482	0.482
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	<0.463	U	0.463	0.463	<0.517	U	0.517	0.517	<0.437	U	0.437	0.437	<0.479	U	0.479	0.479	<0.516	U	0.516	0.516	<0.482	U	0.482	0.482
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	<0.463	U	0.463	0.463	<0.517	U	0.517	0.517	<0.437	U	0.437	0.437	<0.479	U	0.479	0.479	<0.516	U	0.516	0.516	<0.482	U	0.482	0.482
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	<0.463	U	0.463	0.463	<0.517	U	0.517	0.517	<0.437	U	0.437	0.437	<0.479	U	0.479	0.479	<0.516	U	0.516	0.516	<0.482	U	0.482	0.482
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	<0.463	U	0.463	0.463	0.13	A,J,w	0.517	0.517	<0.437	U	0.437	0.437	<0.479	U	0.479	0.479	0.221	A	0.516	0.516	<0.482	U	0.482	0.482
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	<0.463	U	0.463	0.463	<0.517	U	0.517	0.517	<0.437	U	0.437	0.437	<0.479	U	0.479	0.479	0.0867	A	0.516	0.516	<0.482	U	0.482	0.482
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	0.211	A,J,w	0.463	0.463	0.178	A,J,w	0.517	0.517	<0.437	U	0.437	0.437	<0.479	U	0.479	0.479	0.213	A	0.516	0.516	<0.482	U	0.482	0.482
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	<0.463	U	0.463	0.463	<0.517	U	0.517	0.517	<0.437	U	0.437	0.437	<0.479	U	0.479	0.479	<0.516	U	0.516	0.516	<0.482	U	0.482	0.482
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	<0.463	U	0.463	0.463	<0.517	U	0.517	0.517	<0.437	U	0.437	0.437	<0.479	U	0.479	0.479	<0.516	U	0.516	0.516	<0.482	U	0.482	0.482
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	<0.463	U	0.463	0.463	0.112	A	0.517	0.517	0.0927	A	0.437	0.437	<0.479	U	0.479	0.479	<0.516	U	0.516	0.516	<0.482	U	0.482	0.482
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	<0.463	U	0.463	0.463	<0.517	U	0.517	0.517	<0.437	U	0.437	0.437	<0.479	U	0.479	0.479	0.12	A,J,w	0.516	0.516	<0.482	U	0.482	0.482
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	0.0871	A	0.463	0.463	0.134	A	0.517	0.517	<0.437	U	0.437	0.437	<0.479	U	0.479	0.479	0.159	A,J,w	0.516	0.516	<0.482	U	0.482	0.482
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	<0.0927	U	0.0927	0.0927	***0.703***	A	0.104	0.104	<0.0875	U	0.0875	0.0875	<0.0962	U	0.0962	0.0962	0.237	A,J,w	0.11	0.11	<0.0964	U	0.0964	0.0964
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	0.628	A,B,z	0.123	0.123	0.647	A,B,z	0.12	0.12	0.502	A,B,z	0.113	0.113	0.326	A,J,w	0.0975	0.0975	0.706	A,B,z	0.132	0.132	<0.0987	U	0.0987	0.0987
Total HpCDD	37871-00-4	--	--	--	--	--	4.57		0.463	0.463	8.05		0.517	0.517	2.16		0.437	0.437	5.19		0.479	0.479	32		0.53	0.53	10.9		0.482	0.482
Total HpCDF	38998-75-3	--	--	--	--	--	0.106		0.463	0.463	0.689		0.517	0.517	0.0857		0.437	0.437	0.0958	,B,z	0.479	0.479	1.03		0.516	0.516	<0.482	U	0.482	0.482
Total HxCDD	34465-46-8	--	--	--	--	--	0.751		0.463	0.463	1.37		0.517	0.517	0.241		0.437	0.437	0.554		0.479	0.479	2.49		0.516	0.516	0.76		0.482	0.482
Total HxCDF	55684-94-1	--	--	--	--	--	0.0556		0.463	0.463	0.283		0.517	0.517	0.0472		0.437	0.437	<0.479	U	0.479	0.479	0.413		0.516	0.516	<0.482	U	0.482	0.482
Total PeCDD	36088-22-9	--	--	--	--	--	0.169		0.463	0.463	0.939		0.517	0.517	<0.437	U	0.437	0.437	<0.479	U	0.479	0.479	0.813		0.516	0.516	<0.482	U	0.482	0.482
Total PeCDF	30402-15-4	--	--	--	--	--	0.133		0.463	0.463	0.306		0.517	0.517	0.275		0.437	0.437	0.0172	,B,z	0.479	0.479	0.268		0.516	0.516	0.0212	,B,z	0.482	0.482
Total TCDD	41903-57-5	--	--	--	--	--	<0.0927	U	0.0927	0.0927	0.703		0.104	0.104	<0.0875	U	0.0875	0.0875	<0.0962	U	0.0962	0.0962	0.14		0.11	0.11	<0.0964	U	0.0964	0.0964
Total TCDF	55722-27-5	--	--	--	--	--	1.01	,B,z	0.123	0.123	0.647	,B,z	0.12	0.12	0.593	,B,z	0.113	0.113	0.368		0.0975	0.0975	1.54	,B,z	0.132	0.132	0.193		0.0987	0.0987
PAHs (µg/kg)																														
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT				NT				NT				NT				NT				NT			
Acenaphthylene[B]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT				NT				NT				NT				NT				NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT				NT				NT				NT				NT				NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT				NT				NT				NT				NT				NT			
Benzo(g,h,i)perylene[B]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT				NT				NT				NT				NT				NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT				NT				NT				NT				NT				NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT				NT				NT				NT				NT				NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT				NT				NT				NT				NT				NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT				NT				NT				NT				NT				NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT				NT				NT				NT				NT				NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT				NT				NT				NT				NT				NT			
Phenanthrene[B]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT				NT				NT				NT				NT				NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT				NT				NT				NT				NT				NT			
PCB Congeners (pg/g)																														
8-DiCB	34883-43-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

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Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB78C 1/9/2007 13.5-14.5		MDL	RL	54SB79A 1/9/2007 0-0.5		MDL	RL	54SB79B 1/9/2007 7-8		MDL	RL	54SB79C 1/9/2007 9.5-10.5		MDL	RL	54SB80A 1/9/2007 0-0.5		MDL	RL	54SB80B 1/9/2007 5-6		MDL	RL
							Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
158-HxCB	74472-42-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT				NT				NT				NT				NT				NT			
Explosives (mg/kg)																														
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT				NT				NT				NT				NT				NT			
2,4,6-Trinitrotoluene[B]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT				NT				NT				NT				NT				NT			
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT				NT				NT				NT				NT				NT			
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	NT				NT				NT				NT				NT				NT			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				NT				NT				NT			
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT				NT				NT				NT				NT				NT			
Aminodinitrotoluenes	--	N	--	15.643	204.4	--	NT				NT				NT				NT				NT				NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT				NT				NT				NT				NT				NT			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	NT				NT				NT				NT				NT				NT			
Nitroglycerin (mg/kg)																														
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT				NT				NT				NT				NT				NT			
Percent Solids (%)																														
Percent Solids	--	--	--	--	--	--	NT				NT				NT				NT				NT				NT			

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Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[A]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB80C 1/9/2007 9-10		MDL	RL
							Result	LQ, VQ, r		
TAL Metals (mg/kg)										
Aluminum	7429-90-5	N	40,041	7,821	102,200	--	NT			
Antimony	7440-36-0	N	--	3.13	40.88	0.66	NT			
Arsenic	7440-38-2	C	15.8	0.426	1.91	0.0013	NT			
Barium	7440-39-3	N	209	1,564	20,440	300.8	NT			
Beryllium	7440-41-7	N	1.02	15.64	204.4	57.7	NT			
Cadmium	7440-43-9	N	0.69	7.82	102.2	2.745	NT			
Calcium	7440-70-2	--	--	--	--	--	NT			
Chromium [1]	7440-47-3	N	65.3	23.46	306.6	2.102	NT			
Cobalt	7440-48-4	--	72.3	--	--	--	NT			
Copper	7440-50-8	N	53.5	312.9	4,088	525.9	NT			
Iron	7439-89-6	N	50,962	5,475	71,540	--	NT			
Lead [2]	7439-92-1	--	26.8	400	750	--	NT			
Magnesium	7439-95-4	--	--	--	--	--	NT			
Manganese	7439-96-5	N	2,543	156.4	2,044	47.6	NT			
Mercury [3]	7439-97-6	--	0.13	2.35	30.66	--	NT			
Nickel	7440-02-0	N	62.8	156.4	2,044	--	NT			
Potassium	7440-09-7	--	--	--	--	--	NT			
Selenium	7782-49-2	N	--	39.11	511	0.949	NT			
Silver	7440-22-4	N	--	39.11	511	1.551	NT			
Sodium	7440-23-5	--	--	--	--	--	NT			
Vanadium	7440-62-2	N	108	7.82	102.2	36.51	NT			
Zinc	7440-66-6	N	202	2,346	30,660	681.1	NT			
TCL Pesticides/PCBs (µg/kg)										
4,4'-DDE	72-55-9	C	--	1.9E+03	8.4E+03	1.8E+03	NT			
Aldrin	309-00-2	C	--	3.8E+01	1.7E+02	3.8E-01	NT			
alpha-BHC	319-84-6	C	--	1.0E+02	4.5E+02	4.5E-02	NT			
alpha-Chlordane [4]	5103-71-9	C	--	1.8E+03	8.2E+03	--	NT			
beta-BHC	319-85-7	C	--	3.5E+02	1.6E+03	1.6E-01	NT			
delta-BHC [5]	319-86-8	C	--	1.0E+02	4.5E+02	--	NT			
Dieldrin	60-57-1	C	--	4.0E+01	1.8E+02	1.1E-01	NT			
Endrin aldehyde [6]	7421-93-4	N	--	2.3E+03	3.1E+04	--	NT			
Endrin ketone [6]	53494-70-5	N	--	2.3E+03	3.1E+04	--	NT			
gamma-BHC (Lindane)	58-89-9	C	--	4.9E+02	2.2E+03	2.2E-01	NT			
gamma-Chlordane [4]	5103-74-2	C	--	1.8E+03	8.2E+03	--	NT			
Heptachlor	76-44-8	C	--	1.4E+02	6.4E+02	4.2E+01	NT			
Heptachlor epoxide	1024-57-3	C	--	7.0E+01	3.1E+02	1.2E+00	NT			
Methoxychlor	72-43-5	N	--	3.9E+04	5.1E+05	1.5E+04	NT			
Aroclor 1254 [7]	11097-69-1	C	--	1.6E+02	1.4E+03	5.4E+01	NT			
Aroclor 1260	11096-82-5	C	--	3.2E+02	1.4E+03	--	NT			
TCL SVOCs (µg/kg)										
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+04	2.0E+05	2.9E+01	NT			
2,6-Dinitrotoluene	606-20-2	N	--	7.8E+03	1.0E+05	1.2E+01	NT			
Dinitrotoluene Mix	--	--	--	9.4E+02	2.4E+03	--	NT			
Acenaphthylene [8]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT			
Benzo(g,h,i)perylene [8]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT			
Bis(2-ethylhexyl)phthalate	117-81-7	C	--	4.6E+04	2.0E+05	1.4E+05	NT			
Carbazole	86-74-8	C	--	3.2E+04	1.4E+05	2.3E+01	NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT			
Di-n-butylphthalate	84-74-2	N	--	7.8E+05	1.0E+07	2.5E+05	NT			
Di-n-octylphthalate	117-84-0	--	--	--	--	--	NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT			
Diethylphthalate	84-66-2	N	--	6.3E+06	8.2E+07	2.3E+04	NT			
Dimethylphthalate	131-11-3	--	--	--	--	--	NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT			
N-Nitrosodiphenylamine	86-30-6	C	--	1.3E+05	5.8E+05	3.8E+01	NT			
Phenanthrene [8]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT			
SVOC TICs (µg/kg)										
(7r,8s)-cis-anti-cis-7,8-epoxytricyclo[7	73285-35-5	--	--	--	--	--	NT			
.Gamma.-sitosterol	83-47-6	--	--	--	--	--	NT			
1,2-Benzenedicarboxylic acid, diisononyl	28553-12-0	--	--	--	--	--	NT			
1,4-Methanoazulene, decahydro-4,8,8-trim	475-20-7	--	--	--	--	--	NT			
1-Dotriacontanol	6624-79-9	--	--	--	--	--	NT			
1-Heptadecanol	1454-85-9	--	--	--	--	--	NT			
1-Nonadecanol	1454-84-8	--	--	--	--	--	NT			
16-Octadecenal	56554-87-1	--	--	--	--	--	NT			
17-Octadecenal	56554-86-0	--	--	--	--	--	NT			
Benz[e]acephenanthrylene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT			
Benzenamine, 2-Nitro-n-phenyl-	119-75-5	--	--	--	--	--	NT			
Benzene, 2-Methyl-1,3,5-Trinitro-	118-96-7	N	--	3.9E+03	5.1E+04	--	NT			

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							Result	LQ, VQ, r		
Benzo[b]naphtho[2,3-d]furan	243-42-5	--	--	--	--	--	NT			
Camphene	79-92-5	--	--	--	--	--	NT			
Cholesterol	57-88-5	--	--	--	--	--	NT			
Formic acid, propyl ester	110-74-7	--	--	--	--	--	NT			
Pentadecanal-	24055	--	--	--	--	--	NT			
Testosterone	58-22-0	--	--	--	--	--	NT			
Tridecanoic Acid	638-53-9	--	--	--	--	--	NT			
Dioxin/Furans (pg/g)										
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	--	64		0.934	0.934
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	--	<0.934	U	0.934	0.934
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	--	1.51	A	0.467	0.467
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	--	0.164	A,J,w	0.467	0.467
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	--	<0.467	U	0.467	0.467
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	--	<0.467	U	0.467	0.467
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	--	<0.467	U	0.467	0.467
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	--	<0.467	U	0.467	0.467
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	--	<0.467	U	0.467	0.467
1,2,3,7,8,9-HxCDD	19408-74-3	C	--	1.0E+02	4.6E+02	--	<0.467	U	0.467	0.467
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	--	<0.467	U	0.467	0.467
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	--	<0.467	U	0.467	0.467
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	--	<0.467	U	0.467	0.467
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	--	<0.467	U	0.467	0.467
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	--	<0.467	U	0.467	0.467
2,3,7,8-TCDD	1746-01-6	C	--	4.3E+00	1.9E+01	4.3E-01	<0.0958	U	0.0958	0.0958
2,3,7,8-TCDF	51207-31-9	--	--	--	--	--	<0.102	U	0.102	0.102
Total HpCDD	37871-00-4	--	--	--	--	--	5.32		0.467	0.467
Total HpCDF	38998-75-3	--	--	--	--	--	<0.467	U	0.467	0.467
Total HxCDD	34465-46-8	--	--	--	--	--	0.202		0.467	0.467
Total HxCDF	55684-94-1	--	--	--	--	--	<0.467	U	0.467	0.467
Total PeCDD	36088-22-9	--	--	--	--	--	<0.467	U	0.467	0.467
Total PeCDF	30402-15-4	--	--	--	--	--	0.0336	,B,z	0.467	0.467
Total TCDD	41903-57-5	--	--	--	--	--	<0.0958	U	0.0958	0.0958
Total TCDF	55722-27-5	--	--	--	--	--	0.0934		0.102	0.102
PAHs (µg/kg)										
Acenaphthene	83-32-9	N	--	4.7E+05	6.1E+06	5.2E+03	NT			
Acenaphthylene[B]	208-96-8	N	--	2.3E+05	3.1E+06	--	NT			
Anthracene	120-12-7	N	--	2.3E+06	3.1E+07	2.3E+04	NT			
Benzo(a)anthracene	56-55-3	C	--	2.2E+02	3.9E+03	2.4E+01	NT			
Benzo(a)pyrene	50-32-8	C	--	2.2E+01	3.9E+02	6.1E+00	NT			
Benzo(b)fluoranthene	205-99-2	C	--	2.2E+02	3.9E+03	7.4E+01	NT			
Benzo(g,h,i)perylene[B]	191-24-2	N	--	2.3E+05	3.1E+06	--	NT			
Benzo(k)fluoranthene	207-08-9	C	--	2.2E+03	3.9E+04	7.4E+02	NT			
Chrysene	218-01-9	C	--	2.2E+04	3.9E+05	2.4E+03	NT			
Dibenz(a,h)anthracene	53-70-3	C	--	2.2E+01	3.9E+02	2.3E+01	NT			
Fluoranthene	206-44-0	N	--	3.1E+05	4.1E+06	3.1E+05	NT			
Fluorene	86-73-7	N	--	3.1E+05	4.1E+06	6.8E+03	NT			
Indeno(1,2,3-cd)pyrene	193-39-5	C	--	2.2E+02	3.9E+03	2.1E+02	NT			
Naphthalene	91-20-3	N	--	1.6E+05	2.0E+06	7.7E+00	NT			
Phenanthrene[B]	85-01-8	N	--	2.3E+05	3.1E+06	--	NT			
Pyrene	129-00-0	N	--	2.3E+05	3.1E+06	3.4E+04	NT			
PCB Congeners (pg/g)										
8-DiCB	34883-43-7	--	--	--	--	--	NT			
18,30-TrCB	37680-65-2	--	--	--	--	--	NT			
20,28-TrCB	38444-84-7	--	--	--	--	--	NT			
31-TrCB	16606-02-3	--	--	--	--	--	NT			
37-TrCB	38444-90-5	--	--	--	--	--	NT			
44,47,65-TeCB	41464-39-5	--	--	--	--	--	NT			
49,69-TeCB	41464-40-8	--	--	--	--	--	NT			
52-TeCB	35693-99-3	--	--	--	--	--	NT			
56-TeCB	41464-43-1	--	--	--	--	--	NT			
60-TeCB	33025-41-1	--	--	--	--	--	NT			
61,70,74,76-TeCB	33284-53-6	--	--	--	--	--	NT			
66-TeCB	32598-10-0	--	--	--	--	--	NT			
77-TeCB	32598-13-3	--	--	--	--	--	NT			
81-TeCB	70362-50-4	--	--	--	--	--	NT			
86,87,97,108,119,125-PeCB	55312-69-1	--	--	--	--	--	NT			
90,101,113-PeCB	68194-07-0	--	--	--	--	--	NT			
95-PeCB	38379-99-6	--	--	--	--	--	NT			
99-PeCB	38380-01-7	--	--	--	--	--	NT			
105-PeCB	32598-14-4	--	--	--	--	--	NT			
114-PeCB	74472-37-0	--	--	--	--	--	NT			
118-PeCB	31508-00-6	--	--	--	--	--	NT			
123-PeCB	65510-44-3	--	--	--	--	--	NT			
126-PeCB	57465-28-8	--	--	--	--	--	NT			
128,166-HxCB	38380-07-3	--	--	--	--	--	NT			
129,138,163-HxCB	55215-18-4	--	--	--	--	--	NT			
132-HxCB	38380-05-1	--	--	--	--	--	NT			
135,151-HxCB	52744-13-5	--	--	--	--	--	NT			
146-HxCB	51908-16-8	--	--	--	--	--	NT			
153,168-HxCB	35065-27.1	--	--	--	--	--	NT			
156,157-HxCB	38380-08-4	--	--	--	--	--	NT			

Table 4-8
Summary of Detected Chemicals in Soil Analytical Samples at Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (ft bgs)	CAS #	C/N	Facility-Wide Background Point Estimate[(A)]	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 1)	54SB80C 1/9/2007 9-10 Result	54SB80C 1/9/2007 9-10 LQ, VQ, r	MDL	RL
158-HxCB	74472-42-7	--	--	--	--	--	NT			
167-HxCB	52663-72-6	--	--	--	--	--	NT			
170-HpCB	35065-30-6	--	--	--	--	--	NT			
177-HpCB	52663-70-4	--	--	--	--	--	NT			
180,193-HpCB	35065-29-3	--	--	--	--	--	NT			
183,185-HpCB	52663-69-1	--	--	--	--	--	NT			
187-HpCB	52663-68-0	--	--	--	--	--	NT			
189-HpCB	39635-31-9	--	--	--	--	--	NT			
194-OcCB	35694-08-7	--	--	--	--	--	NT			
195-OcCB	52663-78-2	--	--	--	--	--	NT			
196-OcCB	42740-50-1	--	--	--	--	--	NT			
201-OcCB	40186-71-8	--	--	--	--	--	NT			
203-OcCB	52663-76-0	--	--	--	--	--	NT			
206-NoCB	40186-72-9	--	--	--	--	--	NT			
209-DeCB	2051-24-3	--	--	--	--	--	NT			
Explosives (mg/kg)										
1,3,5-Trinitrobenzene	99-35-4	N	--	2.3E+02	3.1E+03	--	NT			
2,4,6-Trinitrotoluene[9]	118-96-7	N	--	3.9E+00	5.1E+01	--	NT			
2,4-Dinitrotoluene	121-14-2	N	--	1.6E+01	2.0E+02	2.9E-02	NT			
Dinitrotoluene Mix	--	--	--	9.4E-01	2.4E+00	--	NT			
2-Amino-4,6-Dinitrotoluene	35572-78-2	N	--	1.6E+01	2.0E+02	--	NT			
4-Amino-2,6-Dinitrotoluene	1946-51-0	N	--	1.6E+01	2.0E+02	--	NT			
Aminodinitrotoluenes	--	N	--	15.643	204.4	--	NT			
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	--	3.9E+02	5.1E+03	--	NT			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	C	--	5.8E+00	2.6E+01	--	NT			
Nitroglycerin (mg/kg)										
Nitroglycerin	55-63-0	N	--	7.8E-01	1.0E+01	--	NT			
Percent Solids (%)										
Percent Solids	--	--	--	--	--	--	NT			

Notes:

CAS = Chemical Abstracts Service
ft bgs = Feet Below Ground Surface
mg/kg = Milligram Per Kilogram
µg/kg = Microgram Per Kilogram
pg/g = Picogram Per Gram
TAL = Target Analyte List
TCL = Target Compound List
PCB = Polychlorinated Biphenyl
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Compound
PAH = Polynuclear Aromatic Hydrocarbon
TIC = Tentatively Identified Compound
MDL = Method Detection Limit
RL = Reporting Limit
NT = Not Tested
NR = Not Reported
NI = Not Identified
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code

(A) = Facility-Wide Background Point Estimate as Reported in the Facility-Wide Background Study Report (IT 2001a)
(B) = Re-sampled; Pesticides and PCBs analyzed January 2007.
(C) = Re-sampled; Pesticides, PCBs, and Dioxin/Furans analyzed January 2007.
(D) = Re-sampled; Dioxin/Furans analyzed January 2007
(E) = Re-sampled; PCBs and PCB Congeners analyzed January 2007.
(F) = Re-sampled; PCBs, PCB Congeners, and Dioxin/Furans analyzed January 2007.

[1] = Chromium VI RBC value was used
[2] = Lead criteria are Action Levels; see USEPA Region III guidance
[3] = Mercuric chloride soil RBC value used
[4] = Chlordane RBC value was used
[5] = Alpha-BHC RBC value was used
[6] = Endrin RBC value was used
[7] = Noncarcinogenic Residential RBC value for Aroclor 1254 was used for screening
[8] = Pyrene RBC value was used
[9] = Noncarcinogenic Residential and Industrial RBC values for 2,4,6-Trinitrotoluene were used for screening

RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
Adjusted RBCs = a Hazard Quotient (HQ) of 0.1 applied to non-carcinogens
C/N = Carcinogenic/Noncarcinogenic per EPA RBC Table (October 2007)
SSL DAF1 = Soil Screening Levels at a Dilution Attenuation Factor of 1

= Concentration Exceeds Adjusted Soil Residential RBC
= Concentration Exceeds Adjusted Soil Industrial RBC
underline = Concentration Exceeds Site Background Values
bold italic = Concentration Exceeds SSL DAF1

Laboratory Qualifiers

A	Amount detected is less than the Lower Calibration Limit.
B	Analyte found in associated blank as well as in the sample.
D	Discrepancies between the reported concentrations may be due to dilution of the sample or extract.
J	Estimated value.
E	Concentration exceeded the upper level of the calibration range of the instrument for that specific analysis. For TICs, compound not present in calibration standard, calculated using total peak areas ion chromatographs and response factor of
N	Presumptive evidence of a compound.
P	Greater than 40% difference for detected concentrations between the two GC or HPLC columns.
U	The compound was analyzed for but not detected. The reporting limit will be adjusted to reflect any dilution, and for soil, the percent moisture.

Validation Qualifiers

B	Not detected substantially above the level reported in laboratory or field blanks.
N	Tentative Identification. Consider present. Special methods may be needed to confirm its presence or absence in future sampling efforts.
J	Analyte present. Reported value may not be accurate or precise.
K	Analyte present. Reported value may be biased high. Actual value is expected to be lower.
L	Analyte present. Reported value may be biased low. Actual value is expected to be higher.
R	Unreliable result. Analyte may or may not be present in the sample. Supporting data necessary to confirm result.
U	Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
UJ	Not detected, quantitation limit may be inaccurate or imprecise.
UL	Not detected, quantitation limit is probably higher.

Reason Codes

GC/MS Organics

c	Calibration failure; poor (RRF) or unstable (%D) response
d	MS/MSD or LCS/LCSD RPD imprecision
i	Tuning Failure or poor mass spectrometer performance
l	MS/MSD recovery failure
q	Concentration exceeded the linear range
r	linearity (%RSD or r) failure in initial calibration
s	Surrogate failure
t	Tentatively identified Compound
w	Identification criteria failure
x	Field and/or equipment blank contamination
z	Method blank and/or storage blank contamination

Inorganics and Conventionals

f	Field duplicate imprecision
k	Laboratory duplicate imprecision
m	MS/MSD recovery failure
o	Calibration blank contamination
p	Preparation blank contamination
s	Serial dilution failure
w	Laboratory storage blank contamination
x	CRDL standard recovery failure

GC and HPLC Organics

c	Calibration failure; poor or unstable (%D) response
d	MS/MSD or LCS/LCSD RPD imprecision
g	Dual column confirmation imprecision
i	LCS recovery failure
l	MS/MSD recovery failure
q	linearity (%RSD or r) failure in initial calibration
r	Surrogate failure
s	No confirmation column
w	Field and/or equipment blank contamination
x	Trip blank contamination
z	Method blank and/or storage blank contamination

Note: 1. Source of Data Qualifier Codes: United States Environmental Protection Agency (USEPA) Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses, April 1993.
2. Source of Data Qualifier Codes: United States Environmental Protection Agency (USEPA) Region III Modifications to National Functional Guidelines for Organic Data Review Multimedia, Multi-Concentration (OLMO1.0-OLMO1.9), September 1994.

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Table 4-9
Area B - Summary of Risk Screening Results for Total Soil
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

	CAS #	Facility Background	Adjusted R-RBC	C/N	Adjusted I-RBC	C/N	SSL DAF1	Minimum Detected Concentration	Maximum Detected Concentration	# of Samples that Exceed Adj. R-RBC[A]	# of Samples that Exceed Adj. I-RBC[A]	# of Samples that Exceed SSL[A]	# of Detections	# of Samples
TAL Metals (mg/kg)														
Aluminum	7429-90-5	40,041	7,821	N	102,200	N	--	6,910	22,600	0	0	--	39	39
Antimony	7440-36-0	--	3.1	N	41	N	0.66	0.33	20.7	**1**	0	**1**	13	31
Arsenic	7440-38-2	15.8	0.426	C	1.9	C	0.0013	0.35	5.1	0	0	0	38	39
Barium	7440-39-3	209	1,564	N	20,440	N	301	50.4	245	0	0	0	39	39
Beryllium	7440-41-7	1.02	16	N	204	N	58	0.42	1.1	0	0	0	39	39
Cadmium	7440-43-9	0.69	3.9	N	51	N	2.7	0.05	0.74	0	0	0	4	39
Calcium	7440-70-2	--	--	--	--	--	--	313	33,900	--	--	--	39	39
Chromium[1]	7440-47-3	65.3	23	N	307	N	2.1	10.9	41.6	0	0	0	39	39
Cobalt	7440-48-4	72.3	--	--	--	--	--	4.5	12.2	--	--	--	39	39
Copper	7440-50-8	53.5	313	N	4,088	N	526	0.39	320	**1**	0	0	37	37
Iron	7439-89-6	50,962	5,475	N	71,540	N	--	11,600	35,100	0	0	--	39	39
Lead[2]	7439-92-1	26.8	400	--	750	--	--	4	3,610	**3**	**3**	--	39	39
Magnesium	7439-95-4	--	--	--	--	--	--	1,120	18,500	--	--	--	39	39
Manganese	7439-96-5	2,543	156	N	2,044	N	47.6	159	883.5	0	0	0	39	39
Mercury[3]	7439-97-6	0.13	2.3	--	30.7	--	--	0.018	0.8	0	0	--	33	39
Nickel	7440-02-0	63	156	N	2,044	N	--	7	21.6	0	0	--	39	39
Potassium	7440-09-7	--	--	--	--	--	--	627	2,910	--	--	--	39	39
Selenium	7782-49-2	--	39.1	N	511	N	0.95	0.52	2.6	0	0	**13**	39	39
Silver	7440-22-4	--	39.1	N	511	N	1.6	0.11	0.2	0	0	0	2	39
Sodium	7440-23-5	--	--	--	--	--	--	67.6	1,270	--	--	--	38	39
Vanadium	7440-62-2	108	7.8	N	102	N	36.5	18.8	58.9	0	0	0	39	39
Zinc	7440-66-6	202	2,346	N	30,660	N	681	26.5	762	0	0	**1**	39	39
TCL Pesticides/PCBs (µg/kg)														
4,4'-DDE	72-55-9	--	1,879	C	8,416	C	1,761	7.6	60	0	0	0	3	27
Aldrin	309-00-2	--	37.6	C	168	C	0.38	4.4	4.4	0	0	**1**	1	27
alpha-BHC	319-84-6	--	101	C	454	C	0.045	0.83	0.83	0	0	**1**	1	27
alpha-Chlordane[4]	5103-71-9	--	1,825	C	8,176	C	--	62	490	0	0	--	2	27
beta-BHC	319-85-7	--	355	C	1,590	C	0.16	3.5	3.5	0	0	**1**	1	27
delta-BHC[5]	319-86-8	--	101	C	454	C	--	1.2	6	0	0	--	2	27
Dieldrin	60-57-1	--	39.9	C	179	C	0.11	11	11	0	0	**1**	1	27
Endrin aldehyde[6]	7421-93-4	--	2,346	N	30,660	N	--	2.74	5.6	0	0	--	3	27
Endrin ketone[6]	53494-70-5	--	2,346	N	30,660	N	--	7.5	7.5	0	0	--	1	27
gamma-BHC (Lindane)	58-89-9	--	491	C	2,201	C	0.22	1.1	1.1	0	0	**1**	1	27
gamma-Chlordane[4]	5103-74-2	--	1,825	C	8,176	C	--	55	63	0	0	--	2	27
Heptachlor	76-44-8	--	142	C	636	C	42.1	1.3	2.8	0	0	0	2	27
Heptachlor epoxide	1024-57-3	--	70.2	C	314	C	1.23	2.6	530	**1**	**1**	**5**	5	27
Methoxychlor	72-43-5	--	39,107	N	511,000	N	15,252	3	3	0	0	0	1	27
Aroclor 1254[7]	11097-69-1	--	156	N	1,431	N	54.3	8.04	2,800	**4**	**2**	**5**	9	28
Aroclor 1260	11096-82-5	--	319	C	1,431	C	--	24	510	**2**	0	--	5	28
TCL SVOCs (µg/kg)														
Bis(2-ethylhexyl)phthalate	117-81-7	--	45,623	C	204,400	C	144,470	40	1,900	0	0	0	16	39
Carbazole	86-74-8	--	31,936	C	143,080	C	23.4	42	42	0	0	**1**	1	38
Di-n-butylphthalate	84-74-2	--	782,143	N	10,220,000	N	248,200	44	11,000	0	0	0	9	38
Di-n-octylphthalate	117-84-0	--	--	--	--	--	--	640	640	--	--	--	1	39
Diethylphthalate	84-66-2	--	6,257,143	N	81,760,000	N	22,659	36	96,000	0	0	**1**	13	38
Dimethylphthalate	131-11-3	--	--	--	--	--	--	84	1,900	--	--	--	4	38
N-Nitrosodiphenylamine	86-30-6	--	130,352	C	584,000	C	38	29	1,800	0	0	**6**	7	38
PAHs (µg/kg)														
Acenaphthene	83-32-9	--	469,286	N	6,132,000	N	5,242	26	20,000	0	0	**2**	10	39
Acenaphthylene[8]	208-96-8	--	234,643	N	3,066,000	N	--	16	340	0	0	--	3	39
Anthracene	120-12-7	--	2,346,429	N	30,660,000	N	23,280	7.2	26	0	0	0	3	39
Benzo(a)anthracene	56-55-3	--	220	C	3,920	C	24	5.6	55	0	0	**2**	7	39
Benzo(a)pyrene	50-32-8	--	22	C	392	C	6.1	5.8	74	**5**	0	**7**	8	39
Benzo(b)fluoranthene	205-99-2	--	220	C	3,920	C	73.8	5	100	0	0	**2**	12	39
Benzo(g,h,i)perylene[8]	191-24-2	--	234,643	N	3,066,000	N	--	6.5	84	0	0	--	5	39
Benzo(k)fluoranthene	207-08-9	--	2,200	C	39,200	C	738	6.7	140	0	0	0	7	39
Chrysene	218-01-9	--	22,000	C	392,000	C	2,389	9	61	0	0	0	7	39
Dibenz(a,h)anthracene	53-70-3	--	22	C	392	C	22.8	8.9	18	0	0	0	3	39
Fluoranthene	206-44-0	--	312,857	N	4,088,000	N	312,732	4.3	160	0	0	0	12	39
Fluorene	86-73-7	--	312,857	N	4,088,000	N	6,765	13	73	0	0	0	3	39

Table 4-9
Area B - Summary of Risk Screening Results for Total Soil
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

	CAS #	Facility Background	Adjusted R-RBC	C/N	Adjusted I-RBC	C/N	SSL DAF1	Minimum Detected Concentration	Maximum Detected Concentration	# of Samples that Exceed Adj. R-RBC[A]	# of Samples that Exceed Adj. I-RBC[A]	# of Samples that Exceed SSL[A]	# of Detections	# of Samples
Indeno(1,2,3-cd)pyrene	193-39-5	--	220	C	3,920	C	208	5.1	100	0	0	0	6	39
Naphthalene	91-20-3	--	156,429	N	2,044,000	N	7.7	83.5	8,600	0	0	**10**	10	39
Phenanthrene[8]	85-01-8	--	234,643	N	3,066,000	N	--	12	94	0	0	**--**	5	39
Pyrene	129-00-0	--	234,643	N	3,066,000	N	34,100	7.575	160	0	0	0	19	39
Explosives (mg/kg)														
1,3,5-Trinitrobenzene	99-35-4	--	235	N	3,066	N	--	1.9	1.9	0	0	**--**	1	1
2,4,6-Trinitrotoluene[9]	118-96-7	--	3.9	N	51	N	--	0.45	80	**3**	**3**	**--**	4	39
2,4-Dinitrotoluene	121-14-2	--	15.6	N	204	N	0.029	0.38	160	**1**	0	**3**	3	39
DNT Mixture	--	--	0.94	--	4.2	--	--	0.38	160	**2**	**2**	**--**	3	39
2-Amino-4,6-Dinitrotoluene	355-72-78-2	--	15.6	N	204	N	--	9.6	35	**1**	0	**--**	2	39
4-Amino-2,6-Dinitrotoluene	1946-51-0	--	15.6	N	204	N	--	14	31	**1**	0	**--**	2	39
Aminodinitrotoluenes	--	--	15.6	--	204	--	--	23.6	66	**2**	0	**--**	2	39
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	--	391	N	5,110	N	--	110	110	0	0	**--**	1	39
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	--	5.8	C	26	C	--	8.2	8.2	**1**	0	**--**	1	39
Nitroglycerin (mg/kg)														
Nitroglycerin	55-63-0	--	0.78	N	10.2	N	--	95.025	400	**2**	**2**	**--**	2	39
Dioxin/Furans (pg/g)														
Total 2,3,7,8-TCDD TEQ[10]	--	--	4.3	C	19.1	C	8.6	0.007	183.2	**10**	**6**	**8**	51	51

Notes:

CAS = Chemical Abstract Service
mg/kg = Milligram per Kilogram
µg/kg = Microgram per kilogram
pg/g = Picogram per Gram
TAL = Target Analyte List
TCL = Target Compound List
PCB = Polychlorinated Biphenyl
SVOC = Semivolatile Organic Compound
PAH = Polynuclear Aromatic Hydrocarbon
DNT = Dinitrotoluene
Facility Background = Facility-Wide Background Point Estimate as Reported in the Facility-Wide Background Study Report (IT 2001a)
RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
Adjusted RBCs = a Hazard Quotient (HQ) of 0.1 applied to non-carcinogens
R-RBC = Adjusted Residential RBC
I-RBC = Adjusted Industrial RBC
C/N = Carcinogenic/Noncarcinogenic per EPA RBC Table (October 2007)
SSL DAF1 = Soil Screening Levels at a Dilution Attenuation Factor of 1

-- = No screening value available
[A] = For inorganics, number of samples that exceed background (if available) and screening level
[1] = Chromium VI RBC value was used
[2] = Lead criteria are Action Levels; see USEPA Region III guidance
[3] = Mercuric chloride soil RBC value used
[4] = Chlordane RBC value was used
[5] = Alpha-BHC RBC value was used
[6] = Endrin RBC value was used
[7] = Noncarcinogenic Residential RBC value for Aroclor 1254 was used for screening
[8] = Pyrene RBC value was used
[9] = Noncarcinogenic Residential and Industrial RBC values for 2,4,6-Trinitrotoluene were used for screening
[10] = See Table 6-3C for Total 2,3,7,8-TCDD TEQ Calculations

Table 4-10
Sample Assemblages Groundwater - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Area A			
Sampling Date	**Monitoring Wells Sampled**	**Sampled Analytes**	**Detected Analyte Classes Used in COPC Screening for HHRA**
March 2003	54MW4 (D), 54MW7 (D), and 54MW6 (U)	TAL metals and mercury (total and dissolved), TCL SVOCs, PAHs, explosives, nitroglycerin, and perchlorate	TCL SVOCs, PAHs, and TAL metals and mercury (total and dissolved)
November/ December 2006	54MW4 (D), 54MW7 (D), and 54MW6 (U)	Explosives, perchlorate, pesticides, PCBs, and dioxin/furans	None[1]
March 2007	54MW4 (D), 54MW7 (D), and 54MW6 (U)	Explosives and perchlorate	None[1]
June 2007	54MW4 (D), 54MW7 (D), and 54MW6 (U)	Explosives, perchlorate, and dioxin/furans	Explosives, perchlorate, and dioxin/furans[2]

Notes:
(U) = Upgradient Well
(D) = Downgradient Well
[1] = Most recent data for explosives, perchlorate, and dioxin/furans used for COPC screening
Data used in nature and extents assessment to demonstrate trends
[2] = Most recent data for explosives, perchlorate, and dioxin/furans used for COPC screening

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Table 4-11
Summary of Detected Chemicals in Groundwater Analytical Samples at Area B
March 2003
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	Units	54MW4 3/4/2003 Result	LQ, VQ, r	MDL	RL	54MW6 3/3/2003 Result	LQ, VQ, r	MDL	RL	54MW7 3/4/2003 Result	LQ, VQ, r	MDL	RL	54MW7-DUP(GW-DUP-1) 3/4/2003 Result	LQ, VQ, r	MDL	RL
TAL Metals																					
Aluminum	7429-90-5	N	3,650	--	ug/L	<100	U	29.5	100	145	B,x	29.5	100	295		29.5	100	150		29.5	100
Aluminum, Dissolved	7429-90-5	N	3,650	--	ug/L	<100	U	11.8	100	<100	U	11.8	100	15.8	B,K,w	11.8	100	14.7	B,K,w	11.8	100
Barium	7440-39-3	N	730	2,000	ug/L	16.3		0.2	10	74.4		0.2	10	70.4		0.2	10	57.1		0.2	10
Barium, Dissolved	7440-39-3	N	730	2,000	ug/L	15.8		0.2	10	70.5		0.2	10	55.3		0.2	10	55.4		0.2	10
Calcium	7440-70-2	--	--	--	ug/L	113,000		26.2	1,000	28,000		26.2	1,000	45,700		26.2	1,000	39,400		26.2	1,000
Calcium, Dissolved	7440-70-2	--	--	--	ug/L	112,000		7.9	1,000	27,500		7.9	1,000	40,300		7.9	1,000	40,300		7.9	1,000
Chromium [1]	7440-47-3	N	10.95	100	ug/L	1	B	0.7	5	3.5	B,B,x	0.7	5	7.1		0.7	5	3.7	B	0.7	5
Chromium, Dissolved [1]	7440-47-3	N	10.95	100	ug/L	<5	U	0.6	5	1.6	B	0.6	5	0.98	B	0.6	5	0.67	B	0.6	5
Copper	7440-50-8	N	146	1,300	ug/L	<5	U	1.2	5	1.5	B	1.2	5	1.4	B	1.2	5	<5	U	1.2	5
Iron	7439-89-6	N	2,555	--	ug/L	128		15	100	951		15	100	381		15	100	163		15	100
Lead, Dissolved [2]	7439-92-1	--	15	--	ug/L	<3	U	1.1	3	1.6	B,K,w	1.1	3	<3	U	1.1	3	1.2	B,K,w	1.1	3
Magnesium	7439-95-4	--	--	--	ug/L	51,800		7.4	1,000	13,600		7.4	1,000	14,800		7.4	1,000	12,300		7.4	1,000
Magnesium, Dissolved	7439-95-4	--	--	--	ug/L	50,000		5.3	1,000	12,100		5.3	1,000	11,600		5.3	1,000	11,700		5.3	1,000
Manganese	7439-96-5	N	73	--	ug/L	1.1	B,B,o	0.2	10	27		0.2	10	110		0.2	10	79.3		0.2	10
Manganese, Dissolved	7439-96-5	N	73	--	ug/L	0.87	B,B,o	0.2	10	6.8	B	0.2	10	71.2		0.2	10	72.9		0.2	10
Mercury, Dissolved [3]	7439-97-6	N	0.37	2	ug/L	<0.2	U	0.1	0.2	<0.2	U	0.1	0.2	0.13	B	0.1	0.2	<0.2	U	0.1	0.2
Nickel	7440-02-0	N	73	--	ug/L	<5	U	1.2	5	3.2	B	1.2	5	5.7		1.2	5	3.6	B	1.2	5
Nickel, Dissolved	7440-02-0	N	73	--	ug/L	1.8	B,B,x	1	5	2.4	B,B,x	1	5	2.4	B,B,x	1	5	1.8	B,B,x	1	5
Potassium	7440-09-7	--	--	--	ug/L	1,730	L,w	30.6	1,000	1,180	L,w	30.6	1,000	426	B,L,w	30.6	1,000	357	B,L,w	30.6	1,000
Potassium, Dissolved	7440-09-7	--	--	--	ug/L	2,840		68.4	1,000	1,990	K,w	68.4	1,000	627	B,B,o	68.4	1,000	617	B,B,o	68.4	1,000
Selenium	7782-49-2	N	18.25	50	ug/L	3	BN,B,p	2.1	5	4.4	BN,B,p	2.1	5	2.6	BN,B,p	2.1	5	3.1	BN,B,p	2.1	5
Selenium, Dissolved	7782-49-2	N	18.25	50	ug/L	3.8	B,B,o	2.6	5	<5	U	2.6	5	4	B,B,o	2.6	5	4.3	B,B,o	2.6	5
Sodium	7440-23-5	--	--	--	ug/L	4,290		235	2,000	2,830		235	2,000	8,480		235	2,000	8,700		235	2,000
Sodium, Dissolved	7440-23-5	--	--	--	ug/L	2,760	E,L,w	99.3	2,000	1,730	BE,L,w	99.3	2,000	7,100	E,J,s	99.3	2,000	7,190	E,J,s	99.3	2,000
Vanadium	7440-62-2	N	3.65	--	ug/L	<20	U	0.7	20	0.72	B	0.7	20	1.2	B	0.7	20	0.78	B	0.7	20
Vanadium, Dissolved	7440-62-2	N	3.65	--	ug/L	<20	U	0.4	20	0.49	B	0.4	20	0.48	B	0.4	20	0.77	B	0.4	20
Zinc	7440-66-6	N	1,095	--	ug/L	7.3	B,L,w	0.6	20	<20	U,UL,w	0.6	20	3.7	B,L,w	0.6	20	1.4	B,L,w	0.6	20
Zinc, Dissolved	7440-66-6	N	1,095	--		7	B,B,p	1	20	3.4	B,B,p	1	20	9.2	B	1	20	11.6	B	1	20
TCL SVOCs																					
Bis(2-ethylhexyl)phthalate	117-81-7	C	4.78	6	ug/L	2	J	1	10	<10	U	1	10	<10	U	1	10	<10	U	1	10
Explosives (ug/L)																					
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	N	182.5	--	ug/L	<7.2	U	0.96	7.2	<5.6	U	0.75	5.6	4.7	JP,J,g	0.644	4.8	<6.4	U	0.859	6.4
Field Parameters																					
Dissolved Oxygen	--	--	--	--	mg/L	1.77				7.10				4.23				4.23			
Oxidation Reduction Potential	--	--	--	--	mV	0.8				85.5				131.1				131.1			
pH	--	--	--	--	SU	7.18				7.55				6.94				6.94			
Conductivity	--	--	--	--	mS	0.362				0.170				0.291				0.291			
Temperature	--	--	--	--	°C	14.53				17.52				13.17				13.17			
Turbidity	--	--	--	--	NTU	3.18				19.9				1.98				1.98			

Notes:

CAS = Chemical Abstracts Service
µg/L = Microgram Per Liter
MDL = Method Detection Limit
RL = Reporting Limit
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code
RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
C = Carcinogenic per EPA RBC Table (October 2007)
N = Noncarcinogenic per EPA RBC Table (October 2007)
MCL = Maximum Contaminant Level

mV = millivolt
SU = Standard Units
mS = miliSiemen
°C = degrees Celcius
NTU = Nephelometric Turbidity

=Exceeds Adjusted T-RBC
=Exceeds MCL

Data Qualifiers:
B = Not detected substantially above the level reported in laboratory or field blanks.
E = Concentration exceeded the upper level of the calibration range of the instrument for that specific analysis. For TICs, compound not present in calibration standard, calculated using total peak areas ion chromatographs and response factor of 1.
J = Analyte present. Reported value may not be accurate or precise.
K = Analyte present. Reported value may be biased high. Actual value is expected to be lower
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher
N = Sample spike recovery is outside of control limits.
U = Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation limit may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
g = Dual column confirmation imprecision
l = LCS recovery failure
m = MS/MSD recovery failure.
o = Calibration blank contamination
p = Preparation blank contamination
s = Serial dilution failure
w = Field and/or equipment blank contamination
x = Trip blank contamination
z = Method blank and/or storage blank contamination

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Table 4-12
Area B Quarterly Groundwater Monitoring Results Summary
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

First Quarter - November/December 2006

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	54MW4 11/30/2006		MDL	RL	54MW6 11/29/2006		MDL	RL	54MW7 12/5/2006		MDL	RL
					Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Explosives (ug/L)																
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
1,3-Dinitrobenzene	99-65-0	N	0.37	--	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5
2,4-Dinitrotoluene	121-14-2	N	7.3	--	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5
2,6-Dinitrotoluene	606-20-2	N	3.65	--	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5
Dinitrotoluene Mixture	--	C	0.098	--	<5				<5				<5			
2-Nitrotoluene	88-72-2	N	6.08	--	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5
3-Nitrotoluene	99-08-1	--	--	--	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5
Aminodinitrotoluenes	--	N	7.3	--	ND				ND				ND			
4-Nitrotoluene	99-99-0	C	4.19	--	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
HMX	2691-41-0	N	182.5	--	<5	U	0.25	5	<5	U	0.25	5	0.66	J	0.25	5
Nitrobenzene	98-95-3	N	0.353	--	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5
RDX	121-82-4	C	0.609	--	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
Tetryl	479-45-8	N	14.6	--	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5
Dioxin/Furans (ng/L)																
Total 2,3,7,8-TCDD TEQ	--	C	4.47E-04	--	2.98E-03		--	--	1.09E-03		--	--	1.04E-04		--	--
Perchlorate (ug/L)																
Perchlorate	14797-73-0	N	2.56	24.5	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10
Field Parameters																
Dissolved Oxygen (mg/L)	--	--	--	--	9.9				11.63				10.46			
Oxidation Reduction Potential (mV)	--	--	--	--	-92				181				170			
pH (SU)	--	--	--	--	7.77				8				7.56			
Conductivity (mS)	--	--	--	--	1.13				0.297				0.729			
Temperature (°C)	--	--	--	--	15				16.6				15.9			
Turbidity (NTU)	--	--	--	--	2.66				4.87				5.91			

Second Quarter - March 2007

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	54MW-4 3/27/2007		MDL	RL	54MW-6 3/27/2007		MDL	RL	54MW-7 3/27/2007		MDL	RL
					Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Explosives (ug/L)																
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	<5	U	0.045	5	<5	U	0.045	5	<5	U	0.045	5
1,3-Dinitrobenzene	99-65-0	N	0.37	--	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	<5	U	0.1	5	<5	U	0.1	5	<5	U	0.1	5
2,4-Dinitrotoluene	121-14-2	N	7.3	--	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5
2,6-Dinitrotoluene	606-20-2	N	3.65	--	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
Dinitrotoluene Mixture	--	C	0.098	--	<5				<5				<5			
2-Nitrotoluene	88-72-2	N	6.08	--	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5
3-Nitrotoluene	99-08-1	--	--	--	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	<5	U	0.24	5	<5	U	0.24	5	<5	U	0.24	5
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5
Aminodinitrotoluenes	--	N	7.3	--	ND				ND				ND			
4-Nitrotoluene	99-99-0	C	4.19	--	<5	U	0.49	5	<5	U	0.49	5	<5	U	0.49	5
HMX	2691-41-0	N	182.5	--	<5	U,UJ,l	0.2	5	<5	U,UJ,l	0.2	5	1.2	J,J,l	0.2	5
Nitrobenzene	98-95-3	N	0.353	--	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
RDX	121-82-4	C	0.609	--	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5
Tetryl	479-45-8	N	14.6	--	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
Perchlorate (ug/L)																
Perchlorate	14797-73-0	N	2.56	24.5	<0.2	U	0.036	0.2	<0.2	U	0.036	0.2	<0.2	U	0.036	0.2
Field Parameters																
Dissolved Oxygen (mg/L)	--	--	--	--	5.97				8.8				6			
Oxidation Reduction Potential (mV)	--	--	--	--	-95				135				-44			
pH (SU)	--	--	--	--	7.16				8.21				7			
Conductivity (mS)	--	--	--	--	1.11				0.314				0.323			
Temperature (°C)	--	--	--	--	15.68				17.77				14.25			
Turbidity (NTU)	--	--	--	--	1.54				31.1				6.59			

Table 4-12
Area B Quarterly Groundwater Monitoring Results Summary
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Third Quarter - June 2007

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	54MW4 DUP AVG 6/5/2007		MDL	RL	54MW-6 6/5/2007		MDL	RL	54MW-7 6/5/2007		MDL	RL
					Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Explosives (ug/L)																
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	0.09125	J	0.045	5	<5	U	0.045	5	<5	U	0.045	5
1,3-Dinitrobenzene	99-65-0	N	0.37	--	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	<5	U	0.1	5	<5	U	0.1	5	<5	U	0.1	5
2,4-Dinitrotoluene	121-14-2	N	7.3	--	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5
2,6-Dinitrotoluene	606-20-2	N	3.65	--	<5	U,UJ,c	0.16	5	<5	U	0.16	5	<5	U,UJ,c	0.16	5
Dinitrotoluene Mixture	--	C	0.098	--	<5				<5				<5			
2-Nitrotoluene	88-72-2	N	6.08	--	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5
3-Nitrotoluene	99-08-1	--	--	--	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	<5	U	0.24	5	<5	U	0.24	5	<5	U	0.24	5
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5
Aminodinitrotoluenes	--	N	7.3	--	ND				ND				ND			
4-Nitrotoluene	99-99-0	C	4.19	--	<5	U	0.49	5	<5	U	0.49	5	<5	U	0.49	5
HMX	2691-41-0	N	182.5	--	<5	U	0.2	5	<5	U	0.2	5	3.2	J	0.2	5
Nitrobenzene	98-95-3	N	0.353	--	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
RDX	121-82-4	C	0.609	--	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5
Tetryl	479-45-8	N	14.6	--	<5	U,UJ,c	0.15	5	<5	U,UJ,c	0.15	5	<5	U,UJ,c	0.15	5
Dioxin/Furans (ng/L)																
Total 2,3,7,8-TCDD TEQ	--	C	4.47E-04	--	ND		--	--	ND		--	--	ND		--	--
Perchlorate (ug/L)																
Perchlorate	14797-73-0	N	2.56	24.5	<0.2	U	0.08	0.2	<0.2	U	0.08	0.2	<0.2	U	0.08	0.2
Field Parameters																
Dissolved Oxygen (mg/L)	--	--	--	--	5.15				4.5				7.72			
Oxidation Reduction Potential (mV)	--	--	--	--	91				76				225			
pH (SU)	--	--	--	--	6.39				6.03				6.97			
Conductivity (mS)	--	--	--	--	0.003				0.003				0.302			
Temperature (°C)	--	--	--	--	14.54				19.28				3.03			
Turbidity (NTU)	--	--	--	--	0.67				9.96				0.71			

Fourth Quarter - September 2007

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	54MW4 9/19/2007		MDL	RL	54MW6 9/19/2007		MDL	RL	54MW7 DUP AVG 9/19/2007		MDL	RL
					Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Explosives (ug/L)																
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	<5	U	0.045	5	<5	U	0.045	5	<5	U	0.045	5
1,3-Dinitrobenzene	99-65-0	N	0.37	--	<5	U	0.071	5	<5	U	0.071	5	<5	U	0.071	5
2,4,6-Trinitrotoluene	118-96-7	N	1.83	--	<5	U	0.1	5	<5	U	0.1	5	<5	U	0.1	5
2,4-Dinitrotoluene	121-14-2	N	7.3	--	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5
2,6-Dinitrotoluene	606-20-2	N	3.65	--	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
Dinitrotoluene Mixture	--	C	0.098	--	ND				ND				ND			
2-Nitrotoluene	88-72-2	N	6.08	--	<5	U	0.28	5	<5	U	0.28	5	<5	U	0.28	5
3-Nitrotoluene	99-08-1	--	--	--	<5	U	0.17	5	<5	U	0.17	5	<5	U	0.17	5
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	--	<5	U	0.24	5	<5	U	0.24	5	<5	U	0.24	5
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5
Aminodinitrotoluenes	--	N	7.3	--	ND				ND				ND			
4-Nitrotoluene	99-99-0	C	4.19	--	<5	U	0.49	5	<5	U	0.49	5	<5	U	0.49	5
HMX	2691-41-0	N	182.5	--	<5	U	0.2	5	<5	U	0.2	5	2.45	J,J,g	0.2	5
Nitrobenzene	98-95-3	N	0.353	--	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
RDX	121-82-4	C	0.609	--	<5	U	0.092	5	<5	U	0.092	5	<5	U	0.092	5
Tetryl	479-45-8	N	14.6	--	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
Perchlorate (ug/L)																
Perchlorate	14797-73-0	N	2.56	24.5	<0.2	U	0.08	0.2	0.1	J	0.08	0.2	<0.2	U	0.08	0.2
Field Parameters																
Dissolved Oxygen (mg/L)	--	--	--	--	4.03				7.47				4.56			
Oxidation Reduction Potential (mV)	--	--	--	--	-1				236				266			
pH (SU)	--	--	--	--	7.91				8.13				6.97			
Conductivity (mS)	--	--	--	--	1.1				0.267				0.766			
Temperature (°C)	--	--	--	--	16.08				16.69				16.83			
Turbidity (NTU)	--	--	--	--	0.43				4.37				0.39			

Notes:

CAS = Chemical Abstracts Service
ug/L = Microgram Per Liter
ng/L = Nanogram Per Liter
MDL = Method Detection Limit
RL = Reporting Limit
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code

mV = millivolt
SU = Standard Units
mS = milliSiemen
°C = degrees Celcius
NTU = Nephelometric Turbidity

Data Qualifiers:
J = Analyte present. Reported value may not be accurate or precise.
U = Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
c = Calibration failure
g = Dual column confirmation imprecision
l = LCS recovery failure
m = MS/MSD recovery failure.

RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
C/N = Carcinogenic/Noncarcinogenic per RBC Table (Oct 2007)
MCL = Maximum Contaminant Level

=Exceeds Adjusted T-RBC

=Exceeds MCL

See Table 6-3D (December 2006) and Table 6-3E (June 2007) for Total 2,3,7,8-TCDD TEQ Calculation

Table 4-13
Area B - Summary of Risk Screening Results for Groundwater
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

	CAS #	Adjusted T-RBC	C/N	MCL	Minimum Detected Concentration	Maximum Detected Concentration	# Samples that Exceed Adj. T-RBC	# Samples that Exceed MCL	# of Detections	# of Samples
TAL Metals (ug/L)										
Aluminum	7429-90-5	3,650	N	--	145	222.5	0	--	2	3
Aluminum, Dissolved	7429-90-5	3,650	N	--	15.25	15.25	0	--	1	3
Barium	7440-39-3	730	N	2,000	16.3	74.4	0	0	3	3
Barium, Dissolved	7440-39-3	730	N	2,000	15.8	70.5	0	0	3	3
Calcium	7440-70-2	--	--	--	28,000	113,000	--	--	3	3
Calcium, Dissolved	7440-70-2	--	--	--	27,500	112,000	--	--	3	3
Chromium [1]	7440-47-3	10.95	N	100	1	5.4	0	0	3	3
Chromium, Dissolved [1]	7440-47-3	10.95	N	100	0.825	1.6	0	0	2	3
Copper	7440-50-8	146	N	1,300	1	1.5	0	0	2	3
Iron	7439-89-6	2,555	N	--	128	951	0	--	3	3
Lead, Dissolved	7439-92-1	15	--	--	0.875	1.6	0	--	2	3
Magnesium	7439-95-4	--	--	--	13,550	51,800	--	--	3	3
Magnesium, Dissolved	7439-95-4	--	--	--	11,650	50,000	--	--	3	3
Manganese	7439-96-5	73	N	--	1.1	94.65	**1**	--	3	3
Manganese, Dissolved	7439-96-5	73	N	--	0.87	72.05	0	--	3	3
Mercury, Dissolved	7439-97-6	0.37	N	2	0.09	0.09	0	0	1	3
Nickel	7440-02-0	73	N	--	3.2	4.65	0	--	2	3
Nickel, Dissolved	7440-02-0	73	N	--	1.8	2.4	0	--	3	3
Potassium	7440-09-7	--	--	--	391.5	1,730	--	--	3	3
Potassium, Dissolved	7440-09-7	--	--	--	622	2,840	--	--	3	3
Selenium	7782-49-2	18.25	N	50	2.85	4.4	0	0	3	3
Selenium, Dissolved	7782-49-2	18.25	N	50	3.8	4.15	0	0	2	3
Sodium	7440-23-5	--	--	--	2,830	8,590	--	--	3	3
Sodium, Dissolved	7440-23-5	--	--	--	1,730	7,145	--	--	3	3
Vanadium	7440-62-2	3.65	N	--	0.72	0.99	0	--	2	3
Vanadium, Dissolved	7440-62-2	3.65	N	--	0.49	0.625	0	--	2	3
Zinc	7440-66-6	1,095	N	--	2.55	7.3	0	--	2	3
Zinc, Dissolved	7440-66-6	1,095	N	--	3.4	10.4	0	--	3	3
TCL SVOCs (ug/L)										
Bis(2-ethylhexyl)phthalate	117-81-7	4.78	C	6	2	2	0	0	1	3
Explosives (ug/L)										
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5	2691-41-0	183	N	--	2.45	2.45	0	--	1	3
Perchlorate (ug/L)										
Perchlorate	14797-73-0	2.56	N	24.5	0.1	0.1	0	0	1	3
Dioxin/Furans (ng/L)										
Total 2,3,7,8-TCDD TEQ[2]	--	4.46E-04	C	0.03	ND	ND	0	0	0	0

Notes:

CAS = Chemical Abstract Service
TAL = Target Analyte List
ug/L = Microgram Per Liter
ng/L = Nanogram Per Liter
RBC = USEPA Region III Risk-Based Concentration
(RBC) values from the October 11, 2007,
RBC Table and October 11, 2007, Alternate RBC Table

Adjusted RBCs = a Hazard Quotient (HQ) of 0.1 applied to non-carcinogens
T-RBC = Adjusted Tap Water RBC
C/N = Carcinogenic/Noncarcinogenic per EPA RBC Table (October 2007)
MCL = Maximum Contaminant Level
ND = Not Detected
[1] = Chromium VI RBC value was used
[2] = See Table 6-3E for Results and Calculation of Total 2,3,7,8-TCDD TEQ

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Table 4-14
New River Surface Water and Sediment Pore Water Sample Results
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Surface Water

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	BTAG	NR-SW-1 11/30/2006		MDL	RL	NR-SW-2 11/30/2006		MDL	RL	NR-SW-3 11/30/2006		MDL	RL	NR-SW-4 11/30/2006		MDL	RL	NR-SW-5 11/30/2006		MDL	RL	NR-SW-6 11/30/2006		MDL	RL
					Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Explosives (ug/L)																												
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
1,3-Dinitrobenzene	99-65-0	N	0.365	--	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5
2,4,6-Trinitrotoluene	118-96-7	C	1.83	100	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5
2,4-Dinitrotoluene	121-14-2	N	7.3	44	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5
2,6-Dinitrotoluene	606-20-2	N	3.65	81	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	1,480	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5
2-Nitrotoluene	88-72-2	N	6.083	--	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5
3-Nitrotoluene	99-08-1	--	--	750	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5
4-Nitrotoluene	99-99-0	C	4.19	1,900	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
HMX	2691-41-0	N	182.5	150	<5	U	0.25	5	<5	U	0.25	5	<5	U	0.25	5	<5	U	0.25	5	<5	U	0.25	5	<5	U	0.25	5
Nitrobenzene	98-95-3	N	0.353	--	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5
RDX	121-82-4	C	0.609	360	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
Tetryl	479-45-8	N	14.6	--	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5
Perchlorate (ug/L)																												
Perchlorate	14797-73-0	--	2.555	--	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10
Field Parameters																												
Dissolved Oxygen (mg/L)	--	--	--	--	17.05				15.83				14.64				12.93				14.83				15.11			
Oxidation Reduction Potential (mV)	--	--	--	--	219				118				47				53				32				35			
pH (SU)	--	--	--	--	8.9				8.1				7.96				7.81				7.67				8.3			
Conductivity (mS)	--	--	--	--	0.116				0.113				0.118				0.174				0.117				0.155			
Temperature (°C)	--	--	--	--	10.1				9.9				10.1				10.3				10.2				10.4			
Turbidity (NTU)	--	--	--	--	71.3				13.7				17.48				9.94				7.66				6.21			

Pore Water

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	BTAG	NR-PW-1 11/30/2006		MDL	RL	NR-PW-2 11/30/2006		MDL	RL	NR-PW-3 11/30/2006		MDL	RL	NR-PW-4 11/30/2006		MDL	RL	NR-PW-5 11/30/2006		MDL	RL	NR-PW-6 11/30/2006		MDL	RL
					Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Explosives (ug/L)																												
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
1,3-Dinitrobenzene	99-65-0	N	0.365	--	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5
2,4,6-Trinitrotoluene	118-96-7	C	1.83	100	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5
2,4-Dinitrotoluene	121-14-2	N	7.3	44	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5
2,6-Dinitrotoluene	606-20-2	N	3.65	81	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	1,480	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5
2-Nitrotoluene	88-72-2	N	6.083	--	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5
3-Nitrotoluene	99-08-1	--	--	750	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5
4-Nitrotoluene	99-99-0	C	4.19	1,900	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
HMX	2691-41-0	N	182.5	150	<5	U	0.25	5	<5	U	0.25	5	<5	U	0.25	5	<5	U	0.25	5	1.7	J	0.25	5	<5	U	0.25	5
Nitrobenzene	98-95-3	N	0.353	--	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5
RDX	121-82-4	C	0.609	360	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
Tetryl	479-45-8	N	14.6	--	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5
Perchlorate (ug/L)																												
Perchlorate	14797-73-0	--	2.555	--	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10
Field Parameters																												
Dissolved Oxygen (mg/L)	--	--	--	--	10.38				10.46				12.2				9.35				10.82				11.34			
Oxidation Reduction Potential (mV)	--	--	--	--	-109				-174				20				-182				-44				-58			
pH (SU)	--	--	--	--	7.33				7.21				7.47				7.57				7.44				7.2			
Conductivity (mS)	--	--	--	--	0.307				0.344				0.248				0.38				0.553				0.353			
Temperature (°C)	--	--	--	--	12.8				10.7				10.8				10.6				13.2				11.9			
Turbidity (NTU)	--	--	--	--	16.35				37.9				22.7				4.86				3.63				11.85			

Table 4-14
New River Surface Water and Sediment Pore Water Sample Results
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Surface Water

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	BTAG	NR-SW-7 12/1/2006		MDL	RL	NR-SW-8 12/1/2006		MDL	RL	NR-SW-8-DUP(DUP-4) 12/1/2006		MDL	RL	NR-SW-9 12/1/2006		MDL	RL	NR-SW-10 12/1/2006		MDL	RL
					Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Explosives (ug/L)																								
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
1,3-Dinitrobenzene	99-65-0	N	0.365	--	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5
2,4,6-Trinitrotoluene	118-96-7	C	1.83	100	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5
2,4-Dinitrotoluene	121-14-2	N	7.3	44	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5
2,6-Dinitrotoluene	606-20-2	N	3.65	81	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	1,480	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5
2-Nitrotoluene	88-72-2	N	6.083	--	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5
3-Nitrotoluene	99-08-1	--	--	750	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5
4-Nitrotoluene	99-99-0	C	4.19	1,900	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
HMX	2691-41-0	N	182.5	150	<5	U	0.25	5	<5	U	0.25	5	<5	U	0.25	5	<5	U	0.25	5	<5	U	0.25	5
Nitrobenzene	98-95-3	N	0.353	--	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5
RDX	121-82-4	C	0.609	360	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
Tetryl	479-45-8	N	14.6	--	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5
Perchlorate (ug/L)																								
Perchlorate	14797-73-0	--	2.555	--	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10
Field Parameters																								
Dissolved Oxygen (mg/L)	--	--	--	--	13.13				13.27				13.27				13.76				14.69			
Oxidation Reduction Potential (mV)	--	--	--	--	10				41				41				51				52			
pH (SU)	--	--	--	--	8.11				7.8				7.8				7.62				7.83			
Conductivity (mS)	--	--	--	--	0.140				0.124				0.124				0.131				0.114			
Temperature (°C)	--	--	--	--	11.7				12.5				12.5				11.8				11			
Turbidity (NTU)	--	--	--	--	148				13.8				13.8				20.5				11.46			

Pore Water

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	BTAG	NR-PW-6-DUP(DUP-3) 11/30/2006		MDL	RL	NR-PW-7 12/1/2006		MDL	RL	NR-PW-8 12/1/2006		MDL	RL	NR-PW-9 12/1/2006		MDL	RL	NR-PW-10 12/1/2006		MDL	RL
					Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Explosives (ug/L)																								
1,3,5-Trinitrobenzene	99-35-4	N	109.5	--	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
1,3-Dinitrobenzene	99-65-0	N	0.365	--	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5	<5	U	0.23	5
2,4,6-Trinitrotoluene	118-96-7	C	1.83	100	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5	<5	U	0.075	5
2,4-Dinitrotoluene	121-14-2	N	7.3	44	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5	<5	U	0.12	5
2,6-Dinitrotoluene	606-20-2	N	3.65	81	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5	<5	U	0.27	5
2-Amino-4,6-dinitrotoluene	35572-78-2	N	7.3	1,480	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5	<5	U	0.2	5
2-Nitrotoluene	88-72-2	N	6.083	--	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5	<5	U	0.26	5
3-Nitrotoluene	99-08-1	--	--	750	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5	<5	U	0.22	5
4-Amino-2,6-dinitrotoluene	1946-51-0	N	7.3	--	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5	<5	U	0.31	5
4-Nitrotoluene	99-99-0	C	4.19	1,900	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5	<5	U	0.15	5
HMX	2691-41-0	N	182.5	150	<5	U	0.25	5	<5	U	0.25	5	<5	U	0.25	5	<5	U	0.25	5	<5	U	0.25	5
Nitrobenzene	98-95-3	N	0.353	--	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5	<5	U	0.058	5
RDX	121-82-4	C	0.609	360	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5	<5	U	0.16	5
Tetryl	479-45-8	N	14.6	--	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5	<5	U	0.18	5
Perchlorate (ug/L)																								
Perchlorate	14797-73-0	--	2.555	--	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10	<10	U	1.84	10
Field Parameters																								
Dissolved Oxygen (mg/L)	--	--	--	--	11.34				9.25				9.74				10.55				10.18			
Oxidation Reduction Potential (mV)	--	--	--	--	-58				-194				-173				-173				-157			
pH (SU)	--	--	--	--	7.2				7.54				7.36				7.23				7.47			
Conductivity (mS)	--	--	--	--	0.353				0.517				0.660				0.533				0.479			
Temperature (°C)	--	--	--	--	11.9				13				12.9				13.2				13.1			
Turbidity (NTU)	--	--	--	--	11.85				3.72				5.6				15.87				1.66			

Notes:

CAS = Chemical Abstracts Service
mg/L = Milligram Per Liter
ug/L = Microgram Per Liter
MDL = Method Detection Limit
RL = Reporting Limit
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code

mV = millivolt
SU = Standard Units
mS = milliSiemen
°C = degrees Celcius
NTU = Nephelometric Turbidity

RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
C = Carcinogenic per EPA RBC Table (October 2007)
N = Noncarcinogenic per EPA RBC Table (October 2007)
BTAG = Biological Technical Assistance Group Water - BTAG Freshwater Screening Values, 2006a

=Exceeds Adjusted T-RBC
=Exceeds BTAG Screening Value

Data Qualifiers:
J = Analyte present. Reported value may not be accurate or precise
U = Not detected. The associated number indicates the approximate sample concentration necessary to be detected.

Table 4-15
New River Surface Water and Sediment Pore Water Sample Non-Detect MDL Screening
SMWU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Surface Water Parameter Name	CAS #	Units	Number of Non-Detects	Minimum MDL	Maximum MDL	BTAG Screening Value	Maximum MDL Exceeds SL	Adjusted T-RBC	Maximum MDL Exceeds SL
Explosives									
1,3,5-Trinitrobenzene	99-35-4	ug/L	11	0.16	0.16	--	NS	109.5	N
1,3-Dinitrobenzene	99-65-0	ug/L	11	0.23	0.23	--	NS	0.365	N
2,4,6-Trinitrotoluene	118-96-7	ug/L	11	0.075	0.075	100	N	1.83	N
Surface Water	121-14-2	ug/L	11	0.12	0.12	44	N	7.3	N
2,6-Dinitrotoluene	606-20-2	ug/L	11	0.27	0.27	81	N	3.65	N
2-Amino-4,6-dinitrotoluene	35572-78-2	ug/L	11	0.2	0.2	1,480	N	7.3	N
2-Nitrotoluene	88-72-2	ug/L	11	0.26	0.26	--	NS	6.08	N
3-Nitrotoluene	99-08-1	ug/L	11	0.22	0.22	750	N	--	NS
4-Amino-2,6-dinitrotoluene	1946-51-0	ug/L	11	0.31	0.31	--	NS	7.3	N
4-Nitrotoluene	99-99-0	ug/L	11	0.15	0.15	1,900	N	4.19	N
HMX	2691-41-0	ug/L	11	0.25	0.25	150	N	182.5	N
Nitrobenzene	98-95-3	ug/L	11	0.058	0.058	--	NS	0.353	N
RDX	121-82-4	ug/L	11	0.16	0.16	360	N	0.609	N
Tetryl	479-45-8	ug/L	11	0.18	0.18	--	NS	14.6	N
Perchlorate									
Perchlorate	14797-73-0	ug/L	11	1.84	1.84	--	NS	2.555	N

Pore Water Parameter Name	CAS #	Units	Number of Non-Detects	Minimum MDL	Maximum MDL	BTAG Screening Value	Maximum MDL Exceeds SL	Adjusted T-RBC	Maximum MDL Exceeds SL
Explosives									
1,3,5-Trinitrobenzene	99-35-4	ug/L	11	0.16	0.16	--	NS	109.5	N
1,3-Dinitrobenzene	99-65-0	ug/L	11	0.23	0.23	--	NS	0.365	N
2,4,6-Trinitrotoluene	118-96-7	ug/L	11	0.075	0.075	100	N	1.83	N
2,4-Dinitrotoluene	121-14-2	ug/L	11	0.12	0.12	44	N	7.3	N
2,6-Dinitrotoluene	606-20-2	ug/L	11	0.27	0.27	81	N	3.65	N
2-Amino-4,6-dinitrotoluene	35572-78-2	ug/L	11	0.2	0.2	1,480	N	7.3	N
2-Nitrotoluene	88-72-2	ug/L	11	0.26	0.26	--	NS	6.08	N
3-Nitrotoluene	99-08-1	ug/L	11	0.22	0.22	750	N	--	NS
4-Amino-2,6-dinitrotoluene	1946-51-0	ug/L	11	0.31	0.31	--	NS	7.3	N
4-Nitrotoluene	99-99-0	ug/L	11	0.15	0.15	1,900	N	4.19	N
HMX	2691-41-0	ug/L	10	0.25	0.25	150	N	182.5	N
Nitrobenzene	98-95-3	ug/L	11	0.058	0.058	--	NS	0.353	N
RDX	121-82-4	ug/L	11	0.16	0.16	360	N	0.609	N
Tetryl	479-45-8	ug/L	11	0.18	0.18	--	NS	14.6	N
Perchlorate									
Perchlorate	14797-73-0	ug/L	11	1.84	1.84	--	NS	2.555	N

Notes:

CAS = Chemical Abstracts Service
ug/L = Microgram Per Liter
MDL = Method Detection Limit
SL = Screening Level
NS = No Screening Level Available
N = Maximum MDL Does Not Exceed SL

RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
Adjusted T-RBC = a Hazard Quotient (HQ) of 0.1 applied to non-carcinogenic Tap Water RBCs
BTAG = Biological Technical Assistance Group Water - BTAG Freshwater Screening Values, 2004

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Table 4-16
Summary of Detected Chemicals in Sediment Analytical Samples
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (inches)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	BTAG Sediment Screening Level	NR-SED-1 11/8/2006 0-4		MDL	RL	NR-SED-2 11/8/2006 0-4		MDL	RL	NR-SED-3 11/8/2006 0-4		MDL	RL	NR-SED-3-DUP(DUP-3) 11/8/2006 0-4		MDL	RL	NR-SED-4 11/8/2006 0-4		MDL	RL	NR-SED-5 11/8/2006 0-4		MDL	RL
						Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																													
Aluminum	7429-90-5	N	7,821	102,200	--	9,800		1.6	10	5,300		1.6	10	8,200		1.6	10	11,000		1.6	10	30,000		1.6	10	17,000		790	5,000
Antimony	7440-36-0	N	3.13	40.88	2	0.26	,B,p	0.036	0.2	0.2	J,B,p	0.036	0.2	0.37	,B,p	0.036	0.2	0.33	,B,p	0.036	0.2	0.13	J,B,p	0.036	0.2	0.48	,B,p	0.036	0.2
Arsenic	7440-38-2	C	0.426	1.91	9.8	2.2	,J,s	0.023	0.1	1.6	,J,s	0.023	0.1	2.5	,J,s	0.023	0.1	2.6	,J,s	0.023	0.1	2.2	,J,s	0.023	0.1	6.1	,J,s	0.023	0.1
Barium	7440-39-3	N	1,564	20,440	--	94		0.1	1	62		0.1	1	110		0.1	1	130		0.1	1	240		0.1	1	540		1	10
Beryllium	7440-41-7	N	15.64	204.4	--	0.69	J	0.016	1	0.48	J	0.016	1	0.56	J	0.016	1	0.87	J	0.016	1	1.4		0.016	1	1.3		0.016	1
Cadmium	7440-43-9	N	3.91	51.1	0.99	1.2	J	0.5	2	0.71	J	0.5	2	1	J	0.5	2	1.5	J	0.5	2	1.4	J	0.5	2	1.3	J	0.5	2
Calcium	7440-70-2	--	--	--	--	1,500		10	50	910		10	50	1,100		10	50	1,500		10	50	4,700		10	50	3,100		10	50
Chromium	7440-47-3	N	23.46	306.6	43.4	23		0.57	5	15		0.57	5	21		0.57	5	24		0.57	5	44		0.57	5	20		0.57	5
Cobalt	7440-48-4	--	--	--	50	8.6		0.35	2	5.3		0.35	2	7.1		0.35	2	10		0.35	2	18		0.35	2	8.3		0.35	2
Copper	7440-50-8	N	312.9	4,088	31.6	15	,J,s	0.022	0.1	8.7	,J,s	0.022	0.1	23	,J,s	0.022	0.1	29	,J,s	0.022	0.1	25	,J,s	0.022	0.1	47	,J,s	0.11	0.5
Iron	7439-89-6	N	5,475	71,540	20,000	32,000	,J,s	4.6	100	28,000	,J,s	4.6	100	39,000	,J,s	4.6	100	39,000	,J,s	4.6	100	41,000	,J,s	4.6	100	39,000	,J,s	230	5,000
Lead	7439-92-1	--	400	750	35.8	91		0.21	1	77		0.083	0.4	160		0.21	1	160		0.21	1	43		0.041	0.2	88		0.21	1
Magnesium	7439-95-4	--	--	--	--	2,300		3.4	50	1,400		3.4	50	1,700		3.4	50	2,400		3.4	50	6,300		3.4	50	2,200		3.4	50
Manganese	7439-96-5	N	156.43	2,044	460	930		0.14	1	630		0.14	1	1,400		0.14	1	1,600		0.14	1	1,200		0.14	1	420		0.7	5
Mercury	7439-97-6	--	2.3	30.7	0.18	0.041	J	0.0077	0.05	0.025	J	0.0077	0.05	0.084		0.0077	0.05	0.13		0.0077	0.05	0.068		0.0077	0.05	0.43		0.0077	0.05
Nickel	7440-02-0	N	156.43	2,044	22.7	11	,J,s	0.027	0.1	7.9	,J,s	0.027	0.1	13	,J,s	0.027	0.1	13	,J,s	0.027	0.1	22	,J,s	0.027	0.1	13	,J,s	0.027	0.1
Potassium	7440-09-7	--	--	--	--	1,200		7.5	50	750		7.5	50	820		7.5	50	1,100		7.5	50	3,300		7.5	50	2,600		7.5	50
Selenium	7782-49-2	N	39.11	511	2	0.13	J	0.063	0.2	0.12	J	0.063	0.2	0.14	J	0.063	0.2	0.12	J	0.063	0.2	0.084	J	0.063	0.2	0.63	,L,m	0.063	0.2
Silver	7440-22-4	N	39.11	511	1	0.12		0.017	0.1	0.097	J	0.017	0.1	0.2		0.017	0.1	0.22		0.017	0.1	0.16		0.017	0.1	0.18		0.017	0.1
Sodium	7440-23-5	--	--	--	--	<100	U	19	100	<100	U	19	100	<100	U	19	100	<100	U	19	100	25	J	19	100	260		19	100
Thallium	7440-28-0	N	0.548	7.154	--	0.28		0.0085	0.1	0.22		0.0085	0.1	0.58		0.0085	0.1	0.68		0.0085	0.1	0.56		0.0085	0.1	0.55		0.0085	0.1
Vanadium	7440-62-2	N	7.821	102.2	--	22	,J,s	0.024	0.1	16	,J,s	0.024	0.1	22	,J,s	0.024	0.1	23	,J,s	0.024	0.1	45	,J,s	0.024	0.1	23	,J,s	0.024	0.1
Zinc	7440-66-6	N	2,346	30,660	121	400		0.85	5	300		0.85	5	420		0.85	5	590		0.85	5	180		0.85	5	250		4.3	25
Explosives (mg/kg)																													
2,4,6-Trinitrotoluene	118-96-7	N	3.9	51	0.092	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5
2,4-Dinitrotoluene	121-14-2	N	15.64	204.4	0.0416	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5

Table 4-16
Summary of Detected Chemicals in Sediment Analytical Samples
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (inches)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	BTAG Sediment Screening Level	NR-SED-6 11/8/2006 0-4		MDL	RL	NR-SED-7 11/8/2006 0-4		MDL	RL	NR-SED-8 11/8/2006 0-4		MDL	RL	NR-SED-9 11/8/2006 0-4		MDL	RL	NR-SED-9-DUP(DUP-2) 11/8/2006 0-4		MDL	RL	NR-SED-10 11/8/2006 0-4		MDL	RL
						Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																													
Aluminum	7429-90-5	N	7,821	102,200	--	13,000		1.6	10	11,000		1.6	10	6,600		1.6	10	7,900		1.6	10	7,600		1.6	10	22,000		1.6	10
Antimony	7440-36-0	N	3.13	40.88	2	0.19	J	0.036	0.2	0.13	J,B,p	0.036	0.2	0.16	J	0.036	0.2	1.1		0.036	0.2	1.7		0.036	0.2	0.66		0.036	0.2
Arsenic	7440-38-2	C	0.426	1.91	9.8	2.3	,J,s	0.023	0.1	2.1	,J,s	0.023	0.1	2	,J,s	0.023	0.1	1.9	,J,s	0.023	0.1	2.1	,J,s	0.023	0.1	2.5	,J,s	0.023	0.1
Barium	7440-39-3	N	1,564	20,440	--	180		0.1	1	120		0.1	1	81		0.1	1	100		0.1	1	110		0.1	1	180		0.1	1
Beryllium	7440-41-7	N	15.64	204.4	--	0.87	J	0.016	1	0.75	J	0.016	1	0.58	J	0.016	1	0.92	J	0.016	1	0.55	J	0.016	1	1.4		0.016	1
Cadmium	7440-43-9	N	3.91	51.1	0.99	1.4	J	0.5	2	1.3	J	0.5	2	0.74	J	0.5	2	1.6	J	0.5	2	1.3	J	0.5	2	2.8		0.5	2
Calcium	7440-70-2	--	--	--	--	3,000		10	50	3,200		10	50	4,700		10	50	1,600		10	50	1,700		10	50	1,600		10	50
Chromium	7440-47-3	N	23.46	306.6	43.4	26		0.57	5	23		0.57	5	17		0.57	5	18		0.57	5	16		0.57	5	35		0.57	5
Cobalt	7440-48-4	--	--	--	50	12		0.35	2	8.7		0.35	2	7.4		0.35	2	8.7		0.35	2	7.8		0.35	2	17		0.35	2
Copper	7440-50-8	N	312.9	4,088	31.6	20	,J,s	0.022	0.1	12	,J,s	0.022	0.1	13	,J,s	0.022	0.1	16	,J,s	0.022	0.1	21	,J,s	0.022	0.1	24	,J,s	0.022	0.1
Iron	7439-89-6	N	5,475	71,540	20,000	32,000	,J,s	0.46	10	35,000	,J,s	4.6	100	23,000	,J,s	0.46	10	79,000	,B,p	460	10,000	39,000	,J,s	0.46	10	43,000	,J,s	0.46	10
Lead	7439-92-1	--	400	750	35.8	90		0.21	1	100		0.21	1	47		0.041	0.2	170		0.21	1	210		0.21	1	280		0.41	2
Magnesium	7439-95-4	--	--	--	--	3,500		3.4	50	3,500		3.4	50	3,400		3.4	50	2,000		3.4	50	1,800		3.4	50	3,600		3.4	50
Manganese	7439-96-5	N	156.43	2,044	460	1,100		0.14	1	1,100		0.14	1	730		0.14	1	800		0.14	1	1,000		0.14	1	1,600		0.14	1
Mercury	7439-97-6	--	2.3	30.7	0.18	0.44		0.0077	0.05	0.061		0.0077	0.05	0.26		0.0077	0.05	0.041	J	0.0077	0.05	0.058		0.0077	0.05	0.11		0.0077	0.05
Nickel	7440-02-0	N	156.43	2,044	22.7	13	,J,s	0.027	0.1	12	,J,s	0.027	0.1	10	,J,s	0.027	0.1	10	,J,s	0.027	0.1	8.5	,J,s	0.027	0.1	17	,J,s	0.027	0.1
Potassium	7440-09-7	--	--	--	--	1,700		7.5	50	1,500		7.5	50	1,000		7.5	50	850		7.5	50	860		7.5	50	1,800		7.5	50
Selenium	7782-49-2	N	39.11	511	2	0.22		0.063	0.2	0.23		0.063	0.2	0.1	J	0.063	0.2	0.15	J	0.063	0.2	0.18	J	0.063	0.2	0.24		0.063	0.2
Silver	7440-22-4	N	39.11	511	1	0.16		0.017	0.1	0.13		0.017	0.1	0.098	J	0.017	0.1	0.11		0.017	0.1	0.1		0.017	0.1	0.16		0.017	0.1
Sodium	7440-23-5	--	--	--	--	69	J	19	100	<100	U	19	100	<100	U	19	100	<100	U	19	100	<100	U	19	100	<100	U	19	100
Thallium	7440-28-0	N	0.548	7.154	--	0.4		0.0085	0.1	0.44		0.0085	0.1	0.19		0.0085	0.1	0.46		0.0085	0.1	0.41		0.0085	0.1	0.6		0.0085	0.1
Vanadium	7440-62-2	N	7.821	102.2	--	23	,J,s	0.024	0.1	21	,J,s	0.024	0.1	15	,J,s	0.024	0.1	17	,J,s	0.024	0.1	17	,J,s	0.024	0.1	40	,J,s	0.024	0.1
Zinc	7440-66-6	N	2,346	30,660	121	350		0.85	5	460		0.85	5	270		0.85	5	550		0.85	5	540		0.85	5	800		0.85	5
Explosives (mg/kg)																													
2,4,6-Trinitrotoluene	118-96-7	N	3.9	51	0.092	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	0.38	J	0.051	2.5
2,4-Dinitrotoluene	121-14-2	N	15.64	204.4	0.0416	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	1.4	J	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5

Table 4-16
Summary of Detected Chemicals in Sediment Analytical Samples
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (inches)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	BTAG Sediment Screening Level	NR-SED-11 11/8/2006 0-4		MDL	RL	NR-SED-12 11/8/2006 0-4		MDL	RL	NR-SED-13 11/8/2006 0-4		MDL	RL	NR-SED-14 11/8/2006 0-4		MDL	RL	NR-SED-15 11/8/2006 0-4		MDL	RL	NR-SED-16 11/8/2006 0-4		MDL	RL
						Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																													
Aluminum	7429-90-5	N	7,821	102,200	--	11,000		1.6	10	7,200		1.6	10	9,300		1.6	10	7,200		160	1,000	12,000		1.6	10	21,000		1.6	10
Antimony	7440-36-0	N	3.13	40.88	2	0.55		0.036	0.2	0.4		0.036	0.2	0.6		0.036	0.2	0.11	J	0.036	0.2	0.2		0.036	0.2	0.32		0.036	0.2
Arsenic	7440-38-2	C	0.426	1.91	9.8	1.7	,J,s	0.023	0.1	1.6	,J,s	0.023	0.1	2	,J,s	0.023	0.1	1.6	,L,m	0.023	0.1	2.3	,J,s	0.023	0.1	4.3	,J,s	0.023	0.1
Barium	7440-39-3	N	1,564	20,440	--	120		0.1	1	72		0.1	1	91		0.1	1	75		0.1	1	140		0.1	1	220		0.1	1
Beryllium	7440-41-7	N	15.64	204.4	--	0.77	J	0.016	1	0.52	J	0.016	1	0.77	J	0.016	1	0.61	J	0.016	1	0.97	J	0.016	1	2.2		0.016	1
Cadmium	7440-43-9	N	3.91	51.1	0.99	1.2	J	0.5	2	1	J	0.5	2	1.1	J	0.5	2	0.95	J	0.5	2	1.6	J	0.5	2	3.6		0.5	2
Calcium	7440-70-2	--	--	--	--	2,400		10	50	1,600		10	50	2,200		10	50	1,500	,K,m	10	50	2,200		10	50	3,400		10	50
Chromium	7440-47-3	N	23.46	306.6	43.4	21		0.57	5	15		0.57	5	18		0.57	5	16		0.57	5	18		0.57	5	21		0.57	5
Cobalt	7440-48-4	--	--	--	50	9.5		0.35	2	6.2		0.35	2	8.4		0.35	2	5.5		0.35	2	10		0.35	2	16		0.35	2
Copper	7440-50-8	N	312.9	4,088	31.6	19	,J,s	0.022	0.1	12	,J,s	0.022	0.1	17	,J,s	0.022	0.1	8.6	,J,s	0.022	0.1	13	,J,s	0.022	0.1	20	,J,s	0.022	0.1
Iron	7439-89-6	N	5,475	71,540	20,000	29,000	,J,s	0.46	10	30,000	,J,s	0.46	10	28,000	,J,s	0.46	10	35,000	,B,p	230	5,000	41,000	,J,s	0.46	10	84,000	,B,p	460	10,000
Lead	7439-92-1	--	400	750	35.8	120		0.21	1	100		0.21	1	130		0.21	1	86	,L,m	0.21	1	190		0.21	1	500		0.83	4
Magnesium	7439-95-4	--	--	--	--	3,400		3.4	50	2,200		3.4	50	2,600		3.4	50	1,900	,K,m	3.4	50	3,100		3.4	50	2,900		3.4	50
Manganese	7439-96-5	N	156.43	2,044	460	900		0.14	1	640		0.14	1	470		0.14	1	330		0.7	5	1,500		0.14	1	4,400		0.14	1
Mercury	7439-97-6	--	2.3	30.7	0.18	0.065		0.0077	0.05	0.042	J	0.0077	0.05	0.056		0.0077	0.05	0.033	J	0.0077	0.05	0.048	J	0.0077	0.05	0.11		0.0077	0.05
Nickel	7440-02-0	N	156.43	2,044	22.7	12	,J,s	0.027	0.1	8.2	,J,s	0.027	0.1	11	,J,s	0.027	0.1	7.9	,J,s	0.027	0.1	12	,J,s	0.027	0.1	17	,J,s	0.027	0.1
Potassium	7440-09-7	--	--	--	--	1,600		7.5	50	1,000		7.5	50	1,200		7.5	50	870		7.5	50	1,400		7.5	50	1,400		7.5	50
Selenium	7782-49-2	N	39.11	511	2	0.25		0.063	0.2	0.18	J	0.063	0.2	0.41		0.063	0.2	0.16	J,L,m	0.063	0.2	0.2	J	0.063	0.2	0.45		0.063	0.2
Silver	7440-22-4	N	39.11	511	1	0.13		0.017	0.1	0.088	J	0.017	0.1	0.15		0.017	0.1	0.081	J	0.017	0.1	0.14		0.017	0.1	0.22		0.017	0.1
Sodium	7440-23-5	--	--	--	--	<100	U	19	100	<100	U	19	100	<100	U	19	100	<100	U	19	100	<100	U	19	100	<100	U	19	100
Thallium	7440-28-0	N	0.548	7.154	--	0.38		0.0085	0.1	0.23		0.0085	0.1	0.31		0.0085	0.1	0.27		0.0085	0.1	0.94		0.0085	0.1	2.3		0.0085	0.1
Vanadium	7440-62-2	N	7.821	102.2	--	21	,J,s	0.024	0.1	17	,J,s	0.024	0.1	20	,J,s	0.024	0.1	15	,J,s	0.024	0.1	21	,J,s	0.024	0.1	24	,J,s	0.024	0.1
Zinc	7440-66-6	N	2,346	30,660	121	390		0.85	5	390		0.85	5	400		0.85	5	340		4.3	25	750		0.85	5	1,700		0.85	5
Explosives (mg/kg)																													
2,4,6-Trinitrotoluene	118-96-7	N	3.9	51	0.092	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5
2,4-Dinitrotoluene	121-14-2	N	15.64	204.4	0.0416	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5

Table 4-16
Summary of Detected Chemicals in Sediment Analytical Samples
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (inches)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	BTAG Sediment Screening Level	NR-SED-17 11/8/2006 0-4		MDL	RL	NR-SED-17-DUP(DUP-1) 11/8/2006 0-4		MDL	RL	NR-SED-18 11/8/2006 0-4		MDL	RL	NR-SED-19 11/8/2006 0-4		MDL	RL	NR-SED-20 11/8/2006 0-4		MDL	RL	NR-SED-21 11/8/2006 0-4		MDL	RL
						Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
TAL Metals (mg/kg)																													
Aluminum	7429-90-5	N	7,821	102,200	--	11,000		1.6	10	9,400		1.6	10	10,000		1.6	10	4,500		1.6	10	7,300		1.6	10	18,000		1.6	10
Antimony	7440-36-0	N	3.13	40.88	2	0.47		0.036	0.2	0.45		0.036	0.2	0.21		0.036	0.2	0.18	J	0.036	0.2	0.19	J	0.036	0.2	0.26		0.036	0.2
Arsenic	7440-38-2	C	0.426	1.91	9.8	2.5	,J,s	0.023	0.1	2.3	,J,s	0.023	0.1	1.8	,J,s	0.023	0.1	1.7	,J,s	0.023	0.1	1.8	,J,s	0.023	0.1	4.4	,J,s	0.023	0.1
Barium	7440-39-3	N	1,564	20,440	--	110		0.1	1	110		0.1	1	110		0.1	1	44		0.1	1	84		0.1	1	180		0.1	1
Beryllium	7440-41-7	N	15.64	204.4	--	0.76	J	0.016	1	0.73	J	0.016	1	0.71	J	0.016	1	0.52	J	0.016	1	0.56	J	0.016	1	1.6		0.016	1
Cadmium	7440-43-9	N	3.91	51.1	0.99	1.2	J	0.5	2	1.2	J	0.5	2	1.2	J	0.5	2	0.86	J	0.5	2	1	J	0.5	2	2.5		0.5	2
Calcium	7440-70-2	--	--	--	--	2,600		10	50	2,400		10	50	2,900		10	50	1,000		10	50	2,100		10	50	11,000		10	50
Chromium	7440-47-3	N	23.46	306.6	43.4	17		0.57	5	19		0.57	5	24		0.57	5	13		0.57	5	14		0.57	5	20		0.57	5
Cobalt	7440-48-4	--	--	--	50	9.2		0.35	2	8.4		0.35	2	9.5		0.35	2	4.6		0.35	2	7.4		0.35	2	15		0.35	2
Copper	7440-50-8	N	312.9	4,088	31.6	19	,J,s	0.022	0.1	17	,J,s	0.022	0.1	13	,J,s	0.022	0.1	7.3	,J,s	0.022	0.1	11	,J,s	0.022	0.1	17	,J,s	0.022	0.1
Iron	7439-89-6	N	5,475	71,540	20,000	31,000	,J,s	0.46	10	32,000	,J,s	0.46	10	28,000	,J,s	0.46	10	29,000	,J,s	0.46	10	27,000	,J,s	0.46	10	74,000	,B,p	460	10,000
Lead	7439-92-1	--	400	750	35.8	110		0.21	1	110		0.21	1	82		0.083	0.4	96		0.21	1	94		0.21	1	320		0.41	2
Magnesium	7439-95-4	--	--	--	--	2,800		3.4	50	2,800		3.4	50	3,600		3.4	50	1,400		3.4	50	2,600		3.4	50	7,400		3.4	50
Manganese	7439-96-5	N	156.43	2,044	460	470		0.14	1	700		0.14	1	550		0.14	1	450		0.14	1	730		0.14	1	2,300		0.14	1
Mercury	7439-97-6	--	2.3	30.7	0.18	0.078		0.0077	0.05	0.063		0.0077	0.05	0.044	J	0.0077	0.05	0.024	J	0.0077	0.05	0.036	J	0.0077	0.05	0.079		0.0077	0.05
Nickel	7440-02-0	N	156.43	2,044	22.7	12	,J,s	0.027	0.1	11	,J,s	0.027	0.1	12	,J,s	0.027	0.1	6.7	,J,s	0.027	0.1	9.4	,J,s	0.027	0.1	19	,J,s	0.027	0.1
Potassium	7440-09-7	--	--	--	--	1,200		7.5	50	1,100		7.5	50	1,600		7.5	50	620		7.5	50	1,000		7.5	50	1,300		7.5	50
Selenium	7782-49-2	N	39.11	511	2	0.31		0.063	0.2	0.18	J	0.063	0.2	0.21		0.063	0.2	0.084	J	0.063	0.2	0.18	J	0.063	0.2	0.33		0.063	0.2
Silver	7440-22-4	N	39.11	511	1	0.13		0.017	0.1	0.12		0.017	0.1	0.1		0.017	0.1	0.067	J	0.017	0.1	0.11		0.017	0.1	0.2		0.017	0.1
Sodium	7440-23-5	--	--	--	--	<100	U	19	100	<100	U	19	100	<100	U	19	100	<100	U	19	100	<100	U	19	100	<100	U	19	100
Thallium	7440-28-0	N	0.548	7.154	--	0.37		0.0085	0.1	0.35		0.0085	0.1	0.36		0.0085	0.1	0.16		0.0085	0.1	0.25		0.0085	0.1	1.9		0.0085	0.1
Vanadium	7440-62-2	N	7.821	102.2	--	20	,J,s	0.024	0.1	20	,J,s	0.024	0.1	21	,J,s	0.024	0.1	14	,J,s	0.024	0.1	18	,J,s	0.024	0.1	23	,J,s	0.024	0.1
Zinc	7440-66-6	N	2,346	30,660	121	450		0.85	5	470		0.85	5	370		0.85	5	370		0.85	5	350		0.85	5	940		0.85	5
Explosives (mg/kg)																													
2,4,6-Trinitrotoluene	118-96-7	N	3.9	51	0.092	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5
2,4-Dinitrotoluene	121-14-2	N	15.64	204.4	0.0416	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5

Table 4-16
Summary of Detected Chemicals in Sediment Analytical Samples
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date / Sample Depth (inches)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	BTAG Sediment Screening Level	NR-SED-22 11/8/2006 0-4 Result	LQ, VQ, r	MDL	RL	NR-SED-23 11/8/2006 0-4 Result	LQ, VQ, r	MDL	RL
TAL Metals (mg/kg)													
Aluminum	7429-90-5	N	7,821	102,200	--	14,000		1.6	10	19,000		1.6	10
Antimony	7440-36-0	N	3.13	40.88	2	1.9		0.036	0.2	0.26		0.036	0.2
Arsenic	7440-38-2	C	0.426	1.91	9.8	3.4	,J,s	0.023	0.1	2.7	,J,s	0.023	0.1
Barium	7440-39-3	N	1,564	20,440	--	170		0.1	1	180		0.1	1
Beryllium	7440-41-7	N	15.64	204.4	--	1		0.016	1	1.2		0.016	1
Cadmium	7440-43-9	N	3.91	51.1	0.99	1.9	J	0.5	2	2.2		0.5	2
Calcium	7440-70-2	--	--	--	--	10,000		10	50	3,700		10	50
Chromium	7440-47-3	N	23.46	306.6	43.4	24		0.57	5	24		0.57	5
Cobalt	7440-48-4	--	--	--	50	13		0.35	2	15		0.35	2
Copper	7440-50-8	N	312.9	4,088	31.6	24	,J,s	0.022	0.1	20	,J,s	0.022	0.1
Iron	7439-89-6	N	5,475	71,540	20,000	39,000	,J,s	0.46	10	36,000	,J,s	0.46	10
Lead	7439-92-1	--	400	750	35.8	180		0.21	1	200		0.21	1
Magnesium	7439-95-4	--	--	--	--	7,600		3.4	50	4,400		3.4	50
Manganese	7439-96-5	N	156.43	2,044	460	1,900		0.14	1	1,200		0.14	1
Mercury	7439-97-6	--	2.3	30.7	0.18	0.16		0.0077	0.05	0.09		0.0077	0.05
Nickel	7440-02-0	N	156.43	2,044	22.7	16	,J,s	0.027	0.1	17	,J,s	0.027	0.1
Potassium	7440-09-7	--	--	--	--	1,400		7.5	50	1,600		7.5	50
Selenium	7782-49-2	N	39.11	511	2	0.38		0.063	0.2	0.29		0.063	0.2
Silver	7440-22-4	N	39.11	511	1	0.45		0.017	0.1	0.2		0.017	0.1
Sodium	7440-23-5	--	--	--	--	21	J	19	100	<100	U	19	100
Thallium	7440-28-0	N	0.548	7.154	--	0.44		0.0085	0.1	0.47		0.0085	0.1
Vanadium	7440-62-2	N	7.821	102.2	--	27	,J,s	0.024	0.1	26	,J,s	0.024	0.1
Zinc	7440-66-6	N	2,346	30,660	121	550		0.85	5	660		0.85	5
Explosives (mg/kg)													
2,4,6-Trinitrotoluene	118-96-7	N	3.9	51	0.092	<2.5	U	0.051	2.5	<2.5	U	0.051	2.5
2,4-Dinitrotoluene	121-14-2	N	15.64	204.4	0.0416	<2.5	U	0.073	2.5	<2.5	U	0.073	2.5

Notes:

CAS = Chemical Abstracts Service
ft bgs = Feet Below Ground Surface
mg/kg = Milligram Per Kilogram
TAL = Target Analyte List
TCL = Target Compound List
MDL = Method Detection Limit
RL = Reporting Limit
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code
(1) = Chromium VI RBC value was used
(2) = Lead criteria are Action Levels; see USEPA Region III guidance
(3) = Mercuric chloride soil RBC value used
[A] = Facility-Wide Background Point Estimate as Reported in the Facility-Wide Background Study Report (IT 2001a)
RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
Adjusted RBCs = a Hazard Quotient (HQ) of 0.1 applied to non-carcinogens
C/N = Carcinogenic per EPA RBC Table (October 2007)
BTAG = Biological Technical Assistance Group Sediment - BTAG Sediment Screening Values, 2004

= Concentration Exceeds Adjusted Soil Residential RBC
= Concentration Exceeds Adjusted Soil Industrial RBC
underline = Concentration Exceeds Facility-Wide Background Values
= Concentration Exceeds BTAG Screening Level

Laboratory Qualifiers

U The compound was analyzed for but not detected. The reporting limit will be adjusted to reflect any dilution, and for soil, the percent moisture.
J Estimated value.

Validation Qualifiers

B Not detected substantially above the level reported in laboratory or field blanks.
J Analyte present. Reported value may not be accurate or precise.
K Analyte present. Reported value may be biased high. Actual value is expected to be lower.
L Analyte present. Reported value may be biased low. Actual value is expected to be higher.
UJ Not detected, quantitation limit may be inaccurate or imprecise.

Reason Codes

Inorganics and Conventionals
m MS/MSD recovery failure
p Preparation blank contamination
s Serial dilution failure

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5.0 CONTAMINANT FATE AND TRANSPORT

This section discusses the fate and transport of site-related COPCs identified in the nature and extent assessment. Primary fate and transport mechanisms occurring at the site are discussed. The objective of the fate and transport analysis is to identify the primary mechanisms affecting the distribution and migration of COPCs and their ultimate fate. COPCs identified at the site are summarized in the following table.

Site COPCs for Nature and Extent Assessment

Soil – Human Health	Soil SSL DAF1	Soil Ecological	Groundwater
Lead	Aldrin	Lead	2,4,6-TNT
Heptachlor Epoxide	Alpha-BHC	2,3,7,8-TCDD TEQ	DNT Mixture
Aroclor 1254	Beta-BHC	2,4,6-TNT	RDX
Aroclor 1260	Dieldrin	2,4-DNT	Perchlorate
Benzo(a)anthracene	Gamma-BHC	Nitroglycerin	
Benzo(a)pyrene	Heptachlor Epoxide		
Benzo(b)fluoranthene	Aroclor 1254		
Dibenz(a,h)anthracene	Carbazole		
Indeno(1,2,3-cd)pyrene	Diethylphlalate		
2,4,6-TNT	N-nitrosodiphenylamine		
DNT Mixture	Benzo(a)anthracene		
Amino DNTs	Benzo(a)pyrene		
RDX	Benzo(b)fluoranthene		
Nitroglycerin	Benzo(k)fluoranthene		
2,3,7,8-TCDD TEQ	Dibenz(a,h)anthracene		
	Indeno(1,2,3-cd)pyrene		
	DNTs		
	2,3,7,8-TCDD TEQ		

The potential for transport of chemicals in environmental media is largely controlled by the physiochemical properties of the chemicals and the matrix through which they travel or migrate. Table 5-1a describes the physiochemical properties of chemicals that affect their fate in environmental media. Table 5-1b describes the fate processes affecting metals including: ion exchange, chemical speciation, and oxidation-reduction potential. Table 5-1c describes the fate processes affecting organic chemicals including: sorption, volatilization, hydrolysis, and abiotic and biotic degradation. Chemicals can be transported with little attenuation or retardation due to these fate processes or they can be delayed or transformed so that minimal migration occurs. The physical and chemical properties of organic COPCs detected in soil and/or groundwater are summarized in Table 5-2.

Primary fate and transport mechanisms for COPCs potentially present at the site include the following:

- Volatilization of chemicals from soil and groundwater;
- Erosion of particulate-bound chemicals from soil;
- Degradation of chemicals in soil and groundwater;
- Leaching of chemicals from soil with infiltrating water; and
- Transport of chemicals with groundwater flow.

Fate and transport processes for site media are discussed in the following sections.

5.1 FATE AND TRANSPORT - SOIL

Fate and transport processes for soil are discussed in the following sections including volatilization, erosion and mass transport, and degradation of chemicals in soil, and leaching of chemical from soil with infiltrating water.

5.1.1 Volatilization

Volatilization can significantly affect the distribution of a chemical in the environment. This process will result in the mass and concentration of a chemical in soil and/or groundwater as the chemical volatilizes to soil gas and ultimately discharges to the atmosphere. Volatilization reactions are most significant in surface soil that is in direct (or near-direct) contact with the atmosphere. These reactions may also occur in groundwater with VOCs. Chemical volatility is typically quantified by a chemical's Henry's constant, which may be calculated from the chemical's vapor pressure, molecular weight, and solubility. The lower the Henry's constant, the less volatile the chemical. Values of Henry's constant for soil COPCs are summarized in Table 5-2. As indicated in Table 5-2, COPCs at the site are characterized by low Henry's constants (i.e., < 0.01) and are not VOCs, and therefore, volatilization is not expected to be a significant influence on the fate of these compounds at the site.

5.1.2 Erosion Processes in Soil

Erosion processes can substantially affect the distribution of soil-bound particulates in the environment and thus influence the distribution of constituents in soil. High winds can scour fine particles from the soil surface and redistribute these particles downwind. Mass transport from surface water runoff during heavy precipitation events can also scour fine soil particles from surface soil, eventually depositing the particles during sedimentation downstream. These erosion processes often represent the primary mechanism for transport of otherwise immobile chemicals, such as lead and dioxins. Potential migration of COPCs at the site by wind erosion or mass transport are unlikely to be significant pathways given that the site areas are covered by heavy vegetation cover (field grass). Chemical sampling did not indicate evidence of transport of COPCs outside of identified disposal areas.

5.1.3 Degradation of Chemicals in Soil

Many organic chemicals that are found in the environment are subject to naturally occurring biotic (biologically based) and abiotic (non-biologically based) transformation reactions. These reactions result in degradation of the chemical. Biodegradation reactions can occur under aerobic (in the presence of oxygen) and anaerobic (in the absence of oxygen) conditions. During biodegradation, naturally occurring microorganisms in the subsurface transform a chemical to another state as a direct or indirect consequence of their metabolic processes. In many cases, biodegradation reactions break down organic chemicals to less toxic forms.

Several naturally occurring abiotic reactions can significantly affect the fate of chemicals in the environment. Common abiotic reactions include photodegradation and hydrolysis. Photodegradation is the process of decomposition of a chemical upon exposure to radiant energy such as the action of light, and is most significant to chemicals in surface soil that are in direct contact with sunlight. Hydrolysis is the degradation reaction of the chemical with components of water (e.g., hydroxyl and hydronium ions) and is therefore most important in saturated environments.

5.1.3.1 Lead

Lead will not be influenced by degradation processes in soil.

5.1.3.2 Explosives

Explosive compounds identified as COPCs in soil include: 2,4,6-TNT, DNT mixture (2,4-DNT and 2,6-DNT), 4ADNT, 2ADNT, RDX and nitroglycerin.

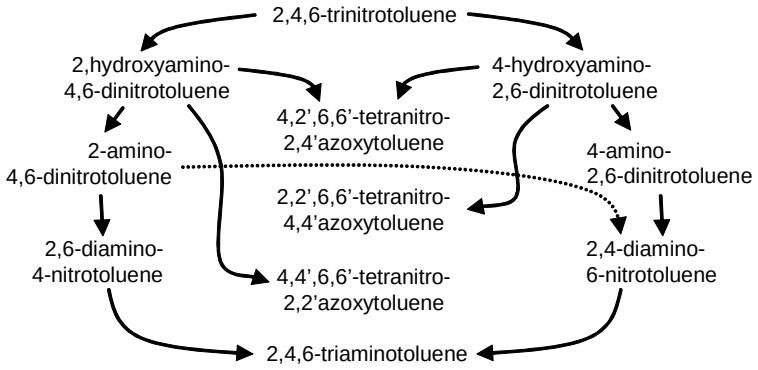
2,4,6-TNT transformation generally occurs by sequential reduction of nitro groups to amino groups. 2,4,6-TNT is readily reduced in soil under anaerobic conditions, with sequential microbial transformations producing 4ADNT and 2ADNT and other degradation by products. Recent studies indicate that 2,4,6-TNT can be degraded under aerobic conditions with production of amino DNT and other degradation byproducts. There is some data to suggest that 2,4,6-TNT in uppermost layers of surface soil may be photolyzed to trinitrobenzene and trinitrobenzaldehyde (HSDB 2007). The half lives of 2,4,6-TNT in soil have been reported as ranging from 4 to 10 years, with a microbial oxidative decomposition rate of 0.017 to 0.05 percent per day (Cataldo et al 1989). The following table provides data to evaluate the transformation of 2,4,6-TNT to 4ADNT and 2ADNT in soil at the site.

Comparison of 2,4,6 TNT and 4ADNT and 2ADNT Results

Sample	Location	Sample Results (mg/kg)		% Transformation to Amino DNTs
		2,4,6-TNT	Amino DNTs	
54SB3A	Area A	0.64	1.84	74%
54SB23B	Area A	15	1.77	12%
54SB25B	Area A	2.7	0.78	29%
54SB27A	Area A	130	10.9	8%
54SB30A	Area A	1.4	ND	<1%
54SB32A	Area A	3.1	1.86	60%
54SB32B	Area A	24	2.7	11%
54SB32C	Area A	0.23	ND	<1%
54SB34A	Area A	0.43	ND	<1%
Detected Concentration Range	Area A	0.23 – 130	0.78 – 10.9	--
54SB42A	Area B	0.45	ND	<1%
54SB46A	Area B	59	23.5	40%
54SB46B	Area B	68	66	97%
54SB49A	Area B	80	ND	<1%
Detected Concentration Range	Area B	0.45 – 80	23.6-66	--

The comparisons presented in the above table indicate that 2,4,6-TNT has undergone varying degrees of transformation to 4ADNT and 2ADNT from degradation processes, with the highest degree of transformation observed in the "hot spot" area of Area B. Based on the observed transformation of 2,4,6-TNT, 4ADNT and 2ADNT in site soil are expected to be reduced in part to the degradation byproducts shown on the figure below.

2,4,6-TNT – Degradation Pathways[1]



Note: [1] from Brannon and Myers 1997

2,4-DNT and 2,6-DNT are impurities of TNT and may undergo some degradation in soil by microorganisms with a reduction of the nitro group to form amino groups including 4-amino-2-nitrotoluene and 2-amino-4-nitrotoluene. DNT may undergo photolysis in uppermost surface soil layers based on a rapid rate of photolysis observed in water. DNT is not expected to undergo hydrolysis in soil due to a lack of functional hydrolyzable functional groups (HSDB 2007).

Nitroglycerin undergoes rapid biodegradation using batch reactors and digestors but its rate of biodegradation in soil is unknown. Hydrolysis of nitroglycerin in soil may be important under alkaline conditions but is not expected to be an operable degradation process at the site due to the neutral pH of the soil (HSDB 2007).

5.1.3.3 PCBs – Aroclor 1254 and Aroclor 1260

PCBs are very persistent in the environment and are extremely resistant to oxidation and hydrolysis. PCBs are resistant to chemical degradation by oxidation or hydrolysis (HSDB 2007). Aroclor 1254 and 1260 are PCB mixtures of more than 90 different congeners of chlorobiphenyl. Both of these mixtures have a high degree of chlorination (54% for 1254 and 60% for 1260), which contain higher proportions of the more heavily chlorinated congeners. The persistence of PCBs generally increases with an increase in the degree of chlorination. Aroclor 1254 and 1260 are generally resistant to biodegradation in soil, with limited degradation involving anaerobic reactions, which result in reductive dechlorination to lower chlorinated PCBs; however, this degradation does not necessarily lead to a reduction in toxicity (HSDB 2007). Some biodegradation of lower chlorinated PCBs can occur under aerobic conditions through biotic degradation by microorganisms. Lower chlorinated PCBs tend degrade more readily than higher chlorinated PCBs.

Aroclor 1254 was the predominant PCB detected at the site, with maximum concentrations detected at Area B in surface and terminal depth samples collected from boring 54SB46. PCB congener testing was also conducted on these samples using EPA Method 1668 for the VDEQ list of 52 congeners. Results for Aroclor and congener testing are summarized in the following table.

Comparison of Aroclor and PCB Congener Testing

Sample	Location	Sample Results (µg/kg)				Congener Pattern Detected (Congener # and % by Weight)
		Aroclor 1254	Aroclor 1260	Total Aroclors	Total PCB Congeners VDEQ List	
54SB57A	Area A	200	<38	200	24	Aroclor 1254
54SB46A	Area B	2,800	380	3,180	2,318	Aroclor 1254
54SB46C	Area B	2,600	510	3,110	2,003	Aroclor 1254

Note: µg/kg = micrograms per kilogram.

The results of the congener testing indicated that the type of PCB mixture detected was consistent with Aroclor 1254, which was the primary PCB mixture detected at the site. The total concentrations detected for the congeners are less than for Aroclor 1254 and total Aroclors; this may reflect testing for 52 congeners rather than all of the other congeners potentially present in the mixtures at lower percentages by weight. Congener testing does not indicate significant weathering of Aroclors detected. This is consistent with the higher proportions of the heavily chlorinated congeners detected and tendency for these mixtures to be resistant to degradation.

5.1.3.4 Pesticides - Heptachlor Epoxide

Heptachlor epoxide is not produced commercially, but rather is formed by the chemical and biological transformation of heptachlor in the environment. Heptachlor epoxide adsorbs strongly to soil and is extremely resistant to biodegradation, persisting for many years in the upper soil layers (HSDB 2007).

Both heptachlor and heptachlor epoxide were detected in soil samples, with analytical results summarized in the following for both chemicals.

Comparison of Heptachlor and Heptachlor Epoxide Results

Sample	Location	Sample Results (µg/kg)		% Transformation to Heptachlor Epoxide
		Heptachlor	Heptachlor Epoxide	
54SB25B	Area A	<0.34	290	>99%
54SB30A	Area A	4.8	<0.26	<1%
54SB30B	Area A	<0.34	7.4	>99%
54SB32A	Area A	1.1	110	>99%
54SB32B	Area A	<0.34	250	>99%
54SB33B	Area A	<0.34	1.9	>99%
Detected Concentration Range	Area A	1.1 – 4.8	1.9 - 290	--
54SB46A	Area B	1.3	21	94%
54SB46B	Area B	2.8	530	>99%
54SB49B	Area B	<0.34	2.6	>99%
54SB55A	Area B	<0.34	5.9	>99%
54SB55B	Area B	<0.34	4.1	>99%
Detected Concentration Range	Area B	1.3 – 2.8	2.6 - 530	--

Note: µg/kg = micrograms per kilogram.

Comparison of the heptachlor and heptachlor epoxide results indicates that the majority of the heptachlor present at the locations sampled has transformed to heptachlor epoxide; and therefore, minimal changes in heptachlor epoxide concentrations in soil are expected due to transformation from heptachlor. Heptachlor epoxide remaining in soil at the site is not expected to significantly biodegrade.

5.1.3.5 Dioxins

Dioxins are highly stable in soil under most environmental conditions. Photodegradation is the primary degradation mechanism affecting the fate of dioxins in soil (ATSDR 1998). This process is limited to the uppermost layer of surface soil and therefore, is unlikely to influence the overall occurrence of dioxins at the site due to their occurrence both at the surface and subsurface and the nature of vegetative cover.

5.1.3.6 PAHs

PAHs identified as COPCs in soil at the site consisted of high molecular weight compounds benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Total concentrations of high molecular weight COPCs detected at the site are low (less than 700 µg/kg at Area A and less than 300 µg/kg at Area B), with higher concentrations detected in subsurface soil than in surface soil.

Microbial metabolism is the primary process for degradation of PAHs in soil. Hydrolysis, oxidation reduction, and photodegradation are not considered important processes for the degradation of PAHs in soil. The higher molecular weight PAHs that are COPCs at the site will tend to have lower rates and degrees of degradation than middle to lower molecular weight PAHs. The rate and extent of biodegradation of PAHs in soil is also influenced by soil properties such as organic content, structure, particle size, pH, temperature, and oxygen content, and the characteristics of microbial populations in the soil. The presence of metals in soil that are toxic to microorganisms will impede degradation (ATSDR 1995).

Experimentally reported half-lives for high molecular weight PAHs in soil are typically in the range of 1 to 1.5 years but will vary depending soil and site characteristics. Specific information on the relative

degradation rates of PAHs in site soil is not available; it is possible that some degradation of PAHs has occurred at the site given the low concentrations of high molecular weight compounds detected. Elevated levels of lead at Area B are not expected to have an adverse impact on PAH degradation given the low-levels or absence of detectable levels of PAHs in the lead "hot spot" area.

5.1.4 Leaching of Chemicals from Soil to Groundwater

Chemicals in soils have the potential to migrate to greater depths with infiltrating water. As precipitation infiltrates, chemicals may be leached from the soil and carried to greater depths and potentially to groundwater. Factors affecting leaching are discussed in the following section followed by a site-specific assessment of the potential for SSL DAF1 COPCs leaching from soil to groundwater. The degree to which a chemical is leached is strongly influenced by the chemical's tendency to partition to the solid or aqueous phases, which is largely a function of the chemical's solubility and particle affinity.

Water Solubility

Water solubility of a chemical is the mass of chemical that will dissolve in a unit volume of water at a specific temperature. Chemicals with a high solubility can often be readily dissolved in water and therefore are susceptible to being mobilized from the soil matrix with infiltrating water and migrating downward to groundwater. Chemicals with a low solubility tend to partition to soil.

The solubility of organic chemicals is typically a function of the hydrophobic nature of the chemical. Many organic chemicals are non-polar and therefore do not dissolve readily into water, which is a polar solution. Several of the COPCs identified in soil at the site, such as dioxins, PAHs, and PCBs have low water solubility. Water solubility data for COPCs are summarized in Table 5-2.

Adsorption

The aqueous concentration of chemicals in soil systems can also be substantially influenced by adsorption reaction to the soil matrix. Adsorption is the ability of a substance to bind to the surface of soil particles from reactions that occur between the chemical and the soil particle surface. Organic compounds are frequently non-polar, and therefore, tend to interact with organic matter commonly associated with the soil matrix. The tendency for a chemical to be adsorbed to the organic fraction of soil (or sediment) can be measured by the chemical's organic carbon partition coefficient (K_{oc}). The lower the K_{oc} values the more leaching potential from soil to water as summarized below. Organic compounds with a K_{oc} less than 100 liters per kilogram (L/kg) have a high potential to leach from soil or sediment to water, while K_{oc} values in the range of 100 to 500 L/kg, such 2,4-DNT and 2,6-DNT, indicate a moderate leaching potential. Progressively higher values of K_{oc} greater than 500 L/kg indicate lower leaching potential. Organic compounds with K_{oc} values in the range of 1E+04 to 1E+06 L/kg, such as PCBs, high molecular weight PAHs, and dioxins, are generally immobile or nearly immobile in soil. Values of K_{oc} for COPCs are summarized in Table 5-2.

Site-specific distribution coefficients (K_d) can be estimated for each organic COPC, as the product of the K_{oc} of the chemical and the fraction of the organic carbon (f_{oc}) in the soil matrix. The distribution coefficient is a measure of the ratio of chemical mass that partitions to the solid and liquid phases under equilibrium conditions. The fraction of organic carbon in site soil is estimated as 1% based on the average result of TOC testing of site soil conducted by MSE in 1998. Calculated K_d values are presented in Table 5-2. The relatively mobility of site COPCs in soil have been estimated in the following table based on solubility, K_{oc} and K_d values.

Relative Mobility of COPCs in Soil

Immobile	Slight	Low	Moderate
Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(b)fluoranthene Benzo(a)pyrene Benzo(k)fluoranthene 2,3,7,8-TCDD TEQ Aroclor 1260 Aroclor 1254	Carbazole N-Nitrosodiphenylamine Heptachlor Epoxide	2,4,6-TNT	Nitroglycerin RDX* Amino DNTs 2,4-DNT 2,6-DNT Diethylphlalate

*Groundwater COPC, detected only in groundwater.

COPCs classified as immobile or slightly mobile are unlikely to leach from soil to groundwater at levels of potential concern. 2,4,6-TNT, 2,4-DNT, 2,6-DNT, and RDX have leached to groundwater at levels above their adjusted T-RBCs and therefore, are of potential concern.

5.1.4.1 Development of Site Specific Soil-to-Groundwater SSLs

Site-specific soil-to-groundwater SSLs have been calculated for both Area A and Area B to evaluate the potential for leaching of COPCs to groundwater at concentrations of potential concern. EPA equation B-13 included in Appendix B of the Supplemental Guidance for Developing SSLs for Superfund Site (USEPA 2002c) has been modified to incorporate the following site-specific parameter data for each disposal area as summarized in the following table.

$$C_t = C_w(K_{oc} * f_{oc} + \frac{\theta_a + \theta_w * H'}{\rho_b}) \qquad \text{Equation } 5-1$$

where:

Parameter	Definition (Units)	Value	Source
Source Area Size	Used to Calculate Dilution Attenuation Factor (DAF), (ft^2)	Area A: 11,715 ft^2 Area B: 17,870 ft^2	Figure 5-1 Figure 5-2
DAF	Dilution Attenuation Factor (unitless)	Area A: 12 Area B: 10	EPA 1994b – DAF Values as Function of Source Area – Table A4
C_t	Screening level in soil, (mg/kg)	Calculated Using Equation 5-1	USEPA 2002c
C_w	Target leachate concentration (mg/L) x Site-Specific DAF	Chemical Specific T-RBC Disposal Unit DAF	USEPA Region III – October 2007 RBC Table
K_{oc}	Soil organic carbon-water partition coefficient (L/kg)	Chemical Specific	RAIS (2007)
f_{oc}	Organic carbon content of soil, (kg/kg)	0.01 (1%)	Average Concentration of TOC from MSE Soil Testing in 1998
θ_w	Water-filled soil porosity, (L_{water}/L_{soil})	0.33	Average of RFI Physical Soil Test Results
θ_a	Air-filled soil porosity, (L_{air}/L_{soil}), ($\eta - \theta_w$)	0.03	Average of RFI Physical Soil Test Results

Parameter	Definition (Units)	Value	Source
ρ_b	Dry soil bulk density	1.5 kg/L	Average of RFI Physical Soil Test Results
H'	Henry's law constant	Chemical-specific	RAIS (2007)

Notes: RAIS = Risk Assessment Information System – Chemical Specific Factors at http://rais.ornl.gov/
EPA 1994b – Determination of Groundwater Dilution Attenuation Factors for Fixed Waste Sites using EPACMTP – Appendix E – Table A4.

Detailed SSL calculations are presented in Appendix C.8. The leaching potential of COPCs is evaluated in the following based on the chemical properties of the COPCs, comparisons of the site data to SSLs, and an evaluation of site groundwater data.

5.1.4.2 Lead

Most lead is retained strongly in soil and very little leaches to groundwater. Conditions at the site are conducive to the immobilization of lead in soil due to the neutral pH of site soil and the presence of organic matter (1.5 to 3.5%). Leaching of lead to groundwater at the site is not apparent from groundwater monitoring data. Lead has not been detected in groundwater samples collected at Area A and low-levels of lead (1.6 µg/L or less) have been detected in the background well at Area B and in one downgradient well at Area B. The lead solubility in groundwater also will be limited by the neutral pH of site groundwater.

5.1.4.3 SVOCs and PAHs

N-nitrosodiphenylamine and several high molecular weight PAH compounds were identified as COPCs for the soil-to-groundwater migration pathway at Area A. The detected concentrations of PAHs in soil were below site-specific SSLs.

Area A - Comparison of SVOC Soil Data to Site Specific Soil-to-Groundwater SSLs

COPC	Concentration (mg/kg)			Above SSL
	Minimum	Maximum	Site-Specific SSL	
N-nitrosodiphenylamine	0.066	1.20	10.13	No
Benzo(a)anthracene	0.0036	0.035	0.832	No
Benzo(a)pyrene	0.002	0.134*	0.283	No
Benzo(b)fluoranthene	0.0049	0.725	2.89	No
Benzo(k)fluoranthene	0.0037	1.00	2.83	No
Dibenz(a,h)anthracene	0.016	0.681	0.943	No
Indeno(1,2,3-cd)pyrene	0.0059	0.517	9.65	No

Note: Duplicate average of Method 8270

Based on their immobile nature in soil and the slightly mobility of the other compounds in soil, the results of SSL comparisons, and the lack of detections in groundwater samples, PAHs and n-nitrosodiphenylamine are not considered COPCs at Area A for the soil-to-groundwater migration pathway.

N-nitrosodiphenylamine, diethylphthlalate, carbazole, and several high molecular weight PAHs were identified as COPCs for the soil-to-groundwater migration pathway at Area B. The high molecular weight PAHs tend to be immobile in soil due to negligible solubility and very high K_{oc} values. N-nitrosodiphenylamine and carbazole also have slight mobility in soil to their low solubility and higher K_{oc} values. Diethylphthlalate has moderate mobility in soil due to its higher solubility and K_{oc} value. The following table indicates that the detection concentrations of SVOCs and PAHs were below their site-specific SSLs.

Area B - Comparison of SVOC and PAH Soil Data to Site Specific Soil-to-Groundwater SSLs

COPC	Concentration (mg/kg)			Above SSL
	Minimum	Maximum	Site-Specific SSL	
Carbazole	0.042	0.042	3.79	No
Diethylphlalate	0.036	96	433	No
N-nitrosodiphenylamine	0.029	1.80	8.44	No
Benzo(a)anthracene	0.0056	0.055	0.693	No
Benzo(a)pyrene	0.0058	0.074	0.236	No
Benzo(b)fluoranthene	0.005	0.100	2.41	No
Dibenz(a,h)anthracene	0.009	0.018	0.786	No
Indeno(1,2,3-cd)pyrene	0.0051	0.100	8.04	No

Based on their immobile nature in soil and the slightly mobility of the other compounds in soil, the results of SSL comparisons, and the lack of detections in groundwater samples, PAHs, diethylphthlalate, and n-nitrosodiphenylamine are not considered COPCs at Area B for the soil-to-groundwater migration pathway.

5.1.4.4 Pesticides

Heptachlor epoxide and gamma-BHC were identified as COPCs for the soil-to-groundwater migration pathway at Area A. These pesticide compounds have low mobility in the subsurface due their low solubilities and higher K_{oc}, and will tend to remain adsorbed to soil (Table 5-2). The following table indicates that detected concentrations of heptachlor epoxide in three soil samples at Area A were above the site specific SSL and the one detected gamma-BHC concentration was below it site specific SSL.

Area A - Comparison of Pesticide Soil Data to Site Specific Soil-to-Groundwater SSLs

COPC	Detected Concentrations (mg/kg)			Above SSL
	Minimum	Maximum	Site-Specific SSL	
Heptachlor Epoxide	0.0019	0.290	0.00467	Yes (3)
gamma-BHC	0.0016	0.0016	0.021	No

The detected concentration of heptachlor epoxide above the site-specific SSL suggests a theoretical potential for this chemical to leach to groundwater in the future at levels of potential concern; although this potential is considered low given the slight mobility of this pesticide in soil, the low-levels detected, and lack of pesticide detections in groundwater.

Several pesticides were detected in one or more soil samples at Area B at concentrations above SSL DAF1. These pesticides have low mobility in the subsurface due to their lower solubility and higher K_{oc} values. The following table indicates that detected concentrations of pesticides were below their site-specific SSLs, with the exception of heptachlor epoxide in two soil samples and dieldrin in one surface sample.

Area B - Comparison of Pesticide Soil Data to Site Specific Soil-to-Groundwater SSLs

COPC	Detected Concentrations (mg/kg)			Above SSL
	Minimum	Maximum	Site-Specific SSL	
Aldrin	0.0044	0.0044	0.0418	No
alpha-BHC	0.0008	0.0008	0.00362	No
beta-BHC	0.0035	0.0035	0.0127	No
Dieldrin	0.011	0.011	0.0045	Yes (1)
gamma-BHC	0.0011	0.0011	0.0175	No
Heptachlor Epoxide	0.0026	0.530	0.00389	Yes (2)

The detected concentrations of heptachlor epoxide and dieldrin above their site-specific SSL suggests a theoretical potential for this chemical to leach to groundwater in the future at levels of potential concern; although this potential is considered low given the slight mobility of these pesticides in soil, the low-levels detected, and the lack of pesticide detections in groundwater. The low-level concentration of dieldrin above its site-specific SSL in surface soil is not considered a concern with respect to groundwater given that this exceedance is limited to one surface sample within the identified "hot spot" area.

5.1.4.5 PCBs

PCBs, such as Aroclor 1254 and 1260, have a low solubility in water and high Koc values, and will tend to be immobile in the environment and remain adsorbed to soil (Table 5-2). The following table indicates that detected concentrations of PCBs in soil at Area A were below the site specific soil-to-groundwater SSL.

Area A - Comparison of PCB Soil Data to Site Specific Soil-to-Groundwater SSLs

COPC	Detected Concentrations (mg/kg)			Above SSL
	Minimum	Maximum	Site-Specific SSL	
Aroclor 1254	0.012	0.200	0.304	No
Aroclor 1260	0.078	0.078	0.832	No

Based on the immobile nature of PCBs in soil, the results of SSL comparisons, and the lack of PCBs detected in groundwater samples, PCBs are not considered a COPC at Area A for the soil-to-groundwater migration pathway.

The following table indicates that detected concentrations of Aroclor 1254 in three soil samples at Area B are above the site specific SSL. Detected concentrations of Aroclor 1260 were below the site-specific SSL.

Area B - Comparison of PCB Soil Data to Site Specific Soil-to-Groundwater SSLs

COPC	Detected Concentrations (mg/kg)			Above SSL
	Minimum	Maximum	Site-Specific SSL	
Aroclor 1254	0.008	2.8	0.253	Yes (3)
Aroclor 1260	0.024	0.510	0.693	No

The detected concentration of Aroclor 1254 above the site-specific SSL suggests a theoretical potential for this chemical to leach to groundwater in the future at levels of potential concern; although this potential is considered low given the immobile nature of PCBs in soil, the low-levels detected, and the lack of PCB detections in groundwater.

5.1.4.6 Dioxins

Dioxins have a low solubility in water and high K_{oc} values, and will tend to be immobile in the environment and remain adsorbed to soil (Table 5-2). The following table indicates that one sample (surface sample) had a dioxin concentration in soil at Area A above its site specific SSL.

Area A - Comparison of Dioxin Soil Data to Site Specific Soil-to-Groundwater SSLs

	Detected Concentrations (mg/kg)			
COPC	Minimum	Maximum	Site-Specific SSL	Above SSL
2,3,7,8-TCDD TEQ	2.86E-08	1.70E-05	7.83E-06	Yes (1)

The detections of dioxins above the site-specific SSL suggests a theoretical potential for this chemical to leach to groundwater in the future at levels of potential concern; although this potential is considered low given the immobile nature of dioxins in soil and the lack of dioxin detections in groundwater at concentrations above adjusted T-RBCs.

The following table indicates that detected concentrations of dioxins in eight soil samples at Area B are above the site specific SSL.

Area B - Comparison of Dioxin Soil Data to Site Specific Soil-to-Groundwater SSLs

	Detected Concentrations (mg/kg)			
COPC	Minimum	Maximum	Site-Specific SSL	Above SSL
2,3,7,8-TCDD TEQ	7.00E-09	1.83E-04	6.52E-06	Yes (8)

The detected concentrations of dioxins above the site-specific SSL suggest a potential for this chemical to leach to groundwater in the future at levels of potential concern; although this potential is considered low given the immobile nature of dioxins in soil and the lack of dioxin detections in groundwater at concentrations above adjusted T-RBCs.

5.1.4.7 Explosives

Explosives detected as COPCs in soil have moderate solubility in water. The K_{oc} values for the explosives range from medium low for amino DNT and nitroglycerin, to moderate for DNT mixtures, and to moderately high for 2,4,6-TNT. Based on their solubility and K_{oc} values, explosives are expected to have some mobility in soil and potential to leach to groundwater if present at sufficiently high concentrations. The following table indicates that 2,4,6-TNT, DNT mixture, amino DNTs, and nitroglycerin had detected concentrations in one or more samples above their site-specific SSLs. HMX and 1,3,5-trinitrobenzene were not identified as COPCs in soil but were included in this assessment because they were detected in groundwater at concentrations below their adjusted T-RBCs.

Area A - Comparison of Explosives Soil Data to Site Specific Soil-to-Groundwater SSLs

	Detected Concentrations (mg/kg)			
COPC	Minimum	Maximum	Site-Specific SSL	Above SSL
1,3,5-Trinitrobenzene	1.8	7.6	146.0	No
2,4,6-TNT	0.23	130	0.408	Yes (8)
DNT Mixture	0.495	28	0.005	Yes (3)
AminoDNTs	0.200	10.9	1.095	Yes (2)
HMX	6.8	6.8	411.2	No
Nitroglycerin	32	32	0.069	Yes (1)

2,4,6-TNT and DNT have been detected in groundwater at levels above their adjusted T-RBCs. Amino DNTs, 1,3,5-trinitrobenzene, and HMX have been detected in groundwater but at concentrations below their adjusted T-RBCs. Nitroglycerin has not been detected in groundwater. The above data indicate that remaining concentrations of 2,4,6-TNT, DNT mixture, and amino DNT may continue to act as a source area for leaching of constituents to groundwater at levels of potential concern.

The following table compares the soil data for explosives at Area B to site-specific SSLs and indicates that 2,4,6-TNT, DNT mixture, amino DNTs, RDX, and nitroglycerin were detected in soil at concentrations above their site-specific SSLs.

Area B - Comparison of Explosives Soil Data to Site Specific Soil-to-Groundwater SSLs

	Detected Concentrations (mg/kg)			
COPC	**Minimum**	**Maximum**	**Site-Specific SSL**	**Above SSL**
1,3,5-Trinitrobenzene	1.9	1.9	121.7	No
2,4,6-TNT	0.45	80	0.415	Yes (4)
DNT Mixture	0.38	160	0.004	Yes (3)
AminoDNTs	24	66	0.912	Yes (2)
HMX	110	110	342.6	No
RDX	8.2	8.2	0.016	Yes (1)
Nitroglycerin	95	400	0.057	Yes (2)

HMX and 1,3,5-trinitrobenzene have been detected in groundwater at Area B at concentrations below their adjusted T-RBCs. Other explosives have not been detected in groundwater at this disposal unit. The above indicate that remaining concentrations of 2,4,6-TNT, DNT mixture, amino DNTs, and nitroglycerin have the potential to leach to groundwater

The detected concentrations of 2,4,6-TNT, DNT mixture, amino DNTs, and nitroglycerin above their site-specific SSLs suggests a potential for these chemicals to leach to groundwater in the future at levels of potential concern; although these chemicals have not been detected in groundwater samples collected from Area B.

5.1.4.8 Nature and Extent of Soil-to-Groundwater SSL Exceedances

The lateral and vertical extent of COPCs in soil at concentrations above site-specific, soil-to-groundwater SSLs for Area A and Area B are shown on Figures 5-1 and 5-2, respectively. These areas are slightly larger than the identified adjusted RBC exceedance areas at these disposal areas. Explosives were the primary COPCs exceeding SSLs at Area A, while explosives and dioxins were the primary COPCs exceeding SSLs at Area B. The vertical extent of SSL exceedances is less than 16 ft bgs at Area A, and more than 12 ft bgs at Area B.

5.2 FATE AND TRANSPORT - GROUNDWATER

Fate and transport processes for site-related COPCs in groundwater are discussed in the following sections. Primary COPCs identified in groundwater include: 2,4,6-TNT, DNT mixture, RDX, and perchlorate.

5.2.1 Volatilization

Volatilization of a chemical from groundwater will result in a reduction of its mass and concentration as the chemical volatilizes to soil gas and ultimately discharges to the atmosphere. This process may also occur in groundwater with VOCs. However, as shown in Table 5-2, COPCs in groundwater at the site are characterized by low Henry's constants (i.e., < 0.01) and are not VOCs, and therefore, volatilization is not expected to be a significant influence on the fate of these compounds in groundwater at the site.

5.2.2 Source Removal

Removal of the mounds of propellant ash and hot spots in soil at Area A has reduced the available source area to maintain the strength of the dissolved phase constituent plume in groundwater. Remaining concentrations in soil at Area A are orders of magnitude lower than those formerly in the propellant ash and associated hot spots. Since RFI monitoring began in 2003, concentrations in groundwater have decreased substantially in the source area (wells 54MW2 and 54MW3), as discussed in Section 4.2.3. Concentrations have also decreased downgradient of the source area since this time. Removal of a substantial part of the source area has allowed other processes in groundwater such as degradation and dispersion to further reduce concentrations in groundwater as discussed in Sections 5.2.3 and 5.2.4, respectively.

5.2.3 Degradation of Chemicals in Groundwater

Groundwater COPCs explosives and perchlorate can be subjected to transformation and degradation in groundwater, which will reduce their concentrations over time.

5.2.3.1 2,4,6-TNT and Degradation Products

2,4,6-TNT can under transformation to 4ADNT and 2ADNT and other degradation by products in groundwater via an anaerobic or aerobic pathway. These transformations can occur in groundwater under a wide variety of pH conditions (pH of 5 to 7) and ORP conditions (-150 to +500 mV) (Pennington et al 1999a). Transformation products 4ADNT and 2ADNT have been detected in groundwater along with 2,4,6-TNT; results are summarized in the following table for the round of groundwater samples collected in June 2007.

Comparison of 2,4,6 TNT and 4ADNT and 2ADNT Results – June 2007

Sample	Sample Results (µg/L)		% Transformation to Amino DNTs
	2,4,6-TNT	Amino DNTs	
54MW2	3.9	6.3	62%
54MW3	1	2.13	68%
54MW5	0.49	1.25	72%
54MW8	<0.1	ND	<1%
54MW9	<0.1	0.94	>99%
54MW10	2.4	ND	<1%

The comparisons presented in the above table indicate that 2,4,6-TNT has undergone varying degrees of transformation to 4ADNT and 2ADNT from degradation processes, with the highest degree of transformation in the "source area" at Area A and at downgradient well 54MW9. Given the higher dissolved oxygen levels (2-10%) measured in groundwater and positive ORP values, the 2,4,6-TNT degradation pathway in groundwater at the site is expected to be aerobic.

5.2.3.2 RDX

Transformation by products of RDX include: mono-, di-, and trinitroso- derivatives. These products are rarely observed in groundwater but have been observed in the laboratory. RDX nitroso- transformation products are formed more readily under aerobic conditions than anaerobic conditions. Under anaerobic conditions, the nitroso compounds are rapidly mineralized (Pennington 1999b).

Aerobic groundwater conditions at the site appear to be unfavorable for degradation, and therefore, significant microbial degradation of RDX is not expected in site groundwater. However, the lack of detectable concentrations of RDX in soil indicates that concentrations in groundwater are unlikely to increase due to leaching from soil. Previous soil source removal activities at the site and other processes

in groundwater such as dispersion are likely responsible for the observed reductions in RDX concentrations in groundwater, as discussed in Sections 5.2.2 and 5.2.4, respectively.

5.2.3.3 DNT

Aerobic degradation of 2,4-DNT and 2,6-DNT to carbon dioxide and nitrate by native microbes in groundwater has been documented. 2,6-DNT may inhibit complete mineralization of DNTs under certain aerobic conditions, which will result in production of unstable intermediate degradation by products and aminonitrotoluenes as end products (Merki, Porter, and Weiss 2006).

2,4-DNT and 2,6-DNT have not been detected consistently in groundwater at the site. When detected, the concentrations are low. For the latest sampling event in September 2007, 2,4-DNT was only detected in well 54MW10 and at a concentration of 0.65 µg/L. 2,6-DNT was not detected in samples collected during the September 2007 sampling event.

The degree that aerobic degradation of DNT has contributed to the low observed concentrations in groundwater is not known. Previous source removal activities at the site and other processes in groundwater such as dispersion have likely contributed to the sporadically low concentrations detected in groundwater as discussed in Sections 5.2.1 and 5.2.3.

5.2.3.4 Perchlorate

Perchlorate occurs as ammonium, potassium, magnesium, or sodium salts. The perchlorate anion (ClO_4^-) consists of a tetrahedral of oxygen atoms around a central chlorine atom. Perchlorate is a strong oxidizer due to its +7 valence. Under typical groundwater conditions, perchlorate can persist in the environment due to high solubility, limited tendency to absorb to soil surfaces, and its resistance to reactions with other available constituents in the subsurface.

Biological degradation of perchlorate can occur by microorganisms via an anaerobic pathway if an electron donor is present to complete microbial degradation process, such as a carbon substrate or other source. The biological degradation pathway for perchlorate is shown below.

Perchlorate Degradation Pathway[1] (from Borden 2006)

Perchlorate (ClO_4^-)
↓
Chlorate (ClO_3^-)
↓
Chlorite (ClO_2^-
↓
Chloride (Cl^-)

Note: [1] from Borden 1996

In most natural groundwater systems, dilution is considered the most important process influencing fate and transport of perchlorate and this process along with previous soil source removal activities conducted at Area A are likely responsible for the observed decreases in perchlorate concentrations in groundwater over time, as discussed in Section 5.2.2.

5.2.4 Dispersion Processes in Groundwater

As contaminated water flows through a porous medium it will mix with non-contaminated water and as a result it will dilute (mechanical dispersion). Mixing that occurs along the direction of groundwater flow is called longitudinal dispersion and mixing that occurs perpendicular to the direction of groundwater is called lateral dispersion. Longitudinal dispersion is influenced by pore size, flow path length through the porous media, and the friction in the pore. Lateral dispersion occurs due to the splitting and branching of water as it flow paths through porous media.

Dispersion processes have influenced the configuration of the dissolved phase constituent plume at the site along with previous source removal activities and degradation of chemicals in groundwater. The mixing zone between Area A and the New River, where water from the New River can flow into the aquifer when river stage is above base flow, has likely caused dispersion and dilution of the dissolved phase plume, particularly during high flow events. Some enhanced transverse dispersion of the plume is apparent toward the north within 100 ft of the New River. It is believed that the fringes of the plume have been stretched approximately 100 ft to the north in the direction of river flow due to these mixing processes.

5.2.5 Adsorption and Retardation

The migration rate of chemicals in groundwater can be slowed relative to groundwater flow due to attenuation reactions such as adsorption. The effect of adsorption reaction on chemical migration rates is typically quantified by using a retardation factor (R), which may be estimated from the chemical-specific distribution coefficient (K_d) in liters per kilogram, soil bulk density in kilograms per liter (ρ_b) and porosity (n) per the following equation:

$$R = 1 + (\rho_b/n) \times K_d \qquad \text{Equation 5-2}$$

As discussed in Section 5.1.4, distribution coefficients (K_d) for site COPCs have been calculated in Table 5-2 using site-specific data and reference values for K_{oc}. Calculated retardation factors for explosives COPCs in groundwater are summarized in the following table.

Calculated Retardation Factors for Explosives in Groundwater

Chemical	Retardation factor (R)
2,4,6-TNT	76.02
DNT Mixture	16.19
RDX	3.56
Amino DNTs	5.11

Using the above retardation values, the velocity of migration for a particular chemical (v_c) can be then estimated from the linear groundwater flow velocity calculated for the site using the following equation:

$$v_c = v/R \qquad \text{Equation 5-3}$$

Substituting the above retardation rates and the estimated groundwater flow velocity calculated for Area A (0.52 ft/day or 189.8 ft/yr) into Equation 5-3 resulted in the following migration rates for explosives within the alluvial portion of the aquifer:

Calculated Migration Rates for Explosives in Groundwater – Alluvial Portion of Aquifer

	Velocity	
Chemical	ft/day	ft/yr
2,4,6-TNT	0.007	2.56
DNT Mixture	0.032	11.68
RDX	0.146	53.29
Aminodinitrotoluenes	0.102	37.23

The potential for retardation of explosives in groundwater at the site is higher in the alluvial portion of the aquifer, where groundwater flows through porous media containing organic carbon. Retardation also likely occurs to some degree in bedrock weathered to saprolite. Rates of retardation in the bedrock portion of the aquifer are more difficult to estimate but may be lower than in the alluvial portion of the aquifer.

5.3 SURFACE WATER AND SEDIMENT

Surface water, sediment pore-water, and sediment sampling conducted for the RFI did not indicate impacts at the groundwater/surface water interface, in surface water, or in sediment from site groundwater discharge at levels of potential concern. Groundwater COPCs were not detected in surface water, sediment-pore water, or sediment samples collected adjacent to the site. One sediment pore-water sample (PW-5) had a low-level detection of HMX (1.7 µg/L) below the laboratory reporting limit and the HMX concentration detected in the closest monitoring well 54MW8 (2.7 µg/L). The concentration of HMX detected was two orders of magnitude below its T-RBC (180.5 µg/L) and BTAG fresh water screening value (150 µg/L). HMX was not detected in the surface water samples. Groundwater COPCs 2,4,6-TNT, RDX, DNT mixture, and perchlorate were not detected in surface water or sediment pore water samples.

As discussed in Section 5.2.4, dispersion processes and the mixing zone between Area A and the New River has likely caused dispersion and dilution of the dissolved phase plume. Further dilution of the dissolved phase plume will occur as groundwater discharges to the New River; based on the discharge calculations in Section 2.7.4.2, potentially three orders of magnitude or greater dilution of COPC concentrations is possible depending on the specific discharge rates.

Estimates of the mass flux at the groundwater/surface water interface can be calculated as the product of the groundwater discharge (Q) and the constituent concentration. The value of Q calculated in Section 2.7.4.2 has been adjusted to reflect the width of dissolved phase plume (450 ft) at the interface with the New River. Mass flux has been calculated for total explosives and perchlorate using the sampling data from wells 54MW8, 54MW9, and 54MW10 located closest to the New River. For the June 2007 groundwater sampling event, the average concentrations of total explosives and perchlorate in these three wells were 5.52 and 0.43 µg/L, respectively.

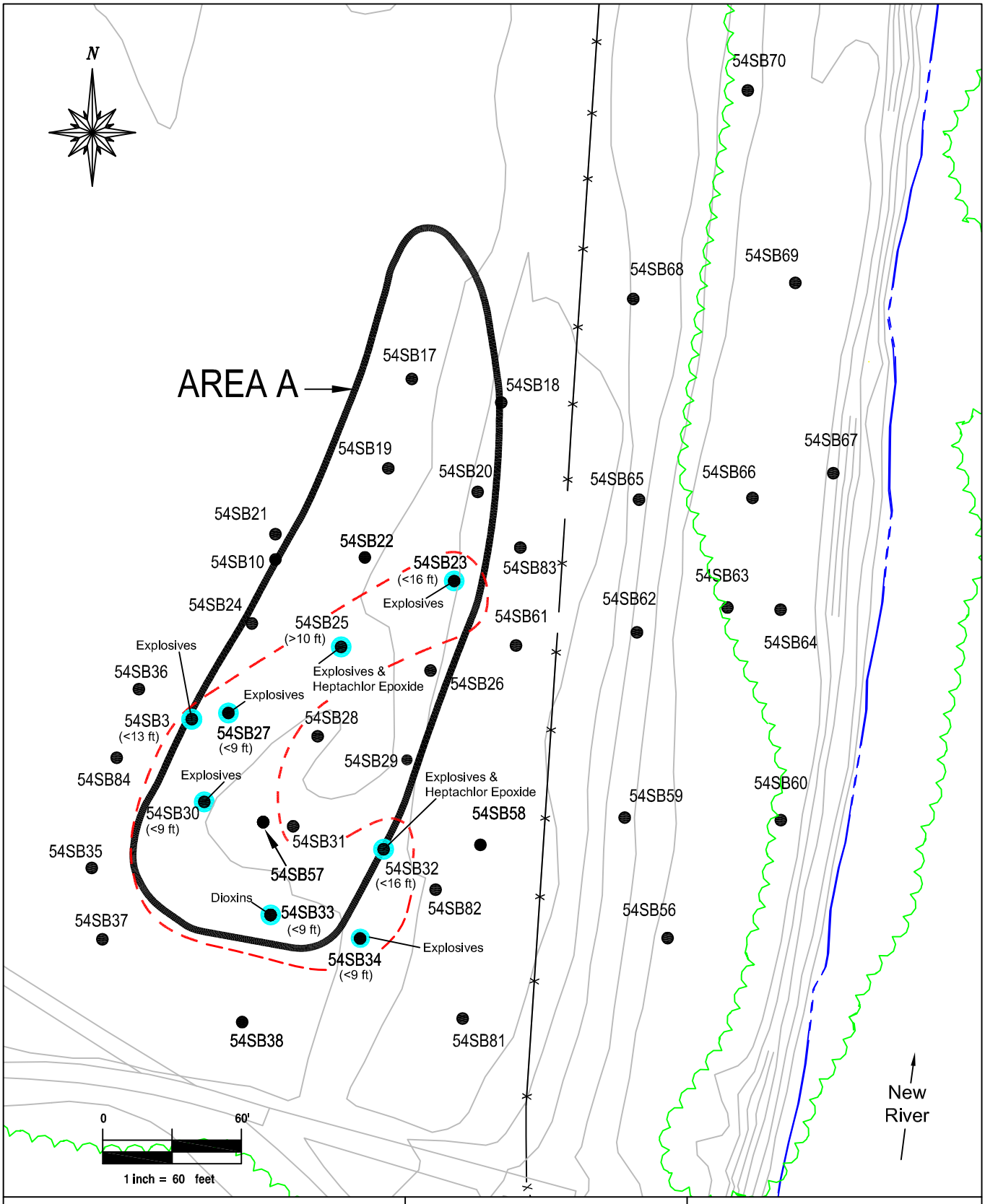
The following values were used to calculate the estimated mass flux at the groundwater/surface water interface:

Q =	6,390 cfd 0.074 cfs	Site Q adjusted for plume width of 450 ft
C_e =	5.52 µg/L 5.5E-09 pounds	Average total explosives concentration for 54MW8, 54MW9, and 54MW10 for June 2007 sampling event. Concentrations converted to pounds.
C_p =	0.43 µg/L 4.3E-10 pounds	Average perchlorate concentration for 54MW8, 54MW9, and 54MW10 for June 2007 sampling event. Concentrations converted to pounds

Using the above values, the potential mass loading of explosives and perchlorate to surface water of the New River calculated is approximately 3.5E-05 pounds per day and 2.7E-06 pounds per day, respectively. When accounting for dilution processes in surface water and other processes, the mass loading is expected to be approximately 1E-08 to 1E-09 pounds per day for explosives and perchlorate, which will result in constituent concentrations below detectable levels.

5.4 FATE AND TRANSPORT SUMMARY

At Area A, the fate and transport assessment identified the potential continued leaching of explosives from soil to groundwater and potential future leaching of heptachlor epoxide and dioxins from soil to groundwater as concerns. At Area B, the fate and transport assessment identified potential future leaching of explosives, dioxins, Aroclor 1254, and heptachlor epoxide from soil to groundwater as concerns.



Legend

- Approximate SWMU Boundary
- Soil Boring Location
- Approximate Lateral Extent of Concentrations above Site Specific SSLs
- SSL Exceedance
- (<9 ft) Approximate Vertical Extent below Ground Surface

Figure 5-1

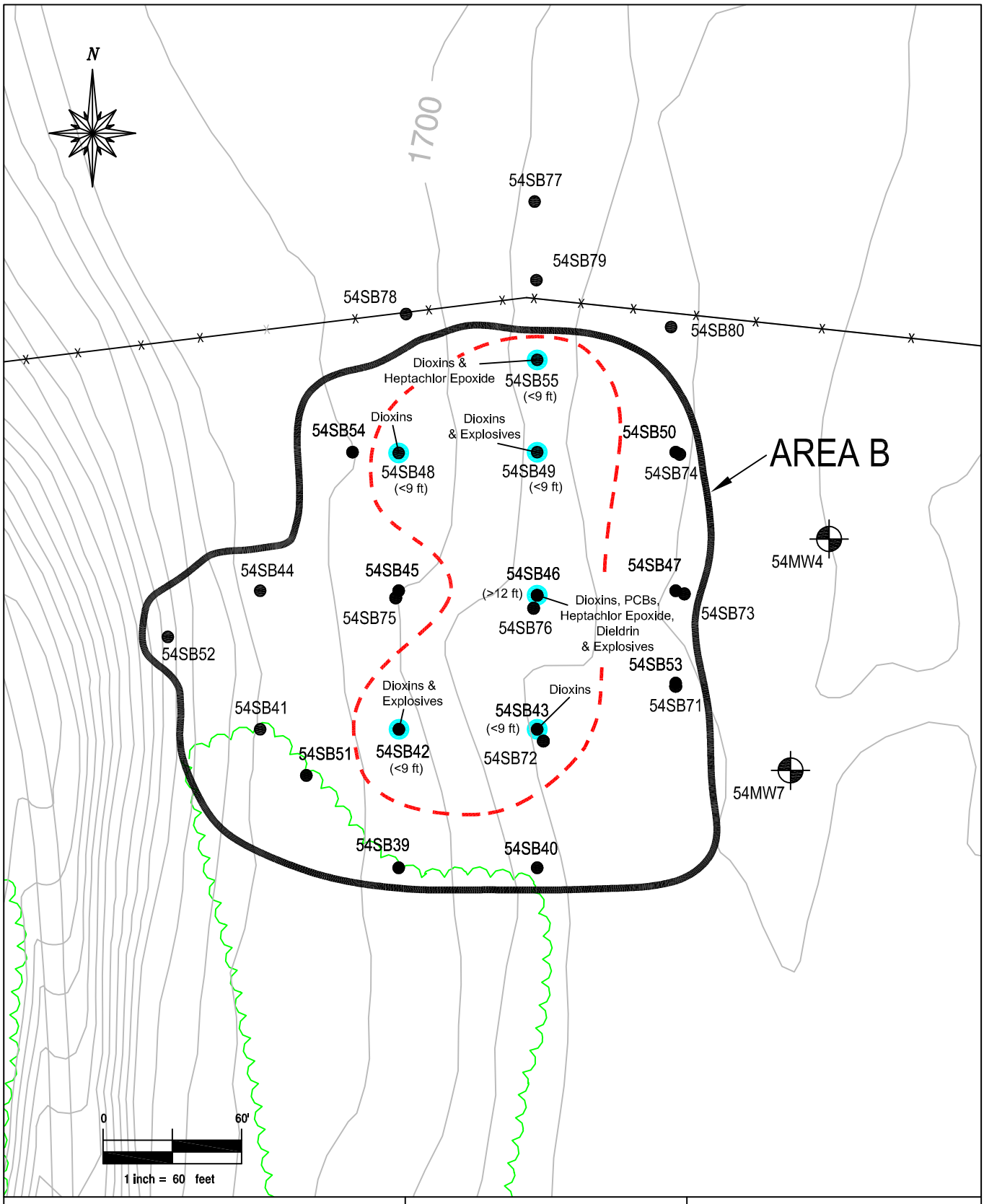
Area A - Extent of Soil Concentrations above Site Specific Soil-to-Groundwater Screening Levels (SSLs)

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig5-1 A SSL

SWMU 54

RCRA Facility Investigation
Radford Army Ammunition Plant
Radford, Virginia

URS Group, Inc.
5540 Falmouth Street
Suite 201
Richmond, Virginia 23230



Legend

- Approximate SWMU Boundary
- Soil Boring Location
- Approximate Lateral Extent of Concentrations above Site Specific SSLs
- SSL Exceedance
- (<9 ft) Approximate Vertical Extent below Ground Surface

Figure 5-2

Area B - Extent of Soil Concentrations above Site Specific Soil-to-Groundwater Screening Levels (SSLs)

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig5-2 B SSL

SWMU 54

RCRA Facility Investigation
Radford Army Ammunition Plant
Radford, Virginia

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Richmond, Virginia 23230

Table 5-1a
Chemical Properties Affecting Fate and Transport
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, VIrginia

Property	Description
Specific Gravity	Specific gravity is the ratio of the density of a chemical to the density of water and its tendency to float (specific gravity <1) or sink (specific gravity >1) in water. Chemicals that are immiscible in water can exist as non-aqueous phase liquids and are referred to as light non-aqueous phase liquid if their specific gravity is less than one, or dense non-aqueous phase liquid if their specific gravity is greater than one.
Water Solubility	Water solubility of a chemical is the mass of chemical that will dissolve in a unit volume of water at a specific temperature. Chemicals with a high solubility tend to remain dissolved in water rather than partition to soil or sediment are less likely to volatilize, and more likely to biodegrade. Chemicals with a low solubility tend to partition to soil or sediment, are more likely to volatilize and less likely to biodegrade.
Vapor Pressure	Vapor pressure of a chemical is how readily it will volatilize to the atmosphere. Volatilization from water is dependent upon vapor pressure and Henry's law constant. Vapor pressures in their pure state range from 0.001 to 760 millimeters mercury (mm Hg) for liquids to less than 1E-10 mm Hg for solids.
Henry's Law Constant	Henry's law constant of a chemical is a measure of how a chemical will partition between air and water at equilibrium. It is the ratio of the vapor pressure to the water solubility (atm-m^3/mole) and can be used to calculate the rate of volatilization of a chemical from water. Chemicals with a high Henry's law constant more readily volatilize from water.
Organic Carbon Partition Coefficient (K_{oc})	K_{oc} is a measure of the tendency for a chemical to be sorbed to the organic fraction of soil and sediment. The lower the K_{oc} values the more leaching potential from soil or sediment to water. Chemicals with a K_{oc} less than 100 milliliters per gram (mL/g) have a high potential to leach from soil or sediment to water, while K_{oc} values in the range of 100 to 500 mL/g indicate a moderate leaching potential.
Octanol-Water Partition Coefficient (Ko_w)	K_{ow} describes the partitioning of an organic chemical between a polar phase (water) and a relatively nonpolar phase (1-octanol). It is equated to the partitioning (sorption) in an aquifer of a chemical between the water and the porous media organic content. A chemical with a high K_{ow} is hydrophobic and may be relatively immobile in an aqueous system but may be mobilized in the presence of an organic solvent.

Table 5-1b
Fate Processes Affecting Metals
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Process	Description
Ion Exchange	Ion exchange is a specific category of adsorption due to an affinity of the solid surface for the chemical. Ion exchange occurs when the adsorbent charge deficiency can be neutralized more efficiently by ions in solution than by those ions currently adsorbed. As an example, if sodium ions (monovalent) have accumulated at the interface and suddenly calcium ions (divalent) appear, the surface excess can be more efficiently neutralized by the calcium ions than by the sodium ions; thus, the sodium ions will desorb and the calcium ions will adsorb and an exchange of ions will occur. Clay minerals are frequently the dominant source of ion exchange in the subsurface. The surface charge of clays and many other mineral surfaces is a function of pH. At low pH (excess hydrogen ions), the surface can exhibit a positive net charge while at higher pH (excess hydroxyl ions) the surface can exhibit a negative charge (Knox et al 1993). The surface area of the exchange site significantly influences the level of adsorption; this parameter is typically discussed in terms of the cation exchange capacity (CEC) of the medium and is expressed in units of milliequivalents of exchanging cations per 100 grams of solids (meq/100 g). CEC values indicate the likely type of clay present; the higher the CEC value the greater the absorption potential.
Chemical Speciation	Most metals occur in more than one ionic form (species) in solid and aqueous media. These species form from hydrolysis, oxidation reduction reactions, and complexation reactions, which may have different valences and mobilities in soil water, groundwater, and surface water due to different affinities for adsorption and different solubilty controls. Simple ionic specifies frequently combine ligands to form ionic or neutral-charge aqueous complexes. Environmental conditions that affect speciation of metals include pH, redox potential, and organic ligands.
Oxidation Reduction Potential (ORP)	Redox refers to the transfer of electrons and resultant specifies change of ions or compounds. Oxidation is the loss of electrons and reduction is the gain of electrons. Redox can cause changes in the mobility of many metals, such as site COPCs iron, manganese, and arsenic. The ability of a redox reaction to occur is a function of the redox potential. Redox potential is typically defined in terms of the negative logarithm of the free-electron activity (pE). The redox potential can also be expressed in terms of volts (Eh). Low values of pE indicate high electron activity and favor electron-rich species (reduced). High values of pE indicate low electron activity and favor electron-poor species (oxidized) (Knox et al 1993).

Table 5-1c
Fate Processes Affecting Organics
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Process	Description
Sorption	Sorption includes the processes of adsorption and absorption. Adsorption is a mass transfer process where a substance is transferred from a phase to the surface of a medium (e.g. soil or sediment) where it is bounded by chemical or physical forces. Absorption is the partitioning between two phases (Knox et al. 1993). Sorption reactions are either sorbent or solvent-motivated. Sorbent-motivated reactions occur when there is an attraction between the sorbent and the solute and the chemical accumulates at the surface due to the affinity of the surface for the chemical. Solvent-motivated reactions occur when the chemical is hydrophobic, such as nonionic organics, where the chemical will accumulate at an interface or partition into a nonionic phase (associate with the organic content of the medium). For nonionic organics, the fraction of organic content (foc) of the subsurface material is the dominant soil characteristic affecting sorption (Knox et al. 1993). Primary indicators of the partitioning of a chemical are the organic carbon water partition coefficient (Koc), soil/water distribution coefficient (Kd), the octanol water partitioning coeffient (Kow), and the calculated retardation factor.
Hydrolysis	Hydrolysis is the degradation process via chemical reactions (oxidation, reduction, hydrolysis) without the participation of organisms. Hydrolysis is a chemical decomposition process that uses water to split chemical bonds of substances. There are two types of hydrolysis, acid and enzymatic. Hydrolysis is limited to chemical that contain hydrolysable groups and is affected by the contaminant's hydrolysis half life.
Volatilization	Volatilization is the process by which a contaminant changes from a liquid phase to a gas phase. This process applies to organic contaminants migrating from the soil or surface water. Volatile organic chemicals are a class of chemicals that easily evaporate or mix with the atmosphere. The potential volatilization of a chemical is affected by the compounds vapor pressure, solubility, organic carbon partitioning coefficient, and the temperature.
Abiotic Degradation	Abiotic degradation includes degradation processes in which organisms do not participate. Photolysis describes the abiotic degradation process via photochemical reactions such as photooxidation, photomineralisation without the participation of organisms. As described above, hydrolysis is an additional process of abiotic degradation.
Biotic Degradation	Biotic degradations the process in which chemical degradation of a contaminant is aided by soil organisms. Biotic degradation can be either aerobic or anaerobic. The rate of metabolism/cometabolism is affected by the contaminant's biochemical oxygen demand, chemical oxygen demand, degree of halogenation, etc. Reactions include; but are not limited, to oxidation/reduction and hydrolysis, as described above.

Table 5-2
Physical Constants for COPCs
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Chemical	CAS #	Molecular Weight (g/mol)	Henry's Law Constant (atm-m^3/mol)	Unitless Henry's Law Constant	Organic Carbon Partition Coef. (Koc) (L/kg)	Log of Octanol-Water Partition Coef. (log Kow)	Octanol-Water Partition Coef. (Kow) (L/kg)	Water Solubility (mg/L)	Vapor Pressure (mm Hg)
Aldrin	309002	364.92	4.39E-05	1.80E-03	1.06E+04	6.5	3.16E+06	1.70E-02	1.20E-04
Alpha-BHC	319846	290.83	1.22E-05	4.99E-04	3.38E+03	4.14	1.38E+04	8.00E+00	3.52E-05
Aroclor 1254	11097691	326.44	2.83E-04	1.16E-02	7.56E+04	6.79	6.17E+06	3.40E-03	6.53E-06
Aroclor 1260	11096825	395.33	3.34E-04	1.37E-02	2.07E+05	8.27	1.86E+08	2.84E-04	4.05E-05
Benz[a]anthracene	56553	228.3	1.20E-05	4.91E-04	2.31E+05	5.76	5.75E+05	9.40E-03	1.90E-06
Benzo[a]pyrene	50328	252.32	4.56E-07	1.87E-05	7.87E+05	6.13	1.35E+06	1.62E-03	5.49E-09
Benzo[b]fluoranthene	205992	252.32	6.56E-07	2.69E-05	8.03E+05	5.78	6.03E+05	1.50E-03	5.00E-07
Benzo[k]fluoranthene	207089	252.32	5.83E-07	2.39E-05	7.87E+05	6.11	1.29E+06	8.00E-04	9.65E-10
Beta-BHC	319857	290.83	4.39E-07	1.80E-05	3.38E+03	4.14	1.38E+04	8.00E+00	3.52E-05
Carbazole	86748	167.21	5.10E-07	2.09E-05	1.13E+04	3.72	5.25E+03	1.80E+00	7.50E-07
Dibenz[a,h]anthracene	53703	278.36	1.23E-07	5.03E-06	2.62E+06	6.54	3.47E+06	1.03E-03	1.39E-11
Indeno[1,2,3-cd]pyrene	193395	276.34	3.46E-07	1.42E-05	2.68E+06	6.7	5.01E+06	1.90E-04	1.25E-10
Dieldrin	60571	222.4	9.98E-06	4.09E-04	1.06E+04	5.2	1.58E+05	2.50E-01	3.00E-06
Diethylphlalate	84662	222.4	6.07E-07	2.49E-05	1.26E+02	2.42	2.63E+02	1.08E+03	2.10E-03
Dinitrotoluene Mixture, 2,4/2,6-	25321146	182.14	3.95E-07	1.62E-05	3.71E+02	2.18	1.51E+02	2.70E+02	2.15E-03
Dinitrotoluene, 2,4-	121142	182.14	5.39E-08	2.21E-06	3.64E+02	1.98	9.55E+01	2.70E+02	1.47E-04
Dinitrotoluene, 2,6-	606202	182.14	7.44E-07	3.05E-05	3.71E+02	2.1	1.26E+02	3.52E+02	5.67E-04
Dinitrotoluene, 2-Amino-4,6-	35572782	197.15	1.61E-10	6.62E-09	1.01E+02	1.84	6.92E+01	1.22E+03	1.07E-05
Dinitrotoluene, 4-Amino-2,6-	19406510	197.15	1.61E-10	6.61E-09	1.01E+02	1.84	6.92E+01	1.22E+03	1.07E-05
Gamma-BHC	58899	290.83	5.12E-06	2.10E-04	3.38E+03	4.14	1.38E+04	8.00E+00	3.52E-05
Heptachlor Epoxide	1024573	389.32	2.10E-05	8.59E-04	5.26E+03	4.98	9.55E+04	2.00E-01	1.95E-05
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	222.12	6.29E-08	2.58E-06	1.95E+02	0.87	7.41E+00	5.97E+01	4.10E-09
HMX	2691410	296.16	8.63E-10	3.54E-08	1.85E+03	0.82	6.61E+00	2.56E+03	2.41E-08
Nitroglycerin	55630	227.09	2.54E-09	1.04E-07	1.31E+02	1.62	4.17E+01	1.38E+03	4.00E-02
N-nitrosodiphenylamine	86306	198.23	1.21E-06	4.95E-05	6.15E+03	3.13	1.35E+03	3.50E+01	6.97E-05
Trinitrotoluene, 2,4,6-	118967	227.13	4.56E-07	1.87E-05	1.83E+03	1.6	3.98E+01	1.30E+02	8.02E-06
1,3,5-Trinitrobenzene	99354	213.11	3.07E-09	1.26E-07	1.09E+03	1.18	1.51E+01	2.78E+02	6.44E-06
TCDD, 2,3,7,8-	1746016	321.98	4.98E-05	2.04E-03	1.46E+05	6.8	6.31E+06	2.00E-04	1.50E-09

Notes:
CAS = Chemical Abstract System
g/mol = Grams per mole
atm-m^3/mol = Cubic meters atmosphere per mole
L/kg = Liters per kilogram
mg/L = Milligrams per liter
mm Hg = Millimeters Mercury

6.0 HUMAN HEALTH RISK ASSESSMENT

This HHRA evaluates the probability and magnitude of potential adverse effects on human health associated with exposure to site-related chemicals in soil and groundwater. Areas A and B are evaluated separately given their 200 ft distance apart and different disposal histories. Refer to Section 2.0 for additional information regarding the sites' backgrounds. The HHRAs were conducted for the sites consistent with guidance included in EPA's *Interim Final Risk Assessment Guidance for Superfund* (RAGS) and other current EPA/EPA Region III resources and guidance documents as noted on the RAGS Part D tables provided in Appendices E.1 (Area A) and E.2 (Area B).

This HHRA is organized consists of the following six sections:

- **Section 6.1: Data Summary and Selection of COPCs:** Relevant site data are gathered, examined, and discussed. Basic constituent statistics and screening levels are summarized. COPCs are identified by comparison to screening criteria as discussed in Section 6.1.2;
- **Section 6.2: Exposure Assessment:** Potentially exposed populations (e.g., receptors) and exposure routes are identified, and exposure point concentrations (EPCs) are calculated for COPCs. Standard exposure factors and health-protective assumptions are used to assess the magnitude, frequency, and duration of exposure for each exposure route and intakes are calculated;
- **Section 6.3: Toxicity Assessment:** Toxicity criteria for COPCs are gathered and presented;
- **Section 6.4: Risk Characterization:** Quantitative risks and hazards are estimated and summarized by combining toxicity criteria with intakes for each exposure route;
- **Section 6.5: Uncertainties Analysis:** Uncertainties, "including uncertainties in the physical setting definition for the site, in the models used, in the exposure parameters, and in the toxicity assessment" (USEPA 1989b) are discussed; and
- **Section 6.6: Summary and Conclusions:** The results of the HHRA are summarized.

As previously stated, the tabulated risk assessment results are presented in accordance with USEPA guidance described in RAGS: Volume I - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments) (USEPA 2001b). RAGS D requires the risk assessment results to be presented in a series of standardized tables, which are presented in Appendices E.1 (Area A) and E.2 (Area B).

6.1 DATA SUMMARY AND SELECTION OF COPCS

6.1.1 Data Summary

Table 6-1 and Table 6-2 identify the samples used in the Area A and Area B COPC screening for soil and groundwater, respectively. Refer to Section 4 for complete data tables for detected analytes for each media and disposal area. Additional information regarding the data used in the HHRAs is summarized below:

- Though several dioxins are known to be toxic, toxicity criteria are limited to 2,3,7,8- TCDD. Therefore, the HHRA uses the method outlined in Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and Dibenzofurans (CDDs and CDFs) (USEPA 1989a and WHO 2005) to assess risks due to exposure to dioxins and/or furans. Each congener is assigned a TEF, which corresponds to its toxicity relative to 2,3,7,8-TCDD. Each congener detection is multiplied by its corresponding TEF; the adjusted concentrations are then summed to derive one total 2,3,7,8-TCDD equivalent concentration for each sample. This concentration is then compared with toxicity criteria for 2,3,7,8-TCDD to calculate risks. TEFs are presented and total 2,3,7,8-TCDD equivalents are calculated for Area A in Tables 6-3A (soil) and 6-

3B (groundwater) and for Area B in Tables 6-3C (soil), 6-3D (groundwater-December 2006),and 6-3E (groundwater-June 2007).

- If a constituent was measured by two methods, results from the more sensitive analytical method were used. For example PAHs were analyzed as part of the SVOC method, as well as, by a PAH specific method. Results from the specific method were used;
- J-flagged data (estimated concentration) and B-flagged data (detected in an associated blank) are considered detections and are used without modification;
- Rejected results (R-flagged) are not used; and
- Data from duplicate sample pairs are averaged and treated as one result. If an analyte is detected in one of the sample pair, one half the detection limit of the non-detect is averaged with the detected result and the result is considered detected.

Additional information regarding specific soil and groundwater samples used in the HHRA is provided in Sections 6.1.1.1 and 6.1.1.2.

6.1.1.1 Surface Soil and Total Soil

Soil samples collected during sampling events completed in 2003, 2004, and 2007 for the RFI were used for the COPC screenings. As presented in Table 6-1, the soil samples for Area A and Area B were segregated and used for the Area A and Area B HHRAs, respectively. In addition in Table 6-1, the soil samples for each area have also been divided into surface soil (0 to 1 ft bgs) and subsurface soil (1 to 15 ft bgs). The two soil data groupings used for COPC screening and the HHRA are surface soil (0 to 1 ft bgs) and total soil (0 to 15 ft bgs). Total soil data grouping consists of combining surface and subsurface soil to address mixing of potential soil contamination during construction or land development activities. Soil samples collected a depth of greater than 15 ft bgs were excluded from the HHRAs since it is unlikely soil below this depth would be disturbed and mixed with surface soil during excavation.

As discussed in the Nature and Extent Assessment (Section 4.1.1), explosives (an indicator chemical class for propellants) were not present in samples collected outside the fence; therefore, to ensure the samples used for selection of COPCs and calculation of EPCs utilized in the HHRA (Section 6.2.3) were representative of the site conditions and not diluted by samples outside the area potentially impacted by site activities, samples outside the fence line were excluded from the HHRA for Area A. Refer to Table 6-1 for the soil sample assemblages used for Area A and Area B. A total of 31 surface soil samples and 36 subsurface soil samples were used for the HHRA for Area A and a total of 26 surface soil samples and 48 subsurface soil samples were used for the HHRA for Area B.

6.1.1.2 Groundwater

Groundwater samples collected during the sampling events completed in 2003, 2004, 2006, and 2007 for the RFI were used for the COPC screenings. The groundwater sampling locations for Area A and Area B are segregated and used for the Area A and Area B HHRAs, respectively. Refer to Table 6-2 for the groundwater sample assemblages used for Area A and Area B.

6.1.2 Identification of COPCs

COPCs were identified for the sites by comparing the maximum detected concentration (MDC) to the following screening levels for each media: USEPA Region III R-RBCs and I-RBCs (surface soil and total soil) and USEPA T-RBCs (groundwater) as presented in the October 2007 USEPA Region III RBC and Alternate RBC Tables (USEPA 2007). In accordance with USEPA Region III guidance, RBCs for non-carcinogenic chemicals were adjusted downward to a HQ of 0.1 to ensure that chemicals with additive effects were not prematurely eliminated during screening.

For nutrients detected in soil (calcium, potassium, magnesium, and sodium) that have no available RBC, the MDC was compared to the recommended daily allowance (RDA)-derived soil ingestion screening criteria. Table 6-4 presents the equation, exposure parameters, and RDAs used, as well as the calculated screening criteria for the adult resident and child resident receptors. The lowest screening criterion for each nutrient (e.g., the screening criteria for the child resident) was selected as the screening criterion.

In addition, lead ALs of 400 mg/kg for residential receptors and 750 mg/kg for industrial receptors were used in the COPC identification since toxicity criteria were not available for lead (USEPA 1994c).

Analytes detected at a maximum concentration greater than the corresponding adjusted RBC or screening values identified above (or those for which no screening criteria exists) were selected as COPCs. COPC screening tables for each area are presented in Appendices E.1 (Area A) and E.2 (Area B), Tables E.1-2.1 (COPC Determination Detects-Surface Soil), E.1-2.2 (COPC Determination Detects-Total Soil), E.1-2.3 (Non-Detect Screening-Soil), E.1-2.4 (COPC Determination Detects-Groundwater), and E.1-2.5 (Non-Detect Screening-Groundwater) for Area A and Tables E.2-2.1 (COPC Determination Detects-Surface Soil), E.2-2.2 (COPC Determination Detects-Total Soil), E.2-2.3 (Non-Detect Screening-Soil), E.2-2.4 (COPC Determination Detects-Groundwater), and E.2-2.5 (Non-Detect Screening-Groundwater) for Area B. A summary of the results of the human health COPC screenings for the sites are presented in the table below.

Human Health COPCs Identified

Chemical	Area A		Area B	
	Soil	Groundwater	Soil	Groundwater
Aluminum	X		X	
Antimony	X		X	
Arsenic	X		X	
Chromium	X		X	
Cobalt	X		X	
Copper			X	
Iron	X		X	
Lead	X		X	
Manganese	X	X	X	X
Vanadium	X		X	
Heptachlor Epoxide	X		X	
Aroclor 1254	X		X	
Aroclor 1260			X	
2-Nitroaniline	X			
Di-n-octylphthalate	X		X	
Dimethylphthalate			X	
2,3,7,8-TCDD TEQ	X		X	
Benzo(a)anthracene	X			
Benzo(a)pyrene	X		X	
Benzo(b)fluoranthene	X			
Dibenz(a,h)anthracene	X			
Indeno(1,2,3-cd)pyrene	X			
2,4,6-Trinitrotoluene	X	X	X	
2,4-DNT	X		X	
2,6-DNT	X			

Chemical	Area A		Area B	
	Soil	Groundwater	Soil	Groundwater
DNT Mixture	X	X	X	
2-Amino-4,6-DNT			X	
4-Amino-2,6-DNT			X	
Aminodinitrotoluenes			X	
RDX		X	X	
Nitroglycerin	X		X	
Perchlorate		X		

6.2 EXPOSURE ASSESSMENT

The objective of the exposure assessment is to estimate "the type and magnitude of exposures to chemicals of potential concern" (USEPA 1989b). When combined with chemical-specific toxicity information (summarized in the toxicity assessment), these exposures produce estimations of potential risks.

6.2.1 Conceptual Site Model/Receptor Characterization

Refined conceptual site models (CSMs) for SWMU 54 are presented on Figure 6-1 and Figure 6-2 for Area A and Area B, respectively. The sites are located in a relatively flat area approximately 200 to 360 ft from the New River. Subsurface geology consists of alluvial deposits overlying limestone/dolomite bedrock of the Elbrook Formation. Groundwater is present within the lower portion of the alluvium (14 to 20 ft bgs) and in the underlying bedrock. As previously discussed in Section 2.6.1, monitoring well data indicates that groundwater flow in the site area is east and southeast toward the New River.

Potentially affected media include surface soil, subsurface soil, and groundwater at the sites, and sediment and surface water in the New River adjacent to the sites. As presented in Section 4.3 in the nature and extents assessment, the results of the sediment, surface water, and sediment pore-water investigation in the New River did not indicate significant impacts or impacts attributable to SWMU 54, and therefore, the media of concern with respect to the HHRA are surface soil, subsurface soil, and groundwater.

The area surrounding the HSA of RFAAP is not highly developed and land use near the Facility is mostly rural with less rugged areas being used for agriculture. Residential and recreational areas are located adjacent to the RFAAP (IT 2002). It is unlikely, however, that the land use within the HSA will change significantly in the foreseeable future. The HSA contains many buildings and facilities, and is likely to remain industrial in nature. Groundwater potentially impacted by the study areas is not currently used as drinking water. It is not reasonably anticipated that groundwater will be used in the future as a drinking water source due to the current and future industrial use of the study area and the location of the sites in the flood plain preventing development of the sites.

Neither area at SWMU 54 is currently active; therefore, maintenance workers are the most likely receptors under current site conditions. Due to installation security, it is unlikely that trespassers could gain access to Area A or Area B; however, risks associated with the maintenance worker are considered protective of the limited exposure experienced by the trespasser. Under future site conditions, maintenance workers continue to be receptors and although the development of the areas is unlikely due to the location of the site in the flood plain. Construction workers and commercial workers may be hypothetical receptors if either area is developed. RFAAP is likely to remain a military installation; therefore, a residential scenario is considered unlikely. However, the hypothetical residential scenario was evaluated for both areas to assess clean closeout requirements under RCRA. A conceptual site diagram presenting the sources, release mechanisms, pathways, and receptors are presented on Figure 6-3 for Area A and Area B.

6.2.2 Identification of Exposure Pathways

The potential receptors identified for the sites include current maintenance workers, hypothetical future commercial workers, hypothetical future construction workers, hypothetical future child resident, hypothetical future adult resident, and hypothetical future lifetime resident. Carcinogenic risk is assessed for the hypothetical lifetime resident to account for cumulative lifetime risk. The exposure duration for the lifetime resident scenario is assumed to be 30 years total; therefore, for carcinogens, exposures are combined for hypothetical child resident (6 years) and adult resident (24 years). In Appendices E.1 (Area A) and E.2 (Area B), Tables E.1-1 and E.2-1 summarize the selection of exposure pathways for each area and receptor listing the rationale for the inclusion or exclusion of each pathway. A conceptual site diagram for the sites is presented on Figure 6-3.

6.2.3 Calculation of EPCs

To calculate intakes, the mean concentration of each COPC is estimated and is referred to as the EPC. To account for uncertainty when estimating EPCs from sample data, the 95% upper confidence limit of the mean (95% UCL) is used instead of the mean itself (USEPA 1989b). Methods used to calculate 95% UCLs are based on guidance provided in the following documents *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (USEPA 2002b) and *On the Computation of a 95% Upper Confidence Limit of the Unknown Population Mean Based Upon Data Sets with Below Detection Limit Observations* (USEPA 2006a).

In general, the method used to calculate a 95% UCL depends on: 1) the prevalence of non-detects, and 2) the data distribution (e.g., normal or lognormal). Non-detects introduce uncertainty in the data set because the true concentration may be between zero to just below the detection limit. Therefore, distributional assumptions are difficult to make for COPCs with a high rate of non-detects. ProUCL 4.0 is used to calculate EPCs for the sites with the exception of data sets with less than 5% detects for which bounding was used to calculate EPCs. EPCs for soil COPCs are presented in Tables E.1-3.1 and E.1-3.2 of Appendix E.1 (Area A) and Tables E.2-3.1 and E.2-3.2 of Appendix E.2 (Area B). EPCs were not calculated for groundwater; therefore, the MDC for COPCs identified for groundwater were used in the risk assessment.

6.2.4 Quantification of Exposure: Calculation of Daily Intakes

For each receptor and pathway, chronic daily intake (CDI, expressed as milligrams of COPC per kilogram body weight per day) for each COPC is estimated by combining the EPC with exposure parameters such as ingestion rate, frequency of contact, duration, and frequency of exposure. In addition, intake parameters are selected so the combination of intake variables results in an estimate of the reasonable maximum exposure for that pathway (USEPA 1989b). The particulate emission factors (PEF) used to calculate inhalation daily intakes were calculated in accordance with the Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA 2002c), as provided in Appendices E.1 (Area A) and E.2 (Area B), Table E.1-4.4 and E.2-4.4. Intake formulas, exposure parameters, and chemical-specific parameters are provided in Appendices E.1 (Area A) and E.2 (Area B), Tables E.1-4.1 through E.1-4.5 and Tables E.2-4.1 through E.2-4.5. The results of the CDI calculations are presented for each receptor in Appendices E.1 (Area A) and E.2 (Area B), Tables E.1-7.1 through E.1-7.6 and Tables E.2-7.1 through E.2-7.6.

6.3 TOXICITY ASSESSMENT

Toxicity criteria used to quantify non-carcinogenic hazards (risk reference doses – RfDs) and carcinogenic risks (e.g., slope factors – CSFs) are presented in Appendices E.1 (Area A) and E.2 (Area B), Tables E.1-5.1, E.1-5.2, E.1-6.1, and E.1-6-2 for Area A and Tables E.2-5.1, E.2-5.2, E.2-6.1, and E.2-6-2 for Area B.

6.4 RISK CHARACTERIZATION

Quantitative risks and hazards due to exposure to COPCs are estimated and summarized by combining toxicity criteria (presented in the Toxicity Assessment) with CDIs (calculated in the Exposure Assessment). Methods used to calculate risks and hazards are taken from USEPA (1989b).

For exposures to potential carcinogens, the individual upper-bound excess lifetime cancer risk was calculated by multiplying the estimated CDI by the CSF. In order to assess the individual excess lifetime cancer risks associated with simultaneous exposure to COPCs, the risks derived from the individual chemicals are summed within each exposure pathway. For the residential scenario, carcinogenic risk was evaluated for the lifetime resident. In addition, carcinogenic risk for the residential scenario for carcinogens that act via a mutagenic mode of action (i.e., benzo(a)pyrene) as identified in the October 2007 Region III RBC table were evaluated in accordance with the *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens* (USEPA 2005).

Non-carcinogenic adverse health effects are calculated by dividing the CDI of each COPC by its RfD, forming a HQ. HQs greater than one (1) indicate the potential for adverse health effects. To estimate non-carcinogenic adverse health effects due to simultaneous exposure to several COPCs, HQs for individual COPCs are summed within each exposure pathway to form a Hazard Index (HI). As with HQs, HIs that are greater than 1 indicate potential adverse health effects. In such cases, COPCs are divided into categories based on the target organ affected (e.g., liver, kidney) and target organ-specific HIs are recalculated. Non-carcinogenic hazards were evaluated for both child and adult residents independently.

Excess lifetime cancer risks derived in this report are compared to USEPA's target risk range for Superfund sites of 1E-06 to 1E-04 (USEPA 1989b). In addition, USEPA's Office of Solid Waste and Emergency Response has issued a directive (USEPA 1991) clarifying the role of HHRA in the Superfund process. The directive states that, if the cumulative carcinogenic risk to a receptor (based on reasonable maximum exposure for both current and future land use) is less than 1E-04 and the non-carcinogenic HI is equal to or less than 1, action generally is not warranted unless adverse environmental effects are likely.

Calculation of risks and hazards due to exposure to COPCs are presented in Appendices E.1 (Area A) and E.2 (Area B) in Tables E.1-7.1 – E.1-7.6 and E.2-7.1 – E.2-7.6. A refinement of the HIs based on target organs is conducted. As shown in Appendices E.1 (Area A) and E.2 (Area B) in Tables E.1-9.1 – E.1-9.6 and E.2-9.1 – E.2-9.6, the refinement consists of calculating HIs on a target organ-specific basis. In addition in Appendices E.1 (Area A) and E.2 (Area B), Tables E.1-10.1 – E.1-10.2 and E.2-10.1 – E.2-10.2 summarize risks and hazards for risk/HI drivers (i.e., those COPCs contributing to a total risk greater than 1.E-04 or a total target organ hazard greater than 1).

Risks and hazards presented in Appendices E.1 (Area A) and E.2 (Area B) in Tables E.1-9.1 – E.1-9.6 and E.2-9.1 – E.2-9.6 are summarized in the tables below.

Area A – Summary of Risks and Hazards

Timeframe/Receptor	Risk	HI	Risk Drivers	Target Organ Segregation HI>1
Current/Future Maintenance Worker	5.E-07	5E-02	None	None
Hypothetical Future Commercial Worker	8.E-06	7E-01	None	None
Hypothetical Future Construction Worker	3.E-06	**9E+00**	None	CNS (HI=9) – Soil (Al – Inh (2), Mn – Ing/Derm/Inh (7))

Timeframe/Receptor	Risk	HI	Risk Drivers	Target Organ Segregation HI>1
Hypothetical Future Adult Resident	2.E-05	2E+00	NA	None
Hypothetical Future Child Resident	3.E-05	**7E+00**	NA	Liver (HI=3) – Soil (Fe-Ing (0.4), 2,4,6-TNT–Ing (0.2) Groundwater (2,4,6-TNT – Ing (2)) CNS (HI=2) – Soil (Al - Ing (0.2), Mn – Ing/Derm (0.6)) Groundwater (Mn – Ing (0.7))
Hypothetical Lifetime Resident	6.E-05	NA	None	NA

Note: NA = Not Applicable
HI = Hazard Index
CNS = Central Nervous System
Bold = Exceeds USEPA Risk or Hazard Range
Al = Aluminum, Fe = Iron, Mn = Manganese, 2,4,6-TNT = 2,4,6-Trinitrotoluene
Ing = Ingestion, Inh = Inhalation, Derm = Dermal

Area B – Summary of Risks and Hazards

Timeframe/Receptor	Risk	HI	Risk Drivers	Target Organ Segregation HI>1
Current/Future Maintenance Worker	4.E-06	9E-01	None	None
Hypothetical Future Commercial Worker	7.E-06	5E-01	None	None
Hypothetical Future Construction Worker	4.E-06	**1E+01**	None	CNS (HI=8) – Soil (Al – Inh (2), Mn – Inh (6))
Hypothetical Future Adult Resident	2E-05	1E+00	NA	None
Hypothetical Future Child Resident	3E-05	**9E+00**	NA	Liver (HI=2) – Soil (Fe - Ing (0.4), 2,4,6-TNT – Ing (2)) Vascular (HI=4) – Soil (Nitroglycerin - Ing (4))
Hypothetical Lifetime Resident	5.E-05	NA	None	NA

Note: NA = Not Applicable
HI = Hazard Index
Bold = Exceeds USEPA Risk or Hazard Range
Al = Aluminum, As = Arsenic, Fe = Iron, Mn = Manganese, 2,4,6-TNT = 2,4,6-Trinitrotoluene,
DNT Mix = Dinitrotoluene Mixture, 2,3,7,8-TCDD Equiv = Total 2,3,7,8- TCDD Equivalents
Ing = Ingestion, Inh = Inhalation

6.4.1 Lead Exposure Models

The MDCs for lead in surface soil and total soil for Area A and Area B were above the lead screening level of 400 mg/kg, and therefore, the potential hazard associated with lead was evaluated using the Integrated Exposure Uptake Biokinetic (IEUBK) model for the hypothetical future child resident scenario (USEPA 2004a) and the EPA Adult Lead Model (USEPA 2003) for adult workers.

Site-specific lead exposures were evaluated for hypothetical future residential exposures using the IEUBK model. This calculation was based on the site-specific mean concentration of lead detected in total soil (46.5 mg/kg – Area A and 251 mg/kg – Area B) and the MDL for lead in groundwater (1.3 µg/L) because lead was not detected in groundwater at Area A and the maximum detected lead concentration in groundwater at Area B (1.6 µg/L). The results of the model are presented in Appendices E.1 (Area A) and E.2 (Area B). The corresponding input parameters and distribution probability plot are also provided in the Appendix for each site. The results of the modeling presented in Appendix E predict the probability of children expected to have blood levels of 10 gram per deciliter (g/dL) or greater. The lead risks are considered unacceptable if the child-blood lead level for more than 5% of children is estimated to equal or exceed the Center for Disease Control and Prevention (CDCP) concern threshold of 10 g/dL.

USEPA developed a physiologically-based pharmacokinetic adult lead model (ALM) (version 05/19/2003) that can be applied to adult worker receptors. The ALM is currently the accepted and standard model to assess adult non-residential exposures to lead in soil and indoor dust. The model uses a simplified representation of lead biokinetics to predict quasi steady-state blood level concentrations among adults who have relatively steady patterns of site exposures. The methodology focuses on estimating fetal blood lead concentrations in female workers. All the equations in the model are used to calculate target concentrations based on the probability of exceeding a blood lead level of 10 g/dL for a fetus. Lead risks are considered unacceptable for a non-residential (worker) receptor if the fetal blood lead level for more than 5% of fetuses of adult female workers is estimated to equal or exceed the CDCP concern threshold of 10 g/dL. The ALM is used to evaluate risks of lead exposure to the fetus of pregnant female industrial workers, construction workers, and other workers that are identified as relevant receptors at a site.

The results of the modeling is presented in Appendices E.1 (Area A) and E.2 (Area B) and summarized in Sections 6.4.1.1 and 6.4.1.2 for Area A and Area B, respectively.

6.4.1.1 Lead Exposure Assessment - Area A

Default parameters were utilized for the ALM model with the following ingestion rates and exposure frequencies: maintenance worker – ingestion rate (100mg/day) and exposure frequency (219 days), commercial worker – ingestion rate (50 mg/day) and exposure frequency (250 days), and construction worker – ingestion rate (330 mg/day) and exposure frequency (250 days). Default parameters were used for the IEUBK model. The arithmetic mean for lead in surface soil (69.7 mg/kg) was used in the model for the maintenance worker and the arithmetic mean for lead in total soil (46.5 mg/kg) was used in the models for the remaining potential receptors. The lead modeling predicts the probability of the receptors to have blood levels of 10 microgram per deciliter or greater. This probability is then compared to an established threshold of 5%. The results of the lead assessments are provided below:

- Current Maintenance Worker: 1.7% probability that fetal blood levels would exceed 10 g/dL (<5%);
- Hypothetical Future Construction Worker: 2.6% probability that fetal blood levels would exceed 10 g/dL (<5%);
- Hypothetical Future Commercial Worker: 1.4% probability that fetal blood levels would exceed 10 g/dL (<5%); and

- Hypothetical Future Child resident: 0.013% probability that child blood levels would exceed 10 g/dL (<5%).

The results of the lead modeling predicted the probability of the receptors for Area A expected to have blood levels of 10 microgram per deciliter or greater were below the established threshold of 5%.

6.4.1.2 Lead Exposure Assessment - Area B

Default parameters were utilized for the ALM model with the following ingestion rates and exposure frequencies: maintenance worker – ingestion rate (100mg/day) and exposure frequency (219 days), commercial worker – ingestion rate (50 mg/day) and exposure frequency (250 days), and construction worker – ingestion rate (330 mg/day) and exposure frequency (250 days). Default parameters were used for the IEUBK model. The arithmetic mean for lead in surface soil (366 mg/kg) was used in the model for the maintenance worker and the arithmetic mean for lead in total soil (251 mg/kg) was used in the models for the remaining potential receptors. The lead modeling predicts the probability of the receptors to have blood levels of 10 microgram per deciliter or greater. This probability is then compared to an established threshold of 5%. The results of the lead assessments are provided below:

- Current Maintenance Worker: 4.7% probability that fetal blood levels would exceed 10 g/dL (<5%);
- Hypothetical Future Construction Worker: 13.4% probability that fetal blood levels would exceed 10 g/dL (>5%):
- Hypothetical Future Commercial Worker: 2.3% probability that fetal blood levels would exceed 10 g/dL (<5%): and
- Hypothetical Future Child resident: 69.4% probability that child blood levels would exceed 10 g/dL (>5%).

The results of the lead modeling predicted the probability of the receptors for Area B expected to have blood levels of 10 microgram per deciliter or greater were below the established threshold of 5% with the exception of the hypothetical future construction worker and hypothetical future child resident.

6.4.2 Iron Margin of Exposure Evaluation

Because iron concentrations in soil resulted in an HQ of 0.5 or higher for the hypothetical future child resident at both Area A and Area B, a "margin of exposure evaluation" was conducted for the sites. This evaluation consists of a comparison of estimated intake of iron to the RDA and concentrations known to cause adverse health effects in children (USEPA 2001a).

For the margin of exposure evaluation, the estimated iron intakes at the sites for a hypothetical future resident child scenario for surface soil and total soil are calculated using the assumptions and equations provided in Appendices E.1 and E.2 for Area A and Area B, respectively. These estimated iron intake levels are then compared to the RDA for children (6 months to 10 years old) of 10 mg/day (NCEA 1996). In addition, using an average child weight of 15 kg (USEPA 1989b), the child intakes for surface soil and total soil are calculated and compared to the calculated provisional (risk reference dose) RfD of 0.7 mg/kg-day. The results of the margin of exposure evaluation are summarized in the table below.

Results of Iron Margin of Exposure Evaluation

	Iron EPC (mg/kg)	RDA Evaluation			Provisional Risk Reference Dose (RfD) Evaluation		
		Child Daily Intake Estimate (mg/day)	RDA (mg/day)	Result	Child Daily Intake (mg/kg-day)	Calculated Provisional RfD (mg/kg-day)	Result
Area A- Total Soil	19,503	3.7	10	<RDA	0.25	0.7	<RfD
Area B-Total Soil	20,993	4	10	<RDA	0.27	0.7	<RfD

The iron exposure assessment results for the hypothetical future child resident were below the applicable iron margin of exposure screening criteria for both Area A and Area B.

6.4.3 Background

Statistical evaluations were conducted to compare metals concentrations in soil at Areas A and B to background concentrations presented in the RFAAP Facility-Wide Background Study Report (IT 2001). These evaluations followed the procedures outlined in the USEPA *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (USEPA 2002a) and included distribution testing of site data sets (Shapiro-Wilk's method) and background data sets (Shapiro-Francia), evaluation of data using descriptive summary statistics, and comparisons of site data to background. At Areas A and B, distribution testing showed that site data sets and background data sets in each case were not normal; and therefore, consistent with Section 4.1 of the above referenced USEPA guidance, comparisons of site to background were conducted using non-parametric testing rather than attempting to transform the data sets logarithmically. Wilcoxon rank sum tests were conducted for each metal with background data sets to evaluate whether site concentrations were consistently higher or lower than the background data set. Appendix C.9 presents results of the statistical evaluations.

Based on the background evaluations presented in Appendix C.9, COPCs identified for Area A that exceed background include aluminum and lead for surface soil and antimony and manganese for total soil. COPCs identified for Area B that exceed background include aluminum for surface soil and antimony for total soil. Note that background comparisons could not be conducted for antimony due to the number of detections in the background data set.

Further statistical evaluations of the nature of aluminum and manganese concentrations at Area A was conducted given the apparent lower concentrations of these chemicals within the disposal unit area compared with background areas outside of the site fence and disposal area. Statistical evaluations of aluminum (surface) and manganese (total) soil data at Area A were conducted to evaluate whether concentrations of these chemicals within the disposal unit area (i.e., soil samples collected inside the fence) tended to be consistently higher than background concentrations outside of the fence and disposal area. A non-parametric Mann Whitney Wilcox Test was conducted given the non normal distribution of aluminum and manganese from inside and outside the disposal area, respectively. The results of these evaluations indicated that the concentrations of aluminum and manganese for the sample distributions from within the disposal unit area were consistently lower than the concentrations of aluminum and manganese for the background sample distributions outside of the fence and disposal unit area. Appendix C.9 presents the results of these additional statistical evaluations. Based on the results of these evaluations, the concentrations of aluminum in surface soil and manganese for total soil within the

disposal area were considered to be within the background range for the site area and not related to site waste disposal activities.

6.5 UNCERTAINTIES

Risk assessments involve the use of assumptions, judgments, and incomplete data to varying degrees that contribute to the uncertainty of the final estimates of risk. Uncertainties result both from the use of assumptions or models in lieu of actual data and from the error inherent in the estimation of risk related parameters and may cause risk to be overestimated or underestimated. Based on the uncertainties described below, this risk assessment should not be construed as presenting an absolute estimate of risk to persons potentially exposed to COPCs.

Consideration of the uncertainty attached to various aspects of the risk assessment allows better interpretation of the risk assessment results and understanding of the potential adverse effects on human health. In general, the primary sources of uncertainty are associated with environmental sampling and analysis, selection of chemicals for evaluation, toxicological data, and exposure assessment. The effects of these uncertainties on the risk estimates are discussed below.

6.5.1 Environmental Sampling and Analysis

If the samples do not adequately represent media at Area A and Area B, hazard/risk estimates could be overestimated or underestimated. The sampling and analysis plan was designed to investigate anticipated areas of contamination and delineate area(s) of concern at Areas A and B. Therefore, there is less chance that the hazard/risk estimates are biased low. Also, if the analytical methods used do not apply to some chemicals that are present at each area, risk could be underestimated. Because the analytical methods at the site were selected to address all chemicals that are known or suspected to be present on the basis of the history of each area, the potential for not identifying a COPC is reduced.

Uncertainty in environmental chemical analysis can stem from several sources including errors inherent in the sampling or analytical procedures. Analytical accuracy errors or sampling errors can result in rejection of data, which decreases the available data for use in the HHRA, or in the qualification of data, which increases the uncertainty in the detected chemical concentrations. There is uncertainty associated with chemicals reported in samples at concentrations below the method reporting limit but still included in data analysis and with those chemicals qualified "J" indicating that the concentrations are estimated. Another issue involves the amount of blank related (i.e., B-qualified) data in the data set. These data were retained in the HHRA without modification. The inclusion of "B" qualified data in the risk assessment may overestimate risk.

Another uncertainty associated with sampling and analysis concerns the inclusion of chemicals that are potentially present in the environment due to anthropogenic sources. For example, PAHs are considered ubiquitous in soil from anthropogenic sources, such as the burning of fossil fuels, forest fires, and airborne particulates eroded from roadways and automobile tires. If such chemicals are not site-related, the risks associated with the site may be overestimated. This uncertainty may have a low-to-moderate effect on overestimating risks.

6.5.2 Selection of Chemicals for Evaluation

A comparison of maximum detected chemical concentrations to USEPA Region III RBCs was conducted for both surface and subsurface soil. Chemicals whose maximum concentrations were below their respective RBCs were not carried through the assessment. It is unlikely that this risk based screening excluded chemicals that should be included, based on the conservative exposure assumptions and conservatively derived toxicity criteria that are the basis of the RBCs. Although following this methodology does not provide a quantitative risk estimate for every chemical, it focuses the assessment on the chemicals accounting for the greatest risks (i.e., chemicals whose maximum concentrations exceed their respective RBCs) and the cumulative risk estimates would not be expected to be significantly

greater. As presented on the non-detect MDL screening tables in Appendices E.1 (Area A), Tables E.1-2.3 and E.1-2.5, and E.2 (Area B), Tables E.2-2.3 and E.2-2.5 (Area B), the maximum MDL exceeded the adjusted RBCs for several chemical in soil and groundwater; therefore, the site-related risks and hazards could be underestimated for the risk assessments due to inadequate detection limits.

Background concentrations of metals in soil at RFAAP have been characterized and are used in statistical comparisons to site soil to evaluate whether concentrations of metals detected at Area A and Area B are consistently higher or lower than background. However, the background data obtained may not fully characterize naturally occurring metals level in the floodplain alluvium or levels occurring in offsite fill used at the site. Uncertainties associated with the use of these data may lead to a low-to-moderate overestimation or underestimation of surface and total soil risks due to metals.

Screening criteria are derived from RDAs for essential human dietary minerals, trace elements, and electrolytes that are toxic at very high doses (i.e., calcium, magnesium, potassium, and sodium). Omitting these essential human nutrients from further evaluation is expected to have a low effect on risk and hazard estimates.

6.5.3 Exposure Assessment

The primary areas of uncertainty affecting exposure parameter estimation involve the assumptions regarding exposure pathways, the estimation of exposure point concentrations, and the exposure parameters used to estimate chemical doses.

An underlying assumption in the HHRA is that individuals at the site would engage in activities that result in exposures via each selected pathway. For example, it was assumed that maintenance workers engage in regular activities (once a week) under current and future land use conditions resulting in exposure to COPCs. This assumption is conservative, in that it is more likely that the activity patterns occur occasionally.

The inhalation of aluminum and manganese by the construction worker receptor is responsible for the non-cancer hazard estimates for Areas A and B. The construction worker evaluation assumes that active excavation activities will occur for 250 days out of a year over 5-workday workweeks with 8-hour workdays. It is unlikely that excavation activities will occur given the small size of Area A and B and the proposed future land uses of the site as a maintained grassy area. Also, Areas A and B fall within the floodplain and are not likely to be developed. The inhalation cancer risk/non-cancer hazard estimates are likely overestimated in the HHRA. There is generally a higher level of uncertainty associated with the use of modeled concentrations (i.e., PEF) than in the use of measured concentrations if valid measurement data are available for the exposure medium and exposure location.

In establishing EPCs, the concentrations of chemicals in the media evaluated are assumed to remain constant over time. Depending on the properties of the chemical and the media in which it was detected, this assumption could overestimate risks, depending on the degree of chemical transport to other media or the rate and extent a chemical degrades over time.

When calculating EPCs from sample data, one half of the MDL was sometimes used for non-detect samples in the calculation of the 95% UCL of the mean. Approaches which substitutes values for non-detected chemical concentrations are associated with uncertainty, because chemicals that were not detected at the specified sample MDL may be absent from the medium or may be present at a concentration below the sample MDL. The uncertainty of the exposure point concentration will increase as the number of non-detects in a data set increases and the uncertainty could result in either the overestimation or underestimation of EPCs.

The 95% UCL is used as the EPC for each medium if at least five samples are available. If the 95% UCL exceeds the maximum detected value or if fewer than five samples are available, the maximum is conservatively used as a default EPC. Using a value that is based on one sampling location (i.e., the

maximum) has associated uncertainty and it adds a great deal of conservatism to the assessment. The 95% UCL was used as the EPC for each chemical in all media at Areas A and B. Therefore, the cancer risk/non-cancer hazard estimates are not likely to be biased high.

The exposure parameters used to describe the extent, frequency, and duration of exposure are associated with uncertainty. Actual risks for individuals within an exposed population may differ from those predicted, depending upon their actual intake rates (e.g., soil ingestion rates), nutritional status, or body weight. Exposure assumptions were selected to produce an upper bound estimate of exposure in accordance with USEPA guidelines regarding evaluation of potential exposures at Superfund sites (e.g., exposures were assumed to occur for 25 years for workers). In addition, many USEPA (1991a) default exposure parameters are highly conservative and are based on risk management interpretations of limited data. For example, although current USEPA guidance recommends default soil ingestion rates of 100 mg/day for individuals over 6 years of age, other studies, such as Calabrese et al. (1990), have shown that the USEPA default soil ingestion rate of 100 mg/day is likely to greatly overestimate adult exposures and risks. In addition, chemicals in soil are assumed 100% bioavailable; this assumes that ingested chemicals present in a soil matrix are absorbed through the gastrointestinal (GI) tract, which is unlikely due to the affinity of contaminants for soil particles. Therefore, based on the conservative exposure assumptions used in the HHRA, exposures and estimated potential risks are likely to be overestimated for the ingestion of soil pathways.

Evaluation of the dermal absorption exposure pathway is affected by uncertainties in dermal exposure parameters. For example, there is uncertainty associated with the exposed skin surface areas used, since the choice of exposed body parts could slightly overestimate or underestimate risks. Uncertainties that are more significant are associated with the selection and use of dermal absorption factors. For this HHRA, the dermal absorption factors and calculations were based on USEPA Region III guidance, USEPA's *Risk Assessment Guidance for Superfund (RAGS): Part E, Supplemental Guidance for Dermal Risk Assessment* (USEPA 2004b). Very limited information is available on dermal absorption of chemicals from contacted soil under environmental conditions. In fact, there are not actual human epidemiological data to support the hypothesis that absorption of soil bound compounds under exposure conditions is a complete route of exposure. For example, the Public Health Statements from the Agency for Toxic Substance Disease Registry (ATSDR 1999b) indicates cadmium is not known to result in human health effects by dermal absorption because virtually zero cadmium can enter the body through the skin under normal circumstances (i.e., without exposure to very high concentrations for long periods or exposure to skin that is damaged (ATSDR 1999a). Therefore, using the dermal absorption factors to evaluate dermal absorption exposures to soil may result in an overestimation of risks.

6.5.4 Toxicological Data

The HHRA relies on USEPA derived dose response criteria. These health effects criteria are conservative and are designed to be protective of sensitive subpopulations. The health criteria used to evaluate long-term exposures, such as RfDs or CSFs, are based on concepts and assumptions that bias an evaluation in the direction of overestimation of health risk. As USEPA notes in its *Guidelines for Carcinogenic Risk Assessment* (USEPA 1986a), there are major uncertainties in extrapolating both from animals to humans and from high to low doses. There are important species differences in uptake, metabolism, and organ distribution of carcinogens, as well as species and strain differences in target site susceptibility, human populations are variable with respect to genetic constitution, diet, occupational and home environment, activity patterns, and other cultural factors.

These uncertainties are compensated for using upper bound 95% UCLs for CSFs (carcinogens), and safety factors for RfDs (non-carcinogens). The assumptions used here provide a rough but plausible estimate of the upper limit of risk; in other words, it is not likely that the true risk would be much more than the estimated risk, but it could very well be considerably lower, even approaching zero. More

refined modeling in the area of dose response calculation (e.g., using maximum likelihood dose response values rather than the 95% UCL) would be expected to substantially lower the final risk.

For dermal absorption exposure pathways, the absence of dermal toxicity criteria necessitates the use of oral toxicity data. To calculate risk estimates for the dermal absorption pathway, absorbed dermal absorption doses are combined with oral toxicity values (also discussed above in Section 6.3). Oral toxicity values, which are typically expressed in terms of potential (or administered) doses, should be adjusted when assessing dermal absorption doses, which are expressed as internal (or absorbed) doses. In this assessment, absolute oral absorption factors that reflect the toxicity study conditions were used to modify the oral toxicity criteria. For those chemicals lacking sufficient information, a default oral absorption factor of 1.0 was used. The risk estimates for the dermal absorption pathways may be overestimated or underestimated, depending on how the values used in the HHRA reflect the difference between the oral and dermal routes.

Inhalation toxicity criteria are unavailable for many of the COPCs. This HHRA does not use oral-based toxicity criteria to estimate risks from inhalation exposure because of the following uncertainties associated with such a substitution:

- Many contaminants show portal-of-entry toxicity – that is, adverse health effects occur primarily at the tissue site at which the chemical is introduced into the body (e.g., GI tract, lung, or skin). For example, orally administered benzo(a)pyrene is associated with benign and malignant tumors in the gut mucosa (Neal and Rigdon 1967), but inhaled benzo(a)pyrene produces an increased incidence of upper respiratory tract tumors (Thyssen et al. 1981). Therefore, quantitative risk estimates based on these two administration routes are dissimilar;
- Physiological and anatomical differences between the GI tract and respiratory systems invalidate a cross-route quantitative risk extrapolation. The small intestine of humans contains a very large surface area that readily absorbs most compounds by passive diffusion (Klaasen et al. 1986). The oral absorption of a few compounds, such as iron, is an energy-dependent (active-transport) process, wherein; the absorption rate is proportional to the body's current need for iron;
- The rate and extent of pulmonary absorption are much more complex and depend on such factors as particle size distribution of the airborne toxicant and blood-gas solubility of the toxicant (Klaasen et al. 1986). Particles with median aerodynamic diameters of approximately 1 micrometer (μm) or less are absorbed by the alveolar region of the human lung. Larger particles deposit in the tracheobronchial or nasopharyngeal regions where they are cleared by mucociliary mechanisms and subsequently swallowed or physically removed and exhaled. Therefore, pulmonary absorption is more highly dependent on the physiochemical properties of the material than oral absorption;
- Because highly soluble gases (e.g., chloroform) are more rapidly absorbed into the blood than poorly soluble gases (e.g., ethylene), they take much longer to reach equilibrium. Thus, the inhalation absorption rate of a gas is more dependent on blood solubility than the oral absorption rate of the same substance administered as a liquid; and
- Human inhalation risk estimates based on oral toxicity data in subhuman species are distorted by both route-to-route extrapolation and interspecies extrapolation. For example, the rodent GI tract, which includes a structurally unique fore stomach, is anatomically and functionally distinct from the human lung, which contains a very large alveolar surface area for extensive absorption. The rate and extent of absorption across these distinct physiological systems are not alike.

In addition, for inhalation exposure to substances present as dusts, vapors, gases, or airborne particulate matter, dose extrapolation is far more complex, and therefore associated with uncertainty. The major confounding factors that prohibit a direct dose extrapolation of an inhaled toxicant are the following:

- Over 40 functionally different cell types in the lung – the distribution, consequent metabolic reactions, and air exchange rates vary widely across species;
- Differential concentration and activity of the detoxifying protein glutathione;
- Interspecies and intraspecies differences in the ability to repair pulmonary cell damage, and to clear toxic contaminants and immune complexes from the respiratory tract. For example, species vary in the ability to activate macrophages – nonspecific immune cells that can both protect the inner lining of the respiratory system and, at high concentrations, damage healthy tissues;
- Anatomical variations in the respiratory pathway, which affect both absorption rates and time to reach steady-state blood levels; and
- Sensitivity to solubility and concentration variables; because of metabolic saturation (i.e., the exhaustion of normal metabolic activity caused by exposure to high concentrations), highly soluble contaminants deviate from first-order kinetics – which makes it difficult to predict the rates and extent of biotransformation and detoxification reactions. Furthermore, intermittent inhalation exposure to highly blood-soluble chemicals results in bioaccumulation in fat tissue because of the insufficient time between exposure sessions for complete clearance of the contaminant. Such slow release from the fat compartment to other body tissues can result in toxicological and metabolic effects that are difficult to assess and vary across species.

For chemicals without Integrated Risk Information System (IRIS) toxicity criteria, provisional toxicity criteria were used where available (Appendices E.1 and E.2 - Tables E.1-5.1 through E.1-6.2 and Tables E.2-5.1 through E.2.6.2). Provisional toxicity criteria present a source of uncertainty, since USEPA has evaluated the compound, but consensus has not been established on the toxicity criteria. Provisional oral toxicity values were used for aluminum, antimony, arsenic, chromium, cobalt, copper, iron, thallium, vanadium, dimethylphthalate, heptachlor epoxide, Aroclor 1254, 2-nitroaniline, di-n-octylphthalate, 2,4-DNT, 2,6-DNT, aminodinitrotoluene, RDX, nitroglycerin, and 2,3,7,8-TCDD equivalents. Provisional inhalation toxicity values were used for aluminum, antimony, cobalt, 2-nitroaniline, benzo(a)pyrene, and 2,3,7,8-TCDD equivalents. For this assessment, use of provisional toxicity criteria was preferable to not evaluating the chemical in order to limit data gaps. However, because these toxicity criteria have not been formally accepted by USEPA, there is uncertainty with these values and, therefore, with the risks calculated using these toxicity criteria.

For some chemicals, toxicity criteria were unavailable (Appendices E.1 and E.2 - Tables E.1-5.1 through E.1-6.2 and Tables E.2-5.1 through E.2.6.2). Although lack of published toxicity data could result in an underestimation of risk, this uncertainty is likely to be balanced by the conservative nature of the verified toxicity values that were available for use.

6.5.5 Risk Characterization

Minor uncertainty is associated with rounding of the risk and hazard estimates. Thus, the actual risk or hazard may be slightly greater or less than the presented values. A related issue is that rounding causes minor differences between summed risk and hazard values, depending on how the summing is performed. For example, RAGS Table 7s in Appendix E presents risks and hazards that are summed for exposure route, exposure point, exposure medium, and medium total. Only for the first (exposure route) are the individual chemical-specific risks and hazards summed to derive the total. For the subsequent summations (exposure point, exposure medium, and medium total), each is the summation of the preceding sums. For this reason, there can also be minor rounding-related differences between the 'same' values presented in RAGS Table 9s and 10s in Appendix E.

6.6 HHRA SUMMARY AND CONCLUSIONS

This HHRA was performed to evaluate the potential human health effects associated with previous activities at the site. Two non-contiguous areas, Area A and Area B were evaluated at the site. Receptors

evaluated for both areas included: current/future maintenance worker, hypothetical future construction worker, hypothetical future commercial worker, hypothetical future adult resident, hypothetical future child resident, and hypothetical future lifetime resident.

6.6.1 Area A Summary

As presented in Section 6.4, the total risk for each receptor is below or within USEPA's target risk range for Superfund sites (1E-06 to 1E-04, USEPA 1989b). The total HIs after target organ segregation for all receptors except the hypothetical future construction worker (Central Nervous System (CNS)) and hypothetical future child resident (CNS and liver) are equal to or below the USEPA reference HI of 1E+00. The iron exposure assessment results for the hypothetical future child resident were below the applicable iron margin of exposure screening criteria for Area A. The results of the lead modeling predicted the probability of the receptors for Area A expected to have blood levels of 10 microgram per deciliter or greater were below the established threshold of 5%.

The site-related CNS HI for the hypothetical construction worker, when excluding metals hazard drivers detected below background (aluminum), is 6E+00 with manganese as the remaining hazard driver for this target organ. When considering the results site-specific background evaluations conducted for manganese (Section 6.4.3), which indicated manganese concentrations below background, the site-related CNS HI for the hypothetical future construction worker scenario is further reduced to less than 1E-01.

The site-related CNS HI for the hypothetical future child resident, when excluding metals hazard drivers in soil detected below background (aluminum), is 1.3E+00 with manganese in soil and groundwater as the remaining hazard driver for this target organ. When considering the results site-specific background evaluations conducted for manganese (Section 6.4.3), which indicated manganese concentrations below background, the site-related CNS HI for the hypothetical future child resident scenario is further reduced to 7E-01 which is below the USEPA reference of 1E+00.

The site-related liver HI for the hypothetical future child resident, when excluding metals hazard drivers in soil detected below background (iron), is 2E+00 which is above the USEPA reference HI of 1E+00 and is primarily due to 2,4,6-TNT in groundwater.

In summary for Area A, the results of the risk assessment indicate that the calculated site-related cancer risks and hazards are within USEPA target ranges for each of the receptors evaluated when considering background and target organs with the exception of the child resident (liver) due to 2,4,6-TNT in groundwater.

6.6.2 Area B Summary

As presented in Section 6.4, the total risk for each receptor is below or within USEPA's target risk range for Superfund sites (1E-06 to 1E-04, USEPA 1989b). The total HIs after target organ segregation for all receptors except the hypothetical future construction worker (CNS) and hypothetical future child resident (liver and vascular) are equal to or below the USEPA reference HI of 1E+00. The iron exposure assessment results for the hypothetical child resident were below the applicable iron margin of exposure screening criteria for Area B. The results of the lead modeling predicted the probability of the receptors for Area B expected to have blood levels of 10 microgram per deciliter or greater were below the established threshold of 5% with the exception of the hypothetical future construction worker and hypothetical future child resident.

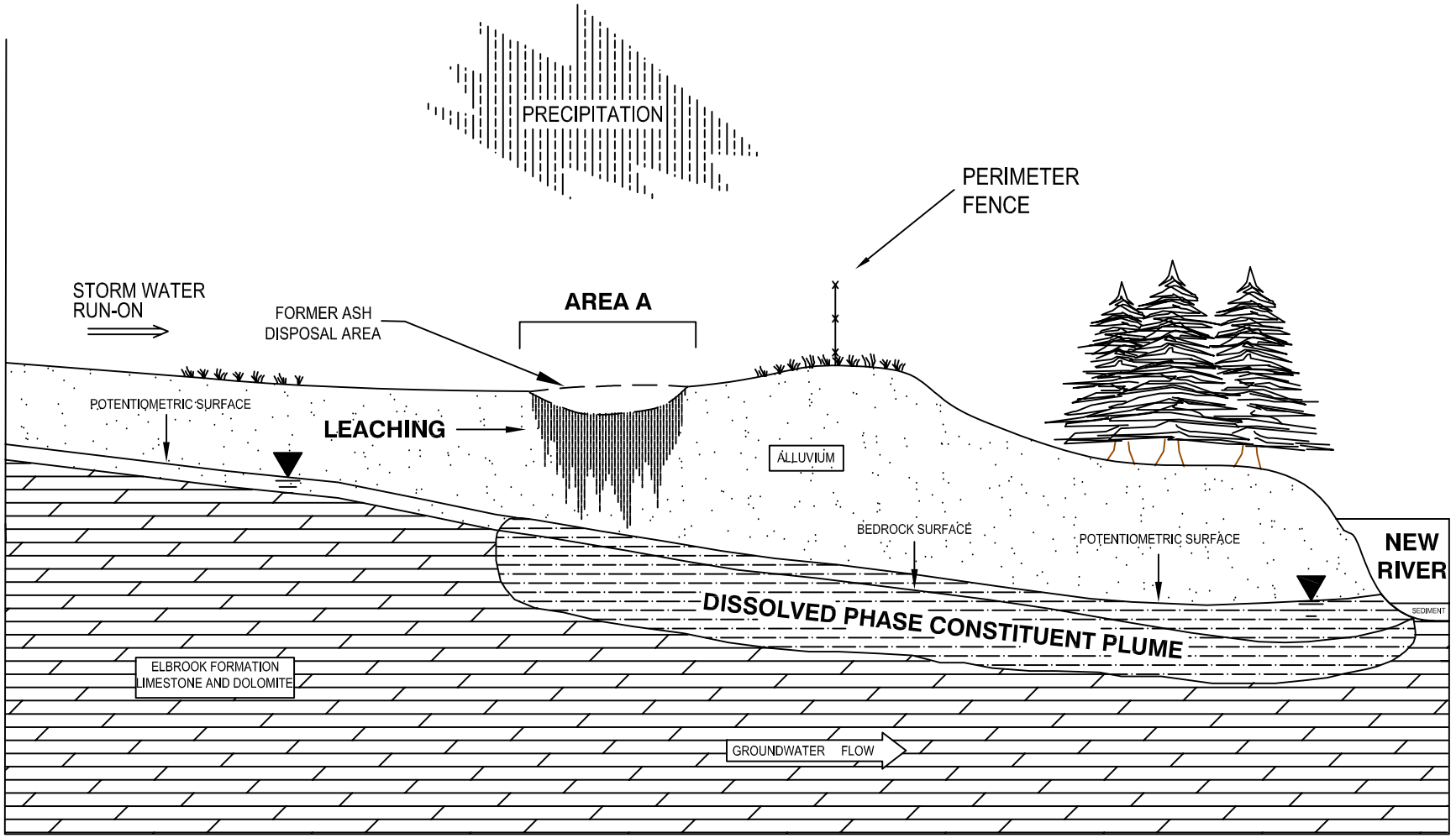
The primary hazard drivers for the elevated target organ specific CNS HI for the hypothetical future construction worker were aluminum and manganese in total soil, but both these chemicals were below background; therefore, the hazard is not considered site-related. The site-related liver HI for hypothetical future child resident, when excluding metals hazard drivers detected below background (iron), is 2E+00 due to 2,4,6-TNT in soil, which exceeds the USEPA reference HI of 1E+00. Because no metals were

identified as hazard drivers for the vascular HI for hypothetical future child resident, the HI remains 4E+00 due to nitroglycerin in soil which exceeds the USEPA reference HI of 1E+00.

The results of the lead modeling predicted the probability of the receptors for Area B expected to have blood levels of 10 microgram per deciliter or greater were below the established threshold of 5% with the exception of the hypothetical future construction worker and hypothetical future child resident. Although lead concentrations were below background for surface soil and total soil based on the background comparison, hot spots are present at a few sample locations (54SB46A, 54SB46B, and 54SB42A) within the SWMU as outlined in Section 4.3.2.1 of the nature and extent assessment and presented on Figure 4-9.

In summary for Area B, the results of the risk assessment indicate that the calculated site-related cancer risks and hazards are within USEPA target ranges for each of the receptors evaluated when considering background and target organs with the exception of the hypothetical future child resident for 2,4,6-TNT (liver) and nitroglycerin (vascular) in total soil. Lead concentrations also pose a potential risk to the hypothetical future construction worker and hypothetical future child resident due to hot spots present within the SWMU.

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CONCEPTUAL DRAWING - NO SCALE IMPLIED

FIGURE 6-1

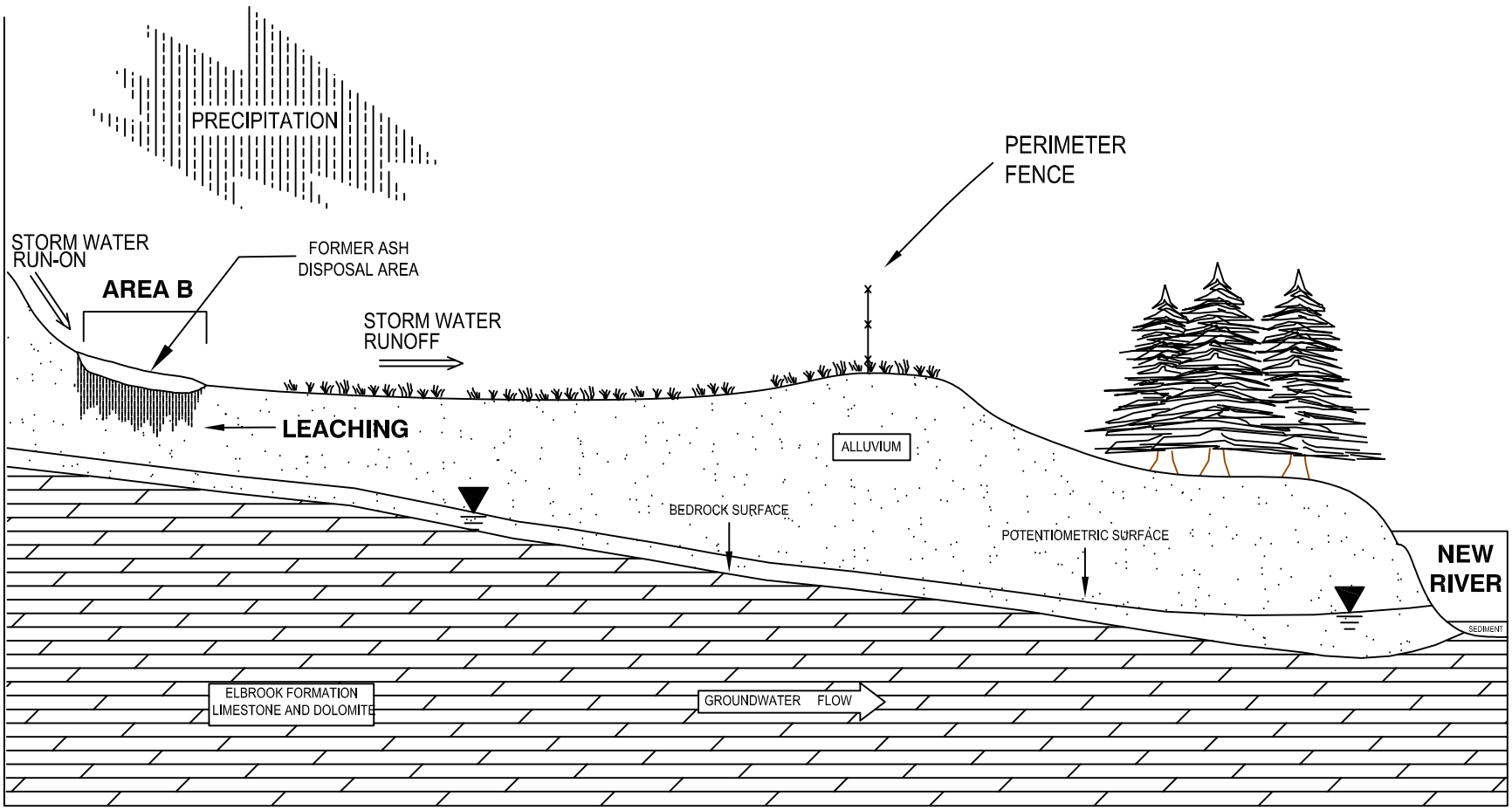
Conceptual Site Model
Area A

Date: August 2005	URS Project #: 21354893
Prepared by: DBC	Approved by: JOS
Scale: Not to Scale	File Name: Fig. 17

SWMU 54

RCRA Facility Investigation
Radford Army Ammunition Plant
Radford, Virginia

URS Group, Inc.
5540 Falmouth Street
Suite 201
Richmond, Virginia 23230



CONCEPTUAL DRAWING - NO SCALE IMPLIED

FIGURE 6-2

Conceptual Site Model
Area B

Date: February 2006	URS Project #: 21354893
Prepared by: DBC	Approved by: JOS
Scale: Not to Scale	File Name: Fig. 18

SWMU 54

RCRA Facility Investigation
Radford Army Ammunition Plant
Radford, Virginia

URS Group, Inc.
5540 Falmouth Street
Suite 201
Richmond, Virginia 23230

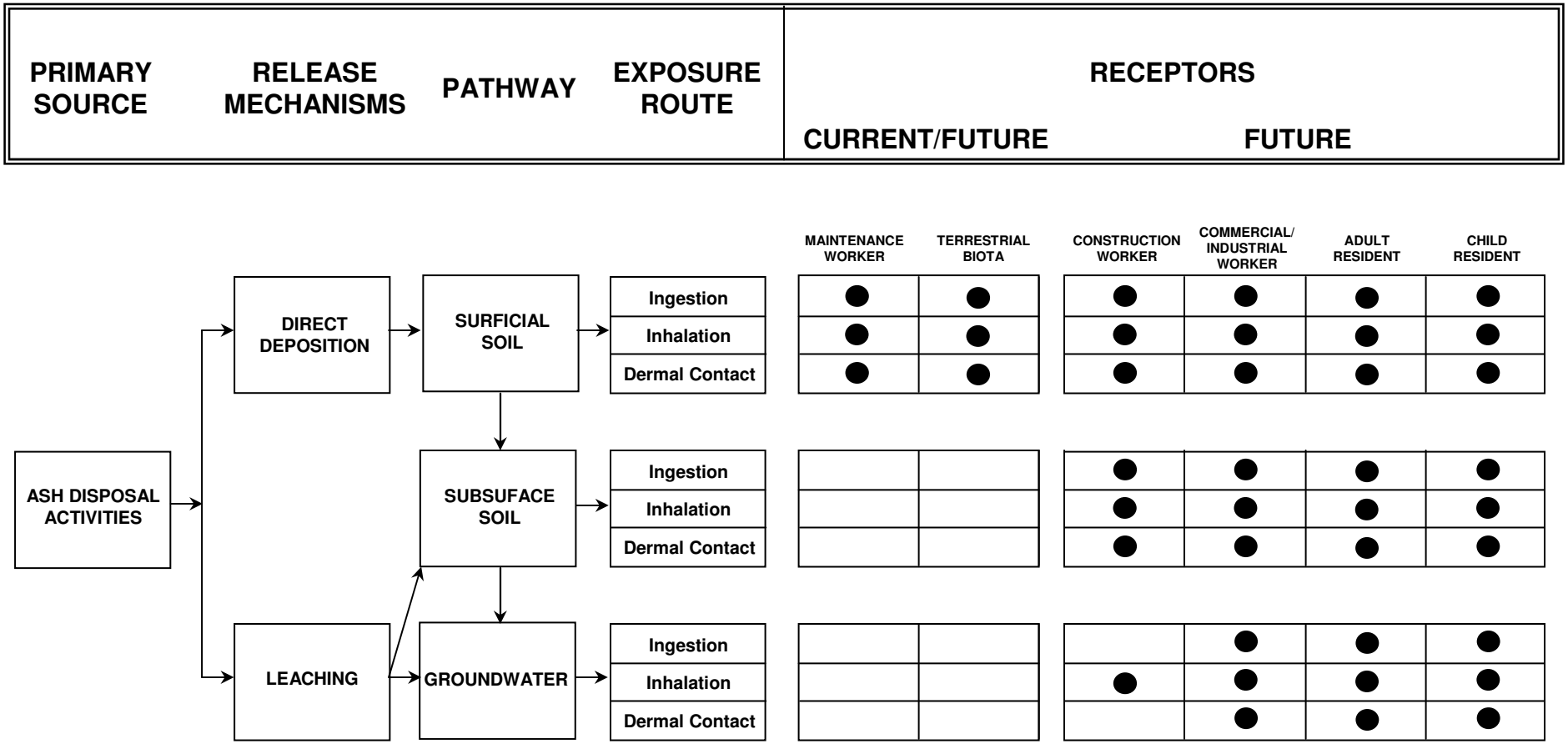


FIGURE 6-3

Conceptual Site Diagram

SWMU 54 RFI Report

Date: *Dec 2007*	**Prepared by:** *CLD*
Scale: *Not to Scale*	**Job Number:** *21354887*

URS

URS Group, Inc.
5540 Falmouth Street,
Suite 201
Richmond, VA 23230

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Table 6-1
Sample Assemblages Surface and Subsurface Soil for COPC Screening
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Area A				
Surface Soil				
54SB3A	54SB22A	54SB29A	54SB36A	54SB82A
54SB10A	54SB23A	54SB30A	54SB37A	54SB83A
54SB17A	54SB24A	54SB31A	54SB38A	54SB84A
54SB18A	54SB25A	54SB32A	54SB57A	
54SB19A	54SB26A	54SB33A	54SB58A	
54SB20A	54SB27A	54SB34A	54SB61A	
54SB21A	54SB28A	54SB35A	54SB81A	
Subsurface Soil				
54SB3B	54SB23B	54SB30B	54SB37B	54SB83B
54SB10B	54SB24B	54SB31B	54SB38B	54SB84B
54SB17B	54SB25B	54SB32B	54SB57B	54SB3C
54SB18B	54SB26B	54SB33B	54SB58B	54SB10C
54SB19B	54SB27B	54SB34B	54SB61B	54SB22C
54SB20B	54SB28B	54SB35B	54SB81B	54SB27C
54SB21B	54SB29B	54SB36B	54SB82B	54SB84C
54SB22B				
Samples Collected Outside Fence Excluded from HHRA				
54SB56A	54SB67A	54SB62B	54SB69B	54SB64C
54SB59A	54SB68A	54SB63B	54SB70B	54SB65C
54SB60A	54SB69A	54SB64B	54SB56C	54SB66C
54SB62A	54SB70A	54SB65B	54SB59C	54SB67C
54SB63A	54SB56B	54SB66B	54SB60C	54SB68C
54SB64A	54SB59B	54SB67B	54SB62C	54SB69C
54SB65A	54SB60B	54SB68B	54SB63C	54SB70C
54SB66A				
Samples Collected at a Depth >15' Excluded from HHRA				
54SB23C	54SB81C			
54SB32C	54SB82C			
54SB34C	54SB83C			
54SB38C				
54SB57C				
54SB58C				
54SB61C				
Area B				
Surface Soil				
54SB39A	54SB46A	54SB53A	54SB75A	
54SB40A	54SB47A	54SB54A	54SB77A	
54SB41A	54SB48A	54SB55A	54SB78A	
54SB42A	54SB49A	54SB71A	54SB79A	
54SB43A	54SB50A	54SB72A	54SB80A	
54SB44A	54SB51A	54SB73A		
54SB45A	54SB52A	54SB74A		
Subsurface Soil				
54SB39B	54SB49B	54SB74B	54SB43C	54SB73C
54SB40B	54SB50B	54SB75B	54SB45C	54SB74C
54SB41B	54SB51B	54SB77B	54SB46C	54SB75C
54SB42B	54SB52B	54SB78B	54SB47C	54SB76C
54SB43B	54SB53B	54SB79B	54SB49C	54SB77C
54SB44B	54SB54B	54SB80B	54SB50C	54SB78C
54SB45B	54SB55B	54SB39C	54SB53C	54SB79C
54SB46B	54SB71B	54SB40C	54SB54C	54SB80C
54SB47B	54SB72B	54SB41C	54SB71C	
54SB48B	54SB73B	54SB42C	54SB72C	
Samples Collected at a Depth >15' Excluded from HHRA				
54DB44C				
54SB51C				

Table 6-2
Sample Assemblages Groundwater for COPC Screening
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Area A			
Sampling Date	**Monitoring Wells Sampled**	**Sampled Analytes**	**Detected Analyte Classes Used in COPC Screening for HHRA**
March 2003	54MW2 (D), 54MW3 (D), and 54MW5 (U)	TAL metals and mercury (total and dissolved), TCL SVOCs, PAHs, explosives, nitroglycerin, and perchlorate	TCL SVOCs, PAHs, and TAL metals and mercury (total and dissolved)
December 2004	54MW8 (D), 54MW9 (D), and 54MW10 (D)	Manganese (total and dissolved), explosives, nitroglycerin, and perchlorate	Manganese (total and dissolved)
November/ December 2006	54MW1 (U), 54MW2 (D), 54MW3 (D), 54MW5 (U), 54MW8 (D), 54MW9 (D), and 54MW10 (D)	Explosives, perchlorate, pesticides, PCBs, and dioxin/furans[1]	Dioxin/furans
March 2007	54MW1 (U), 54MW2 (D), 54MW3 (D), 54MW5 (U), 54MW8 (D), 54MW9 (D), and 54MW10 (D)	Explosives and perchlorate	None[2]
June 2007	54MW1 (U), 54MW2 (D), 54MW3 (D), 54MW5 (U), 54MW8 (D), 54MW9 (D), and 54MW10 (D)	Explosives and perchlorate	Explosives and perchlorate[3]
Area B			
Sampling Date	**Monitoring Wells Sampled**	**Sampled Analytes**	**Detected Analyte Classes Used in COPC Screening for HHRA**
March 2003	54MW4 (D), 54MW7 (D), and 54MW6 (U)	TAL metals and mercury (total and dissolved), TCL SVOCs, PAHs, explosives, nitroglycerin, and perchlorate	TCL SVOCs, PAHs, and TAL metals and mercury (total and dissolved)
November/ December 2006	54MW4 (D), 54MW7 (D), and 54MW6 (U)	Explosives, perchlorate, pesticides, PCBs, and dioxin/furans	None[2]
March 2007	54MW4 (D), 54MW7 (D), and 54MW6 (U)	Explosives and perchlorate	None[2]
June 2007	54MW4 (D), 54MW7 (D), and 54MW6 (U)	Explosives, perchlorate, and dioxin/furans	Explosives, perchlorate, and dioxin/furans[3]

Notes:

(U) = Upgradient Well

(D) = Downgradient Well

[1] = Dioxin/furans samples collected at 54MW1, 54MW2, and 54MW3

[2] = Most recent data for explosives, perchlorate, and dioxin/furans used for COPC screening
Data used in nature and extents assessment to demonstrate trends

[3] = Most recent data for explosives, perchlorate, and dioxin/furans used for COPC screening

Table 6-3A
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB23A [(C)] 12/3/2002 0-1		54SB23B [(C)] 12/3/2002 9-10		54SB23C 1/12/2007 16-17		54SB25A 12/3/2002 0-1		54SB25B 12/3/2002 9-10	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	326		156		169		1500	J,c	112	J,c
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	0.0003	0.491	A	<0.952	U	<1.03	U	15.8	J,c	3.7	J,J,c
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	6.12		2.94	A	2.95	A	34.4		7.4	
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	0.322	A	<0.476	U	<0.517	U	3.8	J	0.85	MJ
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	<0.536	U	<0.476	U	<0.517	U	<5		<5	
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	0.109	A	<0.476	U	<0.517	U	<5		<5	
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	<0.536	U	<0.476	U	<0.517	U	<5		0.45	J
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	0.142	A	<0.476	U	<0.517	U	0.57	MJ	<5	
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	<0.536	U	<0.476	U	<0.517	U	<5		0.15	MJ
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	0.215	A	<0.476	U	<0.517	U	<5		<5	
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	<0.536	U	<0.476	U	<0.517	U	<5		<5	
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	<0.536	U	<0.476	U	<0.517	U	<5		<5	
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	0.088	A,J,w	<0.476	U	<0.517	U	<5		<5	
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	<0.536	U	<0.476	U	<0.517	U	<5		<5	
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	0.103	A,B,z	<0.476	U	<0.517	U	<5		<5	
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	0.204	A,J,w	<0.243	U	<0.288	U	<1		<1	
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	0.44	A,B,z	0.488	A,B,z	0.571	A,B,z	<1		0.87	J,R,p
Total 2,3,7,8-TCDD Equivalents	--	C	4.3E+00	1.9E+01	8.6E+00		0.416		0.076		0.080		0.894		0.177	

Table 6-3A
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB27A [(D)] 12/3/2002 0-1		54SB27B [(D)] 12/3/2002 9-10		54SB27C 1/10/2007 14.3-15.3		54SB30A 12/3/2002 0-1		54SB30B 12/3/2002 9-10	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	4,220	E,J,q	215		95.4		122	J,c	99.7	J,c
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	0.0003	23.3		<0.961	U	<0.905	U	<10		<9.9	
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	69.4		3.33	A	1.34	A	6		4.3	J
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	7.12		<0.48	U	<0.453	U	0.9	MJ	<5	
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	0.47	A	<0.48	U	<0.453	U	<5		<5	
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	0.523	A	<0.48	U	<0.453	U	<5		<5	
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	0.513	A	<0.48	U	<0.453	U	<5		<5	
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	1.44	A	<0.48	U	<0.453	U	<5		<5	
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	0.345	A	<0.48	U	<0.453	U	<5		<5	
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	1.13	A	<0.48	U	<0.453	U	<5		<5	
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	0.151	A	<0.48	U	<0.453	U	<5		<5	
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	0.326	A	<0.48	U	<0.453	U	<5		<5	
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	0.279	A	<0.48	U	0.0742	A	<5		<5	
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	0.376	A	<0.48	U	<0.453	U	<5		<5	
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	0.406	A	<0.48	U	0.0778	A	<5		<5	
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	<0.258	U	<0.24	U	<0.0954	U	<1		<1	
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	0.511	A,B,z	0.363	A,B,z	0.348	A,B,z	<1		<1	
Total 2,3,7,8-TCDD Equivalents	--	C	4.3E+00	1.9E+01	8.6E+00		2.947		0.098		0.068		0.106		0.073	

Table 6-3A
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB32A 12/3/2002 0-1		54SB32B 12/3/2002 9-10		54SB33A [B] 12/3/2002 1-2		54SB33B 12/3/2002 9-10		54SB34A [D] 12/3/2002 0-1	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	530	J,c	663	J,c	3,040	J,c	62	J,c	132	
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	0.0003	28.5	J,c	38.5	J,c	163	J,c	<10		<0.964	U
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	66.8		82.7		331		1	MJ	1.69	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	14.3		15.7		58.6		<5		0.112	A,J,w
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	1.1	J	1.5	J	5.5		<5		<0.482	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	1.3	J	1.4	J	4.6	J	<5		<0.482	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	4.8	J	4	J	9.6		<5		<0.482	U
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	4	J	3.8	J	19.6		<5		<0.482	U
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	1.8	MJ	1.8	J	3.5	MJ	<5		<0.482	U
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	4.4	J	4.2	J	17.8		<5		<0.482	U
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	<5		0.42	J	1.4	J	<5		<0.482	U
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	1.4	J	1.2	J	3.6	J	<5		<0.482	U
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	1.8	J	2.4	J	2.2	J	<5		0.0656	A
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	2.2	J	2.2	J	5		<5		<0.482	U
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	2.8	J	3.3	J	3.8	J	<5		0.0887	A
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	0.33	J	0.51	J	0.83	J	<1		<0.0964	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	2		2.6		2.9		<1		0.345	A,B,z
Total 2,3,7,8-TCDD Equivalents	--	C	4.3E+00	1.9E+01	8.6E+00		5.664		6.023		16.988		0.029		0.086	

Table 6-3A
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB34B [(D)] 12/3/2002 9-10		54SB34C 1/10/2007 18.5-19.5		54SB38A [(D)] 12/4/2002 0-1		54SB38B [(D)] 12/4/2002 9-10		54SB38C DUP AVG 1/11/2007 16-17	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	374		371		766		152		242.5	
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	0.0003	0.263	A	<1.11	U	8.32	A	<1.73	U	0.473	A
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	6.02		7.11		25.6		2.01	A	3.435	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	<0.448	U	0.233	,B,z	2.88	A	<0.465	U	0.17175	A,B,z
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	<0.448	U	<0.554	U	0.18	A	<0.465	U	<0.465	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	0.118	A	<0.554	U	0.319	A	<0.465	U	<0.465	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	<0.448	U	<0.554	U	0.239	A	<0.465	U	<0.465	U
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	0.15	A	0.184	A,J,w	0.666	A	<0.465	U	<0.465	U
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	<0.448	U	<0.554	U	0.19	A	<0.465	U	<0.465	U
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	0.269	A	0.284	A	0.701	A	<0.465	U	0.126	A,J,w
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	0.131	A,J,w	0.16	A	0.0879	A	<0.465	U	<0.465	U
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	<0.448	U	<0.554	U	<0.511	U	<0.465	U	<0.465	U
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	0.0788	A,B,z	0.0821	A,B,z	0.151	,J,w	<0.465	U	<0.465	U
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	0.0573	A	<0.554	U	0.219	A	<0.465	U	<0.465	U
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	0.0913	,J,w	0.115	A,B,z	0.217	A,B,z	<0.465	U	<0.465	U
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	<0.0931	U	<0.111	U	<0.102	U	<0.226	U	<0.093	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	0.491	A,B,z	0.517	A,B,z	0.554	A,B,z	0.394	A,B,z	0.3735	A,B,z
Total 2,3,7,8-TCDD Equivalents	--	C	4.3E+00	1.9E+01	8.6E+00		0.272		0.245		0.766		0.066		0.120	

Table 6-3A
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB58A [D] 8/17/2004 0-1		54SB58B [D] 8/17/2004 9-10		54SB58C DUPAVG [D] 8/17/2004 16-18		54SB82A 1/12/2007 0-0.5		54SB82B 1/12/2007 9-10	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	151		142		262.5		122		251	,J,m
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	0.0003	1.36	A	<0.963	U	<1.03	U	<0.997	U	<0.949	U
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	6.83		2.77	A	4.49	A	1.87	A,B,z	4	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	1.02	A	0.143	A,J,w	0.152	A,B,z	0.114	A	0.275	A
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	<0.468	U	<0.481	U	<0.502	U	<0.498	U	<0.474	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	0.152	A	<0.481	U	<0.502	U	<0.498	U	<0.474	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	0.15	A	<0.481	U	<0.502	U	<0.498	U	0.0531	A
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	0.259	A	<0.481	U	0.2005	A	<0.498	U	0.123	A
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	0.148	A,J,w	<0.481	U	<0.502	U	<0.498	U	0.0436	A,J,w
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	0.333	A,J,w	<0.481	U	0.2685	A	<0.498	U	0.184	A
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	<0.468	U	<0.481	U	<0.502	U	<0.498	U	0.0626	A
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	<0.468	U	<0.481	U	<0.502	U	<0.498	U	0.0683	A
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	0.172	A,B,z	0.0655	A,J,w	<0.502	U	0.0738	A,B,z	0.0759	A,J,wz
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	0.135	A	<0.481	U	<0.502	U	<0.498	U	0.116	A
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	0.2	A,B,z	0.0693	A,B,z	0.15665	A,B,z	0.0957	A,B,z	0.144	A,B,z
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	2.13		<0.125	U	<0.121	U	<0.0997	U	<0.0949	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	0.922	A,B,z	0.481	A,B,z	0.418	A,B,z	0.463	A,B,z	0.414	A,B,z
Total 2,3,7,8-TCDD Equivalents	--	C	4.3E+00	1.9E+01	8.6E+00		2.372		0.074		0.171		0.038		0.247	

Table 6-3A
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB82C DUP AVG 1/12/2007 18-19		54SB83A 1/11/2007 0-0.5		54SB83B 1/11/2007 9-10		54SB83C DUP AVG 1/11/2007 21-22	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)														
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	384.5		113		170		170	
1,2,3,4,6,7,8,9-OCDF (OCDD)	39001-02-0	--	--	--	--	0.0003	0.44	A	<0.923	U	<0.933	U	<1.01	U
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	5.68		2.33	A	2.51	A	2.81	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	0.2255	A	0.109	A,B,z	0.108	A,B,z	<0.506	U
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	<0.568	U	<0.461	U	<0.467	U	<0.506	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	0.09195	A	<0.461	U	<0.467	U	<0.506	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	<0.568	U	<0.461	U	<0.467	U	<0.506	U
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	0.20	A	<0.461	U	<0.467	U	<0.506	U
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	0.17035	,J,w	<0.461	U	<0.467	U	<0.506	U
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	0.2565	A	<0.461	U	<0.467	U	<0.506	U
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	0.1845	A	<0.461	U	<0.467	U	<0.506	U
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	0.086	A,J,w	<0.461	U	<0.467	U	<0.506	U
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	0.0884	A,J,w	<0.461	U	<0.467	U	<0.506	U
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	0.1835	A	<0.461	U	<0.467	U	<0.506	U
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	0.111	A,J,w	<0.461	U	0.0579	A,B,z	0.0809	,J,w
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	<0.136	U	<0.108	U	<0.116	U	<0.114	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	0.4395	A,B,z	0.402	,B,z	0.498	,B,z	0.425	A,B,z
Total 2,3,7,8-TCDD Equivalents	--	C	4.3E+00	1.9E+01	8.6E+00		0.406		0.057		0.076		0.103	

Notes:
CAS = Chemical Abstracts Service
pg/g = Picogram per gram
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code
RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
C/N = Carcinogenic/Noncarcinogenic per EPA RBC Table (October 2007)

Data Qualifiers:
J = Analyte present. Reported value may not be accurate or precise.
U = Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
A = Amount detected is less than the Lower Calibration Limit.
B = Not detected substantially above the level reported in laboratory or field blanks.
MJ = Estimate Maximum Possible Concentration (EMPC) value.
E = Concentration exceeded the upper level of the calibration range of the instrument for that specific analysis. For TICs, compound not present in calibration standard, calculated using total peak areas ion chromatographs and response factor of 1.
c = Calibration failure; poor (RRF) or unstable (%D) response
z = Method blank and/or storage blank contamination
w = Laboratory storage blank contamination
x = CRDL standard recovery failure

Total 2,3,7,8-TCDD Equivalents are calculated by summing the detected concentration times the TEF for each chemical. Non-detects, R-flagged data, and B-flagged data are excluded from summed total.

= Concentration Exceeds Adjusted Soil Residential RBC

= Concentration Exceeds Adjusted Soil Industrial RBC

Table 6-3B
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Groundwater - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	TEF	54MW1 11/29/2006		MDL	RL	54MW2 11/29/2006		MDL	RL	54MW3 12/5/2006		MDL	RL	54MW3-DUP(DUP-5) 12/5/2006		MDL	RL
						Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r			Result	LQ, VQ, r		
Dioxin/Furans (ng/L)																					
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	0.0003	0.00589	A,B,z	0.00719	0.00719	0.00696	A,B,z	0.0061	0.0061	0.0207	A,B,z	0.00512	0.00512	0.0117	A,B,z	0.00623	0.00623
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	0.0003	<0.00661	U	0.00661	0.00661	<0.00521	U	0.00521	0.00521	0.00217	A	0.00512	0.00512	<0.00587	U	0.00587	0.00587
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	0.01	<0.00336	U	0.00336	0.00336	<0.00355	U	0.00355	0.00355	0.00199	A,B,x	0.00256	0.00256	<0.00285	U	0.00285	0.00285
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	0.01	<0.00259	U	0.00259	0.00259	<0.0026	U	0.0026	0.0026	<0.00256	U	0.00256	0.00256	<0.00258	U	0.00258	0.00258
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	0.01	<0.00259	U	0.00259	0.00259	<0.0026	U	0.0026	0.0026	<0.00256	U	0.00256	0.00256	<0.00258	U	0.00258	0.00258
1,2,3,4,7,8-HxCDD	39227-28-6				0.1	<0.00259	U	0.00259	0.00259	<0.0026	U	0.0026	0.0026	<0.00256	U	0.00256	0.00256	<0.00258	U	0.00258	0.00258
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	0.1	<0.00259	U	0.00259	0.00259	<0.0026	U	0.0026	0.0026	<0.00256	U	0.00256	0.00256	<0.00258	U	0.00258	0.00258
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	0.1	<0.00259	U	0.00259	0.00259	<0.0026	U	0.0026	0.0026	<0.00256	U	0.00256	0.00256	<0.00258	U	0.00258	0.00258
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	0.1	<0.00259	U	0.00259	0.00259	<0.0026	U	0.0026	0.0026	<0.00256	U	0.00256	0.00256	<0.00258	U	0.00258	0.00258
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.08E-02	--	0.1	<0.00259	U	0.00259	0.00259	<0.0026	U	0.0026	0.0026	<0.00256	U	0.00256	0.00256	<0.00258	U	0.00258	0.00258
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	0.1	<0.00259	U	0.00259	0.00259	<0.0026	U	0.0026	0.0026	<0.00256	U	0.00256	0.00256	<0.00258	U	0.00258	0.00258
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	1	<0.00259	U	0.00259	0.00259	<0.0026	U	0.0026	0.0026	<0.00256	U	0.00256	0.00256	<0.00258	U	0.00258	0.00258
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	0.03	<0.00259	U	0.00259	0.00259	<0.0026	U	0.0026	0.0026	<0.00256	U	0.00256	0.00256	<0.00258	U	0.00258	0.00258
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	0.1	<0.00259	U	0.00259	0.00259	<0.0026	U	0.0026	0.0026	<0.00256	U	0.00256	0.00256	<0.00258	U	0.00258	0.00258
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	0.3	<0.00259	U	0.00259	0.00259	0.001	A,J,w	0.0026	0.0026	<0.00256	U	0.00256	0.00256	<0.00258	U	0.00258	0.00258
2,3,7,8-TCDD	1746-01-6	C	4.46E-04	30	1	<0.00459	U	0.00459	0.00459	<0.00425	U	0.00425	0.00425	<0.00224	U	0.00224	0.00224	<0.00203	U	0.00203	0.00203
2,3,7,8-TCDF	51207-31-9	--	--	--	0.1	<0.00267	U	0.00267	0.00267	<0.00226	U	0.00226	0.00226	<0.00115	U	0.00115	0.00115	<0.00121	U	0.00121	0.00121
Total 2,3,7,8-TCDD Equivalents			4.465E-04			ND				3.00E-04				6.51E-07				ND			

Notes:

CAS = Chemical Abstracts Service
ng/L = Nanogram Per Liter
MDL = Method Detection Limit
RL = Reporting Limit
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code
RBC = USEPA Region III Risk-Based Concentration (RBC) values from the Octoebr 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
C = Carcinogenic per EPA RBC Table (October 2007)
N = Noncarcinogenic per EPA RBC Table (October 2007)
MCL = Maximum Contaminant Level
Total 2,3,7,8-TCDD Equivalents are calculated by summing the detected concentration times the TEF for each chemical. Non-detects, R-flagged data, and B-flagged data are excluded from summed total.
ND = Not Detected

Data Qualifiers:
A = Amount detected is less than the Lower Calibration Limit.
B = Not detected substantially above the level reported in laboratory or field blanks.
J = Analyte present. Reported value may not be accurate or precise.
U = Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
w = Laboratory storage blank contamination
x = CRDL standard recovery failure
z = Method blank and/or storage blank contamination

Table 6-3C
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB39A [(D)] 12/10/2002 0-1		54SB39B [(D)] 12/10/2002 9-10		54SB39C 1/8/2007 15-16		54SB40A [(D)] 12/10/2002 0-1		54SB40B [(D)] 12/10/2002 9-10		54SB40C 1/8/2007 11-12	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																		
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	68.4	A	116		55.7	A	234	,J,i	164		24.6	
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	0.0003	<11.9	U	<10.2	U	<11.1	U	6.96	A,J,i	0.341	,J,w	0.0643	A
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	4.01	A	<5.12	U	4.56	A	10.1		3.41	A	0.786	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	<5.96	U	0.614	A,J,w	<5.56	U	2.88	A	0.394	A	0.165	A,J,w
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	<5.96	U	<5.12	U	<5.56	U	<0.49	U	<0.412	U	<0.435	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	<5.96	U	<5.12	U	<5.56	U	0.198	A	<0.412	U	<0.435	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	<5.96	U	<5.12	U	<5.56	U	0.407	A	0.114	A,J,w	<0.435	U
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	<5.96	U	<5.12	U	<5.56	U	0.46	A	0.234	A,J,w	<0.435	U
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	<5.96	U	<5.12	U	<5.56	U	0.372	A	0.12	A	<0.435	U
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	<5.96	U	<5.12	U	<5.56	U	0.453	A	0.221	A,J,w	<0.435	U
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	<5.96	U	<5.12	U	<5.56	U	<0.49	U	<0.412	U	<0.435	U
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	<5.96	U	<5.12	U	<5.56	U	<0.49	U	<0.412	U	<0.435	U
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	1.05	A	<5.12	U	1.09	A	0.231	A	0.0874	A	<0.435	U
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	<5.96	U	<5.12	U	<5.56	U	0.646	A,J,w	0.223	A	<0.435	U
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	0.858	A	1.11	A	1.09	A	0.474	A	0.153	A	<0.435	U
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	<1.19	U	<1.02	U	<1.11	U	0.733	A	<0.0824	U	<0.0869	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	6.1	A	5.18	A	6.1	A	0.57	A,B,z	0.265	A,B,z	<0.0869	U
Total 2,3,7,8-TCDD Equivalents			4.3E+00	1.9E+01	8.6		0.960		0.892		1.032		1.338		0.227		0.017	

Table 6-3C
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB41A [D] 12/10/2002 0-1		54SB41B [D] 12/10/2002 9-10		54SB41C 1/9/2007 14-15		54SB42A DUP AVG [C] 12/10/2002 0-1		54SB42B [C] 12/10/2002 9-10		54SB42C 1/8/2007 13.5-14.5	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																		
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	440		2.17	A,B,z	49.5		3,760		1,050		18.7	,B,z
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	0.0003	<0.92	U	<0.888	U	<0.985	U	23.45		69.5		0.407	A
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	10		0.547	A,J,w	1.47	A	66.95		113		1.08	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	1.01	A	<0.444	U	<0.493	U	10.83		28		0.79	A
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	<0.46	U	<0.444	U	<0.493	U	1.8015	A	3.2	A	<0.445	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	0.291	A,J,w	<0.444	U	<0.493	U	1.6505	A	1.94	A	<0.445	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	0.154	A,J,w	<0.444	U	<0.493	U	1.89	A	8.26		<0.445	U
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	<0.46	U	<0.444	U	<0.493	U	1.735	A	4.72	A	<0.445	U
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	0.162	A,J,w	<0.444	U	<0.493	U	1.225	A	7.05		<0.445	U
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	0.36	A	<0.444	U	0.323	A	2.0725	A	4.41	A	0.164	A
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	<0.46	U	<0.444	U	<0.493	U	1.593	A	2.55	A	<0.445	U
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	<0.46	U	<0.444	U	<0.493	U	1.5575	A,J,w	2.36	A	0.135	A
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	0.143	A,J,w	<0.444	U	<0.493	U	1.592	A	7.4		0.237	A
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	0.232	A,B,z	<0.444	U	<0.493	U	1.3015	A,J,w	5.49		0.302	A
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	0.241	A,B,z	0.071	A	0.067	A,J,w	1.445	A	8.62		0.466	A
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	1.26		<0.0888	U	<0.103	U	0.3595	A,J,w	0.8	A	<0.0889	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	<0.217	U	0.236	A,B,z	0.262	A,B,z	3.3865	A,J,f	6.66		0.459	A,J,w
Total 2,3,7,8-TCDD Equivalents			4.3E+00	1.9E+01	8.6		1.603		0.027		0.082		5.815		11.854		0.393	

Table 6-3C
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB43A [F] 12/4/2002 0.5-1		54SB43B [D] 12/4/2002 8-9		54SB43C [D] 12/4/2002 10-11		54SB45A [D] 12/2/2002 0-1		54SB45B [D] 12/2/2002 9-10		54SB45C 1/9/2007 12-13	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																		
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	1,860		120		733		70		47.8		29.2	
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	0.0003	216		<1.02	U	64.6		0.382	A,B,z	0.575	A,B,z	<0.984	U
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	210		2.2	A,J,w	53.8		1.83	A	2.04	A	1.15	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	86.9		0.216	A,J,w	14.3		0.223	A,J,w	0.888	A	0.148	A
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	6.24		<0.509	U	0.825	A	<0.397	U	<0.457	U	<0.492	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	3.22	A	<0.509	U	0.489	A	<0.494	U	<0.592	U	<0.492	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	10.7		<0.509	U	0.974	A,J,w	<0.397	U	0.142	A	<0.492	U
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	8.89		<0.509	U	1.28	A	<0.505	U	<0.605	U	<0.492	U
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	8.08		<0.509	U	0.819	A	<0.397	U	0.139	A	<0.492	U
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	8.34		<0.509	U	<0.477	U	<0.545	U	<0.653	U	<0.492	U
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	2.51	A	<0.509	U	0.206	A,J,w	<0.397	U	<0.457	U	<0.492	U
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	<0.49	U	0.12	A	<0.477	U	<0.397	U	<0.457	U	<0.492	U
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	6.49		0.0713	A,J,w	0.537	A,J,w	<0.397	U	0.141	A	<0.492	U
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	8.97		<0.509	U	0.745	A,J,w	<0.397	U	0.413	A	<0.492	U
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	7.69		0.106	A	0.64	A,J,w	<0.397	U	0.225	A,B,z	<0.492	U
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	1.05		<0.102	U	0.405	A	<0.0795	U	<0.0913	U	<0.0984	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	9.85		<0.106	U	0.9	A	0.221	A	0.298	A	0.274	A,B,z
Total 2,3,7,8-TCDD Equivalents			4.3E+00	1.9E+01	8.6		13.262		0.214		2.083		0.064		0.147		0.022	

Table 6-3C
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB46A [E] 12/4/2002 0.5-1		54SB46B 12/4/2002 7.5-9		54SB46C [C] 12/4/2002 11-12		54SB47A DUP AVG[D] 12/9/2002 0-1		54SB47B [D] 12/9/2002 9-10		54SB47C 1/9/2007 9-10	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																		
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	17,790		5,320		8,600	E,J,q	2,440		78.3		59.2	
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	0.0003	2,060	J,c	1,400	J,c	965		1.36	A,B,z	<0.954	U	<0.922	U
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	3,090		1,070		687		24.8		1.71	A	1.5	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	1,030		417		276		0.937		0.225	A,J,w	0.17	A,B,z
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	54.9		43.4		16.9		<0.506	U	<0.477	U	<0.461	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	62.7		14.2		8.57		0.281	A	<0.477	U	<0.461	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	116		60.7		15.3		<0.506	U	0.0592		<0.461	U
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	154		40.1		27.4		0.423	A	<0.477	U	<0.461	U
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	57		27		10.1		0.123	A,B,z	<0.477	U	0.0442	A,J,w
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	163		35.5		20.5		0.747	A	<0.477	U	<0.461	U
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	3.3	J	2.3	J	2.99	A	<0.506	U	<0.477	U	<0.461	U
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	34.5	J,c	6.8	M,J,c	4.87	A,J,w	<0.506	U	<0.477	U	0.0922	A
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	<5		<5		4.39	A	0.105	A	<0.477	U	0.0627	A,J,w
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	57		27.2		13.2		0.168	A,B,z	<0.477	U	0.133	A,J,w
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	29.6		14.6		6.06		0.152	A,B,z	<0.477	U	0.12	A,J,w
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	5.9		2.7		0.765	A	<0.101	U	<0.0954	U	<0.112	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	43		21		6.12		0.293	A	<0.115	U	0.247	A
Total 2,3,7,8-TCDD Equivalents			4.3E+00	1.9E+01	8.6		162.584		54		30.671		1.167		0.049		0.205	

Table 6-3C
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB48A 12/9/2002 0-1		54SB48B 12/9/2002 9-10		54SB49A 12/4/2002 1-2		54SB49B 12/4/2002 9-10		54SB50A [(D)] 12/9/2002 0-1		54SB50B [(D)] 12/9/2002 9-10	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																		
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	4,230	E,J,c	56.2		5,700	J,i	23.4	J,c	656		73.1	
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	0.0003	435	J,c	<9.9		1,060	J,c	<10		8.16	A	<0.932	U
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	495		2.4	J	1,560	J,i	<5		21.6		2.07	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	147		<5		870		<5		4.16	A	0.261	A
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	14.1		<5		47.4		<5		0.309	A	<0.466	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	7.6		<5		43.6		<5		0.311	A	<0.466	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	26.3		<5		197		<5		0.408	A	<0.466	U
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	18.8		<5		153		<5		0.643	A	<0.466	U
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	11.4		<5		87.5		<5		0.318	A,B,z	<0.466	U
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	21		<5		147		<5		0.821	A,J,w	0.103	A
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	<5		<5		5.5		<5		0.123	A,B,z	<0.466	U
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	5		<5		36.9	J,c	<5		<0.58	U	<0.466	U
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	7.4		<5		<5		<5		0.2	A	0.106	A,J,w
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	12.3		<5		89.6		<5		0.429	A,J,w	0.0932	A
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	11.9		<5		82.3		<5		0.306	A,J,w	0.125	A,J,w
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	1.3		<1		10		<1		<0.154	U	<0.117	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	9.6		<1		125	J,i	<1		0.61	A	0.578	A,B,z
Total 2,3,7,8-TCDD Equivalents			4.3E+00	1.9E+01	8.6		28.753		0.0409		183.212		0.00702		0.880		0.106	

Table 6-3C
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB50C 1/9/2007 11.5-12.5		54SB53A [(D)] 12/10/2002 0-1		54SB53B [(D)] 12/10/2002 9-10		54SB53C 1/9/2007 12-13		54SB54A [(D)] 12/9/2002 0-1		54SB54B DUP AVG[(D)] 12/9/2002 9-10	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																		
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	56.6		651		86.7		83.9		122		66.4	
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	0.0003	<0.982	U	222		<0.872	U	0.22	A,B,z	<1.04	U	0.392	A,B,z
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	1.41	A	58		1.6	A	1.93	A	2.94	A	2.105	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	0.157	A	79.6		0.0715	,B,z	0.155	A,B,z	0.376	A,J,w	0.198	A,J,f
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	<0.491	U	10.5		<0.436	U	<0.466	U	<0.522	U	<0.484	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	<0.491	U	0.835	A	<0.436	U	<0.466	U	<0.615	U	<0.484	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	<0.491	U	8.34		<0.436	U	<0.466	U	<0.522	U	<0.484	U
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	<0.491	U	2.41	A	<0.436	U	<0.466	U	<0.628	U	<0.484	U
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	0.0668	A	4.64		<0.436	U	<0.466	U	<0.522	U	<0.484	U
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	<0.491	U	2.33	A	<0.436	U	<0.466	U	<0.678	U	<0.484	U
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	<0.491	U	2.39	A	<0.436	U	<0.466	U	<0.522	U	<0.484	U
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	<0.491	U	<0.453	U	<0.436	U	<0.466	U	<0.522	U	<0.484	U
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	0.106	A,J,w	1.18	A	<0.436	U	<0.466	U	<0.522	U	<0.484	U
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	<0.491	U	3.5	A	<0.436	U	<0.466	U	<0.522	U	<0.484	U
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	0.116	A	1.55	A	<0.436	U	0.069	A,B,z	0.071	A,B,z	<0.484	U
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	<0.0982	U	0.454	A	<0.0872	U	<0.0932	U	<0.104	U	<0.0968	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	0.542	A,B,z	1.28		<0.103	U	0.272	A,J,w	0.265	A	0.302	A,B,z
Total 2,3,7,8-TCDD Equivalents			4.3E+00	1.9E+01	8.6		0.077		5.270		0.042		0.072		0.096		0.043	

Table 6-3C
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB54C 1/9/2007 12-13		54SB55A 12/9/2002 0-1		54SB55B DUP AVG 12/9/2002 9-10		54SB77A 1/9/2007 0-0.5		54SB77B 1/9/2007 7-8		54SB77C DUP AVG 1/9/2007 10-11	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																		
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	57.4	A,B,z	1,210	J,c	40.8		120		32.3		35	
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	0.0003	1	A	211	J,c	<9.9		2	A	<0.972	U	<0.967	U
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	2.09	A	204		<5		5.76		1.01	A	1.18	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	0.427	A	125		<5		1.19	A	0.187	A	0.18075	A,J,w
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	<0.486	U	16.1		<5		<0.412	U	<0.486	U	<0.483	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	<0.486	U	8.5		<5		<0.412	U	<0.486	U	<0.483	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	<0.486	U	91.6		<5		0.183	A,J,w	<0.486	U	<0.483	U
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	<0.486	U	14.3		<5		<0.412	U	<0.486	U	<0.483	U
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	<0.486	U	40.4		<5		0.135	A,J,w	<0.486	U	<0.483	U
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	<0.486	U	22.7		<5		<0.412	U	<0.486	U	<0.483	U
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	<0.486	U	5.7		<5		<0.412	U	<0.486	U	<0.483	U
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	<0.486	U	9.9		<5		<0.412	U	<0.486	U	<0.483	U
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	<0.486	U	37.5		<5		0.135	A	<0.486	U	<0.483	U
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	<0.486	U	38.6		<5		0.147	A	<0.486	U	<0.483	U
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	0.0894	A	56.7		<5		0.193	A	<0.486	U	0.15555	A,J,w
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	<0.129	U	2.7		<1		1.34		<0.0972	U	<0.0967	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	0.282	A	28.5		<1		0.39	A,J,w	0.29	A,J,w	0.236	A,B,z
Total 2,3,7,8-TCDD Equivalents			4.3E+00	1.9E+01	8.6		0.080		59.642		0.0122		1.594		0.051		0.071	

Table 6-3C
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB78A 1/9/2007 0-0.5		54SB78B DUP AVG 1/9/2007 9-10		54SB78C 1/9/2007 13.5-14.5		54SB79A 1/9/2007 0-0.5		54SB79B 1/9/2007 7-8		54SB79C 1/9/2007 9.5-10.5	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)																		
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	109		41.8		38.6		66.3		18	,B,z	45.2	
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	0.0003	1.25	A,B,z	<0.986	U	0.171	A	0.558	A	0.145	A,J,w	<0.958	U
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	5.5		1.42	A	1.38	A	2.39	A	0.689	A	1.57	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	1.08	A	0.20825	A,B,z	<0.463	U	0.335	A	0.0857	A	0.151	A,J,w
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	<0.468	U	<0.493	U	<0.463	U	<0.517	U	<0.437	U	<0.479	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	0.159	A	<0.493	U	<0.463	U	<0.517	U	<0.437	U	<0.479	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	<0.468	U	<0.493	U	<0.463	U	<0.517	U	<0.437	U	<0.479	U
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	0.271	A	<0.493	U	<0.463	U	0.13	A,J,w	<0.437	U	<0.479	U
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	<0.468	U	<0.493	U	<0.463	U	<0.517	U	<0.437	U	<0.479	U
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	<0.468	U	<0.493	U	0.211	A,J,w	0.178	A,J,w	<0.437	U	<0.479	U
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	<0.468	U	<0.493	U	<0.463	U	<0.517	U	<0.437	U	<0.479	U
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	<0.468	U	<0.493	U	<0.463	U	<0.517	U	<0.437	U	<0.479	U
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	0.14	A	<0.493	U	<0.463	U	0.112	A	0.0927	A	<0.479	U
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	<0.468	U	<0.493	U	<0.463	U	<0.517	U	<0.437	U	<0.479	U
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	0.212	A,B,z	0.16015	A,J,w	0.0871	A	0.134	A	<0.437	U	<0.479	U
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	1.76		<0.103	U	<0.0927	U	0.703	A	<0.0875	U	<0.0962	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	0.5	A	0.164	A	0.628	A,B,z	0.647	A,B,z	0.502	A,B,z	0.326	A,J,w
Total 2,3,7,8-TCDD Equivalents			4.3E+00	1.9E+01	8.6		1.969		0.091		0.073		0.825		0.011		0.063	

Table 6-3C
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Soil - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	CAS #	C/N	Adjusted Soil RBC (Residential)	Adjusted Soil RBC (Industrial)	Soil to Groundwater SSL (DAF 20)	TEF	54SB80A 1/9/2007 0-0.5		54SB80B 1/9/2007 5-6		54SB80C 1/9/2007 9-10	
							Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)												
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	--	0.0003	369		167		64	
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	--	0.0003	0.766	A	<0.964	U	<0.934	U
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	--	0.01	8.82		3.22	A	1.51	A
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	--	0.01	0.557	A	<0.482	U	0.164	A,J,w
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	--	0.01	<0.516	U	<0.482	U	<0.467	U
1,2,3,4,7,8-HxCDD	39227-28-6	--	--	--	--	0.1	<0.516	U	<0.482	U	<0.467	U
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	--	0.1	<0.516	U	<0.482	U	<0.467	U
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	--	0.1	0.221	A	<0.482	U	<0.467	U
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	--	0.1	0.0867	A	<0.482	U	<0.467	U
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.0E+02	4.6E+02	--	0.1	0.213	A	<0.482	U	<0.467	U
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	--	0.1	<0.516	U	<0.482	U	<0.467	U
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	--	1	<0.516	U	<0.482	U	<0.467	U
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	--	0.03	<0.516	U	<0.482	U	<0.467	U
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	--	0.1	0.12	A,J,w	<0.482	U	<0.467	U
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	--	0.3	0.159	A,J,w	<0.482	U	<0.467	U
2,3,7,8-TCDD	1746-01-6	C	4.3E+00	1.9E+01	8.6E+00	1	0.237	A,J,w	<0.0964	U	<0.0958	U
2,3,7,8-TCDF	51207-31-9	--	--	--	--	0.1	0.706	A,B,z	<0.0987	U	<0.102	U
Total 2,3,7,8-TCDD Equivalents			4.3E+00	1.9E+01	8.6		0.553		0.082		0.036	

Notes:

CAS = Chemical Abstracts Service
pg/g = Picogram per gram
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code
RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
C = Carcinogenic per EPA RBC Table (October 2007)
N = Noncarcinogenic per EPA RBC Table (October 2007)

Data Qualifiers:
J = Analyte present. Reported value may not be accurate or precise.
U = Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
A = Amount detected is less than the Lower Calibration Limit.
B = Not detected substantially above the level reported in laboratory or field blanks.
MJ = Estimate Maximum Possible Concentration (EMPC) value.
E = Concentration exceeded the upper level of the calibration range of the instrument for that specific analysis. For TICs, compound not present in calibration standard, calculated using total peak areas ion chromatographs and response factor of 1.
c = Calibration failure; poor (RRF) or unstable (%D) response
z = Method blank and/or storage blank contamination
w = Laboratory storage blank contamination
x = CRDL standard recovery failure
I = Tuning Failure or poor mass spectrometer performance
f = Field duplicate imprecision

Total 2,3,7,8-TCDD Equivalents are calculated by summing the detected concentration times the TEF for each chemical. Non-detects, R-flagged data, and B-flagged data are excluded from summed total.

= Concentration Exceeds Adjusted Soil Residential RBC

= Concentration Exceeds Adjusted Soil Industrial RBC

Table 6-3D
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Groundwater - Area B - December 2006
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	TEF	54MW4 11/30/2006 Result	LQ, VQ, r	MDL	RL	54MW6 11/29/2006 Result	LQ, VQ, r	MDL	RL	54MW7 3/4/2003 Result	LQ, VQ, r	MDL	RL
Dioxin/Furans (ng/L)																	
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	0.0003	0.00798	A,B,z	0.00531	0.00531	0.00765	A,B,x	0.00515	0.00515	0.0121	A,B,z	0.00519	0.00519
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	0.0003	0.00227	A	0.00531	0.00531	0.0013	A	0.00515	0.00515	0.00137	A	0.00519	0.00519
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	0.01	0.00155	A,B,x	0.00265	0.00265	0.0012	A,B,x	0.00258	0.00258	0.00106	A,B,x	0.0026	0.0026
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	0.01	0.00117	A	0.00265	0.00265	0.000825	A	0.00258	0.00258	0.000415	A	0.0026	0.0026
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	0.01	0.000913	A	0.00265	0.00265	<0.00258	U	0.00258	0.00258	<0.0026	U	0.0026	0.0026
1,2,3,4,7,8-HxCDD	39227-28-6				0.1	<0.00265	U	0.00265	0.00265	<0.00258	U	0.00258	0.00258	<0.0026	U	0.0026	0.0026
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	0.1	0.00119	A	0.00265	0.00265	<0.00258	U	0.00258	0.00258	<0.0026	U	0.0026	0.0026
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	0.1	0.00127	A,J,w	0.00265	0.00265	<0.00258	U	0.00258	0.00258	<0.0026	U	0.0026	0.0026
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	0.1	0.00108	A	0.00265	0.00265	<0.00258	U	0.00258	0.00258	<0.0026	U	0.0026	0.0026
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.08E-02	--	0.1	0.00121	A	0.00265	0.00265	<0.00258	U	0.00258	0.00258	<0.0026	U	0.0026	0.0026
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	0.1	0.000998	A	0.00265	0.00265	0.000763	A	0.00258	0.00258	<0.0026	U	0.0026	0.0026
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	1	0.00168	A	0.00265	0.00265	0.000948	A	0.00258	0.00258	<0.0026	U	0.0026	0.0026
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	0.03	0.002	A	0.00265	0.00265	0.000948	A,B,x	0.00258	0.00258	<0.0026	U	0.0026	0.0026
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	0.1	0.000955	A	0.00265	0.00265	0.000619	A	0.00258	0.00258	<0.0026	U	0.0026	0.0026
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	0.3	0.00166	A	0.00265	0.00265	0.000907	A,B,x	0.00258	0.00258	0.000332	A,J,w	0.0026	0.0026
2,3,7,8-TCDD	1746-01-6	C	4.46E-04	30	1	<0.00122	U	0.00122	0.00122	<0.00101	U	0.00101	0.00101	<0.000945	U	0.000945	0.000945
2,3,7,8-TCDF	51207-31-9	--	--	--	0.1	0.00051	A,J,w	0.000658	0.000658	<0.000569	U	0.000569	0.000569	<0.000557	U	0.000557	0.000557
Total 2,3,7,8-TCDD Equivalents			4.46E-04			2.98E-03				1.09E-03				1.04E-04			

Notes:

CAS = Chemical Abstracts Service
ng/L = Nanogram Per Liter
MDL = Method Detection Limit
RL = Reporting Limit
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code
Total 2,3,7,8-TCDD Equivalents are calculated by summing the detected concentration times the TEF for each chemical. Non-detects, R-flagged data, and B-flagged data are excluded from summed total.

RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
C = Carcinogenic per EPA RBC Table (October 2007)
N = Noncarcinogenic per EPA RBC Table (October 2007)
MCL = Maximum Contaminant Level

=Exceeds Adjusted T-RBC

Data Qualifiers:
A = Amount detected is less than the Lower Calibration Limit.
B = Not detected substantially above the level reported in laboratory or field blanks.
J = Analyte present. Reported value may not be accurate or precise.
U = Not detected. The associated number indicates the approximate sample concentration necessary to be
w = Laboratory storage blank contamination
x = CRDL standard recovery failure
z = Method blank and/or storage blank contamination

Table 6-3E
Dioxin/Furan 2,3,7,8-TCDD Equivalents Calculation - Groundwater - Area B - June 2007
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID / Sample Date	CAS	C/N	Adjusted Tap Water RBC	MCL	TEF	54MW-4 6/5/2007 Result	LQ, VQ, r	MDL	RL	54MW4-DUP(DUP-1) 6/5/2007 Result	LQ, VQ, r	MDL	RL	54MW-6 6/5/2007 Result	LQ, VQ, r	MDL	RL	54MW-7 6/5/2007 Result	LQ, VQ, r	MDL	RL
Dioxin/Furans (ng/L)																					
1,2,3,4,6,7,8,9-OCDD (OCDD)	3268-87-9	--	--	--	0.0003	<0.1019	U	0.1019	0.1019	<0.1016	U	0.1016	0.1016	<0.1011	U	0.1011	0.1011	<0.102	U	0.102	0.102
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	--	--	--	0.0003	<0.1019	U	0.1019	0.1019	<0.1016	U	0.1016	0.1016	<0.1011	U	0.1011	0.1011	<0.102	U	0.102	0.102
1,2,3,4,6,7,8-HpCDD	35822-39-4	--	--	--	0.01	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	--	--	0.01	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	--	--	0.01	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
1,2,3,4,7,8-HxCDD	39227-28-6				0.1	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
1,2,3,4,7,8-HxCDF	70648-26-9	--	--	--	0.1	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
1,2,3,6,7,8-HxCDD	57653-85-7	--	--	--	0.1	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
1,2,3,6,7,8-HxCDF	57117-44-9	--	--	--	0.1	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
1,2,3,7,8,9-HxCDD	19408-74-3	C	1.08E-02	--	0.1	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
1,2,3,7,8,9-HxCDF	72918-21-9	--	--	--	0.1	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
1,2,3,7,8-PeCDD	40321-76-4	--	--	--	1	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
1,2,3,7,8-PeCDF	57117-41-6	--	--	--	0.03	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
2,3,4,6,7,8-HxCDF	60851-34-5	--	--	--	0.1	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
2,3,4,7,8-PeCDF	57117-31-4	--	--	--	0.3	<0.051	U	0.051	0.051	<0.0508	U	0.0508	0.0508	<0.0506	U	0.0506	0.0506	<0.051	U	0.051	0.051
2,3,7,8-TCDD	1746-01-6	C	4.46E-04	30	1	<0.0102	U	0.0102	0.0102	<0.0102	U	0.0102	0.0102	<0.0101	U	0.0101	0.0101	<0.0102	U	0.0102	0.0102
2,3,7,8-TCDF	51207-31-9	--	--	--	0.1	<0.0102	U	0.0102	0.0102	<0.0102	U	0.0102	0.0102	<0.0101	U	0.0101	0.0101	<0.0102	U	0.0102	0.0102
Total 2,3,7,8-TCDD Equivalents			4.46E-04			ND				ND				ND				ND			

Notes:

CAS = Chemical Abstracts Service
ng/L = Nanogram Per Liter
MDL = Method Detection Limit
RL = Reporting Limit
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code

Total 2,3,7,8-TCDD Equivalents are calculated by summing the detected concentration times the TEF for each chemical. Non-detects, R-flagged data, and B-flagged data are excluded from summed total.

RBC = USEPA Region III Risk-Based Concentration (RBC) values from the October 11, 2007, RBC Table and October 11, 2007, Alternate RBC Table
C = Carcinogenic per EPA RBC Table (October 2007)
N = Noncarcinogenic per EPA RBC Table (October 2007)
MCL = Maximum Contaminant Level

=Exceeds Adjusted T-RBC

Data Qualifiers:
U = Not detected. The associated number indicates the approximate sample concentration necessary to be detected.

Table 6-4
RDA-based Screening Criteria Calculations
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

SOIL AND GROUNDWATER CRITERIA

Soil Screening Criteria (mg/kg) = $\frac{\text{RDA/AI}}{(IR_S \times EF \times ED \times 10^{-6}\ \text{kg/mg} \times \text{year}/365\ \text{days}) / AT}$

Groundwater Screening Criteria (µg/L) = $\frac{\text{RDA/AI} \times 1000\ \mu\text{g/mg}}{(IR_W \times EF \times ED \times \text{year}/365\ \text{days}) / AT}$

Parameter	Definition	Value	Units
RDA/AI	= Recommended Daily Allowance/Adequate Intake	nutrient-specific	mg/day
IR_S	= Soil Ingestion Rate		
	- adult resident	100	mg soil/day
	- child resident	200	mg soil/day
IR_W	= Tap water ingestion rate		
	- adult resident	2	L water/day
	- child resident	1	L water/day
EF	= Exposure frequency		
	- residential	350	days/year
ED	= Exposure duration		
	- adult resident	24	years
	- child resident	6	years
AT	= Averaging time		
	- adult resident	24	years
	- child resident	6	years

	Reference	CAS	RDA/AI[c,d] (mg/day)		Soil Screening Criteria (mg/kg)			Groundwater Screening Criteria (µg/L)		
			Adult	Child	Adult Resident	Child Resident	Selected Criteria (Minimum)	Adult Resident	Child Resident	Selected Criteria (Minimum)
Calcium	(a)	7440-70-2	800	210	8.3E+06	1.1E+06	1.095E+06	4.2E+05	2.2E+05	2.2E+05
Magnesium	(a)	7439-95-4	130	30	1.4E+06	1.6E+05	1.564E+05	6.8E+04	3.1E+04	3.1E+04
Potassium	(b)	2023-69-5	1600	500	1.7E+07	2.6E+06	2.607E+06	8.3E+05	5.2E+05	5.2E+05
Sodium	(b)	7440-23-5	400	120	4.2E+06	6.3E+05	6.257E+05	2.1E+05	1.3E+05	1.3E+05

(a) Recommended Dietary Allowances, 10th edition ©1989 by the National Academy of Sciences (National Academy Press, Washington, D.C.)
(b) Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride, ©1997 by the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes, Food and Nutrition Board, Institute of Medicine (National Academy Press, Washington, D.C.)
(c) RDA/AIs for calcium and magnesium represent the lower end of the RDA/AI for persons 7 years old and over (adults) and 6 years old and under (children).
(d) RDA/AIs for potassium and sodium represent the lower end of the minimum requirement for healthy persons 7 years old and over (adults) and 6 years old and under (children).

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7.0 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

7.1 ECOLOGICAL RISK SCREENING PROCESS

The purpose of the ecological risk screening is to provide conclusions and recommendations regarding potential ecological risk associated with SWMU 54. SLERAs were performed at Area A and Area B in accordance with the Ecological Risk Assessment Guidance for Superfund (ERAGS): Process for Designing and Conducting Ecological Risk Assessments (USEPA 1997). The SLERA process is summarized below in Sections 7.1.1 through 7.1.7. Refer to Appendix F.1 for a detailed description of the SLERA process utilized for the evaluation of SWMU 54 and example sample calculations. A summary of the SLERA results are provided in Section 7.2 (Area A) and Section 7.3 (Area B) and the complete tables for the SLERA are provided in Appendices F.2 (Area A) and F.3 (Area B).

7.1.1 Scope of Work

The SLERA includes Steps 1, 2, and 3a of ERAGS (USEPA 1997). Step 1 includes a screening-level problem formulation and ecological effects evaluation. Step 2 includes a preliminary exposure estimate and risk calculation. Step 3a reviews and refines the conservative assumptions used in the risk calculation (Step 2). The addition of Step 3a focuses the outcome of the SLERA, streamlines the review process, and functions as the initial basis for ecological risk management decision making.

The objectives of the ecological risk screening are to:

- Identify potentially complete exposure pathways between chemicals of potential ecological concern (COPECs) and receptors;
- Assess whether the COPECs exceed toxicological screening values that are considered to be protective of ecological receptors;
- Identify uncertainty and/or data gaps in the ecological risk screening; and
- Identify an appropriate scientific management decision point (SMDP) for each site area based on the ecological risk screening results.

7.1.1.1 Ecological Site Characterization

An overview of the site physiography, water resources, geology, and soil for SWMU 54 is presented in Section 2.0. The site consists of two non-contiguous disposal areas for propellant burning ash disposal located at the eastern-most extent of the HSA adjacent to New River (investigated as Areas A and B). The site is bordered by the river to the east and a fence borders the site along the eastern and northern border and a paved road is located to south.

The area is comprised grasslands without unique habitat features. Consequently, grasses provide the cover type and shrub or tree species are not established. The area is bordered to the south and west by hardwoods. Grassland communities at RFAAP comprise 4,379 acres, or about 63 percent of the 6,901-acre total (Virginia Department of Game and Inland Fisheries 1999). Observations made during the site reconnaissance indicate the vegetation community at the Landfill appears healthy and vigorous (See photographic logs, Appendix A). Indications of chemical vegetative stress were not observed.

In addition to the information contained in Section 2.0, additional site characterization is required for the ecological risk screening, which includes local ecological receptors (threatened and endangered species) and ecological resources. A discussion of potential biota likely to use the site areas, are included in this section. During a site reconnaissance performed on July 21, 2005, wildlife species were not observed at the site. During subsequent site visits, wildlife species were observed at the site such as squirrels, deer, and red foxes.

The Virginia Department of Conservation, Division of Natural Heritage and U.S. Fish and Wildlife Service were contacted to gather information regarding the potential for threatened or endangered species to utilize the RFAAP. Results of these inquiries are provided in Appendix F.4.

In addition, the Virginia Department of Game and Inland Fisheries Installation-Wide Biological Survey (1999) recorded various species associated with the grassland communities at RFAAP. Based on their survey of the grassland habitats, the invertebrates (approximately 250 species) and birds (83 species) accounted for the majority of species observations at RFAAP. Potential species utilizing the grassland areas of the site include common passerine birds (e.g., American robin) and small mammals (e.g., short-tailed shrew). Larger mammals (e.g., white-tailed deer and red fox) and raptors (e.g., red-tailed hawk) may potentially utilize the grassland habitat for foraging. Animals such as the mallard duck, belted kingfisher, and raccoon could be expected to forage in the New River.

The Virginia Department of Game and Inland Fisheries survey identified three threatened wildlife species and two rare plant species associated with RFAAP grassland communities (currently not on the 2002 Plant Watch List; http://www.dcr.state.va.us/dnh/plantlist02.pdf). They include:

- Regal Fritillary Butterfly (*Speyeria idalia*);
- Henslow's Sparrow (*Ammodramus henslowii*);
- Loggerhead Shrike (*Lanius ludovicianus*);
- Midland Sedge (*Carex mescochorea*); and
- Shaggy False Gromwell (*Onosmodium hispidissimum*).

Threatened wildlife observations in 1999 at RFAAP included the Regal Fritillary Butterfly (VDGIF 1999). The Regal Fritillary Butterfly was documented in the east-central and eastern edges of the MMA.

7.1.2 Identification of Chemicals of Potential Ecological Concern

Areas A and B are evaluated separately in the SLERA for soil given that these disposal areas are non-contiguous units approximately 200 ft apart with different waste disposal histories and characteristics. Although the sites are assessed separately, due to the proximity of the sites an area use factor for the refined exposure assessment and risk characterization was calculated as the ratio of the sum of the site areas to the average home range of the receptor (see Section 7.1.6.2). As presented in Section 4.5 in the nature and extents assessment, the results of the sediment, surface water, and sediment pore-water investigation in the New River did not indicate significant impacts or impacts attributable to SWMU 54; therefore, the medium of concern with respect to the SLERA is surface soil.

7.1.2.1 Approach

Soil samples were collected from 0 to 1 ft bgs below organic layers at the surface. This layer contains the zone of highest biological activity of soil organisms and the soil that is most frequently contacted by terrestrial biota. Although fossorial wildlife may be in contact with soil below 1 ft bgs, the preys of these animals are primarily associated with surficial soil. Furthermore, incidental exposure to the soil below 1 ft bgs is likely to be insignificant relative to surface soil exposure.

Terrestrial grassland surficial soil (0 to 1 ft bgs) represents the potential exposure media to ecological receptors. The following sections describe the process used to evaluate soil, the selection of COPECs evaluated in the SLERA, and the uncertainties associated with COPEC selection.

7.1.2.1 Terrestrial

Potential ecological receptors at SWMU 54 may be exposed to COPECs in soil through the following exposure routes:

- Direct contact/absorption from soil;

- Direct ingestion of soil;
- Incidental ingestion of soil; and
- Direct ingestion of biota with accumulated COPECs.

Although receptors may be exposed to COPECs through inhalation or drinking surface water, sufficient literature regarding toxicity due to these pathways is lacking to quantitatively evaluate such exposure routes. Given the potential mobility of COPECs between food web trophic levels, a number of terrestrial categories were selected. Individual receptor species were selected to represent five wildlife receptor categories and these species possess the following characteristics that are essential for assessing COPEC mobility within the food web:

- Highly likely to occur at the site in relatively high abundance;
- Limited home range;
- Important role in the local food web; and
- Sufficient toxicological information is available in the literature.

Receptor categories and the species selected to represent the wildlife categories include:

- Plant communities;
- Soil invertebrate/microbial communities;
- Omnivorous birds: American Robin (*Turdus migratorius*);
- Carnivorous birds: Red-tailed Hawk (*Buteo jamaicensis*);
- Herbivorous animals: Meadow Vole (*Microtus pennsylvanicus*);
- Omnivorous mammals: Red Fox (*Vulpes vulpes*); and
- Carnivorous mammals: Short-tailed Shrew (*Blarina brevicauda*).

Potential wildlife utilizing the site includes passerine bird and small mammalian species common to RFAAP grasslands (VDGIF 1999).

7.1.3 Identification of Exposure Pathways and Potential Receptors Analysis

7.1.3.1 Data Organization

The following table identifies the soil samples used for the SLERA. Each of these samples were selectively analyzed for TCL SVOCs, PAHs, explosives (including nitroglycerin and Pentaerythritol tetranitrate [PETN]), herbicides, TAL metals and cyanide, TCL pesticides, TCL PCBs, and TCL dioxin/furans. Refer to Table 3-1 for a detailed list of samples and analytes.

Soil Samples Evaluated for SWMU 54 SLERA

Soil - Area A	Soil - Area B
54SB3A, 54SB10A, 54SB17A, 54SB18A, 54SB19A, 54SB20A, 54SB21A, 54SB22A, 54SB23A, 54SB23A, 54SB24A, 54SB25A, 54SB26A, 54SB27A, 54SB28A, 54SB29A, 54SB30A, 54SB31A, 54SB32A, 54SB33A, 54SB33A, 54SB34A, 54SB35A, 54SB36A, 54SB37A, 54SB38A, 54SB57A, 54SB58A, 54SB61A, 54SB81A, 54SB82A, 54SB83A, 54SB84A	54SB39A, 54SB40A, 54SB41A, 54SB42A, 54SB43A, 54SB44A, 54SB45A, 54SB46A, 54SB47A, 54SB48A, 54SB49A, 54SB50A, 54SB51A, 54SB52A, 54SB53A, 54SB54A, 54SB55A, 54SB71A, 54SB72A, 54SB73A, 54SB74A, 54SB75A, 54SB77A, 54SB78A, 54SB79A, 54SB80A

Detected chemical occurrence and distribution tables are presented in Tables 7-1 (Area A) and 7-2 (Area B) for surface soil in Area A and Area B, respectively. Refer to Section 4, Table 4-1 (Area A) and Table 4-8 (Area B) for a complete list of results for detected analytes. In addition to evaluate the adequate sensitivity of the MDL for the necessary screening levels, Tables 7-3 (Area A) and 7-4 (Area B) provide a screening of the maximum MDL versus available ecological screening values for non-detected chemicals in surface soil in Area A and Area B, respectively.

Chemicals that were not detected in at least one sample were considered as uncertain analytes in the evaluation of risk. Other qualified analytical data were retained in the assessment, with the exception of tentatively identified compounds (TICs) identified by the laboratory qualifier "NJ." TICs were not evaluated quantitatively in the risk assessment.

In cases where chemicals were analyzed using multiple laboratory methods, the analytical results for the method with the lowest MDL were retained for the risk assessment. For example, concentrations of PAHs were assessed using Method 8310 rather than the SVOC Method 8270. Eliminating the method having the higher detection limit did not result in exclusion of samples with higher detected concentrations.

7.1.3.2 Ecological Conceptual Site Model (ECSM)

The terrestrial ECSM is presented on Figure 7-1. Surface soil is a potential exposure medium of concern based on historical activities at the site. Based on the site characterization and data, the terrestrial receptor exposure to surface soil pathway exists.

7.1.4 Identification of Assessment and Measurement Endpoints

Assessment endpoints are explicit statements of ecological resources (entities) and attributes of those entities that are important to protect (USEPA 1998). Measurement endpoints represent quantifiable ecological characteristics that can be measured, interpreted, and related to ecological resources chosen as assessment endpoints. Assessment and measurement endpoints for the resources in the terrestrial sites are outlined below.

7.1.4.1 Terrestrial

Assessment and measurement endpoints for terrestrial receptors are as follows:

Assessment Endpoints	Measurement Endpoints
• Survival, growth, and reproduction of terrestrial plants	• MDCs for chemicals detected in surface soil will be compared to concentrations representing no adverse effects thresholds to the survival of plants communities reported in the scientific literature
• Survival, growth, and reproduction of soil invertebrates and microbial communities	• MDCs for chemicals detected in surface soil will be compared to concentrations representing no adverse effects thresholds to the survival of soil invertebrates or microbial communities reported in the scientific literature

Assessment Endpoints	Measurement Endpoints
• Survival, growth, and reproduction of terrestrial wildlife (birds and mammals) populations and communities	• MDCs for detected bioaccumulative chemicals in soil (non-dioxin/furan) will be compared to no observable adverse effects levels (NOAELs) and lowest observable adverse effects levels (LOAELs) associated with effects on growth, reproduction, or survival of terrestrial wildlife • Comparison of the maximum additive dose of dioxin/furan congeners ingested from soil and food to NOAEL and LOAEL doses associated with effects on growth, reproduction, or survival of terrestrial wildlife

7.1.5 Preliminary Exposure Estimate and Ecological Effects Evaluation

The preliminary exposure estimate and ecological effects evaluation considers the most conservative risk scenario. Highly conservative assumptions are used to estimate COPEC exposure to terrestrial receptors for pathways to be quantitatively evaluated. Conservative toxicity reference values (TRVs) are used to evaluate the ecological effects of exposure using the two approaches discussed below.

Risk is assessed by comparing the preliminary exposure estimate (MDC) of each detected chemical to the established TRV (detailed in Appendix F.1, Section 2.1). The preliminary risk is characterized in terms of a HQ, which is expressed as:

$$\mathbf{HQ = MDC/TRV}$$

where:

HQ = Hazard Quotient for the contaminant (unitless)
MDC = Maximum Detected Concentration for contaminant (mg/kg)
TRV = Screening Level for contaminant (mg/kg)

An HQ of less than 1 indicates no or negligible risk. The potential for risk increases as the HQ increases above unity. However, this result should be considered in the context of other characteristics of the exposure area. Results of the preliminary exposure assessment are presented in Appendices F.2 (Area A) and F.3 (Area B).

7.1.5.1 Direct Contact Approach

The maximum soil concentrations for detected chemicals are used as the preliminary exposure estimate concentrations to develop a conservative risk scenario for the direct contact pathway to soil invertebrates and terrestrial plants.

Although there are no dioxin or furan benchmarks available for soil invertebrates or plants, plant and invertebrate receptors are much more tolerant of TCDD than fish, birds, and mammals. Dioxins are aryl hydrocarbon receptor agonists, which cause a wide spectrum of adverse toxic effects in many vertebrate species. The observed lack of sensitivity of plants and invertebrates to TCDD is consistent with the view that the aryl hydrocarbon receptor is not present in invertebrates or plants (Gatehouse 2004). Therefore, the calculated risks associated with mammalian and avian receptors, Section 7.1.5.2, are considered protective of plants and invertebrates.

7.1.5.2 Dose Rate Modeling Approach

Preliminary risk characterization for wildlife receptors uses the conservative preliminary exposure estimate and ecological effects evaluation to characterize risk to potential terrestrial receptors. Risk is

assessed by comparing the preliminary exposure estimate of each detected bioaccumulative chemical, as defined in Table 4-2 in Bioaccumulative Testing and Interpretation for the Purpose of Sediment Quality Assessment, Status, and Needs, EPA-823-R-00-001, to the TRV developed in the ecological effects evaluation. An example calculation for dose rate modeling is provided in Appendix F.1., Section 4.1, utilizing the equation below.

$$C_{TRV} = \frac{ADD \cdot BW}{(IR_{food} \ (BAF_{food} \cdot DF) + IR_s \ )AF}$$

where:

C_{TRV} = NOAEL or LOAEL-based screening level (mg chemical/kg soil)

ADD = NOAEL or LOAEL (mg COPC/kg body weight-day)

BW = Minimum Body Weight of the receptor (kg)

IR_{food} = Maximum Ingestion Rate of food (kg food ingested per day, dry weight)

BAF_{food} = BAF of most contaminated dietary component used, specific to prey type and COPC (ratio of mg of COPC/kg fauna, wet weight to mg COPC/ kg substrate, dry weight)

DF = Dietary Fraction (most contaminated dietary component assumed to be 100% of diet)

IR_s = Maximum Incidental Ingestion Rate of soil (kg substrate ingested per day, dry weight)

AF = 100% Area Use Factor

In the preliminary dose rate modeling approach, the maximum COPEC concentrations for detected bioaccumulative chemicals, along with assumptions of maximum ingestion rate, minimum body weight, 100% area use, and 100% bioavailability are used in the conservative risk scenario as the preliminary exposure estimate for soil and compared to the calculated TRVs. Preliminary receptor-specific exposure parameters are presented on Table F.2-9 for Area A (Appendix F.2) and Table F.3-9 for Area B (Appendix F.3).

An equivalency method for dioxin/furan congeners was used to evaluate whether surface soil concentrations pose a threat to terrestrial wildlife. Though several dioxins are known to be toxic, toxicity criteria are limited to 2,3,7,8- TCDD. Each congener is assigned a TEF for avian and mammalian receptors respectively (WHO 2005), which corresponds to its toxicity relative to 2,3,7,8-TCDD. Each congener detection is multiplied by its corresponding TEF; the adjusted concentrations are then summed to derive one total 2,3,7,8-TCDD equivalent concentration for each sample. This concentration is then compared with toxicity criteria for 2,3,7,8-TCDD to calculate risks.

7.1.6 Refined Exposure Estimate and Risk Characterization

Refined exposure estimates and ecological effects are developed for two major receptor categories having complete exposure pathways to be quantitatively evaluated: 1) direct contact to plants and invertebrates, and 2) wildlife ingestion (i.e., omnivorous birds and mammals, carnivorous birds and mammals, and herbivorous mammals). The refined exposure and risk characterization, Step 3a of ERAGS, reviews and refines the conservative assumptions used in the risk calculation (USEPA 1997). In Step 3a, conservative assumptions used in the preliminary exposure and risk characterization are replaced with more environmentally realistic assumptions to evaluate risk posed by constituents identified in the preliminary risk characterization. The addition of Step 3a focuses the outcome of the SLERA, streamlines the review process, and functions as the initial basis for ecological risk management decision-making.

As noted below for the refined exposure estimate and risk characterization, the 95% UCL is used as the exposure concentration rather than the MDC. Methods used to calculate 95% UCLs are based on guidance provided in the following documents *Calculating Upper Confidence Limits for Exposure Point*

Concentrations at Hazardous Waste Sites (USEPA 2002b) and *On the Computation of a 95% Upper Confidence Limit of the Unknown Population Mean Based Upon Data Sets with Below Detection Limit Observations* (USEPA 2006).

In general, the method used to calculate a 95% UCL depends on: 1) the prevalence of non-detects, and 2) the data distribution (e.g., normal or lognormal). Non-detects introduce uncertainty in the data set because the true concentration may be between zero to just below the detection limit. Therefore, distributional assumptions are difficult to make for COPCs with a high rate of non-detects. ProUCL 4.0 is used to calculate EPCs for the sites with the exception of data sets with less than 5% detects for which bounding was used to calculate EPCs. EPCs for soil COPECs are presented in Table F.2-4 of Appendix F.2 (Area A) and Table F.3-4 of Appendix F.3 (Area B).

For the refined evaluation, risk is assessed by comparing the EPC (95% UCL) of each detected chemical to the TRV. The refined risk HQ is expressed as:

HQ = EPC/TRV

where:

HQ = Hazard Quotient for the contaminant (unitless)
EPC = Calculated Exposure Point Concentration for chemical (mg/kg)
TRV = Screening Level for chemical (mg/kg)

An HQ of less than 1 indicates no or negligible risk. The potential for risk increases as the HQ increases above unity. However, this result should be considered in the context of other characteristics of the exposure area. Results of the refined exposure assessment are presented in Appendices F.2 (Area A) and F.3 (Area B).

7.1.6.1 Direct Contact Approach

The refined exposure estimate for the direct contact pathway to soil invertebrate and microbial communities incorporates the 95% UCL as the exposure concentration for evaluating the COPECs using a conservative yet more realistic exposure assumption than MDCs.

7.1.6.2 Dose Rate Modeling Approach

The conservative assumptions used in the preliminary exposure estimate and ecological effects evaluation were replaced with more environmentally realistic assumptions resulting in a more realistic estimate of potential risk. An example calculation for dose rate modeling is provided in Appendix F.1, Section 4.4, utilizing the equation below.

$$C_{TRV} = \frac{ADD \cdot BW}{(IR_{food} \sum (BAF_{food} \cdot DF) + IR_s)AF}$$

where:

C_{TRV} = NOAEL or LOAEL-based screening level (mg chemical/kg soil)

ADD = NOAEL or LOAEL (mg COPC/kg body weight-day)

BW = Average Body Weight of the receptor (kg)

IR_{food} = Average Ingestion Rate of food (kg food ingested per day, dry weight)

BAF_{food} = BAF of dietary component used, specific to prey type and COPC (ratio of mg of COPC/kg fauna, wet weight to mg COPC/ kg substrate, dry weight)

DF = Dietary Fraction

IR_s = Average Incidental Ingestion Rate of soil (kg substrate ingested per day, dry weight)

$AF_{refined}$ = Refined Area Use Factor (detailed below)

The refined exposure estimates and ecological effects are developed for wildlife receptors having complete exposure pathways to be quantitatively evaluated (i.e., omnivorous birds, and carnivorous and herbivorous mammals). In the refined model, an average body weight, average ingestion rate, and a 95% UCL as the EPC are used. Refined receptor-specific exposure parameters are presented on Table F.2-9 for Area A (Appendix F.2) and Table F.3-9 for Area B (Appendix F.3). In addition, a realistic area use factor ($AF_{refined}$) was calculated as the ratio of the site area to the average home range of the receptor which are also presented in Table F.2-9 for Area A (Appendix F.2) and Table F.3-9 for Area B (Appendix F.3). Note that due to the proximity of the sites an area use factor for the refined exposure assessment and risk characterization was calculated as the ratio of the sum of the site areas (0.8 hectares) to the average home range of the receptor.

7.1.7 Risk Management – Scientific Management Decision Point

The findings of the ecological risk screen including site characterization and risk calculations are used as input to risk management decision-making for the site. The SMDP reached from the ecological risk screening concludes that one of the following statements is true:

- There is adequate information to conclude that ecological risks are negligible and therefore there is no need for further action at the site on the basis of ecological risk;
- The information is not adequate to make a decision at this point and further refinement of data is needed to augment the ecological risk screening; or
- The information collected and presented indicates that a more thorough assessment is warranted.

7.2 SLERA RESULTS – AREA A

7.2.1 Preliminary Risk Characterization

The complete preliminary risk characterization tables are provided in Appendix F.2 and summarized below.

7.2.1.1 Terrestrial Plants

Preliminary direct contact HQs calculated for plants are presented in Table 7-5 for detected chemicals. Of the detected chemicals for which screening values were available, the concentrations of aluminum, calcium, chromium, cobalt, copper, lead, manganese, mercury, selenium, vanadium, zinc, heptachlor epoxide, acenaphthene, acenaphthylene, benzo(b)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, 2,4,6-TNT, 2,4-DNT, and 2,6-DNT resulted in HQ values that were greater than 1.

Detections of PAH compounds acenaphthene, acenaphthylene, benzo(b)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene reported by Method 8310, which would have resulted in HQ values greater than 1 were not confirmed by low-level analysis by Method 8270C. Unlike Method 8270C, Method 8310 is susceptible to matrix interference and false positive detections, and therefore, confirmation of the detections with low-level Method 8270C is considered appropriate to confirm the results. Based on the lack of confirmation of detections, PAHs are not considered a potential concern for terrestrial plants at Area A.

7.2.1.2 Soil Invertebrates and Microbial Communities

Preliminary direct contact HQs calculated for invertebrates are presented in Table 7-6 for detected chemicals. Of the detected chemicals for which screening values were available, the concentrations of chromium, copper, iron, manganese, mercury, vanadium, zinc, heptachlor epoxide, acenaphthene, acenaphthylene, benzo(b)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, 2,4,6-TNT, 2,6-DNT, and nitroglycerin resulted in HQ values that were greater than 1.

PAH detections reported by Method 8310, which would have resulted in HQ values greater than 1 were not confirmed by low-level analysis by Method 8270C. Unlike Method 8270C, Method 8310 is susceptible to matrix interference and false positive detections, and therefore, confirmation of the detections with low-level Method 8270C is considered appropriate to confirm the results. Based on the lack of confirmation of detections, PAHs are not considered a potential concern for soil invertebrates and microbial communities at Area A.

7.2.1.3 Terrestrial Wildlife

Quantitative risk characterization for terrestrial wildlife is limited to direct ingestion of biota and incidental ingestion of soil. The calculated total 2,3,7,8-TCDD equivalents used in the screening for Area A are provided in Table 7-7. The preliminary risks for detected bioaccumulative chemicals are summarized in Table 7-8 for each terrestrial wildlife receptor and the chemicals with HQs great than 1 are characterized as follows:

Receptor	NOAEL Only Exceedances	NOAEL and LOAEL Exceedances
Meadow Vole	cadmium, copper, zinc, heptachlor epoxide, 2-amino-DNT, 4-amino-DNT, HMX	arsenic, lead, selenium, 1,3,5-TNB, 2,4,6-TNT
Short-tailed Shrew	arsenic, cadmium, chromium, copper, heptachlor epoxide, Aroclor 1254, Aroclor 1260, 1,3,5-TNB	lead, selenium, zinc, 2,3,7,8-TCDD TEQ (dioxin/furans), 2,4,6-TNT
Red Fox	arsenic, chromium, heptachlor epoxide, Aroclor 1260, 2-amino-DNT, 4-amino-DNT, HMX	cadmium, copper, lead, selenium, zinc, 2,3,7,8-TCDD TEQ (dioxin/furans), Aroclor 1254, 1,3,5-TNB, 2,4,6-TNT
American Robin	2,3,7,8-TCDD TEQ (dioxin/furans), Aroclor 1254, acenaphthene	cadmium, chromium, lead, mercury, selenium, zinc, 4,4'-DDT, 2,4,6-TNT, 2,4-DNT, 2,6-DNT
Red-tailed Hawk	lead, zinc, 2,4-DNT, 2,6-DNT	2,4,6-TNT

The detections of acenaphthene reported by Method 8310, which would have resulted in HQ values greater than 1 were not confirmed by low-level analysis by Method 8270C. Unlike Method 8270C, Method 8310 is susceptible to matrix interference and false positive detections, and therefore, confirmation of the detections with low-level Method 8270C is considered appropriate to confirm the results. Based on the lack of confirmation of detections, acenaphthene are not considered a potential concern for terrestrial wildlife at Area A.

7.2.2 Refined Risk Characterization – Area A

The complete refined risk characterization tables are provided in Appendix F.2 and summarized below.

7.2.2.1 Terrestrial Plants

Refined direct contact HQs calculated for plants are presented in Table 7-5 for detected chemicals. Of the detected chemicals for which screening values were available, the concentrations of aluminum, calcium, chromium, manganese, selenium, vanadium, zinc, acenaphthene, acenaphthylene, naphthalene, and 2,4,6-TNT resulted in refined HQ values that were greater than 1.

As discussed previously in Section 7.2.1.1, PAH compounds acenaphthene, acenaphthylene, and naphthalene are not considered a potential concern for terrestrial plants at Area A due to a lack of confirmation of detections of these compounds by low-level Method 8270C.

7.2.2.2 Soil Invertebrates and Microbial Communities

Refined direct contact HQs calculated for invertebrates are presented in Table 7-6 for detected chemicals. Of the detected chemicals for which screening values were available, the concentrations of chromium, iron, manganese, mercury, vanadium, zinc, acenaphthene, acenaphthylene, naphthalene, and 2,4,6-TNT resulted in refined HQ values that were greater than 1.

As discussed previously in Section 7.2.1.2, PAH compounds acenaphthene, acenaphthylene, and naphthalene are not considered a potential concern for soil invertebrates and microbial communities at Area A due to a lack of confirmation of detections of these compounds by low-level Method 8270C.

7.2.2.3 Terrestrial Wildlife

The refined risk characterization results are presented in Table 7-8 and summarized below for each of the receptors with chemical HQs greater than 1:

Receptor	NOAEL Only Exceedances	NOAEL and LOAEL Exceedances
Meadow Vole	2,4,6-TNT (1.4)	none
Short-tailed Shrew	2,3,7,8-TCDD TEQ (dioxin/furans) (10)	none
Red Fox	none	none
American Robin	lead (3.9), zinc (3.2), 4,4'-DDT (3.1), 2,4-DNT (10), 2,6-DNT (7.1)	2,4,6-TNT (120/4.8)
Red-tailed Hawk	none	none

*Note: (10) = NOAEL-based HQ, (120/4.8) = NOAEL-based HQ/LOAEL-based HQ

7.2.3 Risk Management – Scientific Management Decision Point

Terrestrial plant COPECs with refined HQs greater than 1 included: aluminum, calcium, chromium, manganese, selenium, vanadium, zinc, acenaphthene, acenaphthylene, naphthalene, and 2,4,6-TNT. Although the refined aluminum HQ exceeds 1, the average pH in the soil is greater than 5.5 (see Appendix C.1); therefore, aluminum is not considered a COPEC. Chromium, manganese, and vanadium are consistently below background (see Appendix C.9, Table C.9-1); therefore, these chemicals are not considered site related. Even though refined HQs for selenium (1.1) and zinc (2.9) are greater than 1 and concentrations at the site are above background concentrations via means comparison, these risks present low to moderate risk to terrestrial plants at the site. A discussion of the methodology of site versus background comparison is provided in Section 6.4.3. PAH compounds acenaphthene, acenaphthylene, and naphthalene are not considered a potential concern for terrestrial plants at Area A due to a lack of confirmation of detections of these compounds by low-level Method 8270C.

Soil invertebrates and microbial processes COPECs with refined HQs greater than 1 included chromium, iron, manganese, mercury, vanadium, zinc, acenaphthene, acenaphthylene, naphthalene, and 2,4,6-TNT. Chromium, iron, manganese, mercury, and vanadium are consistently below background; therefore, these chemicals are not considered site related. Even though the refined HQ for zinc (1.5) is greater than 1 and concentrations at the site are above background concentrations via means comparison, these risks present low to moderate risk to soil invertebrates at the site. PAH compounds acenaphthene, acenaphthylene, and naphthalene are not considered a potential concern for soil invertebrates and microbial processes at Area A due to a lack of confirmation of detections of these compounds by low-level Method 8270C.

The refined risk characterization for wildlife resulted in the identification of 2,4,6-TNT with a LOAEL-based HQ greater than 1 for the American Robin.

The lateral extent of contamination for 2,4,6-TNT at Area A with respect to ecological receptors is presented on Figure 7-2.

After consideration of spatial distribution of data at the site, the results of the SLERA, background concentrations, and the nature of the propellant waste historically disposed of at the site, the SMDP is the following:

There is adequate information to conclude that the potential exists for an adverse ecological impact to plants, invertebrates, and the American robin due to 2,4,6-TNT concentrations in soil. Screening level exceedances were identified in the immediate area of soil borings 54SB27, 54SB30, and 54SB32 in the same area identified for human health RBC exceedances and/or SSL exceedances for explosives as shown on Figure 4-4 and Figure 5-1, respectively. No other significant potential impacts to ecological receptors due to site-related activities were identified. Significant uncertainty is associated with the potential impact to the American robin. It is recommended that the need for remedial action to address this potential impact be evaluated along with the uncertainty associated with the derivation of the HQs, the location of HHRA COCs, the fate and transport evaluation, and other relevant factors, which would influence any decision to implement action.

7.3 SLERA RESULTS – AREA B

7.3.1 Preliminary Risk Characterization

The complete preliminary risk characterization tables are provided in Appendix F.3 and summarized below.

7.3.1.1 Terrestrial Plants

Direct contact HQs calculated for plants are presented in Table 7-9 for detected chemicals. Of the detected chemicals for which screening values were available, the concentrations of aluminum, calcium, chromium, copper, lead, manganese, mercury, selenium, vanadium, zinc, acenaphthene, acenaphthylene, naphthalene, 2,4-DNT, and 2,4,6-TNT resulted in HQ values greater than 1.

Detections of PAH compounds acenaphthene, acenaphthylene, and naphthalene reported by Method 8310, which would have resulted in HQ values greater than 1 were not confirmed by low-level analysis by Method 8270C. Unlike Method 8270C, Method 8310 is susceptible to matrix interference and false positive detections, and therefore, confirmation of the detections with low-level Method 8270C is considered appropriate to confirm the results. Based on the lack of confirmation of detections, PAHs are not considered a potential concern for terrestrial plants at Area B.

7.3.1.2 Soil Invertebrates and Microbial Communities

Direct contact HQs calculated for invertebrates are presented in Table 7-10 for detected chemicals. Of the detected chemicals for which screening values were available, the concentrations of chromium, copper, iron, lead, manganese, mercury, vanadium, zinc, acenaphthene, acenaphthylene, naphthalene, and 2,4,6-TNT resulted in HQ values that were greater than 1.

Detections of PAH compounds acenaphthene, acenaphthylene, and naphthalene reported by Method 8310, which would have resulted in HQ values greater than 1 were not confirmed by low-level analysis by Method 8270C. Unlike Method 8270C, Method 8310 is susceptible to matrix interference and false positive detections, and therefore, confirmation of the detections with low-level Method 8270C is considered appropriate to confirm the results. Based on the lack of confirmation of detections, PAHs are not considered a potential concern for soil invertebrates and microbial communities at Area B.

7.3.1.3 Terrestrial Wildlife

Quantitative risk characterization for terrestrial wildlife is limited to direct ingestion of biota and incidental ingestion of soil. The calculated total 2,3,7,8-TCDD equivalents used in the screening for Area B are provided in Table 7-11. The risk for detected bioaccumulative chemicals are summarized in Table 7-12 for each terrestrial wildlife receptor and the chemicals with HQs great than 1 are characterized as follows:

Receptor	NOAEL Only Exceedances	NOAEL and LOAEL Exceedances
Meadow Vole	2,3,7,8-TCDD TEQ (dioxin/furans), 1,3,5-TNB, 2-amino-DNT, 4-amino-DNT, RDX	arsenic, copper, lead, selenium, zinc, 2,4,6-TNT, nitroglycerin
Short-tailed Shrew	cadmium, chromium, dieldrin, 2-amino-DNT, 4-amino-DNT	arsenic, copper, lead, selenium, zinc, 2,3,7,8-TCDD TEQ (dioxin/furans), Aroclor 1254, Aroclor 1260, 2,4,6-TNT, nitroglycerin
Red Fox	cadmium, chromium, dieldrin, heptachlor epoxide, 1,3,5-TNB, 2-amino-DNT, 4-amino-DNT, RDX	arsenic, copper, lead, selenium, zinc, 2,3,7,8-TCDD TEQ (dioxin/furans), Aroclor 1254, Aroclor 1260, 2,4,6-TNT, nitroglycerin
American Robin	cadmium, 4,4'-DDE, dieldrin, Aroclor 1260, RDX	chromium, copper, lead, mercury, selenium, zinc, 2,3,7,8-TCDD TEQ (dioxin/furans), Aroclor 1254, acenaphthene, 2,4,6-TNT, 2,4-DNT
Red-tailed Hawk	zinc, 2,3,7,8-TCDD TEQ (dioxin/furans), 2,4-DNT	lead, 2,4,6-TNT

The detections of acenaphthene reported by Method 8310, which would have resulted in HQ values greater than 1 were not confirmed by low-level analysis by Method 8270C. Unlike Method 8270C, Method 8310 is susceptible to matrix interference and false positive detections, and therefore, confirmation of the detections with low-level Method 8270C is considered appropriate to confirm the results. Based on the lack of confirmation of detections, acenaphthene is not considered a potential concern for terrestrial wildlife at Area B.

7.3.2 Refined Risk Characterization

The complete refined risk characterization tables are provided in Appendix F.3 and summarized below.

7.3.2.1 Terrestrial Plants

Direct contact HQs calculated for plants are presented in Table 7-9 for detected chemicals. Of the detected chemicals for which screening values were available, the concentrations of aluminum, calcium, chromium, lead, manganese, selenium, vanadium, zinc, acenaphthene, naphthalene, 2,4-DNT, and 2,4,6-TNT resulted in HQ values greater than 1.

As discussed previously in Section 7.3.1.1, PAH compounds acenaphthene, acenaphthylene, and naphthalene are not considered a potential concern for terrestrial plants at Area B due to a lack of confirmation of detections of these compounds by low-level Method 8270C.

7.3.2.2 Soil Invertebrates and Microbial Communities

Direct contact HQs calculated for invertebrates are presented in Table 7-10 for detected chemicals. Of the detected chemicals for which screening values were available, the concentrations of chromium, iron, lead, manganese, mercury, vanadium, zinc, acenaphthene, naphthalene, and 2,4,6-TNT resulted in HQ values that were greater than 1.

As discussed previously in Section 7.3.1.2, PAH compounds acenaphthene, acenaphthylene, and naphthalene are not considered a potential concern for soil invertebrates and microbial communities at Area B due to a lack of confirmation of detections of these compounds by low-level Method 8270C.

7.3.2.3 Terrestrial Wildlife

The refined risk characterization results are presented in Table 7-12 and summarized below for each of the receptors with chemical HQs greater than 1:

Receptor	NOAEL Only Exceedances	NOAEL and LOAEL Exceedances
Meadow Vole	lead (1.3), 2,3,7,8-TCDD TEQ (dioxin/furans) (1.3), 2,4,6-TNT (2.1)	Nitroglycerin (17/1.6)
Short-tailed Shrew	lead (5.5), Aroclor 1254 (8.3), Aroclor 1260 (3.5), Nitroglycerin (9.3)	2,3,7,8-TCDD TEQ (dioxin/furans) (200/20)
Red Fox	none	none
American Robin	zinc (4.1), 4,4'-DDE (1.4)	lead (58/5.8), 2,3,7,8-TCDD TEQ (dioxin/furans) (17/1.7), 2,4,6-TNT (180/7.1), 2,4-DNT (60/4.8)
Red-tailed Hawk	none	none

*Note: (200/20) = NOAEL-based HQ/LOAEL-based HQ

7.3.3 Risk Management - Scientific Management Decision Point

Terrestrial plant COPECs with refined HQs greater than 1 included: aluminum, calcium, chromium, lead, manganese, selenium, vanadium, zinc, acenaphthene, naphthalene, 2,4-DNT, and 2,4,6-TNT. Although the refined aluminum HQ exceeds 1, the average pH in the soil is greater than 5.5 (see Appendix C.1); therefore, aluminum is not considered a COPEC. Chromium, manganese, and vanadium are consistently below background (see Appendix C.9, Table C.9-3); therefore, these chemicals are not considered site related. Lead concentrations at the site are below background via means comparison, but it should be noted hot spots are present in the area surrounding borings 54SB42, 54SB46, and 54SB49, as presented on Figure 7-3. Even though refined HQs for selenium (1.5) and zinc (5.4) are greater than 1 and concentrations at the site are above background concentrations via means comparison, these risks present low to moderate risk to terrestrial plants at the site. A discussion of the methodology of site versus background comparison is provided in Section 6.4.3. PAH compounds acenaphthene and naphthalene are not considered a potential concern for terrestrial plants at Area B due to a lack of confirmation of detections of these compounds by low-level Method 8270C.

Soil invertebrates and microbial processes COPECs with refined HQs greater than 1 included chromium, iron, lead, manganese, mercury, vanadium, zinc, acenaphthene, naphthalene, and 2,4,6-TNT. Chromium, iron, manganese, mercury, and vanadium are consistently below background; therefore, these chemicals are not considered site related. Lead concentrations at the site are below background via means comparison, but it should be noted hot spots are present in the area surrounding borings 54SB42, 54SB46, and 54SB49 as presented on Figure 7-3. Even though the refined HQ for zinc (2.7) is greater than 1 and concentrations at the site are above background concentrations via means comparison, these risks are present low to moderate risk to soil invertebrates at the site. PAH compounds acenaphthene and naphthalene are not considered a potential concern for soil invertebrates and microbial processes at Area B due to a lack of confirmation of detections of these compounds by low-level Method 8270C.

The refined risk characterization for wildlife resulted in the identification of the following risk drivers (those chemicals with a NOAEL and LOAEL-based HQs greater than one): meadow vole - nitroglycerin

(NOAEL HQ=17 and LOAEL HQ=1.6); short-tailed shrew - 2,3,7,8-TCDD TEQ – dioxins/furans (NOAEL HQ=200 and LOAEL HQ=20); and American robin 2,3,7,8-TCDD TEQ – dioxins/furans (NOAEL HQ=17 and LOAEL HQ=1.7), lead (NOAEL HQ=58 and LOAEL HQ=5.8), 2,4,6-TNT (NOAEL HQ=180 and LOAEL HQ=7.1), and 2,4-DNT (NOAEL HQ=60 and LOAEL HQ = 4.8) . Refer to Figure 7-3 for the lateral extent of contamination of concern for lead, Figure 7-4 for the lateral extent of contamination of concern for 2,3,7,8-TCDD TEQ – dioxin/furans, and Figure 7-5 for the lateral extent of contamination of concern for explosives. As presented in Section 4.0 on Figure 4-16 and shown on Figures 7-2, 7-4, and 7-5, the extent of contamination of potential concern for ecological receptors is included within the area delineated for human health COPCs in soil at concentrations greater than R-RBCs.

The lateral extent of contamination for 2,3,7,8-TCDD TEQ (dioxin/furans), lead, and explosives at Area B with respect to ecological receptors is presented on Figures 7-3, 7-4, and 7-5, respectively.

After consideration of spatial distribution of data at the site, the results of the SLERA, background concentrations, and the nature of the propellant waste historically disposed of at the site, the SMDP is the following:

There is adequate information to conclude that the potential exists for an adverse ecological impact to plants due to lead, 2,4-DNT, and 2,4,6-TNT concentrations in soil, invertebrates due to the lead and 2,4,6-TNT concentration in soil, the meadow vole due to exposure to nitroglycerin in soil, the short-tailed shrew due to exposure to 2,3,7,8-TCDD TEQ (dioxin/furans,) and the American robin due to exposure to 2,3,7,8-TCDD TEQ, lead, 2,4,6-TNT, and 2,4-DNT in soil at the site. Hot spots for lead, explosives, and dioxins were identified in the immediate area of soil borings 54SB42, 54SB46, and 54SB49 in the same area identified for human health I-RBC exceedances for lead, explosives, and/or dioxins as presented on Figures 4-9, 4-11, and 4-12, respectively. No other significant potential impacts to ecological receptors due to site-related activities were identified. Significant uncertainty is associated with the potential impact to the meadow vole, short-tailed shrew and American robin. It is recommended that the need for remedial action to address this potential impact be evaluated along with the uncertainty associated with the derivation of the HQs, the location of HHRA COCs, the fate and transport evaluation, the "hot spot" locations, and other relevant factors, which would influence any decision to implement action.

7.4 EXPOSURE AND RISK UNCERTAINTY ANALYSIS

Based on this assessment, while factors such as lack of TSV and wildlife profile assumptions may create limited uncertainty, the overall result of the conservative nature of the process has produced a conservative assessment of potential ecological risks associated with the site.

Assumptions and other factors that tend to overestimate, underestimate, or have an unknown effect on the findings of the ecological risk screening are presented below with a discussion of their uncertainty.

7.4.1 Data Quality

Insufficient sampling density or the analyte list may not provide a representative estimate of exposure to COPECs. Misrepresentation of exposure results in uncertainty and may lead to an overestimation or underestimation of risk. Ten or more sampling locations at each of the sites under consideration reduce this uncertainty. Moreover, the extensive list of constituents analyzed reduces the likelihood of failing to identify a COPEC. Therefore, the uncertainty in the ecological risk screening results associated with data quality is likely minimal.

7.4.2 COPEC Bioavailability

Chemical analyses of exposure media measured the total levels of the COPECs rather than the more bioavailable toxic forms. The availability of the total concentrations alone assumes that the entire fraction is bioavailable and toxic. This is likely to be a very conservative assumption that varies from constituent to constituent. It was also assumed that no geochemical factors limited receptor exposure to, or the

potential for toxic expression of COPECs. It is likely that COPECs may, to some degree, adsorb to fine-grained particles and/or complex with chemical complexing agents and organic ligands in the exposure media. Such actions may change the chemical speciation of the COPECs to a less toxic form, or reduce the concentrations of bioavailable chemicals and subsequent uptake by receptors. Therefore, risk is likely to be overestimated.

7.4.3 Wildlife Profile Assumptions

Dose rate models require a number of assumptions, which could result in either an overestimation or underestimation of risk to receptors. For example, body weights and ingestion rates are estimated from limited information. In addition, receptors are assumed to feed on specified food sources, although some such as the Red Fox may feed opportunistically on a greater variety of food types.

Area use factors (AFs) were estimated based on the size of the site relative to the home ranges of the receptors. However, the foraging of birds and mammals is not assessed simply by size, but rather a function of habitat suitability, habitat productivity, and species-specific foraging behaviors. Therefore, because habitat quality is not accounted for in estimating AF, the risk to terrestrial receptors in this assessment is likely to be overestimated.

7.4.4 Lack of Toxicological Data

The evaluation of ecological effects was limited in the direct contact and wildlife ingestion pathways due to limited toxicological data of the COPECs. The effects of many COPECs evaluated for the direct contact pathway to invertebrates and microbial communities were not quantified due to the lack of invertebrate derived TRVs. In addition, NOAEL and LOAEL TRVs were not available for receptors exposed to multiple COPECs. Therefore, due to the lack of toxicological data, the risk to potential receptors may be underestimated or unknown.

7.4.5 TRVs

NOAEL and LOAEL TRVs identified for wildlife receptors represent the most conservative application of toxicity test results identified from the literature. High uncertainty factors were used to provide TRVs representative of chronic exposure and sub-lethal effects. This approach is likely to overestimate the sensitivity of many ecological receptors and likely overestimates risk to potential receptors.

7.4.6 Hazard Quotients

Uncertainties in characterizing risks are primarily associated with the assumption that an HQ greater than 1 is an adequate indicator of the potential for ecological risks of individual chemicals. Given the use of conservative and realistic exposure and effects assumptions previously discussed, there is minimal uncertainty that the potential for ecological risks of individual chemicals are not identified in the ecological risk screening of the sites. Conversely, there is a strong possibility for false positive identification of ecological risks for some individual chemicals.

7.4.7 Exposure and Risk Uncertainty Conclusions

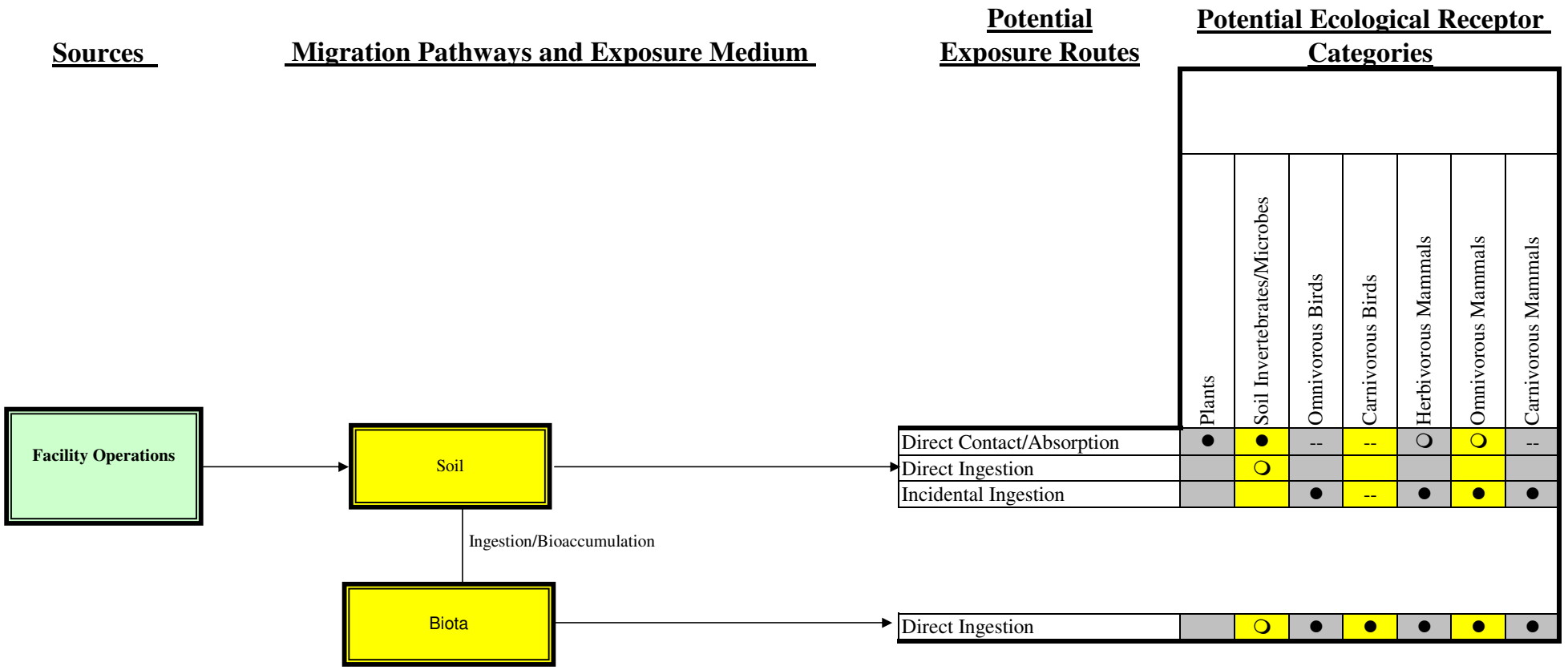
While factors such as lack of TSV and wildlife profile assumptions may create limited uncertainty, the very small size and negligible habitat quality of the site in combination with these limited uncertainties has produced a conservative assessment of potential ecological risks associated with SWMU 54.

7.5 CONCLUSIONS AND RECOMMENDATIONS

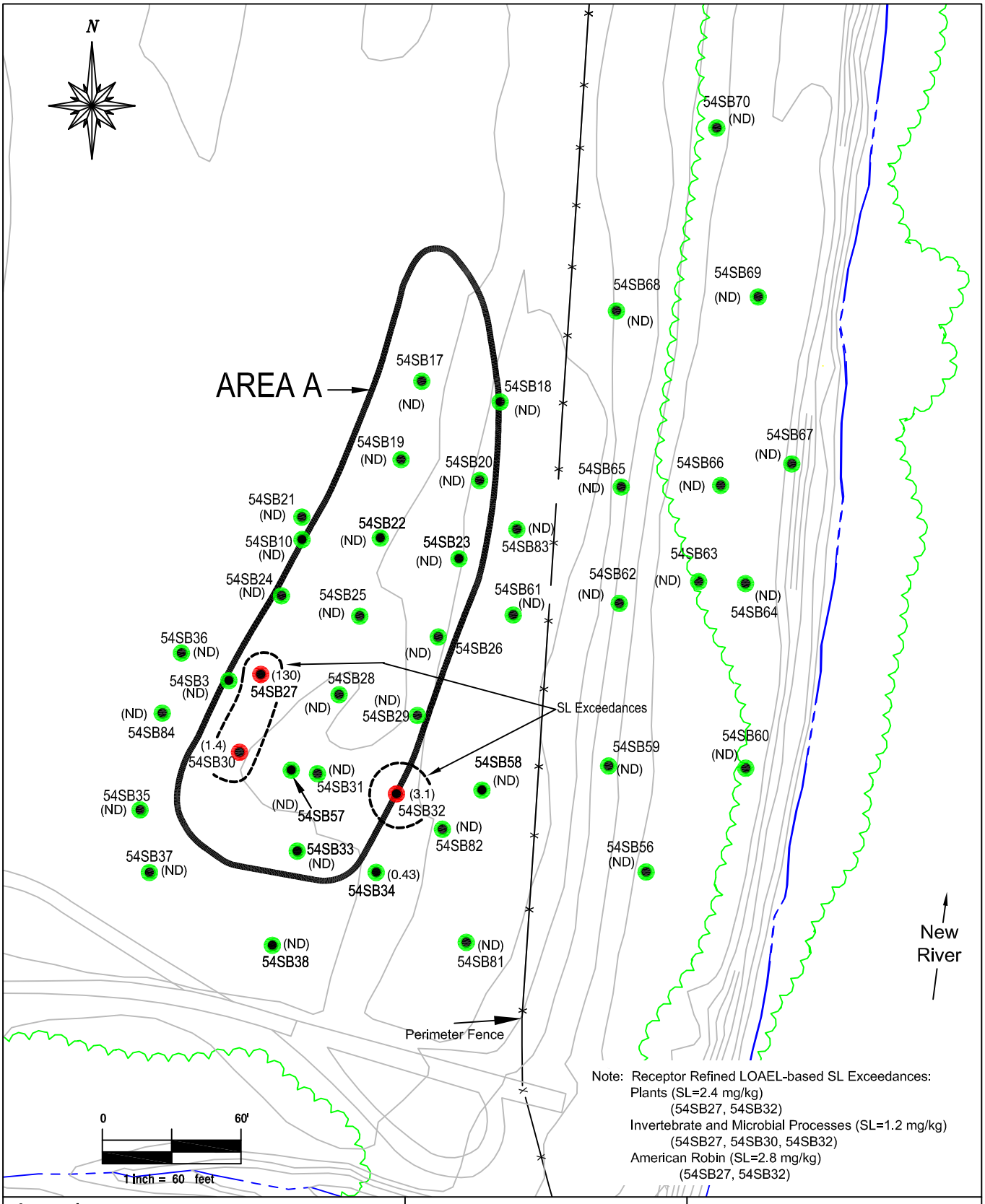
Based on the results of the SLERA and risk management considerations, it is recommended at Area A and Area B that the need for remedial action to address the potential adverse ecological impacts be evaluated along with the uncertainty associated with the derivation of the HQs, the location of HHRA COCs, the fate and transport evaluation, the “hot spot” locations, and other relevant factors which would influence any decision to implement action. As presented for Area A in Section 4.1.3, the lateral extent of contamination for 2,4,6-TNT of potential concern for ecological receptors coincides with the lateral

extent of contamination for this chemical of potential concern for human health. For Area B as presented in Section 4.3.3, the lateral extent of contamination for lead, explosives, and dioxin/furans of potential concern for ecological receptors coincides with the lateral extent of contamination for these chemicals of potential concern for human health.

Figure 7-1
Terrestrial Ecological Conceptual Site Model
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia



Notes:
● = POTENTIALLY COMPLETE PATHWAY EVALUATED QUANTITATIVELY
❍ - COMPLETE PATHWAY EVALUATED QUALITATIVELY
-- - PATHWAY IS INSIGNIFICANT
BLANK = INCOMPLETE PATHWAY



Note: Receptor Refined LOAEL-based SL Exceedances:
Plants (SL=2.4 mg/kg)
(54SB27, 54SB32)
Invertebrate and Microbial Processes (SL=1.2 mg/kg)
(54SB27, 54SB30, 54SB32)
American Robin (SL=2.8 mg/kg)
(54SB27, 54SB32)

Legend

- Approximate SWMU Boundary
- Soil Boring
- (3.1) Detected 2,4,6 TNT Concentration (mg/kg)
- Below Ecological Screening Level(s)
- Above Ecological Screening Level(s)
- Approximate Lateral Extent of Explosives
- ND Non-Detect
- mg/kg Milligram per kilogram

Figure 7-2

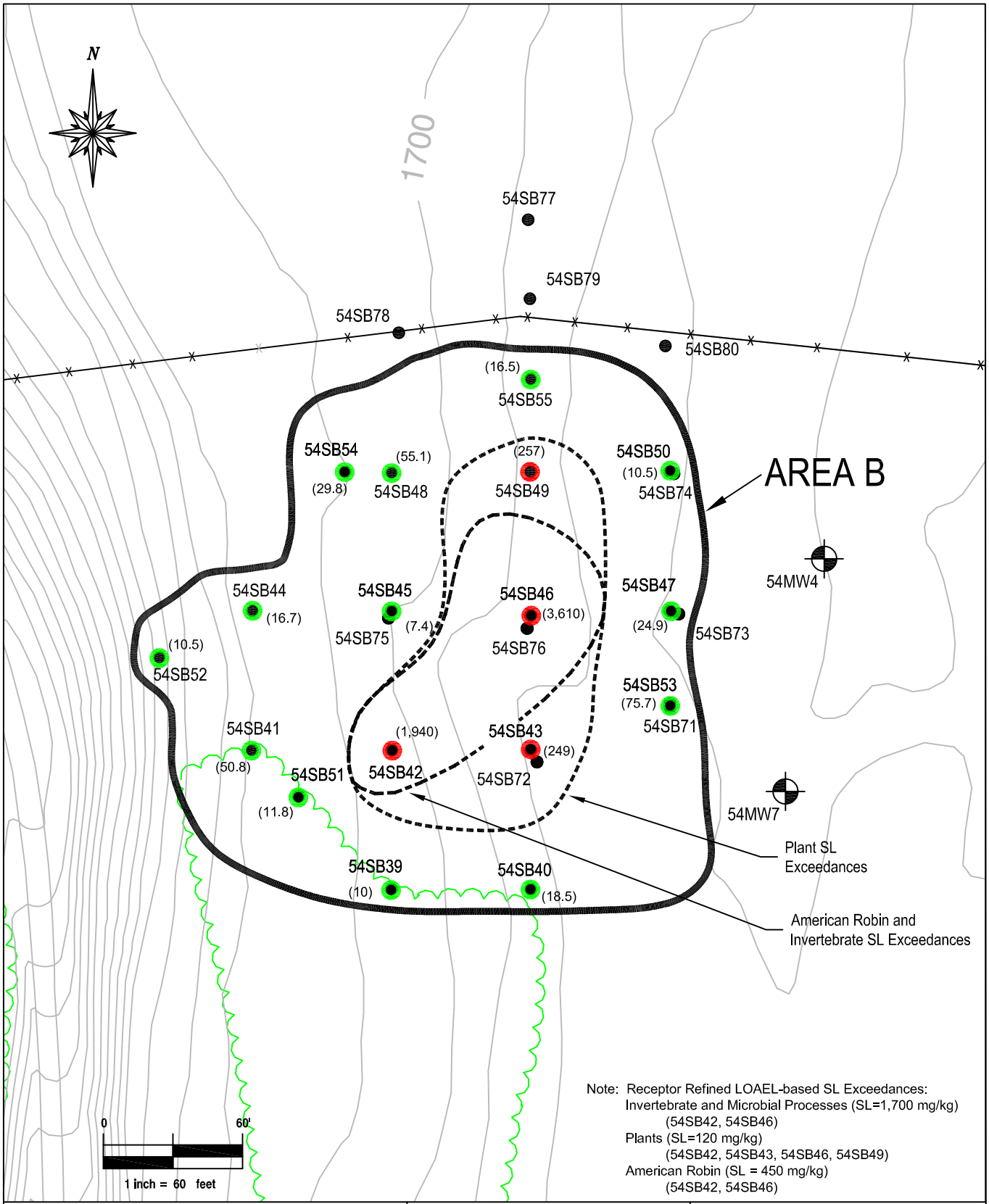
Area A - Extent of Explosives (2,4,6-TNT) in Soil - Ecological

Date: August 2008	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.7-2A Expl in Soil

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Note: Receptor Refined LOAEL-based SL Exceedances:
Invertebrate and Microbial Processes (SL=1,700 mg/kg)
(54SB42, 54SB46)
Plants (SL=120 mg/kg)
(54SB42, 54SB43, 54SB46, 54SB49)
American Robin (SL = 450 mg/kg)
(54SB42, 54SB46)

Legend

- Approximate SWMU Boundary
- Monitoring Well
- Soil Boring
- (19) Detected Lead Concentration (mg/kg)
- Below Ecological Screening Level(s)
- Above Ecological Screening Level(s)
- Approximate Lateral Extent

Figure 7-3

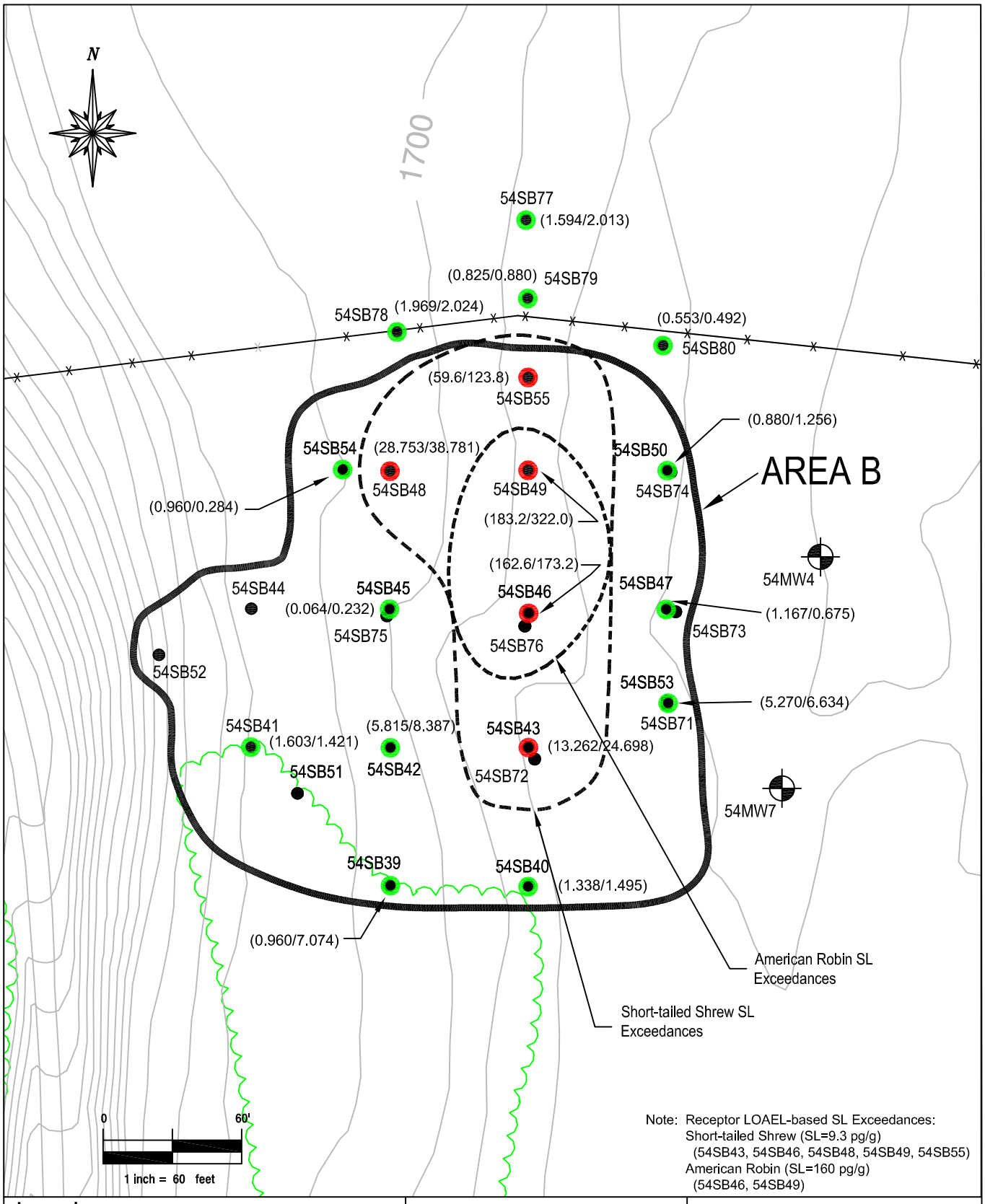
Area B - Extent of Lead in Soil - Ecological

Date: April 2006	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig 7-3 B Eco Lead

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Legend

- Approximate SWMU Boundary
- Monitoring Well
- Soil Boring
- Below Ecological Screening Level(s)
- Above Ecological Screening Level(s)
- (183.2/322.0) 2,3,7,8-TCDD TEQ Mammalian/Avian (pg/g)
- Approximate Lateral Extent

Figure 7-4

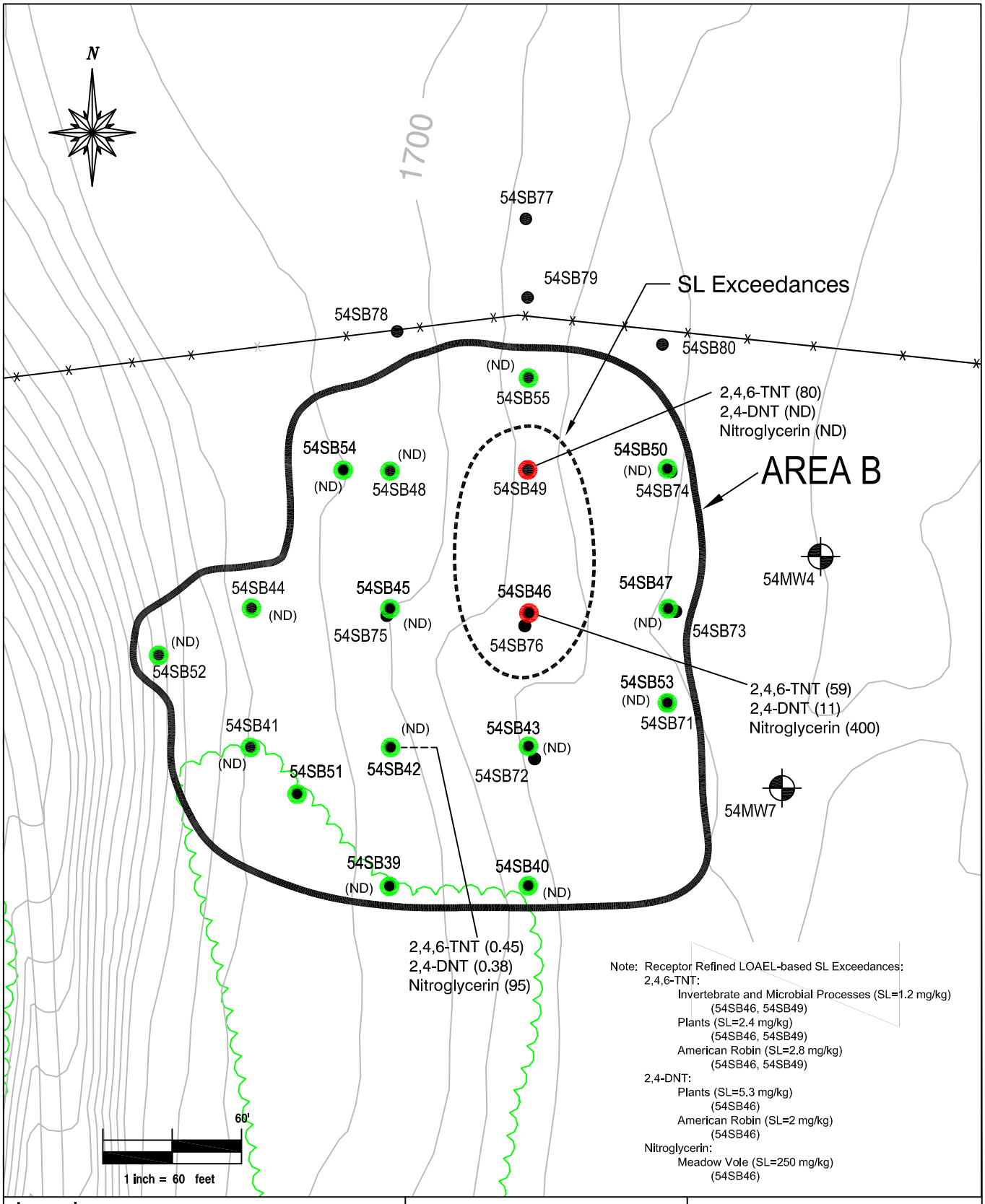
Area B - Extent of Dioxin/Furans in Soil - Ecological

Date: April 2006	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.7-4 B Eco Dioxin

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Legend

- Approximate SWMU Boundary
- Monitoring Well
- Soil Boring
- (3.1) Detected Concentration (mg/kg)
- Below Ecological Screening Level(s)
- Above Ecological Screening Level(s)
- Approximate Lateral Extent of Explosives
- ND Non-Detect
- mg/kg Milligram per kilogram

Figure 7-5

Area B - Extent of Explosives in Soil - Ecological

Date: August 2008	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig.7-5 B Eco Expl

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Table 7-1
SLERA Occurence/Distribution - Area A Surface Soil
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Chemical	CAS #	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
TAL Metals							
Aluminum	7429-90-5	6,620	19,400	mg/kg	54SB23A (C)	25/25	2.4 - 6.8
Antimony	7440-36-0	0.04	0.76	mg/kg	54SB34A (D)	13/22	0.0386 - 0.43
Arsenic	7440-38-2	0.67	2.5	mg/kg	54SB31A	25/25	0.058 - 0.36
Barium	7440-39-3	84.9	206	mg/kg	54SB38A (D)	25/25	0.02 - 0.103
Beryllium	7440-41-7	0.21	1	mg/kg	54SB38A (D)	25/25	0.01 - 0.0267
Cadmium	7440-43-9	0.1	1.6	mg/kg	54SB57A (E)	6/25	0.03 - 0.25
Calcium	7440-70-2	1,020	21,500	mg/kg	54SB21A	25/25	1 - 17.5
Chromium	7440-47-3	12	29.5	mg/kg	54SB31A	25/25	0.07 - 0.998
Cobalt	7440-48-4	5.8	16	mg/kg	54SB57A (E)	25/25	0.07 - 0.233
Copper	7440-50-8	3.9	84.1	mg/kg	54SB34A (D)	25/25	0.15 - 0.516
Iron	7439-89-6	13,700	27,200	mg/kg	54SB25A	25/25	0.731 - 1.7
Lead	7439-92-1	6.4	528	mg/kg	54SB34A (D)	26/26	0.041 - 0.776
Magnesium	7439-95-4	1,880	5,000	mg/kg	54SB57A (E)	25/25	0.66 - 7.67
Manganese	7439-96-5	309	909	mg/kg	54SB38A (D)	25/25	0.02 - 0.474
Mercury	7439-97-6	0.017	0.31	mg/kg	54SB33A (B)	25/25	0.0077 - 0.021
Nickel	7440-02-0	8.4	13.5	mg/kg	54SB32A	25/25	0.0775 - 0.13
Potassium	7440-09-7	832	1,810	mg/kg	54SB57A (E)	25/25	4.3 - 14.9
Selenium	7782-49-2	0.057	2	mg/kg	54SB38A (D)	23/25	0.0486 - 0.41
Silver	7440-22-4	0.049	0.089	mg/kg	54SB57A (E)	3/25	0.0178 - 0.1
Sodium	7440-23-5	38	469	mg/kg	54SB38A (D)	21/25	27.1 - 36.4
Thallium	7440-28-0	0.12	0.2	mg/kg	54SB57A (E)	3/15	0.0733 - 0.64
Vanadium	7440-62-2	16	55.3	mg/kg	54SB23A (C)	25/25	0.07 - 0.401
Zinc	7440-66-6	43.2	337	mg/kg	54SB34A (D)	25/25	0.11 - 0.789
TCL Pesticides/PCBs							
4,4'-DDE	72-55-9	4.8E-03	4.8E-03	mg/kg	54SB57A (E)	1/14	0.0004 - 0.00335
4,4'-DDT	50-29-3	2.1E-03	2.6E-02	mg/kg	54SB57A (E)	3/14	0.00039 - 0.00312
alpha-Chlordane	5103-71-9	3.1E-03	3.1E-03	mg/kg	54SB57A (E)	1/14	0.00022 - 0.0026
delta-BHC	319-86-8	5.0E-04	5.0E-04	mg/kg	54SB30A	1/14	0.00015 - 0.00226
Endosulfan Sulfate	1031-07-8	1.8E-03	1.8E-03	mg/kg	54SB25A	1/14	0.0004 - 0.00311
Endrin aldehyde	7421-93-4	1.2E-03	1.2E-03	mg/kg	54SB30A	1/14	0.00035 - 0.00252
gamma-BHC (Lindane)	58-89-9	1.6E-03	1.6E-03	mg/kg	54SB30A	1/14	0.00022 - 0.00304
gamma-Chlordane	5103-74-2	1.0E-02	1.0E-02	mg/kg	54SB57A (E)	1/14	0.00035 - 0.00265
Heptachlor	76-44-8	1.1E-03	4.8E-03	mg/kg	54SB30A	2/14	0.00034 - 0.00285
Heptachlor epoxide	1024-57-3	1.1E-01	1.1E-01	mg/kg	54SB32A	1/14	0.00026 - 0.00401
Methoxychlor	72-43-5	6.3E-03	7.4E-03	mg/kg	54SB30A	2/14	0.0014 - 0.00541
Aroclor 1254	11097-69-1	2.8E-02	2.0E-01	mg/kg	54SB57A (E)	3/14	0.0068 - 0.009
Aroclor 1260	11096-82-5	7.8E-02	7.8E-02	mg/kg	54SB3A	1/14	0.005 - 0.0111
TCL SVOCs							
2-Nitroaniline	88-74-4	5.5E-02	5.5E-02	mg/kg	54SB27A (D)	1/18	0.029 - 0.029
Bis(2-ethylhexyl)phthalate	117-81-7	6.1E-02	2.6E+00	mg/kg	54SB27A (D)	13/18	0.032 - 0.032
Di-n-butylphthalate	84-74-2	4.9E-02	8.0E-01	mg/kg	54SB27A (D)	6/18	0.38 - 0.42
Di-n-octylphthalate	117-84-0	5.7E-02	3.2E-01	mg/kg	54SB28A	7/18	0.38 - 0.42
Diethylphthalate	84-66-2	1.2E-01	6.8E-01	mg/kg	54SB32A	5/18	0.38 - 0.42
N-Nitrosodiphenylamine	86-30-6	6.6E-02	1.2E+00	mg/kg	54SB27A (D)	3/18	0.38 - 0.42
Dioxin/Furans							
Total 2,3,7,8-TCDD TEQ (Mammalian)	--	3.8E-08	1.7E-05	mg/kg	54SB33A (B)	11/11	--
Total 2,3,7,8-TCDD TEQ (Avian)	--	1.3E-08	1.7E-05	mg/kg	54SB33A (B)	11/11	--
PAHs							
Acenaphthene	83-32-9	3.3E-02	1.6E+00	mg/kg	54SB27A (D)	9/13	0.0058 - 0.051
Acenaphthylene	208-96-8	2.2E-02	1.1E+00	mg/kg	54SB27A (D)	5/18	0.0059 - 0.051
Benzo(a)anthracene	56-55-3	3.6E-03	4.9E-02	mg/kg	54SB30A	12/18	0.0022 - 0.01
Benzo(a)pyrene	50-32-8	3.4E-03	5.8E-02	mg/kg	54SB25A	7/18	0.0016 - 0.01
Benzo(b)fluoranthene	205-99-2	5.2E-03	1.1E-01	mg/kg	54SB27A (D)	9/18	0.0017 - 0.01
Benzo(g,h,i)perylene	191-24-2	1.1E-02	3.2E-02	mg/kg	54SB24A	4/18	0.0036 - 0.01
Benzo(k)fluoranthene	207-08-9	3.7E-03	5.7E-02	mg/kg	54SB25A	8/18	0.0014 - 0.01
Chrysene	218-01-9	4.5E-03	2.1E-01	mg/kg	54SB33A (B)	10/18	0.0024 - 0.01
Dibenz(a,h)anthracene	53-70-3	1.6E-02	3.6E-02	mg/kg	54SB24A	4/18	0.0042 - 0.01
Fluoranthene	206-44-0	4.8E-03	9.0E-02	mg/kg	54SB25A	15/18	0.0021 - 0.02
Indeno(1,2,3-cd)pyrene	193-39-5	1.4E-02	3.9E-01	mg/kg	54SB33A (B)	5/18	0.0025 - 0.01
Naphthalene	91-20-3	4.6E-02	9.4E+00	mg/kg	54SB30A	9/12	0.014 - 0.049
Phenanthrene	85-01-8	1.9E-02	1.2E-01	mg/kg	54SB30A	5/18	0.0085 - 0.051
Pyrene	129-00-0	1.3E-02	1.8E-01	mg/kg	54SB27A (D)	13/18	0.0043 - 0.02
Explosives							
1,3,5-Trinitrobenzene	99-35-4	7.6E+00	7.6E+00	mg/kg	54SB27A (D)	1/17	0.079 - 0.246
2,4,6-Trinitrotoluene	118-96-7	4.3E-01	1.3E+02	mg/kg	54SB27A (D)	4/29	0.051 - 0.16
2,4-Dinitrotoluene	121-14-2	1.7E+01	1.7E+01	mg/kg	54SB27A (D)	1/29	0.073 - 0.12
2,6-Dinitrotoluene	606-20-2	1.1E+01	1.1E+01	mg/kg	54SB27A (D)	1/29	0.099 - 0.19
2-Amino-4,6-Dinitrotoluene	35572-78-2	1.7E-01	5.7E+00	mg/kg	54SB27A (D)	3/29	0.088 - 0.106
4-Amino-2,6-Dinitrotoluene	1946-51-0	7.6E-01	5.2E+00	mg/kg	54SB27A (D)	2/29	0.053 - 0.095
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	6.8E+00	6.8E+00	mg/kg	54SB27A (D)	1/29	0.1 - 0.208

Table 7-1
SLERA Occurence/Distribution - Area A Surface Soil
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Notes:

CAS = Chemical Abstracts Service
mg/kg = Milligram Per Kilogram
TAL = Target Analyte List
TCL = Target Compound List
PCB = Polychlorinated Biphenyl
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Compound
PAH = Polynuclear Aromatic Hydrocarbon

(B) = Re-sampled; Pesticides and PCBs analyzed January 2007.
(C) = Re-sampled; Pesticides, PCBs, and Dioxin/Furans analyzed January 2007.
(D) = Re-sampled; Dioxin/Furans analyzed January 2007.
(E) = Re-sampled; PCBs and PCB Congeners analyzed January 2007.

Refer to Table 7-7 for Total 2,3,7,8-TCDD TEQ Calculations

Table 7-2
SLERA Occurence/Distribution - Area B Surface Soil
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Chemical	CAS #	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
TAL Metals							
Aluminum	7429-90-5	8,690	22,600	mg/kg	54SB49A	17/17	2.3 - 7.1
Antimony	7440-36-0	0.44	1.9	mg/kg	54SB46A (E)	7/15	0.14 - 0.68
Arsenic	7440-38-2	0.44	5.1	mg/kg	54SB46A (E)	17/17	0.27 - 0.46
Barium	7440-39-3	91.9	241	mg/kg	54SB51A	17/17	0.02 - 0.04
Beryllium	7440-41-7	0.61	1.1	mg/kg	54SB49A	17/17	0.01 - 0.03
Cadmium	7440-43-9	0.05	0.64	mg/kg	54SB46A (E)	3/17	0.03 - 0.07
Calcium	7440-70-2	636	14,900	mg/kg	54SB46A (E)	17/17	1 - 1.9
Chromium	7440-47-3	14.8	41.6	mg/kg	54SB49A	17/17	0.06 - 0.11
Cobalt	7440-48-4	6.1	12.2	mg/kg	54SB49A	17/17	0.06 - 0.11
Copper	7440-50-8	3.3	195	mg/kg	54SB46A (E)	17/17	0.15 - 0.26
Iron	7439-89-6	13,200	35,100	mg/kg	54SB49A	17/17	1.4 - 2.5
Lead	7439-92-1	7.4	3610	mg/kg	54SB46A (E)	17/17	0.14 - 0.42
Magnesium	7439-95-4	1,120	9,040	mg/kg	54SB46A (E)	17/17	0.65 - 1.5
Manganese	7439-96-5	296	884	mg/kg	54SB42A DUP AVG (C)	17/17	0.02 - 0.04
Mercury	7439-97-6	0.02	0.77	mg/kg	54SB46A (E)	17/17	0.018 - 0.031
Nickel	7440-02-0	7	19.3	mg/kg	54SB49A	17/17	0.11 - 0.18
Potassium	7440-09-7	749	2,880	mg/kg	54SB49A	17/17	4.5 - 21.7
Selenium	7782-49-2	0.56	2.6	mg/kg	54SB49A	17/17	0.34 - 0.6
Silver	7440-22-4	0.11	0.11	mg/kg	54SB46A (E)	1/17	0.07 - 0.13
Sodium	7440-23-5	67.6	1270	mg/kg	54SB49A	16/17	26.6 - 45.5
Vanadium	7440-62-2	23	58.9	mg/kg	54SB49A	17/17	0.07 - 0.13
Zinc	7440-66-6	47.1	555	mg/kg	54SB46A (E)	17/17	0.11 - 0.18
TCL Pesticides/PCBs							
4,4'-DDE	72-55-9	7.6E-03	6.0E-02	mg/kg	54SB46A (E)	2/10	0.0004 - 0.00392
alpha-Chlordane	5103-71-9	6.2E-02	6.2E-02	mg/kg	54SB46A (E)	1/10	0.00022 - 0.00305
delta-BHC	319-86-8	6.0E-03	6.0E-03	mg/kg	54SB49A	1/10	0.00015 - 0.00265
Dieldrin	60-57-1	1.1E-02	1.1E-02	mg/kg	54SB46A (E)	1/10	0.00043 - 0.0032
Endrin aldehyde	7421-93-4	4.4E-03	4.4E-03	mg/kg	54SB73A	1/10	0.00035 - 0.00295
Endrin ketone	53494-70-5	7.5E-03	7.5E-03	mg/kg	54SB49A	1/10	0.00039 - 0.00311
gamma-Chlordane	5103-74-2	5.5E-02	5.5E-02	mg/kg	54SB46A (E)	1/10	0.00035 - 0.00311
Heptachlor	76-44-8	1.3E-03	1.3E-03	mg/kg	54SB46A (E)	1/10	0.00034 - 0.00335
Heptachlor epoxide	1024-57-3	5.9E-03	2.1E-02	mg/kg	54SB46A (E)	2/10	0.00026 - 0.00471
Methoxychlor	72-43-5	3.0E-03	3.0E-03	mg/kg	54SB49A	1/10	0.0014 - 0.00634
Aroclor 1254	11097-69-1	1.5E-02	2.8E+00	mg/kg	54SB46A (E)	5/10	0.0072 - 0.073
Aroclor 1260	11096-82-5	2.4E-02	3.8E-01	mg/kg	54SB46A (E)	2/10	0.0053 - 0.0141
TCL SVOCs							
Bis(2-ethylhexyl)phthalate	117-81-7	5.0E-02	1.4E+00	mg/kg	54SB46A (E)	10/17	0.032 - 0.032
Di-n-butylphthalate	84-74-2	4.4E-02	1.1E+01	mg/kg	54SB46A (E)	6/17	0.38 - 6
Diethylphthalate	84-66-2	3.6E-02	9.6E+01	mg/kg	54SB46A (E)	9/17	0.38 - 6
Dimethylphthalate	131-11-3	1.2E+00	1.9E+00	mg/kg	54SB46A (E)	2/17	0.38 - 6
N-Nitrosodiphenylamine	86-30-6	1.1E-01	1.8E+00	mg/kg	54SB46A (E)	4/17	0.38 - 6
Dioxin/Furans							
Total 2,3,7,8-TCDD TEQ (Mammalian)	--	6.4E-07	1.8E-04	mg/kg	54SB49A	18/18	--
Total 2,3,7,8-TCDD TEQ (Avian)	--	1.3E-08	3.2E-04	mg/kg	54SB49A	18/18	--
PAHs							
Acenaphthene	83-32-9	3.4E-02	3.5E+00	mg/kg	54SB43A (F)	5/17	0.0058 - 0.0059
Acenaphthylene	208-96-8	2.4E-01	2.4E-01	mg/kg	54SB49A	1/17	0.0059 - 0.0059
Benzo(a)anthracene	56-55-3	5.6E-03	1.5E-02	mg/kg	54SB49A	3/17	0.0022 - 0.0022
Benzo(a)pyrene	50-32-8	6.9E-03	5.7E-02	mg/kg	54SB49A	3/17	0.0016 - 0.0016
Benzo(b)fluoranthene	205-99-2	5.0E-03	1.0E-01	mg/kg	54SB49A	7/17	0.0017 - 0.0017
Benzo(g,h,i)perylene	191-24-2	6.5E-03	8.4E-02	mg/kg	54SB50A (D)	2/17	0.0036 - 0.0036
Benzo(k)fluoranthene	207-08-9	6.7E-03	3.2E-02	mg/kg	54SB49A	3/17	0.0014 - 0.0036
Chrysene	218-01-9	1.3E-02	4.2E-02	mg/kg	54SB49A	3/17	0.0014 - 0.0024
Dibenz(a,h)anthracene	53-70-3	8.9E-03	8.9E-03	mg/kg	54SB43A (F)	1/17	0.0024 - 0.0042
Fluoranthene	206-44-0	4.3E-03	7.2E-02	mg/kg	54SB49A	8/17	0.0021 - 0.0042
Indeno(1,2,3-cd)pyrene	193-39-5	3.5E-02	3.5E-02	mg/kg	54SB43A (F)	1/17	0.0025 - 0.014
Naphthalene	91-20-3	8.9E-02	8.6E+00	mg/kg	54SB49A	5/17	0.0025 - 0.014
Phenanthrene	85-01-8	2.1E-02	2.5E-02	mg/kg	54SB49A	2/17	0.0085 - 0.0085
Pyrene	129-00-0	1.0E-02	6.5E-02	mg/kg	54SB50A (D)	8/17	0.0043 - 0.0043
Explosives							
1,3,5-Trinitrobenzene	99-35-4	1.9E+00	1.9E+00	mg/kg	54SB49A	1/1	0.079 - 0.079
2,4,6-Trinitrotoluene	118-96-7	4.5E-01	8.0E+01	mg/kg	54SB49A	3/17	0.16 - 0.16
2,4-Dinitrotoluene	121-14-2	3.8E-01	1.1E+01	mg/kg	54SB46A (E)	2/17	0.12 - 0.12
2-Amino-4,6-Dinitrotoluene	35572-78-2	9.6E+00	9.6E+00	mg/kg	54SB46A (E)	1/17	0.1 - 0.1
4-Amino-2,6-Dinitrotoluene	1946-51-0	1.4E+01	1.4E+01	mg/kg	54SB46A (E)	1/17	0.095 - 0.095
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	8.2E+00	8.2E+00	mg/kg	54SB49A	1/17	0.28 - 0.28
Nitroglycerin							
Nitroglycerin	55-63-0	9.5E+01	4.0E+02	mg/kg	54SB46A (E)	2/17	0.1 - 1

Table 7-2
SLERA Occurence/Distribution - Area B Surface Soil
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Notes:

CAS = Chemical Abstracts Service
mg/kg = Milligram Per Kilogram
TAL = Target Analyte List
TCL = Target Compound List
PCB = Polychlorinated Biphenyl
SVOC = Semivolatile Organic Compound
PAH = Polynuclear Aromatic Hydrocarbon

(C) = Re-sampled; Pesticides, PCBs, and Dioxin/Furans analyzed January 2007.
(D) = Re-sampled; Dioxin/Furans analyzed January 2007.
(E) = Re-sampled; PCBs and PCB Congeners analyzed January 2007.
(F) = Re-sampled; PCBs, PCB Congeners, and Dioxin/Furans analyzed January 2007.

Refer to Table 7-11 for Total 2,3,7,8-TCDD TEQ Calculations

Table 7-3
Non-detected Chemicals MDL Screening for Area A - Surface Soil
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Parameter Name	CAS #	Units	Number of Non-Detects	Minimum MDL	Maximum MDL	Plant SL	Source	Maximum MDL Exceeds SL	Inverte-brate SL	Source	Maximum MDL Exceeds SL	Avian ECO SSL	Source	Maximum MDL Exceeds SL	Mammalian ECO SSL	Source	Maximum MDL Exceeds SL
TAL Metals																	
CADMIUM	7440-38-2	mg/kg	19	0.03	0.05	18	A	N	60	B	N	43	A	N	46	A	N
SILVER	7440-22-4	mg/kg	22	0.08	0.1	560	A	N	50	E	N	4.2	A	N	14	A	N
SODIUM	7440-23-5	mg/kg	10	31.4	34.3	--	--	NS	--	--	NS	--	--	NS	--	--	NS
ANTIMONY	7440-36-0	mg/kg	15	0.0386	0.46	5	F	N	78	A	N	--	--	NS	--	--	NS
SELENIUM	7782-49-2	mg/kg	3	0.0486	0.0486	0.52	A	N	4.1	A	N	--	--	NS	--	--	NS
THALLIUM	7440-28-0	mg/kg	22	0.26	0.64	--	--	--	--	--	NS	--	--	NS	--	--	NS
MERCURY	7439-97-6	mg/kg	1	0.0077	0.0077	0.3	F	N	--	--	NS	--	--	NS	--	--	NS
Pesticides/PCBs																	
4,4'-DDD	72-54-8	ug/kg	26	0.32	2.87	100	G	N	100	C	N	--	--	NS	--	--	NS
4,4'-DDE	72-55-9	ug/kg	25	0.4	3.46	100	G	N	100	C	N	--	--	NS	--	--	NS
4,4'-DDT	50-29-3	ug/kg	23	0.39	3.23	100	G	N	100	C	N	93	A	N	21	A	N
ALDRIN	309-00-2	ug/kg	26	0.17	2.7	100	G	N	100	C	N	--	--	NS	--	--	NS
ALPHA-BHC	319-84-6	ug/kg	26	0.26	3.03	100,000	G	N	--	--	NS	--	--	NS	--	--	NS
ALPHA-CHLORDANE	5103-71-9	ug/kg	25	0.22	2.69	100	G	N	100	C	N	--	--	NS	--	--	NS
BETA-BHC	319-85-7	ug/kg	26	0.28	3.76	100,000	G	N	--	--	NS	--	--	NS	--	--	NS
DELTA-BHC	319-86-8	ug/kg	25	0.15	2.45	100,000	G	N	--	--	NS	--	--	NS	--	--	NS
DIELDRIN	60-57-1	ug/kg	26	0.43	2.83	100	G	N	100	C	N	22	A	N	4.9	A	N
ENDOSULFAN I	959-98-8	ug/kg	26	0.43	3.14	--	--	NS	--	--	NS	--	--	NS	--	--	NS
ENDOSULFAN II	33213-65-9	ug/kg	26	0.58	1.89	--	--	NS	--	--	NS	--	--	NS	--	--	NS
ENDOSULFAN SULFATE	1031-07-8	ug/kg	25	0.4	3.22	--	--	NS	--	--	NS	--	--	NS	--	--	NS
ENDRIN	72-20-8	ug/kg	26	0.35	3.36	100	G	N	100	C	N	--	--	NS	--	--	NS
ENDRIN ALDEHYDE	7421-93-4	ug/kg	25	0.35	4.01	100	G	N	100	C	N	--	--	NS	--	--	NS
ENDRIN KETONE	53494-70-5	ug/kg	26	0.39	3.92	100	G	N	100	C	N	--	--	NS	--	--	NS
GAMMA-BHC (LINDANE)	58-89-9	ug/kg	25	0.22	3.14	100	G	N	100	C	N	--	--	NS	--	--	NS
GAMMA-CHLORDANE	5103-74-2	ug/kg	25	0.35	2.74	100	G	N	100	C	N	--	--	NS	--	--	NS
HEPTACHLOR	76-44-8	ug/kg	24	0.34	2.95	100	G	N	100	C	N	--	--	NS	--	--	NS
HEPTACHLOR EPOXIDE	1024-57-3	ug/kg	25	0.26	4.15	100	G	N	100	C	N	--	--	NS	--	--	NS
METHOXYCHLOR	72-43-5	ug/kg	24	1.4	5.6	100	G	N	100	C	N	--	--	NS	--	--	NS
TOXAPHENE	8001-35-2	ug/kg	26	18	82.2	--	--	NS	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1016	12674-11-2	ug/kg	26	4.9	15	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1221	11104-28-2	ug/kg	26	10.3	15	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1232	11141-16-5	ug/kg	26	5.1	9.96	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1242	53469-21-9	ug/kg	26	6.16	10	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1248	12672-29-6	ug/kg	26	4.2	9.1	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1254	11097-69-1	ug/kg	19	6.8	9	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1260	11096-82-5	ug/kg	25	5	12.1	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
TCL SVOCs																	
1,1'-BIPHENYL	92-52-4	ug/kg	18	22	22	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,2'-OXYBIS(1-CHLOROPROPANE)	108-60-1	ug/kg	18	30	30	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,4,5-TRICHLOROPHENOL	95-95-4	ug/kg	18	49	49	4,000	F	N	9,000	B	N	--	--	NS	--	--	NS
2,4,6-TRICHLOROPHENOL	88-06-2	ug/kg	18	50	50	100	G	N	10,000	B	N	--	--	NS	--	--	NS
2,4-DICHLOROPHENOL	120-83-2	ug/kg	18	22	22	100	G	N	100	C	N	--	--	NS	--	--	NS
2,4-DIMETHYLPHENOL	105-67-9	ug/kg	18	30	30	100	G	N	100	C	N	--	--	NS	--	--	NS
2,4-DINITROPHENOL	51-28-5	ug/kg	18	170	170	20,000	F	N	100	C	**Y**	--	--	NS	--	--	NS
2,4-DINITROTOLUENE	121-14-2	ug/kg	17	20	20	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,6-DINITROTOLUENE	606-20-2	ug/kg	17	21	21	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2-CHLORONAPHTHALENE	91-58-7	ug/kg	18	22	22	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2-CHLOROPHENOL	95-57-8	ug/kg	18	18	18	7,000	F	N	10,000	B	N	--	--	NS	--	--	NS
2-METHYLNAPHTHALENE	91-57-6	ug/kg	18	24	24	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2-METHYLPHENOL	95-48-7	ug/kg	18	27	27	100	G	N	100	C	N	--	--	NS	--	--	NS
2-NITROANILINE	88-74-4	ug/kg	17	29	29	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2-NITROPHENOL	88-75-5	ug/kg	18	26	26	--	--	NS	--	--	NS	--	--	NS	--	--	NS
3,3'-DICHLOROBENZIDINE	91-94-1	ug/kg	18	29	29	--	--	NS	--	--	NS	--	--	NS	--	--	NS
3-NITROANILINE	99-09-2	ug/kg	18	34	34	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4,6-DINITRO-2-METHYLPHENOL	534-52-1	ug/kg	18	35	35	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4-BROMOPHENYL PHENYL ETHER	101-55-3	ug/kg	18	380	420	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4-CHLORO-3-METHYLPHENOL	59-50-7	ug/kg	18	29	29	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4-CHLOROANILINE	106-47-8	ug/kg	18	16	16	20,000	F	N	--	--	NS	--	--	NS	--	--	NS
4-CHLOROPHENYL PHENYL ETHER	7005-72-3	ug/kg	18	380	420	--	--	NS	--	--	NS	--	--	NS	--	--	NS

Table 7-3
Non-detected Chemicals MDL Screening for Area A - Surface Soil
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Parameter Name	CAS #	Units	Number of Non-Detects	Minimum MDL	Maximum MDL	Plant SL	Source	Maximum MDL Exceeds SL	Inverte-brate SL	Source	Maximum MDL Exceeds SL	Avian ECO SSL	Source	Maximum MDL Exceeds SL	Mammalian ECO SSL	Source	Maximum MDL Exceeds SL
4-METHYLPHENOL	106-44-5	ug/kg	18	48	48	100	G	N	100	C	N	--	--	NS	--	--	NS
4-NITROANILINE	100-01-6	ug/kg	18	39	39	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4-NITROPHENOL	100-02-7	ug/kg	18	75	75	100	G	N	7,000	B	N	--	--	NS	--	--	NS
ACENAPHTHENE	83-32-9	ug/kg	18	31	31	100	G	N	100	C	N	--	--	NS	--	--	NS
ACENAPHTHYLENE	208-96-8	ug/kg	18	17	17	100	G	N	100	C	N	--	--	NS	--	--	NS
ACETOPHENONE	98-86-2	ug/kg	18	23	23	--	--	NS	--	--	NS	--	--	NS	--	--	NS
ANTHRACENE	120-12-7	ug/kg	18	25	25	100	G	N	100	C	N	--	--	NS	--	--	NS
ATRAZINE	1912-24-9	ug/kg	18	16	16	--	--	NS	--	--	NS	--	--	NS	--	--	NS
BENZALDEHYDE	100-52-7	ug/kg	18	39	39	--	--	NS	--	--	NS	--	--	NS	--	--	NS
BENZO(A)ANTHRACENE	56-55-3	ug/kg	17	29	29	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(A)PYRENE	50-32-8	ug/kg	17	23	23	100	G	N	--	--	NS	--	--	NS	--	--	NS
BENZO(B)FLUORANTHENE	205-99-2	ug/kg	18	36	36	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(G,H,I)PERYLENE	191-24-2	ug/kg	17	23	23	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(K)FLUORANTHENE	207-08-9	ug/kg	17	29	29	100	G	N	100	C	N	--	--	NS	--	--	NS
BIS(2-CHLOROETHOXY)METHANE	111-91-1	ug/kg	18	21	21	--	--	NS	--	--	NS	--	--	NS	--	--	NS
BIS(2-CHLOROETHYL)ETHER	111-44-4	ug/kg	18	18	18	--	--	NS	--	--	NS	--	--	NS	--	--	NS
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	ug/kg	5	32	32	--	--	NS	--	--	NS	--	--	NS	--	--	NS
BUTYL BENZYL PHTHALATE	85-68-7	ug/kg	18	380	420	--	--	NS	--	--	NS	--	--	NS	--	--	NS
CAPROLACTAM	105-60-2	ug/kg	18	62	62	--	--	NS	--	--	NS	--	--	NS	--	--	NS
CARBAZOLE	86-74-8	ug/kg	18	29	29	--	--	NS	--	--	NS	--	--	NS	--	--	NS
CHRYSENE	218-01-9	ug/kg	17	28	28	100	G	N	100	C	N	--	--	NS	--	--	NS
DI-N-BUTYL PHTHALATE	84-74-2	ug/kg	12	380	420	200,000	F	N	--	--	NS	--	--	NS	--	--	NS
DI-N-OCTYL PHTHALATE	117-84-0	ug/kg	11	380	420	--	--	NS	--	--	NS	--	--	NS	--	--	NS
DIBENZO(A,H)ANTHRACENE	53-70-3	ug/kg	18	21	21	100	G	N	100	C	N	--	--	NS	--	--	NS
DIBENZOFURAN	132-64-9	ug/kg	18	24	24	--	--	NS	--	--	NS	--	--	NS	--	--	NS
DIETHYL PHTHALATE	84-66-2	ug/kg	13	390	420	--	--	NS	--	--	NS	--	--	NS	--	--	NS
DIMETHYL PHTHALATE	131-11-3	ug/kg	18	380	420	--	--	NS	--	--	NS	--	--	NS	--	--	NS
FLUORANTHENE	206-44-0	ug/kg	15	18	18	100	G	N	100	C	N	--	--	NS	--	--	NS
FLUORENE	86-73-7	ug/kg	18	18	18	100	G	N	100	C	N	--	--	NS	--	--	NS
HEXACHLOROBENZENE	118-74-1	ug/kg	18	22	22	--	--	NS	--	--	NS	--	--	NS	--	--	NS
HEXACHLOROBUTADIENE	87-68-3	ug/kg	18	24	24	--	--	NS	--	--	NS	--	--	NS	--	--	NS
HEXACHLOROCYCLOPENTADIENE	77-47-4	ug/kg	18	67	67	--	--	NS	--	--	NS	--	--	NS	--	--	NS
HEXACHLOROETHANE	67-72-1	ug/kg	18	17	17	--	--	NS	--	--	NS	--	--	NS	--	--	NS
INDENO(1,2,3-CD)PYRENE	193-39-5	ug/kg	18	20	20	100	G	N	100	C	N	--	--	NS	--	--	NS
ISOPHORONE	78-59-1	ug/kg	18	28	28	--	--	NS	--	--	NS	--	--	NS	--	--	NS
NAPHTHALENE	91-20-3	ug/kg	18	21	21	100	G	N	100	C	N	--	--	NS	--	--	NS
N-NITROSO-DI-N-PROPYLAMINE	621-64-7	ug/kg	18	21	21	--	--	NS	--	--	NS	--	--	NS	--	--	NS
N-NITROSODIPHENYLAMINE	86-30-6	ug/kg	15	380	420	--	--	NS	--	--	NS	--	--	NS	--	--	NS
NITROBENZENE	98-95-3	ug/kg	18	28	28	--	--	NS	--	--	NS	--	--	NS	--	--	NS
PENTACHLOROPHENOL	87-86-5	ug/kg	18	46	46	5,000	A	N	31,000	A	N	2,100	A	N	2,800	A	N
PHENANTHRENE	85-01-8	ug/kg	18	24	24	100	G	N	100	C	N	--	--	NS	--	--	NS
PHENOL	108-95-2	ug/kg	18	34	34	100	G	N	30,000	B	N	--	--	NS	--	--	NS
PYRENE	129-00-0	ug/kg	15	24	24	100	G	N	100	C	N	--	--	NS	--	--	NS
Dioxin/Furans																	
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	pg/g	4	0.923	1.3	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,4,7,8,9-HpCDF	55673-89-7	pg/g	7	0.461	0.7	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,4,7,8-HxCDD	39227-28-6	pg/g	5	0.461	0.6	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,4,7,8-HxCDF	70648-26-9	pg/g	6	0.2	0.536	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,6,7,8-HxCDD	57653-85-7	pg/g	4	0.461	0.6	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,6,7,8-HxCDF	57117-44-9	pg/g	6	0.2	0.536	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,7,8,9-HxCDD	19408-74-3	pg/g	5	0.461	0.6	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,7,8,9-HxCDF	72918-21-9	pg/g	8	0.3	0.536	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,7,8-PeCDD	40321-76-4	pg/g	8	0.3	0.536	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,7,8-PeCDF	57117-41-6	pg/g	3	0.2	0.461	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,3,4,6,7,8-HxCDF	60851-34-5	pg/g	6	0.2	0.536	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,3,4,7,8-PeCDF	57117-31-4	pg/g	3	0.2	0.461	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,3,7,8-TCDD	1746-01-6	pg/g	7	0.0964	0.3	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,3,7,8-TCDF	51207-31-9	pg/g	2	0.1	0.2	--	--	NS	--	--	NS	--	--	NS	--	--	NS
Total HpCDFs	--	pg/g	1	0.482	0.482	--	--	NS	--	--	NS	--	--	NS	--	--	NS
Total PeCDDs	--	pg/g	4	0.3	0.498	--	--	NS	--	--	NS	--	--	NS	--	--	NS

Table 7-3
Non-detected Chemicals MDL Screening for Area A - Surface Soil
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Parameter Name	CAS #	Units	Number of Non-Detects	Minimum MDL	Maximum MDL	Plant SL	Source	Maximum MDL Exceeds SL	Inverte-brate SL	Source	Maximum MDL Exceeds SL	Avian ECO SSL	Source	Maximum MDL Exceeds SL	Mammalian ECO SSL	Source	Maximum MDL Exceeds SL
Total PeCDFs	--	pg/g	2	0.3	0.461	--	--	NS	--	--	NS	--	--	NS	--	--	NS
Total TCDD	41903-57-5	pg/g	7	0.0964	0.3	--	--	NS	--	--	NS	--	--	NS	--	--	NS
Total TCDF	55722-27-5	pg/g	1	0.2	0.2	--	--	NS	--	--	NS	--	--	NS	--	--	NS
TCL PAHs																	
ACENAPHTHENE	83-32-9	ug/kg	10	5.9	49	100	G	N	100	C	N	--	--	NS	--	--	NS
ACENAPHTHYLENE	208-96-8	ug/kg	13	5.9	51	100	G	N	100	C	N	--	--	NS	--	--	NS
ANTHRACENE	120-12-7	ug/kg	18	5.4	51	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(A)ANTHRACENE	56-55-3	ug/kg	6	2.2	2.2	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(A)PYRENE	50-32-8	ug/kg	11	1.6	10	100	G	N	--	--	NS	--	--	NS	--	--	NS
BENZO(B)FLUORANTHENE	205-99-2	ug/kg	9	1.7	1.7	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(G,H,I)PERYLENE	191-24-2	ug/kg	14	3.6	10	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(K)FLUORANTHENE	207-08-9	ug/kg	10	1.4	9.5	100	G	N	100	C	N	--	--	NS	--	--	NS
CHRYSENE	218-01-9	ug/kg	8	2.4	2.4	100	G	N	100	C	N	--	--	NS	--	--	NS
DIBENZO(A,H)ANTHRACENE	53-70-3	ug/kg	14	4.2	10	100	G	N	100	C	N	--	--	NS	--	--	NS
FLUORANTHENE	206-44-0	ug/kg	3	2.1	2.1	100	G	N	100	C	N	--	--	NS	--	--	NS
FLUORENE	86-73-7	ug/kg	18	14	51	100	G	N	100	C	N	--	--	NS	--	--	NS
INDENO(1,2,3-CD)PYRENE	193-39-5	ug/kg	13	2.5	10	100	G	N	100	C	N	--	--	NS	--	--	NS
NAPHTHALENE	91-20-3	ug/kg	9	14	51	100	G	N	100	C	N	--	--	NS	--	--	NS
PHENANTHRENE	85-01-8	ug/kg	13	8.5	51	100	G	N	100	C	N	--	--	NS	--	--	NS
PYRENE	129-00-0	ug/kg	5	4.3	20	100	G	N	100	C	N	--	--	NS	--	--	NS
PCB Congeners																	
123-PeCB	65510-44-3	pg/g	1	3.83	3.83	--	--	--	--	--	--	--	--	NS	--	--	NS
126-PeCB	57465-28-8	pg/g	1	3.83	3.83	--	--	--	--	--	--	--	--	NS	--	--	NS
169-HxCB	32774-16-6	pg/g	1	3.83	3.83	--	--	--	--	--	--	--	--	NS	--	--	NS
209-DeCB	2051-24-3	pg/g	1	3.83	3.83	--	--	--	--	--	--	--	--	NS	--	--	NS
81-TeCB	70362-50-4	pg/g	1	3.83	3.83	--	--	--	--	--	--	--	--	NS	--	--	NS
Explosives																	
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	40	0.079	0.246	8.6	I	N	18.1	I	N	--	--	NS	--	--	NS
1,3-DINITROBENZENE	99-65-0	mg/kg	41	0.0518	0.097	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	37	0.051	0.16	2.4	H	N	1.2	H	N	--	--	NS	--	--	NS
2,4-DINITROTOLUENE	121-14-2	mg/kg	40	0.0728	0.12	5.3	I	N	19.8	I	N	--	--	NS	--	--	NS
2,6-DINITROTOLUENE	606-20-2	mg/kg	40	0.0987	0.19	4.5	I	N	6.9	I	N	--	--	NS	--	--	NS
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	38	0.088	0.106	80	J	N	--	--	NS	--	--	NS	--	--	NS
2-NITROTOLUENE	88-72-2	mg/kg	41	0.0707	0.16	--	--	NS	--	--	NS	--	--	NS	--	--	NS
3-NITROTOLUENE	99-08-1	mg/kg	41	0.11	0.138	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4-AMINO-2,6-DINITROTOLUENE	1946-51-0	mg/kg	39	0.053	0.095	80	J	N	--	--	NS	--	--	NS	--	--	NS
4-NITROTOLUENE	99-99-0	mg/kg	41	0.116	0.27	--	--	NS	--	--	NS	--	--	NS	--	--	NS
HMX (OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TET)	2691-41-0	mg/kg	40	0.1	0.208	--	--	NS	6.3	I	N	--	--	NS	--	--	NS
NITROBENZENE	98-95-3	mg/kg	41	0.0885	0.17	--	--	NS	--	--	NS	--	--	NS	--	--	NS
RDX (HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE)	121-82-4	mg/kg	41	0.0887	0.28	100	K	N	98.6	I	N	--	--	NS	--	--	NS
TETRYL (METHYL-2,4,6-TRINITROPHENYLNITRAMINE)	479-45-8	mg/kg	41	0.0587	0.4	--	--	NS	--	--	NS	--	--	NS	--	--	NS
Nitroglycerin																	
NITROGLYCERIN	55-63-0	mg/kg	37	1	1.45	--	--	NS	--	--	NS	--	--	NS	--	--	NS

Notes:

CAS = Chemical Abstracts Service
mg/kg = Milligram Per Kilogram
ug/kg = Microgram Per Kilogram
pg/g = Picogram Per Gram
TAL = Target Analyte List
TCL = Target Compound List
PCB = Polychlorinated Biphenyl
SVOC = Semivolatile Organic Compound
PAH = Polynuclear Aromatic Hydrocarbon
MDL = Method Detection Limit
SL = Screening Level
Eco SSL = Ecological Soil Screening Level

Sources:
A = USEPA Eco SSL - Soil Invertebrates, Plants, Avian, Mammalian (http://www.epa.gov/ecotox/ecossl)
B = ORNL - Earthworms - (Toxilogical Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision, Efroymson et al.)
C = BTAG - Fauna - (Region III Biological Technical Assistance Group - Draft Screening Levels - 1995)
E = ORNL - Microbial Processes - (Toxilogical Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision, Efroymson et al.)
F = ORNL - Plants - Toxilogical Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision Efroymson et al.)
G = BTAG - Flora - (Region III Biological Technical Assistance Group - Draft Screening Levels - 1995)
H = Best, E.P.H., H.E. Tatem, K.N. Geter, M.L. Wells and B.K. Lane. 2004. Toxicity and Metabolites of 2,4,6 Trinitrotoluene (TNT) in Plants and Worms from Exposure to Aged Soil.
I = Kuperman. R. 2003. Development of Ecological Toxicity and Biomagnification Data for Explosives Contaminants in Soil.
J = Pennington, Judith C. 1988. Plant Uptake of 2,4,6-Trinitrotoluene, 4-Amino-2,6-Dinitrotoluene, and 2-Amino-4,6-Dinitrotoluene Using 14C-Labeled and Unlabeled Compounds.
K = Simini, M., R.S. Wentsel, R.T. Checkai, C.T. Phillips, N.A. Chester, M.A. Major, and J.C. Amos. 1995. Evaluation of Soil Toxicity at Joliet Army Ammunition Plant.

Y = MDL exceeds screening level
N = MDL does not exceed screening level
NS = No screening level available

Table 7-4
Non-detected Chemicals MDL Screening for Area B - Surface Soil
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Parameter Name	CAS #	Units	Number of Non-Detects	Minimum MDL	Maximum MDL	Plant SL	Source	Maximum MDL Exceeds SL	Inverte-brate SL	Source	Maximum MDL Exceeds SL	Avian ECO SSL	Source	Maximum MDL Exceeds SL	Mammalian ECO SSL	Source	Maximum MDL Exceeds SL
TAL Metals																	
ANTIMONY	7440-36-0	mg/kg	10	0.4	0.49	5	F	N	78	A	N	--	--	NS	0.27	A	**Y**
CADMIUM	7440-43-9	mg/kg	14	0.03	0.07	32	A	N	140	A	N	0.77	A	N	0.36	A	N
SILVER	7439-97-6	mg/kg	16	0.07	0.13	0.3	F	N	0.1	B	**Y**	--	--	NS	--	--	NS
SODIUM	7440-22-4	mg/kg	1	35	35	560	A	N	50	E	N	4.2	A	**Y**	14	A	**Y**
THALLIUM	7440-23-5	mg/kg	17	0.27	0.93	--	--	NS	--	--	NS	--	--	NS	--	--	NS
Pesticides/PCBs																	
4,4'-DDD	72-54-8	ug/kg	10	0.32	3.25	100	G	N	100	C	N	--	--	NS	--	--	NS
4,4'-DDE	72-55-9	ug/kg	8	0.4	3.92	100	G	N	100	C	N	--	--	NS	--	--	NS
4,4'-DDT	50-29-3	ug/kg	10	0.39	3.66	100	G	N	100	C	N	93	A	N	21	A	N
ALDRIN	309-00-2	ug/kg	10	0.17	3.06	100	G	N	100	C	N	--	--	NS	--	--	NS
ALPHA-BHC	319-84-6	ug/kg	10	0.26	3.43	100,000	G	N	--	--	NS	--	--	NS	--	--	NS
ALPHA-CHLORDANE	5103-71-9	ug/kg	9	0.22	3.05	100	G	N	100	C	N	--	--	NS	--	--	NS
BETA-BHC	319-85-7	ug/kg	10	0.28	4.26	100,000	G	N	--	--	NS	--	--	NS	--	--	NS
DELTA-BHC	319-86-8	ug/kg	9	0.15	2.65	100,000	G	N	--	--	NS	--	--	NS	--	--	NS
DIELDRIN	60-57-1	ug/kg	9	0.43	3.2	100	G	N	100	C	N	22	A	N	4.9	A	N
ENDOSULFAN I	959-98-8	ug/kg	10	0.43	3.56	--	--	NS	--	--	NS	--	--	NS	--	--	NS
ENDOSULFAN II	33213-65-9	ug/kg	10	0.58	2.14	--	--	NS	--	--	NS	--	--	NS	--	--	NS
ENDOSULFAN SULFATE	1031-07-8	ug/kg	10	0.4	3.65	--	--	NS	--	--	NS	--	--	NS	--	--	NS
ENDRIN	72-20-8	ug/kg	10	0.35	3.4	100	G	N	100	C	N	--	--	NS	--	--	NS
ENDRIN ALDEHYDE	7421-93-4	ug/kg	9	0.35	2.95	100	G	N	100	C	N	--	--	NS	--	--	NS
ENDRIN KETONE	53494-70-5	ug/kg	9	0.39	3.11	100	G	N	100	C	N	--	--	NS	--	--	NS
GAMMA-BHC (LINDANE)	58-89-9	ug/kg	10	0.22	3.56	100	G	N	100	C	N	--	--	NS	--	--	NS
GAMMA-CHLORDANE	5103-74-2	ug/kg	9	0.35	3.11	100	G	N	100	C	N	--	--	NS	--	--	NS
HEPTACHLOR	76-44-8	ug/kg	9	0.34	3.35	100	G	N	100	C	N	--	--	NS	--	--	NS
HEPTACHLOR EPOXIDE	1024-57-3	ug/kg	8	0.26	4.71	100	G	N	100	C	N	--	--	NS	--	--	NS
METHOXYCHLOR	72-43-5	ug/kg	9	1.4	6.34	100	G	N	100	C	N	--	--	NS	--	--	NS
TOXAPHENE	8001-35-2	ug/kg	10	18	93.2	--	--	NS	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1016	12674-11-2	ug/kg	10	5.2	15	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1221	11104-28-2	ug/kg	10	10.3	15	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1232	11141-16-5	ug/kg	10	5.4	11.6	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1242	53469-21-9	ug/kg	10	6.16	10	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1248	12672-29-6	ug/kg	10	4.5	9.1	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1254	11097-69-1	ug/kg	5	7.48	9	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
AROCLOR 1260	11096-82-5	ug/kg	8	9.2	14.1	40,000	F	N	--	--	NS	--	--	NS	--	--	NS
SVOCs																	
1,1'-BIPHENYL	92-52-4	ug/kg	17	22	22	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,2'-OXYBIS(1-CHLOROPROPANE)	108-60-1	ug/kg	17	30	30	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,4,5-TRICHLOROPHENOL	95-95-4	ug/kg	17	49	49	4,000	F	N	9,000	B	N	--	--	NS	--	--	NS
2,4,6-TRICHLOROPHENOL	88-06-2	ug/kg	17	50	50	100	G	N	10,000	B	N	--	--	NS	--	--	NS
2,4-DICHLOROPHENOL	120-83-2	ug/kg	17	22	22	100	G	N	100	C	N	--	--	NS	--	--	NS
2,4-DIMETHYLPHENOL	105-67-9	ug/kg	17	30	30	100	G	N	100	C	N	--	--	NS	--	--	NS
2,4-DINITROPHENOL	51-28-5	ug/kg	17	170	170	20,000	F	N	100	C	**Y**	--	--	NS	--	--	NS
2,4-DINITROTOLUENE	121-14-2	mg/kg	15	20	20	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,6-DINITROTOLUENE	606-20-2	mg/kg	17	21	21	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2-CHLORONAPHTHALENE	91-58-7	ug/kg	17	22	22	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2-CHLOROPHENOL	95-57-8	ug/kg	17	18	18	7,000	F	N	10,000	B	N	--	--	NS	--	--	NS
2-METHYLNAPHTHALENE	91-57-6	ug/kg	17	24	24	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2-METHYLPHENOL	95-48-7	ug/kg	17	27	27	100	G	N	100	C	N	--	--	NS	--	--	NS
2-NITROANILINE	88-74-4	ug/kg	17	29	29	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2-NITROPHENOL	88-75-5	ug/kg	17	26	26	--	--	NS	--	--	NS	--	--	NS	--	--	NS
3,3'-DICHLOROBENZIDINE	91-94-1	ug/kg	17	29	29	--	--	NS	--	--	NS	--	--	NS	--	--	NS
3-NITROANILINE	99-09-2	ug/kg	17	34	34	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4,6-DINITRO-2-METHYLPHENOL	534-52-1	ug/kg	17	35	35	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4-BROMOPHENYL PHENYL ETHER	101-55-3	ug/kg	17	380	6,000	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4-CHLORO-3-METHYLPHENOL	59-50-7	ug/kg	17	29	29	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4-CHLOROANILINE	106-47-8	ug/kg	17	16	16	20,000	F	N	--	--	NS	--	--	NS	--	--	NS
4-CHLOROPHENYL PHENYL ETHER	7005-72-3	ug/kg	17	380	6,000	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4-METHYLPHENOL	106-44-5	ug/kg	17	48	48	100	G	N	100	C	N	--	--	NS	--	--	NS

Table 7-4
Non-detected Chemicals MDL Screening for Area B - Surface Soil
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Radford Army Ammunition Plant, Radford, Virginia

Parameter Name	CAS #	Units	Number of Non-Detects	Minimum MDL	Maximum MDL	Plant SL	Source	Maximum MDL Exceeds SL	Inverte-brate SL	Source	Maximum MDL Exceeds SL	Avian ECO SSL	Source	Maximum MDL Exceeds SL	Mammalian ECO SSL	Source	Maximum MDL Exceeds SL
4-NITROANILINE	100-01-6	ug/kg	17	39	39	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4-NITROPHENOL	100-02-7	ug/kg	17	75	75	100	G	N	7,000	B	N	--	--	NS	--	--	NS
ACENAPHTHENE	83-32-9	ug/kg	17	31	31	100	G	N	100	C	N	--	--	NS	--	--	NS
ACENAPHTHYLENE	208-96-8	ug/kg	17	17	17	100	G	N	100	C	N	--	--	NS	--	--	NS
ACETOPHENONE	98-86-2	ug/kg	17	23	23	--	--	NS	--	--	NS	--	--	NS	--	--	NS
ANTHRACENE	120-12-7	ug/kg	17	25	25	100	G	N	100	C	N	--	--	NS	--	--	NS
ATRAZINE	1912-24-9	ug/kg	17	16	16	--	--	NS	--	--	NS	--	--	NS	--	--	NS
BENZALDEHYDE	100-52-7	ug/kg	17	39	39	--	--	NS	--	--	NS	--	--	NS	--	--	NS
BENZO(A)ANTHRACENE	56-55-3	ug/kg	17	29	29	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(A)PYRENE	50-32-8	ug/kg	17	23	23	100	G	N	--	--	NS	--	--	NS	--	--	NS
BENZO(B)FLUORANTHENE	205-99-2	ug/kg	17	36	36	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(G,H,I)PERYLENE	191-24-2	ug/kg	17	23	23	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(K)FLUORANTHENE	207-08-9	ug/kg	17	29	29	100	G	N	100	C	N	--	--	NS	--	--	NS
BIS(2-CHLOROETHOXY)METHANE	111-91-1	ug/kg	17	21	21	--	--	NS	--	--	NS	--	--	NS	--	--	NS
BIS(2-CHLOROETHYL)ETHER	111-44-4	ug/kg	17	18	18	--	--	NS	--	--	NS	--	--	NS	--	--	NS
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	ug/kg	7	32	32	--	--	NS	--	--	NS	--	--	NS	--	--	NS
BUTYL BENZYL PHTHALATE	85-68-7	ug/kg	17	380	6,000	--	--	NS	--	--	NS	--	--	NS	--	--	NS
CAPROLACTAM	105-60-2	ug/kg	17	62	62	--	--	NS	--	--	NS	--	--	NS	--	--	NS
CARBAZOLE	86-74-8	ug/kg	17	29	29	--	--	NS	--	--	NS	--	--	NS	--	--	NS
CHRYSENE	218-01-9	ug/kg	17	28	28	100	G	N	100	C	N	--	--	NS	--	--	NS
DI-N-BUTYL PHTHALATE	84-74-2	ug/kg	11	380	430	200,000	F	N	--	--	NS	--	--	NS	--	--	NS
DI-N-OCTYL PHTHALATE	117-84-0	ug/kg	17	380	6,000	--	--	NS	--	--	NS	--	--	NS	--	--	NS
DIBENZO(A,H)ANTHRACENE	53-70-3	ug/kg	17	21	21	100	G	N	100	C	N	--	--	NS	--	--	NS
DIBENZOFURAN	132-64-9	ug/kg	17	24	24	--	--	NS	--	--	NS	--	--	NS	--	--	NS
DIETHYL PHTHALATE	84-66-2	ug/kg	8	380	430	--	--	NS	--	--	NS	--	--	NS	--	--	NS
DIMETHYL PHTHALATE	131-11-3	ug/kg	15	380	1,600	--	--	NS	--	--	NS	--	--	NS	--	--	NS
FLUORANTHENE	206-44-0	ug/kg	17	18	18	100	G	N	100	C	N	--	--	NS	--	--	NS
FLUORENE	86-73-7	ug/kg	17	18	18	100	G	N	100	C	N	--	--	NS	--	--	NS
HEXACHLOROBENZENE	118-74-1	ug/kg	17	22	22	--	--	NS	--	--	NS	--	--	NS	--	--	NS
HEXACHLOROBUTADIENE	87-68-3	ug/kg	17	24	24	--	--	NS	--	--	NS	--	--	NS	--	--	NS
HEXACHLOROCYCLOPENTADIENE	77-47-4	ug/kg	17	67	67	--	--	NS	--	--	NS	--	--	NS	--	--	NS
HEXACHLOROETHANE	67-72-1	ug/kg	17	17	17	--	--	NS	--	--	NS	--	--	NS	--	--	NS
INDENO(1,2,3-CD)PYRENE	193-39-5	ug/kg	17	20	20	100	G	N	100	C	N	--	--	NS	--	--	NS
ISOPHORONE	78-59-1	ug/kg	17	28	28	--	--	NS	--	--	NS	--	--	NS	--	--	NS
N-NITROSO-DI-N-PROPYLAMINE	621-64-7	ug/kg	17	21	21	--	--	NS	--	--	NS	--	--	NS	--	--	NS
N-NITROSODIPHENYLAMINE	86-30-6	ug/kg	13	380	430	--	--	NS	--	--	NS	--	--	NS	--	--	NS
NAPHTHALENE	91-20-3	ug/kg	17	21	21	100	G	N	100	C	N	--	--	NS	--	--	NS
NITROBENZENE	98-95-3	mg/kg	17	28	28	--	--	NS	--	--	NS	--	--	NS	--	--	NS
PENTACHLOROPHENOL	87-86-5	ug/kg	17	46	46	5,000	A	N	31,000	A	N	2,100	A	N	2,800	A	N
PHENOL	108-95-2	ug/kg	17	34	34	100	G	N	30,000	B	N	--	--	NS	--	--	NS
PYRENE	129-00-0	ug/kg	17	24	24	100	G	N	100	C	N	--	--	NS	--	--	NS
Dioxin/Furans																	
1,2,3,4,6,7,8,9-OCDF (OCDF)	39001-02-0	pg/g	3	0.92	11.9	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,4,6,7,8-HpCDF	67562-39-4	pg/g	1	5.96	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,4,7,8,9-HpCDF	55673-89-7	pg/g	11	0.397	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,4,7,8-HxCDD	39227-28-6	pg/g	7	0.412	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,4,7,8-HxCDF	70648-26-9	pg/g	7	0.397	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,6,7,8-HxCDD	57653-85-7	pg/g	5	0.412	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,6,7,8-HxCDF	57117-44-9	pg/g	5	0.397	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,7,8,9-HxCDD	19408-74-3	pg/g	6	0.412	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,7,8,9-HxCDF	72918-21-9	pg/g	12	0.2	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,7,8-PeCDD	40321-76-4	pg/g	14	0.397	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS
1,2,3,7,8-PeCDF	57117-41-6	pg/g	6	0.3	5.39	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,3,4,6,7,8-HxCDF	60851-34-5	pg/g	5	0.397	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,3,4,7,8-PeCDF	57117-31-4	pg/g	1	0.397	0.397	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,3,7,8-TCDD	1746-01-6	pg/g	6	0.0795	1.19	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,3,7,8-TCDF	51207-31-9	pg/g	1	0.217	0.217	--	--	NS	--	--	NS	--	--	NS	--	--	NS
Total HpCDFs	--	pg/g	2	0.522	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS
Total HxCDDs	--	pg/g	3	0.545	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS

Table 7-4
Non-detected Chemicals MDL Screening for Area B - Surface Soil
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Radford Army Ammunition Plant, Radford, Virginia

Parameter Name	CAS #	Units	Number of Non-Detects	Minimum MDL	Maximum MDL	Plant SL	Source	Maximum MDL Exceeds SL	Inverte-brate SL	Source	Maximum MDL Exceeds SL	Avian ECO SSL	Source	Maximum MDL Exceeds SL	Mammalian ECO SSL	Source	Maximum MDL Exceeds SL
Total PeCDDs	--	pg/g	3	0.397	5.96	--	--	NS	--	--	NS	--	--	NS	--	--	NS
Total PeCDFs	--	pg/g	1	0.397	0.397	--	--	NS	--	--	NS	--	--	NS	--	--	NS
Total TCDDs	41903-57-5	pg/g	5	0.0795	1.19	--	--	NS	--	--	NS	--	--	NS	--	--	NS
PAHs																	
ACENAPHTHENE	83-32-9	ug/kg	12	5.8	5.9	100	G	N	100	C	N	--	--	NS	--	--	NS
ACENAPHTHYLENE	208-96-8	ug/kg	16	5.9	5.9	100	G	N	100	C	N	--	--	NS	--	--	NS
ANTHRACENE	120-12-7	ug/kg	17	5.4	5.4	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(A)ANTHRACENE	56-55-3	ug/kg	14	2.2	2.2	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(A)PYRENE	50-32-8	ug/kg	14	1.6	1.6	100	G	N	--	--	NS	--	--	NS	--	--	NS
BENZO(B)FLUORANTHENE	205-99-2	ug/kg	10	1.7	1.7	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(G,H,I)PERYLENE	191-24-2	ug/kg	15	3.6	3.6	100	G	N	100	C	N	--	--	NS	--	--	NS
BENZO(K)FLUORANTHENE	207-08-9	ug/kg	14	1.4	1.4	100	G	N	100	C	N	--	--	NS	--	--	NS
CHRYSENE	218-01-9	ug/kg	14	2.4	2.4	100	G	N	100	C	N	--	--	NS	--	--	NS
DIBENZO(A,H)ANTHRACENE	53-70-3	ug/kg	16	4.2	4.2	100	G	N	100	C	N	--	--	NS	--	--	NS
FLUORANTHENE	206-44-0	ug/kg	9	2.1	2.1	100	G	N	100	C	N	--	--	NS	--	--	NS
FLUORENE	86-73-7	ug/kg	17	14	14	100	G	N	100	C	N	--	--	NS	--	--	NS
INDENO(1,2,3-CD)PYRENE	193-39-5	ug/kg	16	2.5	2.5	100	G	N	100	C	N	--	--	NS	--	--	NS
NAPHTHALENE	91-20-3	ug/kg	11	14	14	100	G	N	100	C	N	--	--	NS	--	--	NS
PHENANTHRENE	85-01-8	ug/kg	15	8.5	8.5	100	G	N	100	C	N	--	--	NS	--	--	NS
PYRENE	129-00-0	ug/kg	9	4.3	4.3	100	G	N	100	C	N	--	--	NS	--	--	NS
PCB Congeners																	
169-HxCB	32774-16-6	pg/g	1	8.13	8.13	--	--	--	--	--	--	--	--	NS	--	--	NS
81-TeCB	70362-50-4	pg/g	1	8.13	8.13	--	--	--	--	--	--	--	--	NS	--	--	NS
Explosives																	
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	16	0.079	0.079	8.6	I	N	18.1	I	N	--	--	NS	--	--	NS
1,3-DINITROBENZENE	99-65-0	mg/kg	17	0.097	0.097	--	--	NS	--	--	NS	--	--	NS	--	--	NS
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	14	0.16	0.16	2.4	H	N	1.2	H	N	--	--	NS	--	--	NS
2,4-DINITROTOLUENE	121-14-2	mg/kg	15	0.12	0.12	5.3	I	N	19.8	I	N	--	--	NS	--	--	NS
2,6-DINITROTOLUENE	606-20-2	mg/kg	17	0.19	0.19	4.5	I	N	6.9	I	N	--	--	NS	--	--	NS
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	16	0.1	0.1	80	J	N	--	--	NS	--	--	NS	--	--	NS
2-NITROTOLUENE	88-72-2	mg/kg	17	0.16	0.16	--	--	NS	--	--	NS	--	--	NS	--	--	NS
3-NITROTOLUENE	99-08-1	mg/kg	17	0.11	0.11	--	--	NS	--	--	NS	--	--	NS	--	--	NS
4-AMINO-2,6-DINITROTOLUENE	1946-51-0	mg/kg	16	0.095	0.095	80	J	N	--	--	NS	--	--	NS	--	--	NS
4-NITROTOLUENE	99-99-0	mg/kg	17	0.27	0.27	--	--	NS	--	--	NS	--	--	NS	--	--	NS
HMX (OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TET)	2691-41-0	mg/kg	17	0.1	0.1	--	--	NS	6.3	I	N	--	--	NS	--	--	NS
NITROBENZENE	98-95-3	mg/kg	17	0.17	0.17	--	--	NS	--	--	NS	--	--	NS	--	--	NS
RDX (HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE)	121-82-4	mg/kg	16	0.28	0.28	100	K	N	98.6	I	N	--	--	NS	--	--	NS
TETRYL (METHYL-2,4,6-TRINITROPHENYLNITRAMINE)	479-45-8	mg/kg	17	0.4	0.4	--	--	NS	--	--	NS	--	--	NS	--	--	NS
Nitroglycerin																	
NITROGLYCERIN	55-63-0	mg/kg	15	0.1	1	--	--	NS	--	--	NS	--	--	NS	--	--	NS

Notes:

CAS = Chemical Abstracts Service
mg/kg = Milligram Per Kilogram
ug/kg = Microgram Per Kilogram
pg/g = Picogram Per Gram
TAL = Target Analyte List
TCL = Target Compound List
PCB = Polychlorinated Biphenyl
SVOC = Semivolatile Organic Compound
PAH = Polynuclear Aromatic Hydrocarbon
MDL = Method Detection Limit
SL = Screening Level
Eco SSL = Ecological Soil Screening Level

Sources:
A = USEPA Eco SSL - Soil Invertebrates, Plants, Avian, Mammalian (http://www.epa.gov/ecotox/ecossl)
B = ORNL - Earthworms - (Toxilogical Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision, Efroymson et al.)
C = BTAG - Fauna - (Region III Biological Technical Assistance Group - Draft Screening Levels - 1995)
E = ORNL - Microbial Processes - (Toxilogical Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision, Efroymson et al.)
F = ORNL - Plants - Toxilogical Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision Efroymson et al.)
G = BTAG - Flora - (Region III Biological Technical Assistance Group - Draft Screening Levels - 1995)
H = Best, E.P.H., H.E. Tatem, K.N. Geter, M.L. Wells and B.K. Lane. 2004. Toxicity and Metabolites of 2,4,6 Trinitrotoluene (TNT) in Plants and Worms from Exposure to Aged Soil.
I = Kuperman. R. 2003. Development of Ecological Toxicity and Biomagnification Data for Explosives Contaminants in Soil.
J = Pennington, Judith C. 1988. Plant Uptake of 2,4,6-Trinitrotoluene, 4-Amino-2,6-Dinitrotoluene, and 2-Amino-4,6-Dinitrotoluene Using 14C-Labeled and Unlabeled Compounds.
K = Simini, M., R.S. Wentsel, R.T. Checkai, C.T. Phillips, N.A. Chester, M.A. Major, and J.C. Amos. 1995. Evaluation of Soil Toxicity at Joliet Army Ammunition Plant.

Y = MDL exceeds screening level
N = MDL does not exceed screening level
NS = No screening level available

Table 7-5
Plant Screening - Soil
Screening Level Ecological Risk Assessment - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Constituent of Potential Ecological Concern	CAS #	Maximum Soil Concentration (mg/kg)	Screening Level (mg/kg)	Hazard Quotient (unitless)	EPC (mg/kg)	EPC Hazard Quotient (unitless)
Inorganics						
Aluminum	7429-90-5	19,400	50	**3.9E+02**	12,632	**2.5E+02**
Antimony	7440-36-0	0.76	5	1.5E-01	NC	NC
Arsenic	7440-38-2	2.5	18	1.4E-01	NC	NC
Barium	7440-39-3	206	500	4.1E-01	NC	NC
Beryllium	7440-41-7	1	10	1.0E-01	NC	NC
Cadmium	7440-43-9	1.6	32	5.0E-02	NC	NC
Calcium	7440-70-2	21,500	4	**5.4E+03**	6,615	**1.7E+03**
Chromium	7440-47-3	29.5	1	**3.0E+01**	20.5	**2.1E+01**
Cobalt	7440-48-4	16	13	**1.2E+00**	8.9	6.8E-01
Copper	7440-50-8	84.1	70	**1.2E+00**	20.1	2.9E-01
Iron	7439-89-6	27,200	NV	NC	NC	NC
Lead	7439-92-1	528	120	**4.4E+00**	110.7	9.2E-01
Magnesium	7439-95-4	5,000	NV	NC	NC	NC
Manganese	7439-96-5	909	500	**1.8E+00**	599	**1.2E+00**
Mercury	7439-97-6	0.31	0.3	**1.0E+00**	0.122	4.1E-01
Nickel	7440-02-0	13.5	38	3.6E-01	NC	NC
Potassium	7440-09-7	1,810	NV	NC	NC	NC
Selenium	7782-49-2	2	1	**2.0E+00**	1.134	**1.1E+00**
Silver	7440-22-4	0.89	560	1.6E-03	NC	NC
Sodium	7440-23-5	469	NV	NC	NC	NC
Thallium	7440-28-0	0.2	1	2.0E-01	NC	NC
Vanadium	7440-62-2	55.3	2	**2.8E+01**	32.03	**1.6E+01**
Zinc	7440-66-6	337	50	**6.7E+00**	145.7	**2.9E+00**
TCL Pesticides/PCBs						
4,4'-DDE	72-55-9	0.0048	0.1	4.8E-02	NC	NC
4,4'-DDT	50-29-3	0.026	0.1	2.6E-01	NC	NC
alpha-Chlordane	5103-71-9	0.0031	0.1	3.1E-02	NC	NC
delta-BHC	319-86-8	0.0005	100	5.0E-06	NC	NC
Endosulfan Sulfate	1031-07-8	0.0018	NV	NC	NC	NC
Endrin Aldehyde	7421-93-4	0.0012	0.1	1.2E-02	NC	NC
gamma-BHC (Lindane)	58-89-9	0.0016	0.1	1.6E-02	NC	NC
gamma-Chlordane	5103-74-2	0.01	0.1	1.0E-01	NC	NC
Heptachlor	76-44-8	0.0048	0.1	4.8E-02	NC	NC
Heptachlor epoxide	1024-57-3	0.11	0.1	**1.1E+00**	0.023	2.3E-01
Methoxychlor	72-43-5	0.0074	0.1	7.4E-02	NC	NC
Aroclor 1254	11097-69-1	0.2	NV	NC	NC	NC
Aroclor 1260	11096-82-5	0.078	NV	NC	NC	NC
TCL SVOCs						
2-Nitroaniline	88-74-4	0.055	NV	NC	NC	NC
Bis(2-ethylhexyl)phthalate	117-81-7	2.6	NV	NC	NC	NC
Di-n-butylphthalate	84-74-2	0.8	200	4.0E-03	NC	NC
Di-n-octylphthalate	117-84-0	0.32	NV	NC	NC	NC
Diethylphthalate	84-66-2	0.68	NV	NC	NC	NC
N-Nitrosodiphenylamine	86-30-6	1.2	NV	NC	NC	NC
PAHs						
Acenaphthene	83-32-9	1.6	0.1	**1.6E+01**	0.51	**5.1E+00**
Acenaphthylene	208-96-8	1.1	0.1	**1.1E+01**	0.211	**2.1E+00**
Benzo(a)anthracene	56-55-3	0.049	0.1	4.9E-01	NC	NC
Benzo(a)pyrene	50-32-8	0.058	0.1	5.8E-01	NC	NC
Benzo(b)fluoranthene	205-99-2	0.11	0.1	**1.1E+00**	0.0266	2.7E-01
Benzo(g,h,i)perylene	191-24-2	0.032	0.1	3.2E-01	NC	NC
Benzo(k)fluoranthene	207-08-9	0.057	0.1	5.7E-01	NC	NC
Chrysene	218-01-9	0.21	0.1	**2.1E+00**	0.0475	4.8E-01
Dibenz(a,h)anthracene	53-70-3	0.036	0.1	3.6E-01	NC	NC
Fluoranthene	206-44-0	0.09	0.1	9.0E-01	NC	NC
Indeno(1,2,3-cd)pyrene	193-39-5	0.39	0.1	**3.9E+00**	0.082	8.2E-01
Naphthalene	91-20-3	9.4	0.1	**9.4E+01**	7.32	**7.3E+01**

Table 7-5
Plant Screening - Soil
Screening Level Ecological Risk Assessment - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Constituent of Potential Ecological Concern	CAS #	Maximum Soil Concentration (mg/kg)	Screening Level (mg/kg)	Hazard Quotient (unitless)	EPC (mg/kg)	EPC Hazard Quotient (unitless)
Phenanthrene	85-01-8	0.12	0.1	**1.2E+00**	0.0362	3.6E-01
Pyrene	129-00-0	0.18	0.1	**1.8E+00**	0.0554	5.5E-01
Explosives						
1,3,5-Trinitrobenzene	99-35-4	7.6	8.6	8.8E-01	NC	NC
2,4,6-Trinitrotoluene	118-96-7	130	2.4	**5.4E+01**	13.6	**5.7E+00**
2,4-Dinitrotoluene	121-14-2	17	5.3	**3.2E+00**	1.65	3.1E-01
2,6-Dinitrotoluene	606-20-2	11	4.5	**2.4E+00**	1.13	2.5E-01
2-Amino-4,6-Dinitrotoluene	355-72-78-2	5.7	80	7.1E-02	NC	NC
4-Amino-2,6-Dinitrotoluene	1946-51-0	5.2	80	6.5E-02	NC	NC
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	6.8	NV	NC	NC	NC

Notes:
CAS = Chemical Abstract Service
mg/kg = Milligram per Kilogram
VOC = Volatile Organic Compound
NV = No Value Available
NC = Not Calculated
Hazard Quotient = Soil Concentration/Screening Level
EPC = Exposure Point Concentration

Table 7-6
Invertebrate and Microbial Screening - Soil
Screening Level Ecological Risk Assessment - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Constituent of Potential Ecological Concern	CAS #	Maximum Soil Concentration (mg/kg)	Screening Level (mg/kg)	Hazard Quotient (unitless)	EPC (mg/kg)	EPC Hazard Quotient (unitless)
Inorganics						
Aluminum	7429-90-5	19,400	NV	NC	NC	NC
Antimony	7440-36-0	0.76	78	9.7E-03	NC	NC
Arsenic	7440-38-2	2.5	60	4.2E-02	NC	NC
Barium	7440-39-3	206	330	6.2E-01	NC	NC
Beryllium	7440-41-7	1	40	2.5E-02	NC	NC
Cadmium	7440-43-9	1.6	140	1.1E-02	NC	NC
Calcium	7440-70-2	21,500	NV	NC	NC	NC
Chromium	7440-47-3	29.5	0.4	**7.4E+01**	20.5	**5.1E+01**
Cobalt	7440-48-4	16	200	8.0E-02	NC	NC
Copper	7440-50-8	84.1	80	**1.1E+00**	20.1	2.5E-01
Iron	7439-89-6	27,200	200	**1.4E+02**	20,416	**1.0E+02**
Lead	7439-92-1	528	1,700	3.1E-01	NC	NC
Magnesium	7439-95-4	5,000	NV	NC	NC	NC
Manganese	7439-96-5	909	100	**9.1E+00**	599	**6.0E+00**
Mercury	7439-97-6	0.31	0.1	**3.1E+00**	0.122	**1.2E+00**
Nickel	7440-02-0	13.5	280	4.8E-02	NC	NC
Potassium	7440-09-7	1,810	NV	NC	NC	NC
Selenium	7782-49-2	2	70	2.9E-02	NC	NC
Silver	7440-22-4	0.89	50	1.8E-02	NC	NC
Sodium	7440-23-5	469	NV	NC	NC	NC
Thallium	7440-28-0	0.2	NV	NC	NC	NC
Vanadium	7440-62-2	55.3	20	**2.8E+00**	32.03	**1.6E+00**
Zinc	7440-66-6	337	100	**3.4E+00**	145.7	**1.5E+00**
TCL Pesticides/PCBs						
4,4'-DDE	72-55-9	0.0048	0.1	4.8E-02	NC	NC
4,4'-DDT	50-29-3	0.026	0.1	2.6E-01	NC	NC
alpha-Chlordane	5103-71-9	0.0031	0.1	3.1E-02	NC	NC
delta-BHC	319-86-8	0.0005	NV	NC	NC	NC
Endosulfan Sulfate	1031-07-8	0.0018	NV	NC	NC	NC
Endrin Aldehyde	7421-93-4	0.0012	0.1	1.2E-02	NC	NC
gamma-BHC (Lindane)	58-89-9	0.0016	0.1	1.6E-02	NC	NC
gamma-Chlordane	5103-74-2	0.01	0.1	1.0E-01	NC	NC
Heptachlor	76-44-8	0.0048	0.1	4.8E-02	NC	NC
Heptachlor epoxide	1024-57-3	0.11	0.1	**1.1E+00**	0.023	2.3E-01
Methoxychlor	72-43-5	0.0074	0.1	7.4E-02	NC	NC
Aroclor 1254	11097-69-1	0.2	NV	NC	NC	NC
Aroclor 1260	11096-82-5	0.078	NV	NC	NC	NC
TCL SVOCs						
2-Nitroaniline	88-74-4	0.055	NV	NC	NC	NC
Bis(2-ethylhexyl)phthalate	117-81-7	2.6	NV	NC	NC	NC
Di-n-butylphthalate	84-74-2	0.8	NV	NC	NC	NC
Di-n-octylphthalate	117-84-0	0.32	NV	NC	NC	NC
Diethylphthalate	84-66-2	0.68	NV	NC	NC	NC
N-Nitrosodiphenylamine	86-30-6	1.2	NV	NC	NC	NC
PAHs						
Acenaphthene	83-32-9	1.6	0.1	**1.6E+01**	0.51	**5.1E+00**
Acenaphthylene	208-96-8	1.1	0.1	**1.1E+01**	0.211	**2.1E+00**
Benzo(a)anthracene	56-55-3	0.049	0.1	4.9E-01	NC	NC
Benzo(a)pyrene	50-32-8	0.058	NV	NC	NC	NC
Benzo(b)fluoranthene	205-99-2	0.11	0.1	**1.1E+00**	0.0266	2.7E-01
Benzo(g,h,i)perylene	191-24-2	0.032	0.1	3.2E-01	NC	NC
Benzo(k)fluoranthene	207-08-9	0.057	0.1	5.7E-01	NC	NC
Chrysene	218-01-9	0.21	0.1	**2.1E+00**	0.0475	4.8E-01
Dibenz(a,h)anthracene	53-70-3	0.036	0.1	3.6E-01	NC	NC
Fluoranthene	206-44-0	0.09	0.1	9.0E-01	NC	NC
Indeno(1,2,3-cd)pyrene	193-39-5	0.39	0.1	**3.9E+00**	0.082	8.2E-01
Naphthalene	91-20-3	9.4	0.1	**9.4E+01**	7.32	**7.3E+01**

Table 7-6
Invertebrate and Microbial Screening - Soil
Screening Level Ecological Risk Assessment - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Constituent of Potential Ecological Concern	CAS #	Maximum Soil Concentration (mg/kg)	Screening Level (mg/kg)	Hazard Quotient (unitless)	EPC (mg/kg)	EPC Hazard Quotient (unitless)
Phenanthrene	85-01-8	0.12	0.1	**1.2E+00**	0.0362	3.6E-01
Pyrene	129-00-0	0.18	0.1	**1.8E+00**	0.0554	5.5E-01
Explosives						
1,3,5-Trinitrobenzene	99-35-4	7.6	18.1	4.2E-01	NC	NC
2,4,6-Trinitrotoluene	118-96-7	130	1.2	**1.1E+02**	13.6	**1.1E+01**
2,4-Dinitrotoluene	121-14-2	17	19.8	8.6E-01	NC	NC
2,6-Dinitrotoluene	606-20-2	11	6.9	**1.6E+00**	1.13	1.6E-01
2-Amino-4,6-Dinitrotoluene	355-72-78-2	5.7	NV	NC	NC	NC
4-Amino-2,6-Dinitrotoluene	1946-51-0	5.2	NV	NC	NC	NC
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,	2691-41-0	6.8	6.3	**1.1E+00**	0.71	1.1E-01

Notes:
CAS = Chemical Abstract Service
mg/kg = Milligram per Kilogram
VOC = Volatile Organic Compound
NV = No Value Available
NC = Not Calculated
Hazard Quotient = Soil Concentration/Screening Level
EPC = Exposure Point Concentration

Table 7-7
Area A Surface Soil Dioxin/Furan Equivalents
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	Mammalian TEF	Avian TEF	54SB23A [C] 12/3/2002 0-1		54SB25A 12/3/2002 0-1		54SB27A [D] 12/3/2002 0-1		54SB30A 12/3/2002 0-1		54SB32A 12/3/2002 0-1		54SB33A [B] 12/3/2002 1-2	
			Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)														
1,2,3,4,6,7,8,9-OCDD (OCDD)	0.0003	0.0001	326		1500	J,c	4,220	E,J,q	122	J,c	530	J,c	3,040	J,c
1,2,3,4,6,7,8,9-OCDF (OCDD)	0.0003	0.0001	0.491	A	15.8	J,c	23.3		<10		28.5	J,c	163	J,c
1,2,3,4,6,7,8-HpCDD	0.01	0.001	6.12		34.4		69.4		6		66.8		331	
1,2,3,4,6,7,8-HpCDF	0.01	0.01	0.322	A	3.8	J	7.12		0.9	MJ	14.3		58.6	
1,2,3,4,7,8,9-HpCDF	0.01	0.01	<0.536	U	<5		0.47	A	<5		1.1	J	5.5	
1,2,3,4,7,8-HxCDD	0.1	0.05	0.109	A	<5		0.523	A	<5		1.3	J	4.6	J
1,2,3,4,7,8-HxCDF	0.1	0.1	<0.536	U	<5		0.513	A	<5		4.8	J	9.6	
1,2,3,6,7,8-HxCDD	0.1	0.01	0.142	A	0.57	MJ	1.44	A	<5		4	J	19.6	
1,2,3,6,7,8-HxCDF	0.1	0.1	<0.536	U	<5		0.345	A	<5		1.8	MJ	3.5	MJ
1,2,3,7,8,9-HxCDD	0.1	0.1	0.215	A	<5		1.13	A	<5		4.4	J	17.8	
1,2,3,7,8,9-HxCDF	0.1	0.1	<0.536	U	<5		0.151	A	<5		<5		1.4	J
1,2,3,7,8-PeCDD	1	1	<0.536	U	<5		0.326	A	<5		1.4	J	3.6	J
1,2,3,7,8-PeCDF	0.03	0.1	0.088	A,J,w	<5		0.279	A	<5		1.8	J	2.2	J
2,3,4,6,7,8-HxCDF	0.1	0.1	<0.536	U	<5		0.376	A	<5		2.2	J	5	
2,3,4,7,8-PeCDF	0.3	1	0.103	A,B,z	<5		0.406	A	<5		2.8	J	3.8	J
2,3,7,8-TCDD	1	1	0.204	A,J,w	<1		<0.258	U	<1		0.33	J	0.83	J
Total 2,3,7,8-TCDD Equivalents (Mammalian)			0.416		0.894		2.947		0.106		5.664		16.988	
Total 2,3,7,8-TCDD Equivalents (Avian)			0.283		0.230		1.622		0.027		8.412		16.798	

Table 7-7
Area A Surface Soil Dioxin/Furan Equivalents
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	Mammalian TEF	Avian TEF	54SB34A [D] 12/3/2002 0-1		54SB38A [D] 12/4/2002 0-1		54SB58A [D] 8/17/2004 0-1		54SB82A 1/12/2007 0-0.5		54SB83A 1/11/2007 0-0.5	
			Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)												
1,2,3,4,6,7,8,9-OCDD (OCDD)	0.0003	0.0001	132		766		151		122		113	
1,2,3,4,6,7,8,9-OCDF (OCDD)	0.0003	0.0001	<0.964	U	8.32	A	1.36	A	<0.997	U	<0.923	U
1,2,3,4,6,7,8-HpCDD	0.01	0.001	1.69	A	25.6		6.83		1.87	A,B,z	2.33	A
1,2,3,4,6,7,8-HpCDF	0.01	0.01	0.112	A,J,w	2.88	A	1.02	A	0.114	A	0.109	A,B,z
1,2,3,4,7,8,9-HpCDF	0.01	0.01	<0.482	U	0.18	A	<0.468	U	<0.498	U	<0.461	U
1,2,3,4,7,8-HxCDD	0.1	0.05	<0.482	U	0.319	A	0.152	A	<0.498	U	<0.461	U
1,2,3,4,7,8-HxCDF	0.1	0.1	<0.482	U	0.239	A	0.15	A	<0.498	U	<0.461	U
1,2,3,6,7,8-HxCDD	0.1	0.01	<0.482	U	0.666	A	0.259	A	<0.498	U	<0.461	U
1,2,3,6,7,8-HxCDF	0.1	0.1	<0.482	U	0.19	A	0.148	A,J,w	<0.498	U	<0.461	U
1,2,3,7,8,9-HxCDD	0.1	0.1	<0.482	U	0.701	A	0.333	A,J,w	<0.498	U	<0.461	U
1,2,3,7,8,9-HxCDF	0.1	0.1	<0.482	U	0.0879	A	<0.468	U	<0.498	U	<0.461	U
1,2,3,7,8-PeCDD	1	1	<0.482	U	<0.511	U	<0.468	U	<0.498	U	<0.461	U
1,2,3,7,8-PeCDF	0.03	0.1	0.0656	A	0.151	,J,w	0.172	A,B,z	0.0738	A,B,z	<0.461	U
2,3,4,6,7,8-HxCDF	0.1	0.1	<0.482	U	0.219	A	0.135	A	<0.498	U	<0.461	U
2,3,4,7,8-PeCDF	0.3	1	0.0887	A	0.217	A,B,z	0.2	A,B,z	0.0957	A,B,z	<0.461	U
2,3,7,8-TCDD	1	1	<0.0964	U	<0.102	U	2.13		<0.0997	U	<0.108	U
Total 2,3,7,8-TCDD Equivalents (Mammalian)			0.086		0.766		2.372		0.038		0.057	
Total 2,3,7,8-TCDD Equivalents (Avian)			0.111		0.315		2.249		0.013		0.014	

Notes:

pg/g = Picogram Per Gram
ft/bgs = Feet Below Ground Surface
TEF = Toxicity Equivalency Factor
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code

Total 2,3,7,8-TCDD Equivalents are calculated by summing the detected concentration times the TEF for each chemical. Non-detects, R-flagged data, and B-flagged data are excluded from summed total.

Qualifiers:

- A Amount detected is less than the Lower Calibration Limit.
- B Not detected substantially above the level reported in laboratory or field blanks.
- E Concentration exceeded the upper level of the calibration range of the instrument for that specific analysis.
- J Analyte present. Reported value may not be accurate or precise.
- U The compound was analyzed for but not detected. The reporting limit will be adjusted to reflect any dilution, and for soil, the percent moisture.
- c Calibration failure; poor (RRF) or unstable (%D) response
- q Concentration exceeded the linear range

Table 7-8
Wildlife Summary
Screening Level Ecological Risk Assessment - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Chemical	CAS#	Meadow Vole					Short-tailed Shrew					Red Fox					American Robin					Red-tailed Hawk				
		Preliminary NOAEL-based HQ	Preliminary LOAEL-based HQ	Preliminary EPC NOAEL HQ	Refined NOAEL-based HQ	Refined LOAEL-based HQ	Preliminary NOAEL-based HQ	Preliminary LOAEL-based HQ	Preliminary EPC NOAEL HQ	Refined NOAEL-based HQ	Refined LOAEL-based HQ	Preliminary NOAEL-based HQ	Preliminary LOAEL-based HQ	Preliminary EPC NOAEL HQ	Refined NOAEL-based HQ	Refined LOAEL-based HQ	Preliminary NOAEL-based HQ	Preliminary LOAEL-based HQ	Preliminary EPC NOAEL HQ	Refined NOAEL-based HQ	Refined LOAEL-based HQ	Preliminary NOAEL-based HQ	Preliminary LOAEL-based HQ	Preliminary EPC NOAEL HQ	Refined NOAEL-based HQ	Refined LOAEL-based HQ
Inorganics																										
Arsenic	7440-38-2	**1.4E+01**	**1.4E+00**	**8.3E+00**	1.7E-01	1.7E-02	**4.9E+00**	4.9E-01	**2.9E+00**	4.2E-01	4.2E-02	**9.1E+00**	9.1E-01	**5.4E+00**	7.5E-04	7.5E-05	1.8E-01	7.1E-02	NC	NC	NC	4.8E-04	1.9E-04	NC	NC	NC
Cadmium	7440-43-9	**1.8E+00**	1.8E-01	5.0E-01	5.2E-02	5.2E-03	**7.4E+00**	7.4E-01	**2.0E+00**	2.4E-01	2.4E-02	**1.5E+01**	**1.5E+00**	**4.1E+00**	2.9E-04	2.9E-05	**1.4E+01**	**1.0E+00**	**3.9E+00**	2.7E-01	2.0E-02	2.9E-01	2.1E-02	NC	NC	NC
Chromium	7440-47-3	3.3E-01	3.3E-02	NC	NC	NC	**3.2E+00**	3.2E-01	**2.2E+00**	1.5E-01	1.5E-02	**6.3E+00**	6.3E-01	**4.4E+00**	5.6E-04	5.6E-05	**3.0E+01**	**6.0E+00**	**2.1E+01**	8.1E-01	1.6E-01	6.5E-01	1.3E-01	NC	NC	NC
Copper	7440-50-8	**1.2E+00**	9.1E-01	2.9E-01	5.5E-02	4.2E-02	**1.0E+00**	7.6E-01	2.4E-01	4.9E-02	3.8E-02	**1.9E+00**	**1.4E+00**	4.5E-01	5.3E-04	4.0E-04	8.9E-01	6.8E-01	NC	NC	NC	1.2E-01	9.4E-02	NC	NC	NC
Lead	7439-92-1	**1.1E+01**	**1.1E+00**	**2.3E+00**	9.8E-02	9.8E-03	**1.2E+01**	**1.2E+00**	**2.5E+00**	3.5E-01	3.5E-02	**2.2E+01**	**2.2E+00**	**4.7E+00**	1.0E-03	1.0E-04	**2.3E+02**	**2.3E+01**	**4.9E+01**	**3.9E+00**	3.9E-01	**8.8E+00**	8.8E-01	**1.8E+00**	1.1E-03	1.1E-04
Mercury	7439-97-6	3.0E-02	3.0E-03	NC	NC	NC	4.1E-02	4.1E-03	NC	NC	NC	8.2E-02	8.2E-03	NC	NC	NC	**4.5E+00**	**2.2E+00**	**1.8E+00**	7.2E-02	3.6E-02	8.7E-03	4.4E-03	NC	NC	NC
Nickel	7440-02-0	1.6E-01	8.1E-02	NC	NC	NC	1.8E-01	9.0E-02	NC	NC	NC	3.5E-01	1.8E-01	NC	NC	NC	2.6E-01	1.9E-01	NC	NC	NC	6.8E-03	4.9E-03	NC	NC	NC
Selenium	7782-49-2	**1.0E+01**	**6.2E+00**	**5.8E+00**	3.8E-01	2.3E-01	**3.4E+00**	**2.1E+00**	**1.9E+00**	3.3E-01	2.0E-01	**6.7E+00**	**4.1E+00**	**3.8E+00**	2.5E-03	1.5E-03	**4.8E+00**	**2.4E+00**	**2.7E+00**	4.2E-01	2.1E-01	3.9E-01	2.0E-01	NC	NC	NC
Silver	7440-22-4	8.2E-05	8.2E-06	NC	NC	NC	6.8E-03	6.8E-04	NC	NC	NC	1.4E-02	1.4E-03	NC	NC	NC	2.6E-02	3.5E-03	NC	NC	NC	1.8E-04	2.4E-05	NC	NC	NC
Zinc	7440-66-6	**1.3E+00**	6.5E-01	5.6E-01	6.1E-02	3.1E-02	**3.0E+00**	**1.5E+00**	**1.3E+00**	1.5E-01	7.7E-02	**6.0E+00**	**3.0E+00**	**2.6E+00**	5.4E-04	2.7E-04	**9.5E+01**	**1.0E+01**	**4.1E+01**	**3.2E+00**	3.5E-01	**4.1E+00**	4.6E-01	**1.8E+00**	1.1E-03	1.2E-04
Dioxin/Furans																										
Total 2,3,7,8-TCDD Equivalents	1746-01-6	3.3E-01	3.3E-02	NC	NC	NC	**7.7E+01**	**7.7E+00**	**4.3E+01**	**1.0E+01**	1.0E+00	**1.5E+03**	**1.5E+02**	**8.7E+01**	1.3E-02	1.3E-03	**8.4E+00**	8.4E-01	**5.8E+00**	7.3E-01	7.3E-02	1.7E-01	1.7E-02	NC	NC	NC
TCL Pesticides/PCBs																										
4,4'-DDE	72-55-9	7.3E-06	7.3E-07	NC	NC	NC	4.6E-04	4.6E-05	NC	NC	NC	9.2E-04	9.2E-05	NC	NC	NC	5.3E-01	5.3E-02	NC	NC	NC	5.4E-03	5.4E-04	NC	NC	NC
4,4'-DDT	50-29-3	7.0E-03	1.4E-03	NC	NC	NC	1.0E-01	2.1E-02	NC	NC	NC	2.1E-01	4.2E-02	NC	NC	NC	**8.6E+01**	**8.6E+00**	**2.5E+01**	**3.1E+00**	3.1E-01	6.1E-01	6.1E-02	NC	NC	NC
alpha-Chlordane	5103-71-9	5.0E-03	5.0E-04	NC	NC	NC	6.6E-03	6.6E-04	NC	NC	NC	1.3E-02	1.3E-03	NC	NC	NC	1.8E-03	3.7E-04	NC	NC	NC	9.5E-05	1.9E-05	NC	NC	NC
delta-BHC	319-86-8	9.4E-03	9.4E-04	NC	NC	NC	9.9E-03	9.9E-04	NC	NC	NC	1.9E-02	1.9E-03	NC	NC	NC	9.1E-04	2.3E-04	NC	NC	NC	5.9E-05	1.5E-05	NC	NC	NC
Endosulfan Sulfate	1031-07-8	2.4E-02	2.4E-03	NC	NC	NC	1.8E-02	1.8E-03	NC	NC	NC	3.4E-02	3.4E-03	NC	NC	NC	1.3E-04	1.3E-05	NC	NC	NC	1.2E-05	1.2E-06	NC	NC	NC
Endrin Aldehyde	7421-93-4	8.3E-03	8.3E-04	NC	NC	NC	9.8E-03	9.8E-04	NC	NC	NC	1.9E-02	1.9E-03	NC	NC	NC	4.9E-02	8.1E-03	NC	NC	NC	2.8E-03	4.6E-04	NC	NC	NC
gamma-BHC (Lindane)	58-89-9	6.9E-05	6.9E-06	NC	NC	NC	1.9E-04	1.9E-05	NC	NC	NC	3.7E-04	3.7E-05	NC	NC	NC	2.1E-03	2.1E-04	NC	NC	NC	5.3E-05	5.3E-06	NC	NC	NC
gamma-Chlordane	5103-74-2	1.6E-02	1.6E-03	NC	NC	NC	2.1E-02	2.1E-03	NC	NC	NC	4.2E-02	4.2E-03	NC	NC	NC	6.0E-03	1.2E-03	NC	NC	NC	3.1E-04	6.2E-05	NC	NC	NC
Heptachlor	76-44-8	1.3E-02	1.3E-03	NC	NC	NC	1.3E-02	1.3E-03	NC	NC	NC	2.5E-02	2.5E-03	NC	NC	NC	1.8E-03	3.7E-04	NC	NC	NC	1.3E-04	2.5E-05	NC	NC	NC
Heptachlor Epoxide	1024-57-3	**1.5E+00**	1.5E-01	3.2E-01	8.4E-03	8.4E-04	**4.1E+00**	4.1E-01	8.6E-01	4.1E-01	4.1E-02	**8.1E+00**	8.1E-01	**1.7E+00**	7.5E-04	7.5E-05	3.0E-01	5.9E-02	NC	NC	NC	7.3E-03	1.5E-03	NC	NC	NC
Methoxychlor	72-43-5	6.4E-04	3.2E-04	NC	NC	NC	7.2E-04	3.6E-04	NC	NC	NC	1.4E-03	7.0E-04	NC	NC	NC	5.6E-04	5.6E-05	NC	NC	NC	3.4E-05	3.4E-06	NC	NC	NC
Aroclor1254	11097-69-1	5.6E-02	5.6E-03	NC	NC	NC	**9.5E+00**	9.5E-01	**3.3E+00**	6.7E-01	6.7E-02	**1.9E+01**	**1.9E+00**	**6.5E+00**	1.4E-03	1.4E-04	**2.5E+00**	2.5E-01	8.4E-01	9.0E-02	9.0E-03	3.2E-02	3.2E-03	NC	NC	NC
Aroclor1260	11096-82-5	2.0E-02	2.0E-03	NC	NC	NC	**3.7E+00**	3.7E-01	9.5E-01	1.9E-01	1.9E-02	**7.4E+00**	7.4E-01	**1.9E+00**	4.1E-04	4.1E-05	9.6E-01	9.6E-02	NC	NC	NC	1.3E-02	1.3E-03	NC	NC	NC
PAHs																										
Acenaphthene	83-32-9	2.6E-01	5.2E-02	NC	NC	NC	8.7E-02	1.7E-02	NC	NC	NC	1.7E-01	3.4E-02	NC	NC	NC	**2.3E+00**	4.6E-01	7.4E-01	4.1E-02	8.1E-03	1.0E-01	2.1E-02	NC	NC	NC
Acenaphthylene	208-96-8	1.7E-02	3.4E-03	NC	NC	NC	1.6E-02	3.3E-03	NC	NC	NC	3.3E-02	6.5E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Benzo(a)anthracene	56-55-3	5.6E-02	5.6E-03	NC	NC	NC	4.0E-02	4.0E-03	NC	NC	NC	7.5E-02	7.5E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Benzo(a)pyrene	50-32-8	1.2E-01	1.2E-02	NC	NC	NC	4.0E-02	4.0E-03	NC	NC	NC	7.8E-02	7.8E-03	NC	NC	NC	1.2E-01	2.4E-02	NC	NC	NC	7.6E-03	1.5E-03	NC	NC	NC
Benzo(b)fluoranthene	205-99-2	3.4E-02	3.4E-03	NC	NC	NC	5.4E-02	5.4E-03	NC	NC	NC	1.0E-01	1.0E-02	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Benzo(g,h,i)perylene	191-24-2	6.4E-02	1.3E-02	NC	NC	NC	4.7E-02	9.4E-03	NC	NC	NC	9.2E-02	1.8E-02	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Benzo(k)fluoranthene	207-08-9	3.3E-03	3.3E-04	NC	NC	NC	2.0E-03	2.0E-04	NC	NC	NC	3.8E-03	3.8E-04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Chrysene	218-01-9	9.2E-03	9.2E-04	NC	NC	NC	4.9E-03	4.9E-04	NC	NC	NC	9.3E-03	9.3E-04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Dibenz(a,h)anthracene	53-70-3	2.8E-03	2.8E-04	NC	NC	NC	7.5E-03	7.5E-04	NC	NC	NC	1.4E-02	1.4E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Fluoranthene	206-44-0	1.1E-02	2.2E-03	NC	NC	NC	3.6E-03	7.3E-04	NC	NC	NC	7.2E-03	1.4E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Indeno(1,2,3-cd)pyrene	193-39-5	3.8E-03	3.8E-04	NC	NC	NC	1.7E-02	1.7E-03	NC	NC	NC	3.2E-02	3.2E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Phenanthrene	85-01-8	1.2E-01	2.3E-02	NC	NC	NC	3.9E-02	7.7E-03	NC	NC	NC	7.7E-02	1.5E-02	NC	NC	NC	3.7E-01	7.4E-02	NC	NC	NC	7.0E-03	1.4E-03	NC	NC	NC
Pyrene	129-00-0	5.2E-02	1.0E-02	NC	NC	NC	1.7E-02	3.5E-03	NC	NC	NC	3.4E-02	6.9E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Explosives																										
1,3,5-Trinitrobenzene	99-35-4	**8.2E+00**	**1.7E+00**	**1.4E+00**	2.6E-01	5.3E-02	**2.7E+00**	5.5E-01	4.7E-01	4.8E-02	9.7E-03	**5.4E+00**	**1.1E+00**	9.4E-01	2.8E-04	5.5E-05	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
2,4,6-Trinitrotoluene	118-96-7	**7.4E+01**	**1.8E+01**	**7.7E+00**	**1.4E+00**	3.5E-01	**2.4E+01**	**6.1E+00**	**2.5E+00**	2.6E-01	6.5E-02	**4.8E+01**	**1.2E+01**	**5.0E+00**	1.5E-03	3.7E-04	**5.0E+03**	**1.9E+02**	**5.2E+02**	**1.2E+02**	**4.8E+00**	**1.2E+02**	**4.8E+00**	**1.3E+01**	--	--
2,4-Dinitrotoluene	121-14-2	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	**4.6E+02**	**3.6E+01**	**4.4E+01**	**1.0E+01**	8.3E-01	**1.1E+01**	9.0E-01	**1.1E+00**	--	--
2,6-Dinitrotoluene	606-20-2	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	**2.9E+02**	**2.4E+01**	**3.0E+01**	**7.1E+00**	5.7E-01	**7.2E+00**	5.8E-01	7.4E-01	--	--
2-Amino-4,6-Dinitrotoluene	355-72-78-2	**1.8E+00**	3.4E-01	2.0E-01	3.7E-02	7.0E-03	6.1E-01	1.1E-01	NC	NC	NC	**1.2E+00**	2.3E-01	1.3E-01	3.9E-05	7.3E-06	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
4-Amino-2,6-Dinitrotoluene	1946-51-0	**1.7E+00**	3.1E-01	1.8E-01	3.3E-02	6.2E-03	5.5E-01	1.0E-01	NC	NC	NC	**1.1E+00**	2.1E-01	1.2E-01	3.5E-05	6.5E-06	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5	2691-41-0	**2.4E+00**	3.4E-01	2.5E-01	7.8E-03	1.1E-03	7.9E-01	1.1E-01	NC	NC	NC	**1.6E+00**	2.2E-01	1.6E-01	1.4E-05	2.0E-06	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

Notes:
CAS = Chemical Abstract Services
NC = Not Calculated
NOAEL = No observable adverse effects level
LOAEL = Lowest observable adverse effects level
HQ = Hazard Quotient
EPC = Exposure Point Concentration
-- = Refined Mammal BAF is 0; therefore, bioaccumulation of these chemicals not a concern for the red-tailed hawk

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Table 7-9
Plant Screening - Soil
Screening Level Ecological Risk Assessment - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Constituent of Potential Ecological Concern	CAS #	Maximum Soil Concentration (mg/kg)	Screening Level (mg/kg)	Hazard Quotient (unitless)	EPC (mg/kg)	EPC Hazard Quotient (unitless)
Inorganics						
Aluminum	7429-90-5	22,600	50	**4.5E+02**	15,708	**3.1E+02**
Antimony	7440-36-0	1.9	5	3.8E-01	NC	NC
Arsenic	7440-38-2	5.1	18	2.8E-01	NC	NC
Barium	7440-39-3	241	500	4.8E-01	NC	NC
Beryllium	7440-41-7	1.1	10	1.1E-01	NC	NC
Cadmium	7440-43-9	0.64	32	2.0E-02	NC	NC
Calcium	7440-70-2	14,900	4	**3.7E+03**	5,942	**1.5E+03**
Chromium	7440-47-3	41.6	1	**4.2E+01**	25	**2.5E+01**
Cobalt	7440-48-4	12.2	13	9.4E-01	NC	NC
Copper	7440-50-8	195	70	**2.8E+00**	58.8	8.4E-01
Iron	7439-89-6	35,100	NV	NC	NC	NC
Lead	7439-92-1	3,610	120	**3.0E+01**	2,581	**2.2E+01**
Magnesium	7439-95-4	9,040	NV	NC	NC	NC
Manganese	7439-96-5	883.5	500	**1.8E+00**	608	**1.2E+00**
Mercury	7439-97-6	0.77	0.3	**2.6E+00**	0.291	9.7E-01
Nickel	7440-02-0	19.3	38	5.1E-01	NC	NC
Potassium	7440-09-7	2,880	NV	NC	NC	NC
Selenium	7782-49-2	2.6	1	**2.6E+00**	1.53	**1.5E+00**
Silver	7440-22-4	0.11	560	2.0E-04	NC	NC
Sodium	7440-23-5	1,270	NV	NC	NC	NC
Vanadium	7440-62-2	58.9	2	**2.9E+01**	39.6	**2.0E+01**
Zinc	7440-66-6	555	50	**1.1E+01**	272.3	**5.4E+00**
TCL Pesticides/PCBs						
4,4'-DDE	72-55-9	0.06	0.1	6.0E-01	NC	NC
alpha-Chlordane	5103-71-9	0.062	0.1	6.2E-01	NC	NC
delta-BHC	319-86-8	0.006	100	6.0E-05	NC	NC
Dieldrin	60-57-1	0.011	0.1	1.1E-01	NC	NC
Endrin Aldehyde	7421-93-4	0.0044	0.1	4.4E-02	NC	NC
Endrin Ketone	53494-70-5	0.0075	0.1	7.5E-02	NC	NC
gamma-Chlordane	5103-74-2	0.055	0.1	5.5E-01	NC	NC
Heptachlor	76-44-8	0.0013	0.1	1.3E-02	NC	NC
Heptachlor Epoxide	1024-57-3	0.021	0.1	2.1E-01	NC	NC
Methoxychlor	72-43-5	0.003	0.1	3.0E-02	NC	NC
Aroclor 1254	11097-69-1	2.8	NV	NC	NC	NC
Aroclor 1260	11096-82-5	0.38	NV	NC	NC	NC
TCL SVOCs						
Bis(2-ethylhexyl)phthalate	117-81-7	1.4	NV	NC	NC	NC
Di-n-butylphthalate	84-74-2	11	200	5.5E-02	NC	NC
Diethylphthalate	84-66-2	96	NV	NC	NC	NC
Dimethylphthalate	131-11-3	1.9	NV	NC	NC	NC
N-Nitrosodiphenylamine	86-30-6	1.8	NV	NC	NC	NC
PAHs						
Acenaphthene	83-32-9	3.5	0.1	**3.5E+01**	1.09	**1.1E+01**
Acenaphthylene	208-96-8	0.24	0.1	**2.4E+00**	0.0424	4.2E-01
Benzo(a)anthracene	56-55-3	0.015	0.1	1.5E-01	NC	NC
Benzo(a)pyrene	50-32-8	0.057	0.1	5.7E-01	NC	NC
Benzo(b)fluoranthene	205-99-2	0.1	0.1	1.0E+00	NC	NC
Benzo(g,h,i)perylene	191-24-2	0.084	0.1	8.4E-01	NC	NC
Benzo(k)fluoranthene	207-08-9	0.032	0.1	3.2E-01	NC	NC
Chrysene	218-01-9	0.042	0.1	4.2E-01	NC	NC
Dibenz(a,h)anthracene	53-70-3	0.0089	0.1	8.9E-02	NC	NC
Fluoranthene	206-44-0	0.072	0.1	7.2E-01	NC	NC
Indeno(1,2,3-cd)pyrene	193-39-5	0.035	0.1	3.5E-01	NC	NC
Naphthalene	91-20-3	8.6	0.1	**8.6E+01**	1.47	**1.5E+01**

Table 7-9
Plant Screening - Soil
Screening Level Ecological Risk Assessment - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Constituent of Potential Ecological Concern	CAS #	Maximum Soil Concentration (mg/kg)	Screening Level (mg/kg)	Hazard Quotient (unitless)	EPC (mg/kg)	EPC Hazard Quotient (unitless)
Phenanthrene	85-01-8	0.025	0.1	2.5E-01	NC	NC
Pyrene	129-00-0	0.065	0.1	6.5E-01	NC	NC
Explosives						
1,3,5-Trinitrobenzene	99-35-4	1.9	8.6	2.2E-01	NC	NC
2,4,6-Trinitrotoluene	118-96-7	80	2.4	**3.3E+01**	20.26	**8.4E+00**
2,4-Dinitrotoluene	121-14-2	11	5.3	**2.1E+00**	9.533	**1.8E+00**
2-Amino-4,6-Dinitrotoluene	355-72-78-2	9.6	80	1.2E-01	NC	NC
4-Amino-2,6-Dinitrotoluene	1946-51-0	14	80	1.8E-01	NC	NC
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	8.2	100	8.2E-02	NC	NC
Nitroglycerin						
Nitroglycerin	55-63-0	400	NV	NC	NC	NC

Notes:
CAS = Chemical Abstract Service
mg/kg = Milligram per Kilogram
PCB = Polychlorinated Biphenyl
SVOC = Semivolatile Organic Compound
PAH = Polynuclear Aromatic Hydrocarbon
NV = No Value Available
NC = Not Calculated
Hazard Quotient = Soil Concentration/Screening Level
EPC = Exposure Point Concentration

Table 7-10
Invertebrate and Microbial Screening - Soil
Screening Level Ecological Risk Assessment - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Constituent of Potential Ecological Concern	CAS #	Maximum Soil Concentration (mg/kg)	Screening Level (mg/kg)	Hazard Quotient (unitless)	EPC (mg/kg)	EPC Hazard Quotient (unitless)
Inorganics						
Aluminum	7429-90-5	22,600	NV	NC	NC	NC
Antimony	7440-36-0	1.9	78	2.4E-02	NC	NC
Arsenic	7440-38-2	5.1	60	8.5E-02	NC	NC
Barium	7440-39-3	241	330	7.3E-01	NC	NC
Beryllium	7440-41-7	1.1	40	2.8E-02	NC	NC
Cadmium	7440-43-9	0.64	140	4.6E-03	NC	NC
Calcium	7440-70-2	14,900	NV	NC	NC	NC
Chromium	7440-47-3	41.6	0.4	**1.0E+02**	25	**6.3E+01**
Cobalt	7440-48-4	12.2	200	6.1E-02	NC	NC
Copper	7440-50-8	195	80	**2.4E+00**	58.8	7.4E-01
Iron	7439-89-6	35,100	200	**1.8E+02**	23,141	**1.2E+02**
Lead	7439-92-1	3,610	1,700	**2.1E+00**	2,581	**1.5E+00**
Magnesium	7439-95-4	9,040	NV	NC	NC	NC
Manganese	7439-96-5	883.5	100	**8.8E+00**	608	**6.1E+00**
Mercury	7439-97-6	0.77	0.1	**7.7E+00**	0.291	**2.9E+00**
Nickel	7440-02-0	19.3	280	6.9E-02	NC	NC
Potassium	7440-09-7	2,880	NV	NC	NC	NC
Selenium	7782-49-2	2.6	70	3.7E-02	NC	NC
Silver	7440-22-4	0.11	50	2.2E-03	NC	NC
Sodium	7440-23-5	1,270	NV	NC	NC	NC
Vanadium	7440-62-2	58.9	20	**2.9E+00**	39.6	**2.0E+00**
Zinc	7440-66-6	555	100	**5.6E+00**	272.3	**2.7E+00**
TCL Pesticides/PCBs						
4,4'-DDE	72-55-9	0.06	0.1	6.0E-01	NC	NC
alpha-Chlordane	5103-71-9	0.062	0.1	6.2E-01	NC	NC
delta-BHC	319-86-8	0.006	NV	NC	NC	NC
Dieldrin	60-57-1	0.011	0.1	1.1E-01	NC	NC
Endrin Aldehyde	7421-93-4	0.0044	0.1	4.4E-02	NC	NC
Endrin Ketone	53494-70-5	0.0075	0.1	7.5E-02	NC	NC
gamma-Chlordane	5103-74-2	0.055	0.1	5.5E-01	NC	NC
Heptachlor	76-44-8	0.0013	0.1	1.3E-02	NC	NC
Heptachlor Epoxide	1024-57-3	0.021	0.1	2.1E-01	NC	NC
Methoxychlor	72-43-5	0.003	0.1	3.0E-02	NC	NC
Aroclor 1254	11097-69-1	2.8	NV	NC	NC	NC
Aroclor 1260	11096-82-5	0.38	NV	NC	NC	NC
TCL SVOCs						
Bis(2-ethylhexyl)phthalate	117-81-7	1.4	NV	NC	NC	NC
Di-n-butylphthalate	84-74-2	11	NV	NC	NC	NC
Diethylphthalate	84-66-2	96	NV	NC	NC	NC
Dimethylphthalate	131-11-3	1.9	NV	NC	NC	NC
N-Nitrosodiphenylamine	86-30-6	1.8	NV	NC	NC	NC
PAHs						
Acenaphthene	83-32-9	3.5	0.1	**3.5E+01**	1.09	**1.1E+01**
Acenaphthylene	208-96-8	0.24	0.1	**2.4E+00**	0.0424	4.2E-01
Benzo(a)anthracene	56-55-3	0.015	0.1	1.5E-01	NC	NC
Benzo(a)pyrene	50-32-8	0.057	NV	NC	NC	NC
Benzo(b)fluoranthene	205-99-2	0.1	0.1	1.0E+00	NC	NC
Benzo(g,h,i)perylene	191-24-2	0.084	0.1	8.4E-01	NC	NC
Benzo(k)fluoranthene	207-08-9	0.032	0.1	3.2E-01	NC	NC
Chrysene	218-01-9	0.042	0.1	4.2E-01	NC	NC
Dibenz(a,h)anthracene	53-70-3	0.0089	0.1	8.9E-02	NC	NC
Fluoranthene	206-44-0	0.072	0.1	7.2E-01	NC	NC
Indeno(1,2,3-cd)pyrene	193-39-5	0.035	0.1	3.5E-01	NC	NC
Naphthalene	91-20-3	8.6	0.1	**8.6E+01**	1.47	**1.5E+01**
Phenanthrene	85-01-8	0.025	0.1	2.5E-01	NC	NC

Table 7-10
Invertebrate and Microbial Screening - Soil
Screening Level Ecological Risk Assessment - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Constituent of Potential Ecological Concern	CAS #	Maximum Soil Concentration (mg/kg)	Screening Level (mg/kg)	Hazard Quotient (unitless)	EPC (mg/kg)	EPC Hazard Quotient (unitless)
Pyrene	129-00-0	0.065	0.1	6.5E-01	NC	NC
Explosives						
1,3,5-Trinitrobenzene	99-35-4	1.9	18.1	1.0E-01	NC	NC
2,4,6-Trinitrotoluene	118-96-7	80	1.2	**6.7E+01**	20.26	**1.7E+01**
2,4-Dinitrotoluene	121-14-2	11	19.8	5.6E-01	NC	NC
2-Amino-4,6-Dinitrotoluene	355-72-78-2	9.6	NV	NC	NC	NC
4-Amino-2,6-Dinitrotoluene	1946-51-0	14	NV	NC	NC	NC
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	8.2	98.6	8.3E-02	NC	NC
Nitroglycerin						
Nitroglycerin	55-63-0	400	NV	NC	NC	NC

Notes:
CAS = Chemical Abstract Service
mg/kg = Milligram per Kilogram
PCB = Polychlorinated Biphenyl
SVOC = Semivolatile Organic Compound
PAH = Polynuclear Aromatic Hydrocarbon
NV = No Value Available
NC = Not Calculated
Hazard Quotient = Soil Concentration/Screening Level
EPC = Exposure Point Concentration

Table 7-11
Area B Surface Soil Dioxin/Furan Equivalents
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	Mammalian TEF	Avian TEF	54SB39A [D] 12/10/2002 0-1		54SB40A [D] 12/10/2002 0-1		54SB41A [D] 12/10/2002 0-1		54SB42A DUP AVG [C] 12/10/2002 0-1		54SB43A [F] 12/4/2002 0.5-1		54SB45A [D] 12/2/2002 0-1	
			Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)														
1,2,3,4,6,7,8,9-OCDD (OCDD)	0.0003	0.0001	68.4	A	234	,J,i	440		3,760		1,860		70	
1,2,3,4,6,7,8,9-OCDF (OCDF)	0.0003	0.0001	<11.9	U	6.96	A,J,i	<0.92	U	23.45		216		0.382	A,B,z
1,2,3,4,6,7,8-HpCDD	0.01	0.001	4.01	A	10.1		10		66.95		210		1.83	A
1,2,3,4,6,7,8-HpCDF	0.01	0.01	<5.96	U	2.88	A	1.01	A	10.83		86.9		0.223	A,J,w
1,2,3,4,7,8,9-HpCDF	0.01	0.01	<5.96	U	<0.49	U	<0.46	U	1.8015	A	6.24		<0.397	U
1,2,3,4,7,8-HxCDD	0.1	0.05	<5.96	U	0.198	A	0.291	A,J,w	1.6505	A	3.22	A	<0.494	U
1,2,3,4,7,8-HxCDF	0.1	0.1	<5.96	U	0.407	A	0.154	A,J,w	1.89	A	10.7		<0.397	U
1,2,3,6,7,8-HxCDD	0.1	0.01	<5.96	U	0.46	A	<0.46	U	1.735	A	8.89		<0.505	U
1,2,3,6,7,8-HxCDF	0.1	0.1	<5.96	U	0.372	A	0.162	A,J,w	1.225	A	8.08		<0.397	U
1,2,3,7,8,9-HxCDD	0.1	0.1	<5.96	U	0.453	A	0.36	A	2.0725	A	8.34		<0.545	U
1,2,3,7,8,9-HxCDF	0.1	0.1	<5.96	U	<0.49	U	<0.46	U	1.593	A	2.51	A	<0.397	U
1,2,3,7,8-PeCDD	1	1	<5.96	U	<0.49	U	<0.46	U	1.5575	A,J,w	<0.49	U	<0.397	U
1,2,3,7,8-PeCDF	0.03	0.1	1.05	A	0.231	A	0.143	A,J,w	1.592	A	6.49		<0.397	U
2,3,4,6,7,8-HxCDF	0.1	0.1	<5.96	U	0.646	A,J,w	0.232	A,B,z	1.3015	A,J,w	8.97		<0.397	U
2,3,4,7,8-PeCDF	0.3	1	0.858	A	0.474	A	0.241	A,B,z	1.445	A	7.69		<0.397	U
2,3,7,8-TCDD	1	1	<1.19	U	0.733	A	1.26		0.3595	A,J,w	1.05		<0.0795	U
2,3,7,8-TCDF	0.1	1	6.1	A	0.57	A,B,z	<0.217	U	3.3865	A,J,f	9.85		0.221	A
Total 2,3,7,8-TCDD Equivalents (Mammalian)			0.960		1.338		1.603		5.815		13.262		0.064	
Total 2,3,7,8-TCDD Equivalents (Avian)			7.074		1.495		1.421		8.387		24.698		0.232	

Table 7-11
Area B Surface Soil Dioxin/Furan Equivalents
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	Mammalian TEF	Avian TEF	54SB46A [E] 12/4/2002 0.5-1		54SB47A DUP AVG[D] 12/9/2002 0-1		54SB48A 12/9/2002 0-1		54SB49A 12/4/2002 1-2		54SB50A [D] 12/9/2002 0-1		54SB53A [D] 12/10/2002 0-1	
			Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)														
1,2,3,4,6,7,8,9-OCDD (OCDD)	0.0003	0.0001	17,790		2,440		4,230	E,J,c	5,700	J,i	656		651	
1,2,3,4,6,7,8,9-OCDF (OCDF)	0.0003	0.0001	2,060	J,c	1.36	A,B,z	435	J,c	1,060	J,c	8.16	A	222	
1,2,3,4,6,7,8-HpCDD	0.01	0.001	3,090		24.8		495		1,560	J,i	21.6		58	
1,2,3,4,6,7,8-HpCDF	0.01	0.01	1,030		0.937		147		870		4.16	A	79.6	
1,2,3,4,7,8,9-HpCDF	0.01	0.01	54.9		<0.506	U	14.1		47.4		0.309	A	10.5	
1,2,3,4,7,8-HxCDD	0.1	0.05	62.7		0.281	A	7.6		43.6		0.311	A	0.835	A
1,2,3,4,7,8-HxCDF	0.1	0.1	116		<0.506	U	26.3		197		0.408	A	8.34	
1,2,3,6,7,8-HxCDD	0.1	0.01	154		0.423	A	18.8		153		0.643	A	2.41	A
1,2,3,6,7,8-HxCDF	0.1	0.1	57		0.123	A,B,z	11.4		87.5		0.318	A,B,z	4.64	
1,2,3,7,8,9-HxCDD	0.1	0.1	163		0.747	A	21		147		0.821	A,J,w	2.33	A
1,2,3,7,8,9-HxCDF	0.1	0.1	3.3	J	<0.506	U	<5		5.5		0.123	A,B,z	2.39	A
1,2,3,7,8-PeCDD	1	1	34.5	J,c	<0.506	U	5		36.9	J,c	<0.58	U	<0.453	U
1,2,3,7,8-PeCDF	0.03	0.1	<5		0.105	A	7.4		<5		0.2	A	1.18	A
2,3,4,6,7,8-HxCDF	0.1	0.1	57		0.168	A,B,z	12.3		89.6		0.429	A,J,w	3.5	A
2,3,4,7,8-PeCDF	0.3	1	29.6		0.152	A,B,z	11.9		82.3		0.306	A,J,w	1.55	A
2,3,7,8-TCDD	1	1	5.9		<0.101	U	1.3		10		<0.154	U	0.454	A
2,3,7,8-TCDF	0.1	1	43		0.293	A	9.6		125	J,i	0.61	A	1.28	
Total 2,3,7,8-TCDD Equivalents (Mammalian)			162.584		1.167		28.753		183.212		0.880		5.270	
Total 2,3,7,8-TCDD Equivalents (Avian)			173.229		0.675		38.781		321.98		1.256		6.634	

Table 7-11
Area B Surface Soil Dioxin/Furan Equivalents
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Sample ID Sample Date Sample Depth (ft bgs)	Mammalian TEF	Avian TEF	54SB54A [(D)] 12/9/2002 0-1		54SB55A 12/9/2002 0-1		54SB77A 1/9/2007 0-0.5		54SB78A 1/9/2007 0-0.5		54SB79A 1/9/2007 0-0.5		54SB80A 1/9/2007 0-0.5	
			Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r	Result	LQ, VQ, r
Dioxin/Furans (pg/g)														
1,2,3,4,6,7,8,9-OCDD (OCDD)	0.0003	0.0001	122		1,210	J,c	120		109		66.3		369	
1,2,3,4,6,7,8,9-OCDF (OCDF)	0.0003	0.0001	<1.04	U	211	J,c	2	A	1.25	A,B,z	0.558	A	0.766	A
1,2,3,4,6,7,8-HpCDD	0.01	0.001	2.94	A	204		5.76		5.5		2.39	A	8.82	
1,2,3,4,6,7,8-HpCDF	0.01	0.01	0.376	A,J,w	125		1.19	A	1.08	A	0.335	A	0.557	A
1,2,3,4,7,8,9-HpCDF	0.01	0.01	<0.522	U	16.1		<0.412	U	<0.468	U	<0.517	U	<0.516	U
1,2,3,4,7,8-HxCDD	0.1	0.05	<0.615	U	8.5		<0.412	U	0.159	A	<0.517	U	<0.516	U
1,2,3,4,7,8-HxCDF	0.1	0.1	<0.522	U	91.6		0.183	A,J,w	<0.468	U	<0.517	U	<0.516	U
1,2,3,6,7,8-HxCDD	0.1	0.01	<0.628	U	14.3		<0.412	U	0.271	A	0.13	A,J,w	0.221	A
1,2,3,6,7,8-HxCDF	0.1	0.1	<0.522	U	40.4		0.135	A,J,w	<0.468	U	<0.517	U	0.0867	A
1,2,3,7,8,9-HxCDD	0.1	0.1	<0.678	U	22.7		<0.412	U	<0.468	U	0.178	A,J,w	0.213	A
1,2,3,7,8,9-HxCDF	0.1	0.1	<0.522	U	5.7		<0.412	U	<0.468	U	<0.517	U	<0.516	U
1,2,3,7,8-PeCDD	1	1	<0.522	U	9.9		<0.412	U	<0.468	U	<0.517	U	<0.516	U
1,2,3,7,8-PeCDF	0.03	0.1	<0.522	U	37.5		0.135	A	0.14	A	0.112	A	<0.516	U
2,3,4,6,7,8-HxCDF	0.1	0.1	<0.522	U	38.6		0.147	A	<0.468	U	<0.517	U	0.12	A,J,w
2,3,4,7,8-PeCDF	0.3	1	0.071	A,B,z	56.7		0.193	A	0.212	A,B,z	0.134	A	0.159	A,J,w
2,3,7,8-TCDD	1	1	<0.104	U	2.7		1.34		1.76		0.703	A	0.237	A,J,w
2,3,7,8-TCDF	0.1	1	0.265	A	28.5		0.39	A,J,w	0.5	A	0.647	A,B,z	0.706	A,B,z
Total 2,3,7,8-TCDD Equivalents (Mammalian)			0.096		59.642		1.594		1.969		0.825		0.553	
Total 2,3,7,8-TCDD Equivalents (Avian)			0.284		123.775		2.013		2.024		0.880		0.492	

Notes:

pg/g = Picogram Per Gram
ft/bgs = Feet Below Ground Surface
TEF = Toxicity Equivalency Factor
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code

Total 2,3,7,8-TCDD Equivalents are calculated by summing the detected concentration times the TEF for each chemical. Non-detects, R-flagged data, and B-flagged data are excluded from summed total.

Qualifiers:

- A Amount detected is less than the Lower Calibration Limit.
- B Not detected substantially above the level reported in laboratory or field blanks.
- E Concentration exceeded the upper level of the calibration range of the instrument for that specific analysis.
- J Analyte present. Reported value may not be accurate or precise.
- U The compound was analyzed for but not detected. The reporting limit will be adjusted to reflect any dilution, and for soil, the percent moisture.
- c Calibration failure; poor (RRF) or unstable (%D) response
- q Concentration exceeded the linear range
- w Identification criteria failure
- z Method blank and/or storage blank contamination

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Table 7-12
Terrestrial Wildlife Summary
Screening Level Ecological Risk Assessment - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Chemical	CAS#	Meadow Vole					Short-tailed Shrew					Red Fox					American Robin					Red-tailed Hawk				
		Preliminary NOAEL-based HQ	Preliminary LOAEL-based HQ	Preliminary EPC NOAEL HQ	Refined NOAEL-based HQ	Refined LOAEL-based HQ	Preliminary NOAEL-based HQ	Preliminary LOAEL-based HQ	Preliminary EPC NOAEL HQ	Refined NOAEL-based HQ	Refined LOAEL-based HQ	Preliminary NOAEL-based HQ	Preliminary LOAEL-based HQ	Preliminary EPC NOAEL HQ	Refined NOAEL-based HQ	Refined LOAEL-based HQ	Preliminary NOAEL-based HQ	Preliminary LOAEL-based HQ	Preliminary EPC NOAEL HQ	Refined NOAEL-based HQ	Refined LOAEL-based HQ	Preliminary NOAEL-based HQ	Preliminary LOAEL-based HQ	Preliminary EPC NOAEL HQ	Refined NOAEL-based HQ	Refined LOAEL-based HQ
Inorganics																										
Arsenic	7440-38-2	**2.8E+01**	**2.8E+00**	**1.2E+01**	2.3E-01	2.3E-02	**1.0E+01**	**1.0E+00**	**4.1E+00**	5.6E-01	5.6E-02	**1.9E+01**	**1.9E+00**	**7.6E+00**	1.0E-03	1.0E-04	3.6E-01	1.4E-01	NC	NC	NC	9.7E-04	3.9E-04	NC	NC	NC
Cadmium	7440-43-9	7.3E-01	7.3E-02	NC	NC	NC	**3.0E+00**	3.0E-01	8.4E-01	1.2E-01	1.2E-02	**6.0E+00**	6.0E-01	**1.7E+00**	1.7E-04	1.7E-05	**5.7E+00**	4.1E-01	**1.6E+00**	1.4E-01	1.0E-02	1.2E-01	8.4E-03	NC	NC	NC
Chromium	7440-47-3	4.6E-01	4.6E-02	NC	NC	NC	**4.6E+00**	4.6E-01	**2.7E+00**	1.8E-01	1.8E-02	**8.9E+00**	8.9E-01	**5.3E+00**	6.7E-04	6.7E-05	**4.2E+01**	**8.4E+00**	**2.5E+01**	9.9E-01	2.0E-01	9.1E-01	1.8E-01	NC	NC	NC
Copper	7440-50-8	**2.8E+00**	**2.1E+00**	8.4E-01	9.0E-02	6.8E-02	**2.3E+00**	**1.8E+00**	7.0E-01	1.4E-01	1.1E-01	**4.4E+00**	**3.3E+00**	**1.3E+00**	7.1E-04	5.4E-04	**2.1E+00**	**1.6E+00**	6.2E-01	9.0E-02	6.9E-02	2.9E-01	2.2E-01	NC	NC	NC
Lead	7439-92-1	**7.4E+01**	**7.4E+00**	**5.3E+01**	**1.3E+00**	1.3E-01	**8.1E+01**	**8.1E+00**	**5.8E+01**	**5.5E+00**	5.5E-01	**1.5E+02**	**1.5E+01**	**1.1E+02**	1.1E-02	1.1E-03	**1.6E+03**	**1.6E+02**	**1.1E+03**	**5.8E+01**	**5.8E+00**	**6.0E+01**	**6.0E+00**	**4.3E+01**	4.3E-03	4.3E-04
Mercury	7439-97-6	7.6E-02	7.6E-03	NC	NC	NC	1.0E-01	1.0E-02	NC	NC	NC	2.0E-01	2.0E-02	NC	NC	NC	**1.1E+01**	**5.6E+00**	**4.2E+00**	1.5E-01	7.3E-02	2.2E-02	1.1E-02	NC	NC	NC
Nickel	7440-02-0	2.3E-01	1.2E-01	NC	NC	NC	2.6E-01	1.3E-01	NC	NC	NC	5.0E-01	2.5E-01	NC	NC	NC	3.8E-01	2.7E-01	NC	NC	NC	9.7E-03	7.0E-03	NC	NC	NC
Selenium	7782-49-2	**1.3E+01**	**8.0E+00**	**7.8E+00**	5.2E-01	3.2E-01	**4.5E+00**	**2.7E+00**	**2.6E+00**	4.3E-01	2.6E-01	**8.7E+00**	**5.3E+00**	**5.1E+00**	2.9E-03	1.8E-03	**6.3E+00**	**3.1E+00**	**3.7E+00**	5.5E-01	2.7E-01	5.1E-01	2.5E-01	NC	NC	NC
Silver	7440-22-4	1.0E-04	1.0E-05	NC	NC	NC	8.3E-03	8.3E-04	NC	NC	NC	1.7E-02	1.7E-03	NC	NC	NC	3.2E-02	4.3E-03	NC	NC	NC	2.2E-04	2.9E-05	NC	NC	NC
Zinc	7440-66-6	**2.1E+00**	**1.1E+00**	**1.1E+00**	8.8E-02	4.4E-02	**4.9E+00**	**2.5E+00**	**2.4E+00**	1.9E-01	9.7E-02	**9.8E+00**	**4.9E+00**	**4.8E+00**	6.1E-04	3.0E-04	**1.6E+02**	**1.7E+01**	**7.6E+01**	**4.1E+00**	4.5E-01	**6.8E+00**	7.5E-01	**3.3E+00**	1.1E-03	1.2E-04
Dioxin/Furans																										
Total 2,3,7,8-TCDD Equivalents	1746-01-6	**3.6E+00**	3.6E-01	**3.6E+00**	**1.3E+00**	1.3E-01	**8.3E+02**	**8.3E+01**	**8.3E+02**	**2.0E+02**	**2.0E+01**	**1.7E+03**	**1.7E+02**	**1.7E+03**	2.9E-01	2.9E-02	**1.6E+02**	**1.6E+01**	**1.3E+02**	**1.7E+01**	**1.7E+00**	**3.3E+00**	3.3E-01	**2.8E+00**	2.5E-03	2.5E-04
TCL Pesticides/PCBs																									NC	NC
4,4'-DDE	72-55-9	9.1E-05	9.1E-06	NC	NC	NC	5.8E-03	5.8E-04	NC	NC	NC	1.2E-02	1.2E-03	NC	NC	NC	**6.6E+00**	6.6E-01	**6.6E+00**	**1.4E+00**	1.4E-01	6.8E-02	6.8E-03	NC	NC	NC
alpha-Chlordane	5103-71-9	1.0E-01	1.0E-02	NC	NC	NC	1.3E-01	1.3E-02	NC	NC	NC	2.6E-01	2.6E-02	NC	NC	NC	3.7E-02	7.4E-03	NC	NC	NC	1.9E-03	3.8E-04	NC	NC	NC
delta-BHC	319-86-8	1.1E-01	1.1E-02	NC	NC	NC	9.7E-02	9.7E-03	NC	NC	NC	1.9E-01	1.9E-02	NC	NC	NC	8.9E-03	2.2E-03	NC	NC	NC	7.1E-04	1.8E-04	NC	NC	NC
Dieldrin	60-57-1	1.9E-01	1.9E-02	NC	NC	NC	**4.8E+00**	4.8E-01	**1.9E+00**	1.9E-01	1.9E-02	**9.6E+00**	9.6E-01	**3.8E+00**	1.1E-04	1.1E-05	**3.6E+00**	3.6E-01	**1.4E+00**	7.7E-02	7.7E-03	9.4E-03	9.4E-04	NC	NC	NC
Endrin aldehyde	7421-93-4	3.0E-02	3.0E-03	NC	NC	NC	3.6E-02	3.6E-03	NC	NC	NC	7.1E-02	7.1E-03	NC	NC	NC	1.8E-01	3.0E-02	NC	NC	NC	1.0E-02	1.7E-03	NC	NC	NC
Endrin ketone	53494-70-5	5.2E-02	5.2E-03	NC	NC	NC	6.1E-02	6.1E-03	NC	NC	NC	1.2E-01	1.2E-02	NC	NC	NC	3.1E-01	5.1E-02	NC	NC	NC	1.8E-02	2.9E-03	NC	NC	NC
gamma-Chlordane	5103-74-2	9.0E-02	9.0E-03	NC	NC	NC	1.2E-01	1.2E-02	NC	NC	NC	2.3E-01	2.3E-02	NC	NC	NC	3.3E-02	6.6E-03	NC	NC	NC	1.7E-03	3.4E-04	NC	NC	NC
Heptachlor	76-44-8	3.4E-03	3.4E-04	NC	NC	NC	3.4E-03	3.4E-04	NC	NC	NC	6.7E-03	6.7E-04	NC	NC	NC	5.0E-04	1.0E-04	NC	NC	NC	3.4E-05	6.8E-06	NC	NC	NC
Heptachlor epoxide	1024-57-3	2.9E-01	2.9E-02	NC	NC	NC	7.8E-01	7.8E-02	NC	NC	NC	**1.6E+00**	1.6E-01	8.2E-01	3.6E-04	3.6E-05	5.6E-02	1.1E-02	NC	NC	NC	1.4E-03	2.8E-04	NC	NC	NC
Methoxychlor	72-43-5	2.6E-04	1.3E-04	NC	NC	NC	2.4E-04	1.2E-04	NC	NC	NC	4.6E-04	2.3E-04	NC	NC	NC	1.8E-04	1.8E-05	NC	NC	NC	1.4E-05	1.4E-06	NC	NC	NC
Aroclor 1254	11097-69-1	7.9E-01	7.9E-02	NC	NC	NC	**1.3E+02**	**1.3E+01**	**4.1E+01**	**8.3E+00**	8.3E-01	**2.7E+02**	**2.7E+01**	**8.1E+01**	1.8E-02	1.8E-03	**3.4E+01**	**3.4E+00**	**1.0E+01**	1.1E+00	1.1E-01	4.5E-01	4.5E-02	NC	NC	NC
Aroclor 1260	11096-82-5	9.9E-02	9.9E-03	NC	NC	NC	**1.8E+01**	**1.8E+00**	**1.7E+01**	**3.5E+00**	3.5E-01	**3.6E+01**	**3.6E+00**	**3.4E+01**	7.4E-03	7.4E-04	**4.7E+00**	4.7E-01	**4.4E+00**	4.7E-01	4.7E-02	6.1E-02	6.1E-03	NC	NC	NC
PAHs																										
Acenaphthene	83-32-9	5.7E-01	1.1E-01	NC	NC	NC	1.9E-01	3.8E-02	NC	NC	NC	3.8E-01	7.5E-02	NC	NC	NC	**5.1E+00**	**1.0E+00**	**1.6E+00**	7.1E-02	1.4E-02	2.3E-01	4.6E-02	NC	NC	NC
Acenaphthylene	208-96-8	3.7E-03	7.4E-04	NC	NC	NC	2.9E-03	5.8E-04	NC	NC	NC	5.8E-03	1.2E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Benzo(a)anthracene	56-55-3	1.7E-02	1.7E-03	NC	NC	NC	1.0E-02	1.0E-03	NC	NC	NC	2.0E-02	2.0E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Benzo(a)pyrene	50-32-8	1.2E-01	1.2E-02	NC	NC	NC	3.9E-02	3.9E-03	NC	NC	NC	7.7E-02	7.7E-03	NC	NC	NC	1.2E-01	2.4E-02	NC	NC	NC	7.5E-03	1.5E-03	NC	NC	NC
Benzo(b)fluoranthene	205-99-2	3.1E-02	3.1E-03	NC	NC	NC	4.0E-02	4.0E-03	NC	NC	NC	7.6E-02	7.6E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Benzo(g,h,i)perylene	191-24-2	1.7E-01	3.4E-02	NC	NC	NC	1.0E-01	2.0E-02	NC	NC	NC	2.0E-01	3.9E-02	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Benzo(k)fluoranthene	207-08-9	1.8E-03	1.8E-04	NC	NC	NC	9.1E-04	9.1E-05	NC	NC	NC	1.7E-03	1.7E-04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Chrysene	218-01-9	1.8E-03	1.8E-04	NC	NC	NC	8.0E-04	8.0E-05	NC	NC	NC	1.5E-03	1.5E-04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Dibenz(a,h)anthracene	53-70-3	6.9E-04	6.9E-05	NC	NC	NC	1.5E-03	1.5E-04	NC	NC	NC	2.9E-03	2.9E-04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Fluoranthene	206-44-0	8.8E-03	1.8E-03	NC	NC	NC	2.9E-03	5.8E-04	NC	NC	NC	5.8E-03	1.2E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Indeno(1,2,3-cd)pyrene	193-39-5	3.4E-04	3.4E-05	NC	NC	NC	1.2E-03	1.2E-04	NC	NC	NC	2.3E-03	2.3E-04	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Phenanthrene	85-01-8	2.4E-02	4.9E-03	NC	NC	NC	8.0E-03	1.6E-03	NC	NC	NC	1.6E-02	3.2E-03	NC	NC	NC	7.7E-02	1.5E-02	NC	NC	NC	1.5E-03	2.9E-04	NC	NC	NC
Pyrene	129-00-0	1.9E-02	3.8E-03	NC	NC	NC	6.3E-03	1.3E-03	NC	NC	NC	1.2E-02	2.5E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Explosives																										
1,3,5-Trinitrobenzene	99-35-4	**2.1E+00**	4.1E-01	**2.1E+00**	3.8E-01	7.6E-02	6.8E-01	1.4E-01	NC	NC	NC	**1.3E+00**	2.7E-01	**1.3E+00**	4.0E-04	8.0E-05	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
2,4,6-Trinitrotoluene	118-96-7	**4.5E+01**	**1.1E+01**	**1.1E+01**	**2.1E+00**	5.3E-01	**1.5E+01**	**3.7E+00**	**3.8E+00**	3.9E-01	9.7E-02	**3.0E+01**	**7.4E+00**	**7.5E+00**	2.2E-03	5.5E-04	**3.1E+03**	**1.2E+02**	**7.8E+02**	**1.8E+02**	**7.1E+00**	**7.5E+01**	**2.9E+00**	**1.9E+01**	--	--
2,4-Dinitrotoluene	121-14-2	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	**2.9E+02**	**2.4E+01**	**2.6E+02**	**6.0E+01**	**4.8E+00**	**7.2E+00**	5.8E-01	**6.3E+00**	--	--
2-Amino-4,6-Dinitrotoluene	355-72-78-2	**3.1E+00**	5.8E-01	5.2E-01	9.6E-02	1.8E-02	**1.0E+00**	1.9E-01	1.7E-01	1.7E-02	3.3E-03	**2.0E+00**	3.8E-01	3.4E-01	1.0E-04	1.9E-05	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
4-Amino-2,6-Dinitrotoluene	1946-51-0	**4.5E+00**	8.5E-01	7.5E-01	1.4E-01	2.6E-02	**1.5E+00**	2.8E-01	2.5E-01	2.5E-02	4.7E-03	**3.0E+00**	5.5E-01	4.9E-01	1.4E-04	2.7E-05	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
RDX (Hexahydro-1,3,5-trinitro-1,3,5-tria	121-82-4	**1.9E+00**	3.7E-01	3.4E-01	1.1E-02	2.2E-03	6.1E-01	1.2E-01	NC	NC	NC	**1.2E+00**	2.4E-01	2.2E-01	1.9E-05	3.8E-06	**5.3E+00**	5.3E-01	9.7E-01	8.4E-02	8.4E-03	2.1E-01	2.1E-02	NC	NC	NC
Nitroglycerin																										
Nitroglycerin	55-63-0	**4.7E+01**	**4.4E+00**	**4.7E+01**	**1.7E+01**	**1.6E+00**	**1.7E+01**	**1.6E+00**	**1.7E+01**	**9.3E+00**	8.7E-01	**3.1E+01**	**2.9E+00**	**3.1E+01**	2.3E-02	2.1E-03	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

Notes:
CAS = Chemical Abstract Services
NC = Not Calculated
NOAEL = No observable adverse effects level
LOAEL = Lowest observable adverse effects level
HQ = Hazard Quotient
EPC = Exposure Point Concentration
-- = Refined Mammal BAF is 0; therefore, bioaccumulation of these chemicals not a concern for the red-tailed hawk

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8.0 ESTABLISHMENT OF CORRECTIVE MEASURE OBJECTIVES

This section identifies the corrective measures objectives (CMOs) for the chemicals of concern (COCs) and media of interest identified by the fate and transport assessments and risk assessments. CMOs are cleanup objectives developed to protect human health and the environment and provide the basis for identification, detailed analysis, and selection of corrective measures alternatives.

8.1 CHEMICAL AND MEDIA OF INTEREST

The risk assessments and fate and transport assessment identified COCs and associated media of interest at Areas A and B, which will be addressed in the CMS.

8.1.1 Area A

HHRA results, as presented in Section 6.0, for Area A indicated that the calculated risks for receptors evaluated under the current land use scenario and future commercial/industrial land-use scenarios were less than 1E-05 and within the USEPA target risk range of 1E-06 to 1E-04. When considering background and target organ segregation, site-related total hazards calculated for the current land use scenario and future commercial/industrial land use scenarios were equal to or less than the USEPA reference HI of 1E+00. Lead and iron were not identified as COCs for the CMS based on the results of the human health exposure assessments.

Calculated risk for the hypothetical future residential use of soil and groundwater at Area A were 6E-05 or less and within the USEPA target risk range of 1E-06 to 1E-04. When considering background and target organ segregation, hazards calculated for future residential use of Area A were at or below the USEPA reference HI of 1E+00 with the exception of the hypothetical future child resident (liver) with an HI of 2E+00 due to 2,4,6-TNT in groundwater. As presented in Section 5.0, several explosives were identified as COCs for the CMS due to their potential for continued leaching to groundwater at levels of potential concern. In addition, heptachlor epoxide and dioxins were identified as COCs due to their potential for future leaching to groundwater at levels of potential concern.

Primary COCs and media of interest for the CMS at Area A are identified in the following table.

Area A – Chemicals and Media of Interest

Media	Receptor/Pathways/Area	Chemicals of Concern
Total Soil	Soil-to-Groundwater	2,4,6-TNT, DNT Mixture, Nitroglycerin, 2,3,7,8-TCDD (TEQ), Amino DNTs, and Heptachlor Epoxide
Total Soil	"Hot spot" area with concentrations exceeding Industrial RBC	2,4,6-TNT and DNT Mixture
Groundwater	Hypothetical Future Child Resident	2,4,6-TNT, DNT Mixture, RDX, and perchlorate
	Hypothetical Lifetime Resident	2,4,6-TNT, DNT Mixture, and RDX

8.1.2 Area B

HHRA results for Area B indicated that the calculated risks for receptors evaluated under the current land use scenario and future commercial/industrial worker scenarios were less than 1E-05 and within the USEPA target risk range of 1E-06 to 1E-04. When considering background and target organ segregation,

site-related total hazards calculated for the current land use scenario and future commercial worker scenarios were equal to or less than the USEPA reference HI of 1E+00.

Calculated risk for the hypothetical future residential use of soil and groundwater at Area B were 5E-05 or less and within the USEPA target risk range of 1E-06 to 1E-04. When considering background and target organ segregation, hazards calculated for future residential use of Area B were at or below the USEPA reference HI of 1E+00 with the exception of the hypothetical future child resident vascular with an HI of 4E+00 due to nitroglycerin in soil and liver with an HI of 2E+00 due to 2,4,6-TNT in soil.

Lead was identified as a COC for the hypothetical future construction worker and hypothetical child resident based on the results of the lead exposure assessment. Iron was not identified as a COC based on the results of the margin of exposure evaluation.

As presented in Section 5.0, explosives, dioxins, pesticides, and Aroclor 1254 were identified as COCs for the CMS due to their potential for future leaching to groundwater at levels of potential concern.

A "hotspot" area was identified within Area B where concentrations of explosives, lead, 2,3,7,8-TCDD (TEQ), Aroclor 1254, and heptachlor epoxide were above I-RBCs in one or more samples. Several of these compounds were also identified as COCs in the fate and transport assessment for the soil-to-groundwater migration pathway, due to their potential to leach to groundwater at levels of potential concern.

Primary COCs and media of interest for the CMS at Area B are identified in the following table.

Area B – Chemicals and Media of Interest

Media	Receptor/Pathway	Chemicals of Concern
Total Soil	Hypothetical Future Construction Worker Hypothetical Future Child Resident	Lead
Total Soil	Hypothetical Future Child Resident	2,4,6-TNT and Nitroglycerin
Total Soil	"Hot Spot" area with concentrations exceeding I-RBCs	2,4,6-TNT, DNT Mixture, Nitroglycerin, Lead, 2,3,7,8-TCDD (TEQ), Aroclor 1254, Heptachlor Epoxide
Total Soil	Soil-to-Groundwater Migration in "Hot Spot Area"	2,4,6-TNT, DNT Mixture, Amino DNTs, RDX, 2,3,7,8-TCDD (TEQ), Aroclor 1254, Heptachlor Epoxide, Dieldrin, Nitroglycerin
Groundwater	None Identified	None Identified

8.2 CORRECTIVE MEASURES OBJECTIVES

CMOs have been developed for the COCs and media of interest at Area A and Area B with consideration of the following:

- Future planned land use of the site is industrial.
- Site development in the future is unlikely given its location immediately adjacent to the New River within an unprotected 100-year floodplain.
- USEPA Region III and VDEQ expectations for final remedies, which include a goal of restoring groundwater to its maximum beneficial uses wherever practicable, within a time-frame that is reasonable given the particular circumstances of the site (USEPA 2000a and 2004).

The residential exposure pathway also will be evaluated in the CMS to assess the remedial effort that would be required to achieve clean closeout at the site with unrestricted future land use without controls or long-term monitoring requirements.

8.2.1 Area A

The following CMOs have been developed for Area A based on the results of the fate and transport assessment and risk assessments:

- CMO No. 1 – Mitigate further leaching of explosives constituents from soil to groundwater at levels that would potentially increase observed concentrations and adversely impact future beneficial use of groundwater; and
- CMO No. 2 – To extent practicable, a goal of restoring site groundwater to the most beneficial use.

8.2.2 Area B

The following CMOs have been developed for Area B based on the results of the fate and transport assessment and risk assessments:

- CMO No. 1 – Mitigate the potential hypothetical future risks that have been identified for exposure to soil under a future construction worker scenario; and
- CMO No. 2 – Prevent leaching of COCs from soil-to-groundwater at levels that would potentially adversely impact future beneficial use of groundwater.

8.3 REMEDIAL GOALS

Site-specific remedial goals (RGs) are calculated in the following sections for identified COCs and media of interest at Area A and Area B.

8.3.1 Area A

For Area A, although the risk assessments resulted in risks and hazards within EPA ranges with the exception of 2,4,6-TNT in groundwater which resulted in an HI of 2 for the liver for the hypothetical future child resident, the soil-to groundwater pathway assessment indicated the potential for impacts to groundwater from chemicals in soil at the site (2,4,6-TNT, DNT mix, nitroglycerin, 2,3,7,8-TCDD TEQ, amino-DNTs, and heptachlor epoxide) and the groundwater results indicated impacts to groundwater above screening levels (2,4,6-TNT, DNT Mix, RDX, and perchlorate). Groundwater remedial goals were calculated for carcinogenic COCs in groundwater based on a target risk of 1E-05 for the hypothetical future lifetime resident and for noncarcinogenic COCs in groundwater based on a target hazard of 1E+00 for the hypothetical future child and adult resident. The lowest calculated RG was selected as the groundwater remedial goal. The equations used for groundwater remedial goal calculation and the remedial goal calculations are provided in Appendix G.1, Tables G.1-1a through G.1-1c. These calculated groundwater remedial goals were then used as the target groundwater concentrations to calculate soil remedial goals for the soil-to-groundwater pathway using site-specific SSL equations as presented in Appendix G.1, Tables G.1-2a through G.1-2c. For chemicals not identified as COCs in groundwater, but identified as COCs for the soil to groundwater pathway (i.e., amino-DNTs, nitroglycerin, heptachlor epoxide, and dioxins), the chemical's T-RBC was used as the target groundwater concentration to calculate soil remedial goals for the soil-to-groundwater pathway using site-specific SSL equations as presented in Appendix G.1, Tables G.1-2d through G.1-2g. A summary of remedial goals for soil and groundwater for Area A are presented in Table 8-1.

The area and volume of impacted soil and groundwater to be addressed by corrective measures at Area A is discussed in Section 8.4.1. This section also discusses reductions in calculated risks and hazards for human health receptors associated with addressing the impacted areas.

8.3.2 Area B

For Area B, the risk assessments resulted in risks and hazards within EPA ranges except for the hypothetical future child resident hazards for 2,4,6-TNT with a target organ of the liver and nitroglycerin with a target organ of the vascular system for total soil and the soil-to groundwater pathway assessment indicated the potential for impacts to groundwater from chemicals in soil at the site (2,4,6-TNT, DNT mix, amino-DNTs, RDX, 2,3,7,8-TCDD TEQ, Aroclor 1254, heptachlor epoxide, dieldrin, and nitroglycerin). Given that the hazards for 2,4,6-TNT and nitroglycerin exceed 1E+00, hazard-based RGs for the hypothetical future child resident for these COCs were calculated using a target hazard of 1E+00. The equations used for soil remedial goal calculation and the remedial goal calculations are provided in Appendix G.2, Tables G.2-1a and G.2-1b. Lead was also identified as a COC for Area B for the hypothetical future construction worker and hypothetical future child resident based on the results of the lead exposure assessment.

The soil-to groundwater pathway assessment for Area B indicated the potential for impacts to groundwater from soil at the site, but groundwater results did not indicate impacts to groundwater above screening levels. Given that groundwater COCs were not identified for Area B, groundwater RGs calculated for Area A (2,4,6-TNT, Dinitrotoluene mix, and RDX) were used as the target groundwater concentrations to calculate soil remedial goals for the soil-to-groundwater pathway using site-specific SSL equations as presented in Appendix G.2, Tables G.2-2a through G.2-2c. For chemicals not identified as COCs in groundwater, but identified as COCs for the soil to groundwater pathway (i.e., amino-DNTs, nitroglycerin, Aroclor 1254, heptachlor epoxide, dieldrin, and dioxins), the chemical's T-RBC was used as the target groundwater concentration to calculate soil remedial goals for the soil-to-groundwater pathway using site-specific SSL equations as presented in Appendix G, Tables G.2-2d through G.2-2i. A summary of remedial goals for soil and groundwater for Area B are presented in Table 8-2.

For 2,4,6-TNT and nitroglycerin, which were identified as COCs in total soil for the child resident and COCs for the soil-to-groundwater migration pathway, the lower of the calculated RGs (child resident hazard-based and soil-to-groundwater migration pathway) was then selected as the RG for that chemical. For lead, a soil remedial goal of 400 mg/kg was selected as recommended by the USEPA for a residential scenario.

The area and volume of impacted soil and groundwater to be addressed by corrective measures at Area B is discussed in Section 8.4.2. This section also discusses reductions in calculated risks and hazards for human health receptors associated with addressing the impacted areas.

8.4 AREA AND VOLUME OF IMPACTED AREA

Based on the CMOs and RGs identified in Sections 8.2 and 8.3, the area and volume of impacted media above RGs to be addressed in the CMS is discussed in the following sections.

8.4.1 Area A

Based on the RGs identified for Area A (Table 8-1), Figure 8-1 shows the approximate area (12,100 ft^2) and in place volume of soil (3,496 bank cubic yards (BCY)) to be addressed by corrective measures for impacted soil where one or more COCs have been detected at concentrations above RGs. The total 12,100 ft^2 area with an average depth of removal of 6 ft bgs includes three areas (1,302 ft^2, 1,100 ft^2, and 324 ft^2) with an average depth of removal of 14 ft bgs. Approximate average soil depths (bgs) and the volume of in-place soil that will be addressed by the corrective measures are also shown on Figure 8-1.

Based on the RGs identified for Area A (Table 8-1), Figure 8-2 shows the area of groundwater to be addressed by corrective measures where one or more COCs have been detected at concentrations above RGs. This approximate 1.5-acre area encompasses monitoring wells 54MW2, 54MW8, and 54MW10 and extends from the disposal unit area toward the New River.

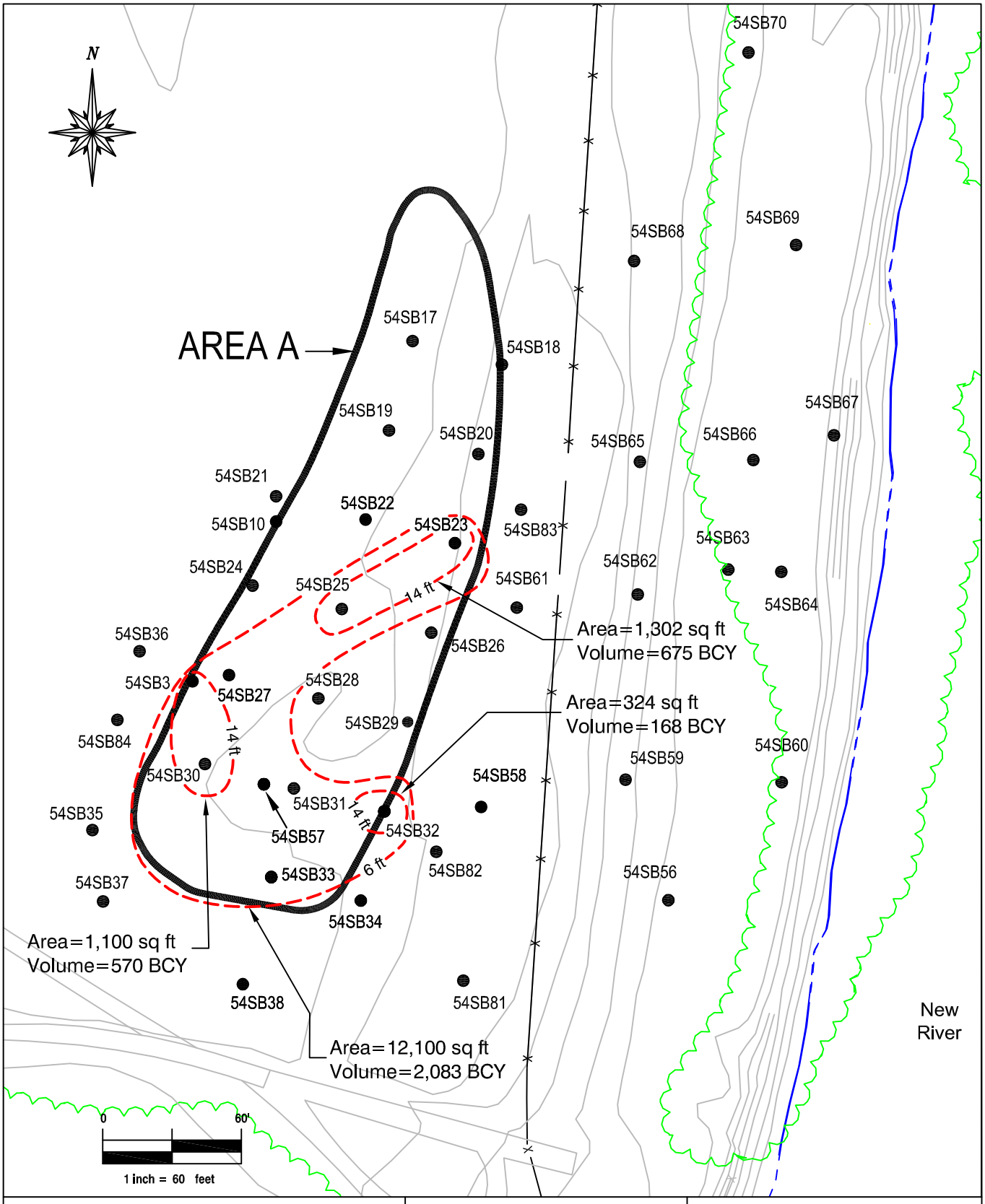
A residual human health risk assessment associated with the site after completion of the proposed corrective measure is provided in Appendix G.1, Tables G.1-3a through G.1-3k. A table listing the soil samples used in the residual risk assessment is provided in Appendix G.1, Table G.1-3a. The residual risk assessment was completed for chemicals identified as site-related COCs for which RGs were calculated (Table 8-1) and chemicals identified as COPCs in the residual risk screenings (Appendix G.1, Tables G.1-3b and G.1-3c) with the exception of metals. As previously discussed in Section 6.6.1, metals were not identified as COCs in soil for Area A when taking background and target organs into consideration; therefore, metals were not included in the residual risk assessment. As presented on Table 8-3, the residual risk assessment resulted in risks of less than or equal to 3E-05 and hazards of less than or equal to 1E+00 for any target organ for all receptors and exposure scenarios evaluated.

8.4.2 Area B

Based on the RGs identified for Area B (Table 8-2), Figure 8-3 shows the approximate area (17,870 ft^2) and in place volume of soil (5,114 BCY) to be addressed by corrective measures where one or more COCs have been detected at concentrations above RGs. The total 17,870 ft^2 area with an average depth of removal of 6 ft bgs includes two areas (3,640 ft^2 and 750 ft^2) with an average depth of removal of 13 ft bgs. Approximate average soil depths (bgs) and the volume of in-place soil that will be addressed by the corrective measures are also shown on Figure 8-3.

A residual human health risk assessment associated with the site after completion of the proposed corrective measure is provided in Appendix G.2., Tables G.2-3a through G.2-3k. A table listing the samples used in the residual risk assessment is provided in Appendix G.2, Table G.2-3a. The residual risk assessment was completed for chemicals identified as site-related COCs for which RGs were calculated (Table 8-2) and chemicals identified as COPCs in the residual risk screenings (Appendix G.2, Tables G.2-3b and G.2-3c) with the exception of metals. With regard to metals (with the exception of lead), metals were not identified as COCs in soil for Area B when taking background and target organs into consideration; therefore, metals were not included in the residual risk assessment. The lead RG for soil of 400 mg/kg is considered protective for residential scenario; therefore, further risk assessment of residual lead in soil at the site is not warranted. As presented on Table 8-3, the residual risk assessment resulted in risks of less than1E-05 and hazards of less than or equal to less and 1E+00 for any target organ for all receptors and exposure scenarios evaluated.

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Legend

- Approximate SWMU Boundary
- Soil Boring Location
- Remedial Boundary
- 6 ft/14 ft Estimated Average Depth of Removal
- BCY Bank Cubic Yards

Figure 8-1

Area A - Remedial Boundaries for Soil

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig8-1 A Rem Bound

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N

1720

AREA B

AREA A

Perimeter Fence

New River

54MW1

54MW2

54MW3

54MW4

54MW5

54MW6

54MW7

54MW8

54MW9

54MW10

Chemical	Units	RG	54MW6				
			3/3/03	11/29/06	3/27/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	<0.54 U	<1.84 U	<0.036 U	<0.08 U	0.1 J
2,4,6-TNT	ug/L	7.82	<0.43	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	<0.61	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW4				
			3/4/03	11/30/06	3/27/07	6/5/07*	9/19/07
Perchlorate	ug/L	10.9	<0.54 U	<1.84 U	<0.036 U	<0.08 U	<0.2 U
2,4,6-TNT	ug/L	7.82	<0.55	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	<0.79	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW7				
			3/4/03*	12/5/06	3/27/07	6/5/07	9/19/07*
Perchlorate	ug/L	10.9	<0.54 U	<1.84 U	<0.036 U	<0.08 U	<0.2 U
2,4,6-TNT	ug/L	7.82	<0.487	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	<0.701	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW9				
			12/21/04	12/1/06	3/27/07	6/5/07	9/18/07
Perchlorate	ug/L	10.9	0.21 B	<1.84 U	0.24	0.23	<0.2 U
2,4,6-TNT	ug/L	7.82	<0.0794 U	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	0.465	ND
RDX	ug/L	6.1	1.1 ,J,g	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW3				
			3/4/03	12/5/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	59.2	<1.84 U	<0.036 U	0.88	0.31
2,4,6-TNT	ug/L	7.82	38	0.85 J	<0.1 U	1 J	1.2 J
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	32	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW8				
			12/21/04	12/1/06	3/27/07	6/5/07	9/18/07
Perchlorate	ug/L	10.9	0.22 B	<1.84 U	0.26	0.7	0.37
2,4,6-TNT	ug/L	7.82	<0.0794 U	<0.075 U	14	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	0.2 J,J,g	<0.16 U	8.1	6.3	<5 U

Chemical	Units	RG	54MW1				
			3/4/03	11/29/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	NS	<1.84 U	<0.036 U	<0.08 U	<0.2 U
2,4,6-TNT	ug/L	7.82	NS	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	NS	ND	ND	ND	ND
RDX	ug/L	6.1	NS	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW5				
			3/4/03	11/29/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	1.6	<1.84 U	0.52	0.58	0.34
2,4,6-TNT	ug/L	7.82	<0.43 U	0.29 J	0.84 J,J,g	0.49 J	0.38 J,J,g
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	<0.61 U	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW2				
			3/4/03	11/29/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	12	<1.84 U	3.6	2	0.57
2,4,6-TNT	ug/L	7.82	<0.365 U	5.6	0.25 J,J,d	3.9 J	0.78 J
DNT Mixture	ug/L	0.932	ND	ND	1.146	ND	ND
RDX	ug/L	6.1	<0.526 U	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW10				
			12/21/04*	12/1/06	3/27/07*	6/5/07	9/18/07
Perchlorate	ug/L	10.9	9.45	<1.84 U	2.9	0.37	2.9
2,4,6-TNT	ug/L	7.82	63.5	2.1 J	6.018	2.4 J	17
DNT Mixture	ug/L	0.932	ND	ND	0.898	ND	0.696
RDX	ug/L	6.1	28.5	3.3 J	3.87	1.6 J	8

Approximate Lateral Extent of Impacted Groundwater to be Addressed by Corrective Measures (2007)

0 100'

1 inch = 100 feet

Legend

- Approximate SWMU Boundary
- Monitoring Well Location (MW)
- ug/L Micrograms per Liter
- < Less than Sample Method Detection Limit
- Exceeds Adjusted Remedial Goal (RG)
- ND Non-Detect for Mixture
- NS Not Sampled

* Duplicate Average Result
See Tables 4-5 and 4-11 for flag definitions

FIGURE 8-2

Groundwater Area to be Addressed by Corrective Measures

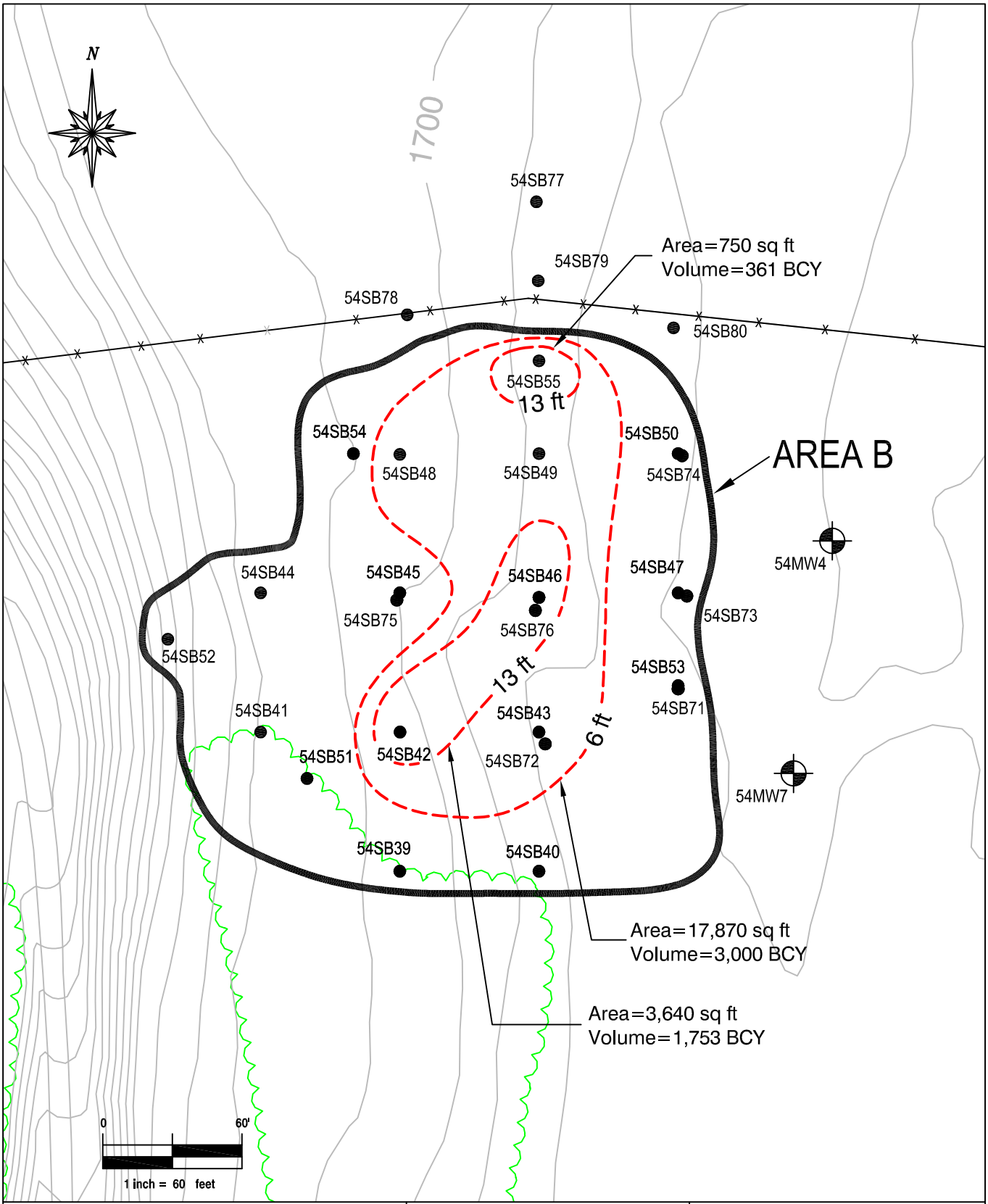
Date: January 2008	URS Project #: 21354893
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 100 feet	File Name: Fig.8-2 Corr. Meas.

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Legend

- Approximate SWMU Boundary
- Soil Boring Location
- Remedial Boundary
- 6 ft/13 ft — Estimated Average Depth of Removal
- BCY — Bank Cubic Yard

Figure 8-3

Area B - Remedial Boundaries for Soil

Date: April 2007	URS Project #: 21355035
Prepared by: DBC	Approved by: CLD
Scale: 1 inch = 60 feet	File Name: Fig8-3 B Rem.Bound

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Table 8-1
Remedial Goals - Area A
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Chemical of Interest	Groundwater RG (mg/L)	Groundwater RG Source[3]	Area A - Soil RG (mg/kg)	Soil RG Source
2,4,6-TNT	0.00782	RG	1.7	SSL[4]
DNT Mixture	0.000932	RG	0.044 or Lab RL (if higher)	SSL[4]
RDX	0.0061	RG	0.161 (not detected in soil)	SSL[4]
Perchlorate	0.0109	RG	--	--
Amino DNTs[1]	--	--	1.095	SSL[5]
Nitroglycerin[2]	--	--	0.069 or Lab RL (if higher)	SSL[5]
Heptachlor Epoxide[2]	--	--	0.0047	SSL[5]
2,3,7,8-TCDD (TEQ) [1]	--	--	7.89E-06	SSL[5]

Notes:

AL = Action Level
TNT = Trinitrotoluene
DNT = Dinitrotoluene
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazacyclohexane
TCDD = Tetrachlorodibenzodioxin
mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter
RG = Remedial Goals

(1) =Not identified as COPC in GW

(2) =Not detected in groundwater

(3) = The lowest of calculated carcinogenic and noncarcinogenic groundwater RGs used (see Appendix G.1, Table G.1-1c) Carcinogenic and noncarinogenic RGs values for groundwater COCs (2,4,6-TNT, DNT Mixture, RDX, and perchlorate) calculated using target risk 1E.-05 for the lifetime resident (see Appendix G.1 Table G.1-1c) and a target hazard of 1 for the adult and child resident (see Appendix G.1 Table G.1-1b)

(4) = Soil SSL RG values for soil-to-groundwater migration pathway calculated with SSL equation using groundwater RGs as target groundwater concentrations (See Tables G.1-2a - G.1-2c)

(5) = Soil SSL RG values for soil-to-groundwater migration pathway calculated with SSL equation using T-RBCs as target groundwater concentrations (See Tables G.1-2d - G.1-2g)

Table 8-2
Remedial Goals - Area B
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Chemical of Interest	Area B - Soil RG (mg/kg)	Soil RG Basis
2,4,6-TNT [2]	1.45	SSL[4]
DNT Mixture [2]	0.037 or Lab RL (if higher)	SSL[4]
RDX [2]	0.134	SSL[4]
Amino DNTs[2]	0.912	SSL[5]
Nitroglycerin[2]	0.057 or Lab RL (if higher)	SSL[5]
Lead[1,3]	400	AL
Aroclor 1254 [2]	0.25	SSL[5]
Heptachlor Epoxide[2]	0.0039	SSL[5]
Dieldrin [2]	0.00446	SSL[5]
2,3,7,8-TCDD (TEQ) [1]	6.57E-06	SSL[5]

Notes:

AL = Action Level
TNT = Trinitrotoluene
DNT = Dinitrotoluene
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazacyclohexane
TCDD = Tetrachlorodibenzodioxin
mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter
RG = Remedial Goals
T-RBC = Tap Water RBC (USEPA, October 2007)

[1] =Not identified as COPC in GW

[2] =Not detected in groundwater

[3] = Lead criteria are Action Levels; see USEPA Region III guidance

[4] = SSL RG values for soil-to-groundwater migration pathway calculated with SSL equation using calculated GW RGs for 2,4,6-TNT, DNT Mixture, and RDX from Area A as target groundwater concentrations (See Tables G.2-2a - G.2-2c)

[5] = Soil SSL RG values for soil-to-groundwater migration pathway calculated with SSL equation using T-RBCs as target groundwater concentrations (See Tables G.2-2d - G.2-2i)

Table 8-3
Calculated Residual Risk Post-Corrective Measures
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Area A	**Risk**			**Hazard**		
	Soil	GW	Total	Soil	GW	Total
Maintenance Worker	3.E-08	--	3.E-08	1.E-03	--	1.E-03
Commercial Worker	3.E-07	5.E-06	6.E-06	3.E-03	5.E-01	5.E-01
Future Construction Worker	8.E-08	2.E-09	8.E-08	2.E-02	3.E-02	5.E-02
Future Adult Resident	9.E-07	1.E-05	2.E-05	9.E-03	1.E+00	1.E+00
Future Child Resident	3.E-06	9.E-06	1.E-05	8.E-02	3.E+00	3.E+00*
Future Lifetime Resident	4.E-06	2.4E-05	3.E-05	--	--	--

Area B	**Risk**			**Hazard**		
	Soil	GW	Total	Soil	GW	Total
Maintenance Worker	1.E-07	--	1.E-07	5.E-03	--	5.E-03
Commercial Worker	4.E-07	--	4.E-07	1.E-02	4.E-02	5.E-02
Future Construction Worker	1.E-07	--	1.E-07	3.E-02	6.E-03	4.E-02
Future Adult Resident	1.E-06	--	1.E-06	3.E-02	1.E-01	1.E-01
Future Child Resident	3.E-06	--	3.E-06	2.6.E-01	2.7.E-01	5.E-01
Future Lifetime Resident	4.E-06	--	4.E-06	--	--	--

Notes:
GW = Groundwater
* No target organ HI>1
See Appendix G.1, Tables G.1-3a through G.1-3.k, for Residual Risk Calculations for Area A
See Appendix G.2, Tables G.2-3a through G.2-3.k, for Residual Risk Calculations for Area B

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9.0 IDENTIFICATION AND SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES

In this section, corrective measures technologies are identified based on their potential applicability to site conditions, COCs, CMOs, and RGs. Each of these technologies is screened based on their expected effectiveness, implementability, and cost as described below:

- **Effectiveness** – with primary consideration of the ability of the technology to meet CMOs, RGs, and be protective of human health and the environment;
- **Implementability** – with primary consideration for the technical and administrative feasibility, and availability of necessary equipment and personnel for implementation; and
- **Cost** – including both capital and present value of operation and maintenance (O&M) costs, as applicable.

Screening of the technologies is presented in Table 9-1. This table briefly describes the technologies and evaluations based on their expected effectiveness, implementability, and relative cost. Key advantages, disadvantages, and/or limitations of each alternative are also identified in this table. Technologies identified and screened for this CMS include:

- Soil excavation and offsite disposal;
- Exsitu onsite biological treatment of soil – composting;
- Onsite solidification/stabilization of soil (exsitu or *in situ*);
- Monitored natural attenuation (MNA) of groundwater; and
- Enhanced in situ bioremediation of groundwater.

The results of the screening indicate that no single technology would be effective in addressing all media and CMOs, and therefore, a combination of soil and groundwater technologies has been retained to develop corrective measure alternatives including:

- Soil excavation and offsite disposal;
- Monitored Natural Attenuation of groundwater; and
- Enhanced *in situ* bioremediation of groundwater.

Corrective measure alternatives are developed and evaluated in Section 10.0.

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Table 9-1
Identification and Screening of Corrective Measures Technologies
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Technology	Description	Effectiveness	Implementability	Relative Cost	Retained for CMA Development
Soil Excavation and Off-Site Disposal	Soil containing COI concentrations above remedial goals are excavated and transported to a permitted treatment and disposal facility or facilities.	• Effective at achieving CMOs and remedial goals for soil. • Effective at dealing with mixed site waste containing lead explosives, dioxins (hazardous and non-hazardous). • Removes release sources. • Lead in Area B hotspot may require stabilization at disposal facility before landfilling.	• Well proven and readily implementable technology. • Relatively short time for implementation and completion. • Beneficial results would be achieved immediately after completion of excavation as source areas would be removed and CMOs and remedial goals achieved. • Administratively feasible and routine in terms of requirements. Could be conducted as an interim measure under existing permit. • Can be implemented without special waste management permits. Appropriate health and safety measures and onsite controls will be required for implementation. • Will require county approval of an erosion and sediment control plan for land disturbance.	Medium to High	Yes
Exsitu Biological Treatment - Soil Composting	Soil is mixed exsitu with bulking agents and organic amendments, such as wood chips, animal, and vegetative wastes, to enhance the porosity of the mixture to be decomposed. Compost is typically placed in long piles known as windrows and periodically mixed with mobile equipment.Maximum degradation efficiency is achieved through maintaining oxygenation (e.g., daily windrow turning), irrigation as necessary, and closely monitoring moisture content, and temperature.	• May be difficult to achieve some remedial goals for explosives. • Will not effectively treat soil at Area B containing lead, dioxins, or PCBs. • Combining this technology with other technologies to treat soil onsite is not expected to be technically practicable or cost effective.	• Personnel and equipment are available for implementation. • Implementation will require a larger land area than is available at immediate site area. • Implementation is administratively feasible but would likely require a permit for onsite waste treatment/management; thereby increasing cost and implementation time. • Will require county approval of an erosion and sediment control plan for land disturbance. • Composting will generate significant excess material than required for site backfill. • May require long-term monitoring and maintenance.	Medium	No
Onsite Solidification of Soil	Solidification is a physical treatment that adds a reagent to transform liquid, sludge, sediment, or soil into a solid form. Solidication immobilizes the contaminants within the crystalline structure of the solidified material. A variety of methods can be used to conduct solification *in situ* (caisson/cutting heads) and exsitu onsite.	• Will effectively immobilize lead in soil. • Less effective treatment method for explosives. • Does not remove source of release to groundwater. • Combining this technology with other technologies to treat soil onsite is not expected to be practicable or cost effective.	• Personnel and equipment are available for implementation. • Implementation will likely require a larger land area than is available at immediate site area. • Implementation is administratively feasible but would likely require a permit for onsite waste treatment/management; thereby increasing cost and implementation time. • Will require county approval of an erosion and sediment control plan for land disturbance. • Would require land use controls and long-term monitoring and maintenance.	Medium to High	No

Table 9-1
Identification and Screening of Corrective Measures Technologies
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Technology	Description	Effectiveness	Implementability	Relative Cost	Retained for CMA Development
Monitored Natural Attenuation of Groundwater	Relies on natural subsurface processes in groundwater, such as dilution, dispersion, volatilization, biodegradation, adsorption, and chemical reactions with subsurface materials to reduce constituent concentrations to levels below remedial goals. Performance groundwater monitoring is required to confirm the effectiveness including achievement and maintenance of remedial goals. Usually implemented in combination with other technologies that address any continuing sources of releases.	• There is evidence of natural attenuation occuring at site after completion of significant source removal in 1999. Explosives and perchlorate concentrations have significantly declined since RFI monitoring began in 2003. • As of the June 2007 sampling event, perchlorate and 2,4,6-TNT concentrations had decreased to levels below remedial goals. • As of the June 2007 sampling event, DNT concentrations were below remedial goals with the exception of 1 well, where the DNT level was slightly above the remedial goal. • As of June 2007, RDX concentrations were below remedial goals with the exception of 1 well. The maximum RDX concentration has decreased from 32 ppb in 2000 to 6.3 ppb in June 2007. • 2,4,6-TNT breakdown to daughter products has been observed. • Sampling of the groundwater/surface water interface did not indicate adverse impacts to sediment or surface water from explosives and perchlorate in groundwater. • Long-term monitoring indicates that dilution and mixing are likely important attenuation processes at the site because the plume area between the disposal unit and the river is a mixing zone for site groundwater and water from New River, which often inflows into this area due to frequent upstream dam releases.	• Well proven and readily implementable technology. • Short time for implementation. • Beneficial results are already being achieved. • Achievement of remedial goals should occur within 5 years. • Administratively feasible and routine in terms of requirements. Could be conducted as an interim measure under existing permit. • Can be implemented without special waste management permits. Appropriate health and safety measures and work procedures will be required for implementation.	Low	Yes
Enhanced *In Situ* Bioremediation of Groundwater	Involves the injection of a slow release organic carbon substrate, such as HRC or emulsified oil, into the groundwater to form a continuous anerobic biobarrier zone where TNT, RDX, and perchlorate would be degraded via reductive processes. Performance monitoring is required to verify effectiveness of treatment.	• Field tests with emulsified oils have shown effective treatment of perchlorate. • TNT and RDX are readily degraded under anaerobic conditions. • Laboratory tests and limited field testing indicate that enhanced *in situ* bioremediation of TNT and RDX should be feasible. • Dissolved organic reactive zone typically has limited downgradient migration from treatment area (50 ft or less). Degradation of secondary water quality parameters, such BOD, COD, TSS, and sulfide may occur in this zone. The mobility of some naturally occuring metals such as iron, manganese, and arsenic may be increased in the treatment zone. In naturally aerobic aquifers such as at the site, groundwater typically returns to near background conditions within a relatively short distance. • Can be used to enhance natural attenuation processes occuring at a site or as a contingency if monitored natural attenuation does not perform as expected. • Can potentially generate methane in vadose zone.	• Personnel and equipment are available for implementation. • Implementation is administratively feasible but may require a permit for groundwater injection and studies to demonstrate that adverse impacts to the New River would not occur. • Treatability/pilot testing would be required before final design and implementation. • Will require water source for injection.	Medium to High	Yes

10.0 DEVELOPMENT OF CORRECTIVE MEASURE ALTERNATIVES

Based on the identification and screening process conducted in Section 9.0, corrective measure technologies are combined into alternatives to be evaluated in the CMS. As part of the development of these alternatives, initial evaluations were conducted to compare implementation of an additional corrective measure alternative that addressed identified risks associated with current and future industrial land use scenarios at the site to Alternative Nos. Two and Three, which in addition to the identified industrial risks also address identified risks associated with the soil-to-groundwater pathway and groundwater (Appendix G.4). These evaluations indicated that the estimated cost expressed as net present value (NPV) of implementing an industrial based alternative ($4,283,921) was approximately 11% higher than the implementing Alternative No. Two ($3,800,027) and less than 1% percent higher than implementing Alternative No. Three ($4,269,622). The difference in cost between the industrial based alternative and the other alternatives was related to leaving waste in place at concentrations that would require long-term monitoring and maintenance beyond the period of remedy implementation for Alternative Nos. Two and Three. Based on this initial evaluation, the alternative based only on addressing industrial risk in soil was not carried forward as a corrective measures alternative for further evaluation in the CMS. The following corrective measures alternatives have been developed to meet the CMOs and RGs identified for Area A and Area B:

- Alternative No. 1: No Further Action;
- Alternative No. 2: Excavation of Soil at Area A and Area B, Offsite Disposal, and Monitored Natural Attenuation (MNA) of Groundwater; and
- Alternative No. 3: Excavation of Soil at Area A and Area B, Offsite Disposal, and Enhanced *In Situ* Bioremediation of Groundwater.

Corrective measures alternatives are described in the following sections.

10.1 ALTERNATIVE ONE – NO FURTHER ACTION

The No Further Action Alternative will be used as a baseline to measure the performance of the other alternatives.

10.2 ALTERNATIVE TWO – EXCAVATION OF SOIL, OFFSITE DISPOSAL, AND MONITORED NATURAL ATTENUATION OF GROUNDWATER

Elements of this alternative for soil and groundwater are described in the following sections.

10.2.1 Soil Excavation

Area A

Under this alternative, soil at Area A with concentrations above soil-to-groundwater RGs for explosives, heptachlor epoxide, and dioxins will be excavated and transported to an offsite landfill. Based on RFI soil data, it is anticipated that excavated soil will be non-hazardous waste; however, a limited area of soil in the area of sample location 54SB27A has the potential to exhibit a 2,4-DNT TCLP concentration above the regulatory threshold of 0.13 mg/L based a total concentration in one surface soil sample of 17 mg/kg (more than 20 times the TCLP limit). Waste characterization testing will be conducted to appropriately characterize material and develop waste profiles for disposal as non-hazardous or hazardous waste.

Soil at Area A will be excavated from the approximate 12,100 ft^2 area shown on Figure 8-1. Based on the assumed depths shown on Figure 8-1, the in place volume of soil to excavated is approximately 3,496 BCY or approximately 4,894 tons based on an estimated soil density of 1.4 tons/yd^3 (based on site-specific physical soil data). For purposes of cost estimating, the following soil excavation quantities and waste types have been assumed at Area A:

- Non-hazardous waste – 4,614 tons of soil containing 2,4,6-TNT and DNT mixture, with 2,4-DNT levels below the TCLP threshold of 0.13 mg/L; and
- D030 characteristic waste (2,4-DNT) – 280 tons from a 30 x 30 x 6 ft area encompassing sample location 54SB27 with 2,4-DNT levels above the TCLP threshold of 0.13 mg/L.

Area B

Under this alternative, soil at Area B with lead concentrations above the RG and other COC concentrations above soil-to-groundwater RGs will be excavated and transported to an offsite landfill. Based on RFI soil data, it is anticipated that excavated soil within the lead "hot spot" area will be hazardous waste based on lead (D008) and 2,4-DNT concentrations (D030). Soil excavated areas outside of the lead "hot spot" area will likely be non-hazardous waste. Waste characterization testing will be conducted to appropriately characterize material and develop waste profiles for disposal as non-hazardous or hazardous waste.

Soil at Area B will be excavated from the approximate 17,870 ft^2 area shown on Figure 8-3. Based on the assumed depths shown on Figure 8-3, the in place volume of soil to excavated is approximately 5,114 BCY or approximately 7,160 tons based on an estimated soil density of 1.4 tons/yd^3 (based on site-specific physical soil data). For purposes of cost estimating, the following soil excavation quantities and waste types have been assumed for Area B:

- Non-hazardous waste – 5,383 tons of soil containing primarily explosives and dioxins; and
- Hazardous waste – 1,777 tons of D008 characteristic waste (lead) with approximately 1,250 tons of this soil also exhibiting a D030 characteristic due to 2,4-DNT concentrations.

Work Plan

A site-specific work plan will be prepared for soil excavation and site restoration activities, which will include plans and specifications for excavation, waste characterization, transportation, and disposal, decontamination, confirmatory sampling, erosion and sediment control, backfilling, and site restoration, QA requirements and procedures, and a health and safety. The work plan will be submitted to the USEPA and VDEQ for approval prior to remedy implementation.

Site Setup

Site set-up for excavation activities will include:

- Mobilizing equipment and personnel;
- Construction of two-lane access roads in both Area A and Area B to support the truck traffic required to transport the excavated material to offsite disposal facilities. The access roads are conceptually planned to be 30-ft wide and will be constructed of Virginia Department of Transportation (VDOT) 21-A stone;
- Construction of a decontamination station including installing a high density polyethylene liner, a sump to collect liquid and a tank to contain decontamination water;
- Setup of sediment and erosion control measures including the installation of super silt fence (filter cloth installed on a chain link fence backing installed in a shallow trench) around the limits of the areas to be excavated; and
- Preparation of staging areas.

Excavation

Conventional earthmoving equipment, such as loaders and excavators, will excavate the soil and directly load it into trucks for offsite transport and disposal. Trucks will be weighed and manifested before

leaving the site. A water truck will also be required for dust suppression during excavation activities. Water required for decontamination will be trucked to the site and stored in an aboveground tank at the decontamination station.

Confirmatory Soil Sampling

Any uncertainties associated with the precise limits of COCs with concentrations above RGs, such as heptachlor epoxide and 2,3,7,8-TCDD, as identified in the Sections 4.0, 5.0, and 8.0, will be addressed during remedy implementation by confirmatory soil sampling. Confirmatory soil sampling will be conducted to define the precise limits of the excavation and remedial area and verify that the lateral and vertical extent of soil with COC concentrations above RGs is removed. Samples will be collected from base and sidewalls of the excavation. The anticipated confirmatory soil sampling program is outlined in Table 10-1.

Description of Remediation Waste

Corrective measures activities are expected to generate the following remediation waste and IDM:

- Approximately 9,997 tons of non-hazardous soil containing explosives, dioxins, pesticides, and PCBs;
- Approximately 2,057 tons of hazardous soil including: 1,777 tons of D008 waste (lead) and 280 tons of D030 (2,4-DNT) waste. Approximately 1,250 tons of the D008 waste is also expected to be characterized as D030 waste; and
- Approximately 2,500 gallons of decontamination water.

Waste Characterization

Soil samples for waste characterization will be collected prior to soil excavation. It is assumed that one composite sample will collected for each 200 BCY of material for analysis of RCRA waste characteristics. Planned waste characterization analysis is outlined in Table 10-2.

Waste Transportation and Disposal

The remediation contractor and Installation will select the final disposal facility for the waste based on the following:

- TSDF capacity to accommodate incoming waste;
- Solicitation of bids using Federal Acquisition Regulations;
- Verification of permits and insurance; and
- The disposal facility must meet the permit compliance requirements.

Site Restoration

Once the excavation is completed, the area will be backfilled with clean fill to a grade consistent with the surrounding terrain. The fill will be compacted in 6 to 8-inch lifts to within 6-inches of finished grade. Approximately 6-inches of topsoil will then be placed and the site will be final graded. Erosion and sediment controls will be implemented and excavation areas will be seeded.

Health and Safety

Health and safety measures will be implemented to protect on-site workers during excavation activities. For cost-estimating purposes, modified Level D PPE and decontamination equipment has been assumed.

10.2.2 Monitored Natural Attenuation of Groundwater

Performance monitoring of groundwater will be coupled with the source removal actions described at both disposal units to verify the following:

- The effectiveness of source removal actions conducted previously in 1999 and source removal actions to be conducted under this alternative;
- Continued decreases in dissolved phase COC concentrations in groundwater to attain proposed RGs; and
- Impacts to the New River from site groundwater continue to be "de minimus" as characterized in the RFI.

A performance monitoring plan will be developed that specifies the locations, frequency, and type of samples necessary to evaluate whether the remedy is performing as expected and whether it is capable of achieving RGs. The monitoring program will be designed to:

- Demonstrate the natural attenuation is occurring as expected;
- Detect changes in environmental conditions that could reduce the efficacy of natural attenuation processes;
- Identify toxic and/or mobile transformation products;
- Verify that plume is not expanding;
- Verify that impacts to the New River are minimal;
- Demonstrate the effectiveness of any controls implemented; and
- Verify attainment of CMOs and RGs.

The performance monitoring will continue until CMOs and RGs have been achieved and maintained for three years. Proposed performance monitoring locations and sampling frequency are identified in Table 10-3. Figure 10-1 shows the proposed monitoring locations.

Additional information on performance monitoring program parameters and anticipated data use is summarized in Table 10-4.

Performance Groundwater Monitoring Plan

A performance groundwater-monitoring plan will be developed that specifies the locations, frequency, and type of samples necessary to evaluate whether the remedy is performing as expected and whether it is capable of achieving RGs. This plan will also outline reporting requirements and frequency. Contingencies will be identified in the plan should the remedy not perform as expected, which would include as one option, implementation of elements contained in Alternative Three to provide for enhanced bioremediation of groundwater in area or areas where the remedy is not performing as expected. The monitoring plan will be submitted to the USEPA and VDEQ for approval prior to remedy implementation.

Performance Monitoring Well Installation

Two additional monitoring wells (54MW11 and 54MW12) will be installed for performance monitoring between the disposal unit point-of-compliance wells at Area A (54MW2 and 54MW3) and downgradient wells 54MW8 and 54MW10 located adjacent to the New River (Figure 10-1). Another two monitoring wells (54MW13 and 54MW14) will be installed south and north of the disposal unit, respectively (Figure 10-1). Note that monitoring well 54MW13 is proposed in the area south of monitoring well 54MW10, which was an identified data gap in the nature and extent assessment for explosives in groundwater. Monitoring wells will be constructed to monitor the same uppermost zone of groundwater as existing

monitoring wells. The combined network of wells will allow for more complete monitoring throughout the plume area.

Description of Remediation Waste

MNA of groundwater is expected to generate the following IDM:

- Approximately fourteen 55-gallon drums of non-hazardous soil from monitoring well installation;
- Approximately seven 55-gallon drums of decontamination and well development water from monitoring well installation;
- Approximately two 55-gallon drums of PPE from monitoring well installation; and
- Approximately one 55-gallon drum of purge water for each sampling event.

Waste Characterization

Planned waste characterization analysis for the monitoring well related IDM is outlined in Table 10-2. Previous waste characterization data (including pH and COD) and existing groundwater sample data will be used to characterize purge water prior to disposal in the RFAAP wastewater treatment plant.

Waste Transportation and Disposal

The remediation contractor and Installation will select the final disposal facility for the waste based on the following:

- Treatment, storage, and disposal facility capacity to accommodate incoming waste;
- Solicitation of bids using Federal Acquisition Regulations;
- Verification of permits and insurance; and
- The disposal facility must meet the permit compliance requirements.

10.3 ALTERNATIVE THREE – EXCAVATION OF SOIL, OFFSITE DISPOSAL, AND *IN SITU* BIOREMEDIATION OF GROUNDWATER

Elements of this alternative for soil and groundwater are described in the following sections. The soil excavation component described below is the same as outlined in Alternative Two.

10.3.1 Soil Excavation

Area A

Under this alternative, soil at Area A with concentrations above soil-to-groundwater RGs for explosives, heptachlor epoxide, and dioxins will be excavated and transported to an offsite landfill. Based on RFI soil data, it is anticipated that excavated soil will be non-hazardous waste; however, a limited area of soil in the area of sample location 54SB27A has the potential to exhibit a 2,4-DNT TCLP concentration above the regulatory threshold of 0.13 mg/L based a total concentration in one surface soil sample of 17 mg/kg (more than 20 times the TCLP limit). Waste characterization testing will be conducted to appropriately characterize material and develop waste profiles for disposal as non-hazardous or hazardous waste.

Soil at Area A will be excavated from the approximate 12,100 ft^2 area shown on Figure 8-1. Based on the assumed depths shown on Figure 9-1, the in place volume of soil to excavated is approximately 3,496 BCY or approximately 4,894 tons based on an estimated soil density of 1.4 $tons/yd^3$ (based on site-specific physical soil data). For purposes of cost estimating, the following soil excavation quantities and waste types have been assumed at Area A:

- Non-hazardous waste – 4,614 tons of soil containing 2,4,6-TNT and DNT mixture, with 2,4-DNT levels below the TCLP threshold of 0.13 mg/L; and

- D030 characteristic waste (2,4-DNT) – 280 tons from a 30 x 30 x 6 ft area encompassing sample location 54SB27 with 2,4-DNT levels above the TCLP threshold of 0.13 mg/L.

Area B

Under this alternative, soil at Area B with lead concentrations above the RG and other COC concentrations above soil-to-groundwater RGs will be excavated and transported to an offsite landfill. Based on RFI soil data, it is anticipated that excavated soil within the lead "hot spot" area will be hazardous waste based on lead (D008) and 2,4-DNT concentrations (D030). Soil excavated areas outside of the lead "hot spot" area will likely be non-hazardous waste. Waste characterization testing will be conducted to appropriately characterize material and develop waste profiles for disposal as non-hazardous or hazardous waste.

Soil at Area B will be excavated from the approximate 17,870 ft^2 area shown on Figure 8-2. Based on the assumed depths shown on Figure 8-3, the in place volume of soil to excavated is approximately 5,114 BCY or approximately 7,160 tons based on an estimated soil density of 1.4 tons/yd^3 (based on site-specific physical soil data). For purposes of cost estimating, the following soil excavation quantities and waste types have been assumed for Area B:

- Non-hazardous waste – 5,383 tons of soil containing primarily explosives and dioxins; and
- Hazardous waste – 1,777 tons of D008 characteristic waste (lead) with approximately 1,250 tons of this soil also exhibiting a D030 characteristic due to 2,4-DNT concentrations.

Work Plan

A site-specific work plan will be prepared for soil excavation and site restoration activities, which will include plans and specifications for excavation, waste characterization, transportation, and disposal, decontamination, confirmatory sampling, erosion and sediment control, backfilling, and site restoration, QA requirements and procedures, and a health and safety. The work plan will be submitted to the USEPA and VDEQ for approval prior to remedy implementation.

Site Setup

Site set-up for excavation activities will include:

- Mobilizing equipment and personnel;
- Construction of two-lane access roads in both Area A and Area B to support the truck traffic required to transport the excavated material to offsite disposal facilities. The access roads are conceptually planned to be 30-ft wide and will be constructed of VDOT 21-A stone;
- Construction of a decontamination station including installing a high density polyethylene liner, a sump to collect liquid and a tank to contain decontamination water;
- Setup of sediment and erosion control measures including the installation of super silt fence (filter cloth installed on a chain link fence backing installed in a shallow trench) around the limits of the areas to be excavated; and
- Preparation of staging areas.

Excavation

Conventional earthmoving equipment, such as loaders and excavators, will excavate the soil and directly load it into trucks for offsite transport and disposal. Trucks will be weighed and manifested before leaving the site. A water truck will also be required for dust suppression during excavation activities. Water required for decontamination will be trucked to the site and stored in an aboveground tank at the decontamination station.

Confirmatory Soil Sampling

Any uncertainties associated with the precise limits of COCs with concentrations above RGs, such as heptachlor epoxide and 2,3,7,8-TCDD, as identified in the Sections 4.0, 5.0, and 8.0, will be addressed during remedy implementation by confirmatory soil sampling. Confirmatory soil sampling will be conducted to define the precise limits of the excavation and remedial area and verify that the lateral and vertical extent of soil with COC concentrations above RGs is removed. Samples will be collected from base and sidewalls of the excavation. The anticipated confirmatory soil sampling program is outlined in Table 10-1.

Description of Remediation Waste

Corrective measures activities are expected to generate the following remediation waste and IDM:

- Approximately 9,997 tons of non-hazardous soil containing explosives, dioxins, pesticides, and PCBs;
- Approximately 2,057 tons of hazardous soil including: 1,777 tons of D008 waste (lead) and 280 tons of D030 (2,4-DNT) waste. Approximately 1,250 tons of the D008 waste is also expected to be characterized as D030 waste; and
- Approximately 2,500 gallons of decontamination water.

Waste Characterization

Soil samples for waste characterization will be collected prior to soil excavation. It is assumed that one composite sample will collected for each 200 BCY of material for analysis of RCRA waste characteristics. Planned waste characterization analysis is outlined in Table 10-2.

Waste Transportation and Disposal

The remediation contractor and Installation will select the final disposal facility for the waste based on the following:

- Treatment, storage, and disposal facility capacity to accommodate incoming waste;
- Solicitation of bids using Federal Acquisition Regulations;
- Verification of permits and insurance; and
- The disposal facility must meet the permit compliance requirements.

Site Restoration

Once the excavation is completed, the area will be backfilled with clean fill to a grade consistent with the surrounding terrain. The fill will be compacted in 6 to8-inch lifts to within 6-inches of finished grade. Approximately 6-inches of topsoil will then be placed and the site will be final graded. Erosion and sediment controls will be implemented and excavation areas will be seeded.

Health and Safety

Health and safety measures will be implemented to protect on-site workers during excavation activities. For cost-estimating purposes, modified Level D PPE and decontamination equipment has been assumed.

10.3.2 *In Situ* Bioremediation of Groundwater

Enhanced *in situ* bioremediation of groundwater will be coupled with the source removal actions described above for the Area A disposal unit to increase the rate of biological degradation of COCs in groundwater. Because the groundwater system in the area of the COC plume is aerobic, and the dominant biological pathway for the majority of the COCs (2,4,6-TNT, RDX, and perchlorate) is an anaerobic pathway the geochemical environment would require manipulation to produce the anaerobic state that is

required to remediate these COCs. To produce these conditions the *in situ* bioremediation remedy would require the injection of a readily digestible organic carbon substrate. Numerous substrates exist and are generally classified under soluble (sodium lactate) viscous or low viscosity (edible oil and edible oil emulsions, HRC) and solids. Sodium lactate is a readily digested organic carbon substrate that can be easily injected into the aquifer; however, it is not a long lasting substance and as such would require frequent re-injection events on a six to eight week frequency. Due to the costs of this treatment, the *in situ* bioremediation remedy for groundwater at Area A will use a slow release organic carbon substrate, which has a longer lasting effect; literature sources cite two to five years, as possible. Based on its ease of handling, injection, and ability to be diffused into the aquifer, which therefore reduces the number of required injection points, emulsified edible oil has been selected as the organic carbon substrate for the *in situ* bioremediation remedy. The edible oil emulsion injectate will consist of a stable emulsion of oil in water which is further diluted to an oil-to-water ratio of 10% by weight. This emulsion would be applied in an injection event. Following injection, the resulting biological activity would form a continuous anaerobic bio-barrier zone where the 2,4,6-TNT, RDX, and perchlorate would be degraded via reductive processes.

Two types of configurations can be used for injection: treatment across a source area or a permeable reactive barrier (PRB) configuration where a series of injection wells are installed perpendicular to groundwater flow. For the PRB configuration, groundwater moves through the treated zone under the natural hydraulic gradient, a portion of the trapped substrate dissolved providing a carbon and energy source to accelerate anaerobic degradation processes. Multiple barriers can be used to achieve higher removal efficiencies or reduce cleanup time for larger constituent plumes.

Because this enhanced *in situ* bioremediation process is anaerobic, groundwater quality could be negatively impacted by the implementation of an anaerobic ISB process. These negative impacts could include:

- Mobilization of metals, specifically iron and manganese;
- Increased biochemical oxygen demand (BOD) of the groundwater due to the elevated levels of dissolved organic carbon resulting from the carbon substrate; and,
- Trace concentrations of metabolic byproducts such as acetate, which can be viewed as degrading water quality.

Field Pilot Study

Due to the complexities and site specific nature of *in situ* bioremediation, a field pilot study would be conducted to verify that this technology is suitable to achieve CMOs and RGs for the site. It would also be used to determine the following:

- Required treatment zone width, which is the length of time the groundwater would need to be in the anaerobic zone to effect biological transformation/degradation of COCs;
- Optimum injection point spacing;
- Optimum location of the bio-barrier injection line relative to maximizing COC degradation, while not creating negative aesthetic impacts to the New River; and
- The width of the aerobic treatment zone (i.e., downgradient of anaerobic treatment zone) required to attenuate water quality impacts created in the anaerobic treatment zone.

A work plan will be developed for the field pilot test and will include: a site-specific data review, preliminary site screening for enhanced anaerobic degradation, proposed technical approach, field program, schedule, QA requirements and procedures, and a health and safety plan.

The *in situ* bioremediation pilot study would consist of the installation of one injection well (PTINJ), two monitoring wells (54MW11 and 54MW15), and eight pilot test monitoring points (54PT1 through 54PT8) as shown on Figure 10-2. Given the locations of existing monitoring wells 54MW3 and 54MW8, the area between these two wells would be ideally suited for the pilot test location. Using this area would allow the installation of the injection point and monitoring points between the existing wells allowing 54MW3 to function as an upgradient well and 54MW8 to function as a sentinel or compliance point well for determining whether natural processes have attenuated any aesthetic impacts created in the anaerobic treatment zone. The remaining wells would be installed in a grid to allow the evaluation of the lateral (cross gradient) dispersion of the treatment zone. The pilot study would likely extend over a three to four month period. Geochemical data would be collected on a weekly basis from the injection point, the 10 pilot study monitoring points, as well as existing monitoring wells 54MW3 and 54MW8 to determine the adequacy of the injection dosage, monitor the progress in developing the necessary geochemical environment in the barrier zone, and to monitor for potential secondary degradation of aesthetic properties of the groundwater near the New River. The monitoring events would be conducted using low purging and sampling with an in-line flow through cell to monitor geochemical parameters. During these monitoring events, field personnel would also monitor for the presence of any free-phase edible oil accumulation in the injection and monitoring points. The geochemical parameters which would be collected during these events include:

- Temperature;
- pH;
- Specific conductance;
- Dissolved oxygen;
- ORP; and
- Turbidity.

In addition to the weekly geochemical monitoring, the pilot study would include four groundwater sampling events. The sampling events would include a baseline sampling event which would be conducted prior to the injection of the emulsified oil substrate, at 6 weeks post injection, 10 weeks post injection, and 14 weeks post injection. The monitoring network would include all of the newly installed pilot-study injection and monitoring points as well as 54MW3 and 54MW8. The analytical parameters would include:

- Explosives;
- Perchlorate;
- TOC and dissolved inorganic carbon;
- Dissolved Ferrous Iron (Fe+2) and Dissolved Manganese (Mn+2) using field test methods;
- Nitrate (NO_3); and
- Sulfate (SO_4^{2-}).

Following completion of the pilot study, the data collected during the study would be used to prepare the full-scale design for the *in situ* bioremediation groundwater remedy.

System Design and Work Plan

A system design and work plan for implementation will be prepared based on the results of the pilot study and will include plans and specifications for the injection system, injection wells, performance monitoring plan, waste characterization, transportation, and disposal, decontamination, sampling, QA requirements

and procedures, health and safety plan, and site restoration plan. The work plan will be submitted to the USEPA and VDEQ for approval prior to remedy implementation.

Injection Point Installation

Injection points will be installed with screened intervals across the water table within the alluvium and extend into underlying weathered and fractured bedrock aquifer to address impacted groundwater. These points will be installed using air drilling techniques to penetrate into bedrock. For purposes of the CMS, it is assumed that injection wells will installed east and downgradient of the Area A disposal unit in a bio-barrier configuration with 15 ft injection point spacing. Figure 10-3 shows the 390 ft long bio-barrier wall configuration of 26 injection points, which would be required to address the full width of the dissolved phase plume. This wall extends north to south perpendicular to the direction of groundwater flow. An approximate 50 ft wide treatment zone is depicted on Figure 10-3 based on studies at other sites showing that the maximum extent of the dissolved organic reactive zone is 50 ft or less (Borden 2006). It is assumed that 2-inch diameter injection wells will be installed into bedrock to an average depth of 40 ft and have a 25 ft screened interval.

Emulsified edible oil Injection

Based on the available hydrogeologic, geochemical, and analytical data, and using the EOS® Barrier Design and the EOS® Emulsion Makeup Worksheets, the *in situ* bioremediation remedy is expected to require approximately 14,000 pounds of emulsified edible oil. A process flow diagram for the injection process is presented in Figure 10-4. The completed EOS design worksheet used for the calculations is included in Appendix G.4. The edible oil emulsion will be diluted to a 10% by weight solution with approximately 10,000 pounds or 1,330 gallons of diluted edible oil emulsion being injected into each of the 26 injection points. In order to distribute the emulsion throughout the aquifer, water is injected into each point following the emulsion solution. The remedy will require the location of an adequate source of water such as a fire hydrant or water tank filled by a remote water source. The emulsified oil is supplied in either 55-gallon drums, 300 gallon bulk shipping totes, and for large quantities, it can also be supplied in bulk by tanker truck. The edible oil emulsion would be mixed with the dilution water in an injection tank and then injected into aquifer via the injection points. This could be done a single point at a time, or if a sufficiently large injection tank can be mobilized multiple wells could be injected at one time.

Performance Monitoring of Groundwater

A performance monitoring plan will be developed that specifies the locations, frequency, and type of samples necessary to evaluate whether the remedy is performing as expected and whether it is capable of achieving RGs. This plan will also outline reporting requirements and frequency. The monitoring plan will be submitted to the USEPA and VDEQ for approval prior to remedy implementation.

The monitoring program will be designed to:

- Evaluate the substrate distribution after injection;
- Monitor emulsified oil performance and geochemical changes;
- Demonstrate that anaerobic degradation processes are reducing concentrations of explosives and perchlorate as intended;
- Detect changes in environmental conditions that could reduce the efficacy of bioremediation processes and other attenuation processes and require additional injection of emulsified edible oil;
- Identify toxic and/or mobile transformation products or other undesirable geochemical changes;
- Verify that the plume is not expanding;
- Verify that impacts to the New River are minimal; and
- Verify attainment of CMOs and RGs.

The performance monitoring will continue until CMOs and RGs have been achieved and maintained for three years. Proposed performance monitoring locations and sampling frequency are identified in Table 10-5. Figure 10-3 shows the proposed monitoring locations.

Four additional monitoring wells (54MW11, 54MW12, 54MW15, and 54MW16) will be installed for performance monitoring between the disposal unit point-of-compliance wells at Area A (54MW2 and 54MW3) and downgradient wells 54MW8 and 54MW10 located adjacent to the New River (Figure 10-2). Another two monitoring wells (54MW13 and 54MW14) will be installed south and north of the disposal unit, respectively (Figure 10-3). Monitoring wells will be constructed to monitor the same uppermost zone of groundwater as existing monitoring wells. The combined network of wells will allow for more complete monitoring throughout the plume area.

Description of Remediation Waste

Implementation of the enhanced *in situ* bioremediation groundwater remedy is expected to generate the following IDM:

- Approximately one hundred 55-gallon drums of non hazardous soil from installation of monitoring wells and injection points;
- Approximately fifty 55-gallon drums of decontamination and well development water from installation of monitoring wells and injection points;
- Approximately five 55-gallon drums of PPE from monitoring well installation; and
- Approximately one 55-gallon drum of purge water for each sampling event.

Waste Characterization

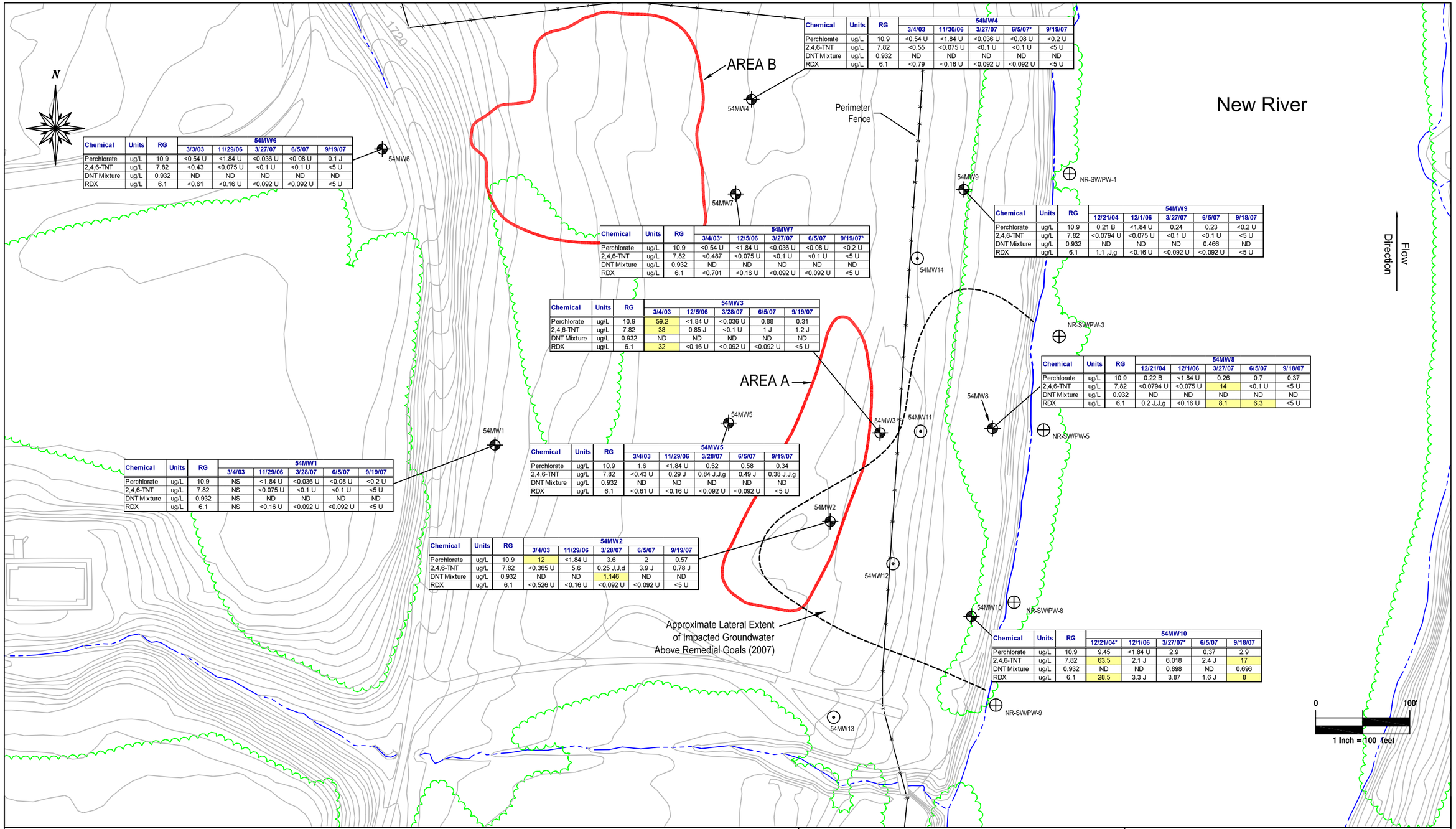
Planned waste characterization analysis for the monitoring well and injection point related IDM is outlined in Table 10-2. Previous waste characterization data (including pH and COD) and existing groundwater sample data will be used to characterize purge water prior to disposal in the RFAAP waste water treatment plant.

Waste Transportation and Disposal

The remediation contractor and Installation will select the final disposal facility for the waste based on the following:

- Treatment, storage, and disposal facility capacity to accommodate incoming waste;
- Solicitation of bids using Federal Acquisition Regulations;
- Verification of permits and insurance; and
- The disposal facility must meet the permit compliance requirements.

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Chemical	Units	RG	54MW4				
			3/4/03	11/30/06	3/27/07	6/5/07*	9/19/07
Perchlorate	ug/L	10.9	<0.54 U	<1.84 U	<0.036 U	<0.08 U	<0.2 U
2,4,6-TNT	ug/L	7.82	<0.55	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	<0.79	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW6				
			3/3/03	11/29/06	3/27/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	<0.54 U	<1.84 U	<0.036 U	<0.08 U	0.1 J
2,4,6-TNT	ug/L	7.82	<0.43	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	<0.61	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW7				
			3/4/03*	12/5/06	3/27/07	6/5/07	9/19/07*
Perchlorate	ug/L	10.9	<0.54 U	<1.84 U	<0.036 U	<0.08 U	<0.2 U
2,4,6-TNT	ug/L	7.82	<0.487	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	<0.701	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW3				
			3/4/03	12/5/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	59.2	<1.84 U	<0.036 U	0.88	0.31
2,4,6-TNT	ug/L	7.82	38	0.85 J	<0.1 U	1 J	1.2 J
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	32	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW5				
			3/4/03	11/29/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	1.6	<1.84 U	0.52	0.58	0.34
2,4,6-TNT	ug/L	7.82	<0.43 U	0.29 J	0.84 J,J,g	0.49 J	0.38 J,J,g
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	<0.61 U	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW1				
			3/4/03	11/29/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	NS	<1.84 U	<0.036 U	<0.08 U	<0.2 U
2,4,6-TNT	ug/L	7.82	NS	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	NS	ND	ND	ND	ND
RDX	ug/L	6.1	NS	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW2				
			3/4/03	11/29/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	12	<1.84 U	3.6	2	0.57
2,4,6-TNT	ug/L	7.82	<0.365 U	5.6	0.25 J,J,d	3.9 J	0.78 J
DNT Mixture	ug/L	0.932	ND	ND	1.146	ND	ND
RDX	ug/L	6.1	<0.526 U	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW9				
			12/21/04	12/1/06	3/27/07	6/5/07	9/18/07
Perchlorate	ug/L	10.9	0.21 B	<1.84 U	0.24	0.23	<0.2 U
2,4,6-TNT	ug/L	7.82	<0.0794 U	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	0.466	ND
RDX	ug/L	6.1	1.1 ,J,g	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW8				
			12/21/04	12/1/06	3/27/07	6/5/07	9/18/07
Perchlorate	ug/L	10.9	0.22 B	<1.84 U	0.26	0.7	0.37
2,4,6-TNT	ug/L	7.82	<0.0794 U	<0.075 U	14	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	0.2 J,J,g	<0.16 U	8.1	6.3	<5 U

Chemical	Units	RG	54MW10				
			12/21/04*	12/1/06	3/27/07*	6/5/07	9/18/07
Perchlorate	ug/L	10.9	9.45	<1.84 U	2.9	0.37	2.9
2,4,6-TNT	ug/L	7.82	63.5	2.1 J	6.018	2.4 J	17
DNT Mixture	ug/L	0.932	ND	ND	0.898	ND	0.696
RDX	ug/L	6.1	28.5	3.3 J	3.87	1.6 J	8

Legend

- Approximate SWMU Boundary
- Monitoring Well Location (MW)
- Surface Water and Pore Water Sample Location (SW/PW)
- ug/L — Micrograms per Liter
- < — Less than Sample Method Detection Limit
- Exceeds Groundwater Remedial Goal (RG)
- ND — Non-Detect for Mixture
- NS — Not Sampled
- NR — New River
- Proposed Additional Monitoring Well

FIGURE 10-1

Monitored Natural Attenuation
Performance Monitoring Network

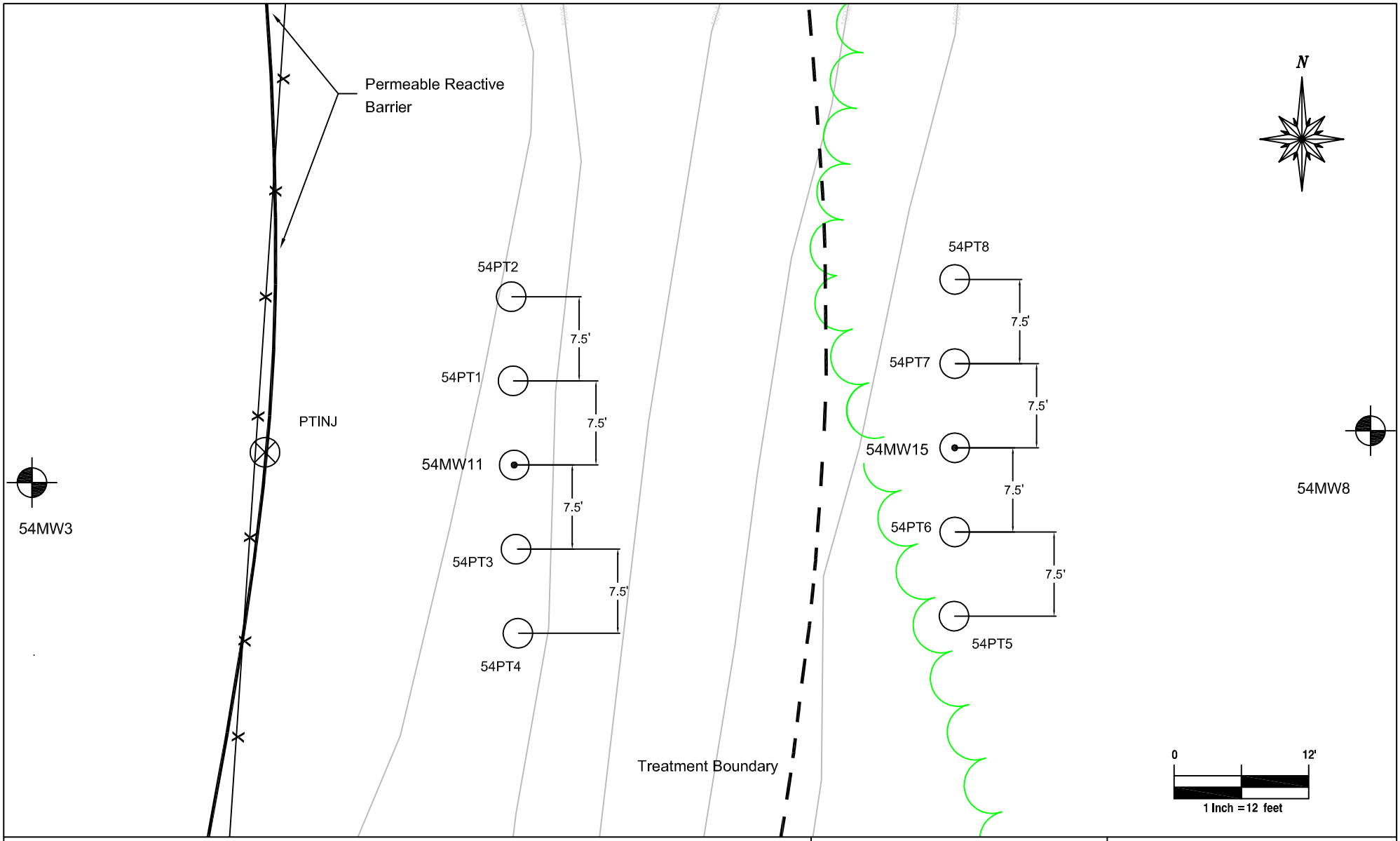
Date: August 2007	URS Project #: 21354893
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 100 feet	File Name: Fig.10-1 MNA Network

SWMU 54

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Legend

- Existing Monitoring Well
- Proposed Monitoring Well
- Proposed Pilot Test Monitoring Point
- Proposed Injection Well
- Perimeter Fence
- Tree Line
- Topographic Contour, feet mean sea level

Figure 10-2

Pilot Test Injection and Monitoring Well Layout

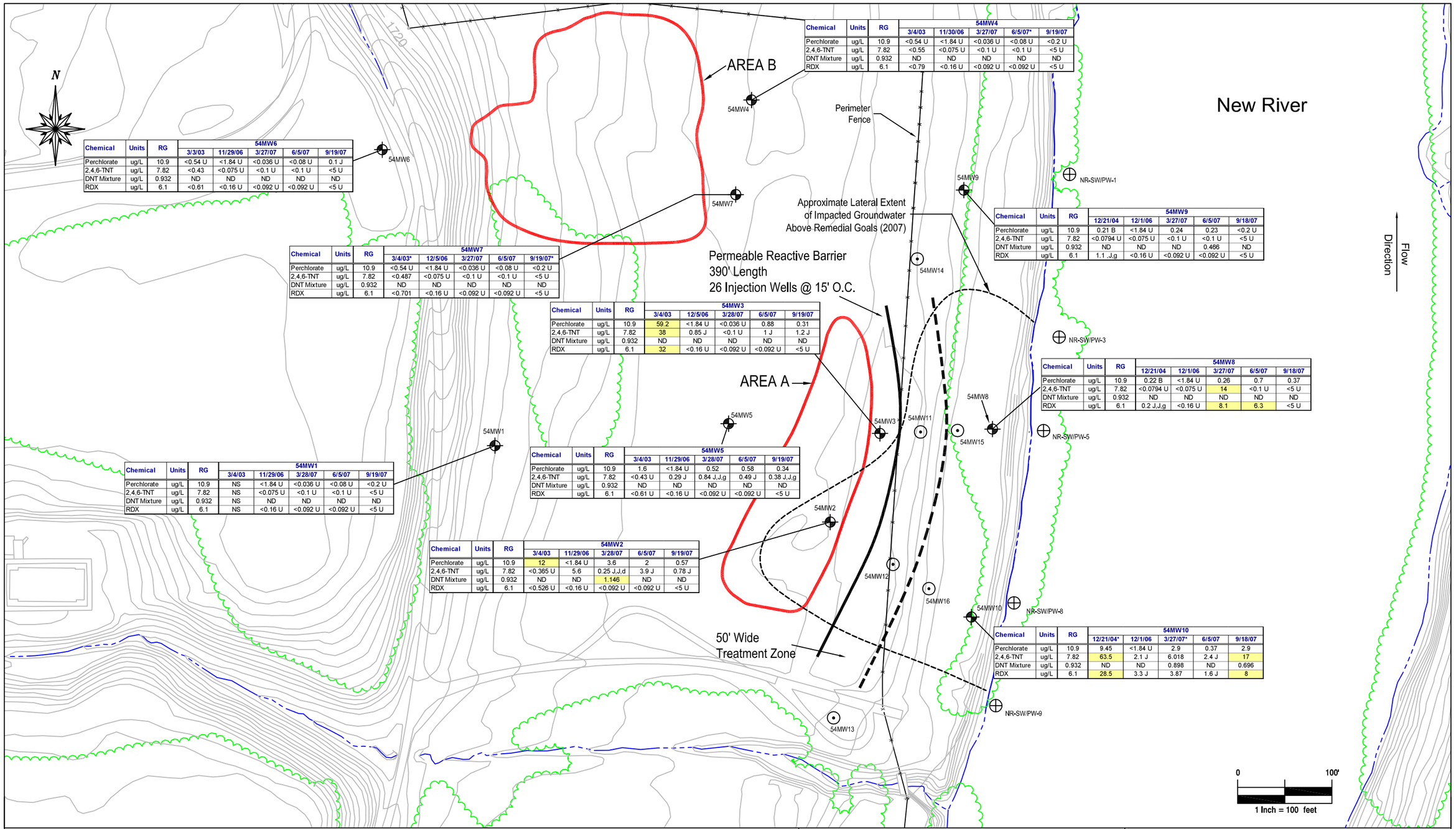
Date: August 2007	Job Number: 21354893
Prepared By: DBC	Reviewed By: JOS
Scale: 1" = 12'	File Name: Fig.10-2 PT Layout

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Chemical	Units	RG	54MW4				
			3/4/03	11/30/06	3/27/07	6/5/07*	9/19/07
Perchlorate	ug/L	10.9	<0.54 U	<1.84 U	<0.036 U	<0.08 U	<0.2 U
2,4,6-TNT	ug/L	7.82	<0.55	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	<0.79	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW6				
			3/3/03	11/29/06	3/27/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	<0.54 U	<1.84 U	<0.036 U	<0.08 U	0.1 J
2,4,6-TNT	ug/L	7.82	<0.43	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	<0.61	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW7				
			3/4/03*	12/5/06	3/27/07	6/5/07	9/19/07*
Perchlorate	ug/L	10.9	<0.54 U	<1.84 U	<0.036 U	<0.08 U	<0.2 U
2,4,6-TNT	ug/L	7.82	<0.487	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	<0.701	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW3				
			3/4/03	12/5/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	59.2	<1.84 U	<0.036 U	0.88	0.31
2,4,6-TNT	ug/L	7.82	38	0.85 J	<0.1 U	1 J	1.2 J
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	32	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW1				
			3/4/03	11/29/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	NS	<1.84 U	<0.036 U	<0.08 U	<0.2 U
2,4,6-TNT	ug/L	7.82	NS	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	NS	ND	ND	ND	ND
RDX	ug/L	6.1	NS	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW5				
			3/4/03	11/29/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	1.6	<1.84 U	0.52	0.58	0.34
2,4,6-TNT	ug/L	7.82	<0.43 U	0.29 J	0.84 J,J,g	0.49 J	0.38 J,J,g
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	<0.61 U	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW2				
			3/4/03	11/29/06	3/28/07	6/5/07	9/19/07
Perchlorate	ug/L	10.9	12	<1.84 U	3.6	2	0.57
2,4,6-TNT	ug/L	7.82	<0.365 U	5.6	0.25 J,J,d	3.9 J	0.78 J
DNT Mixture	ug/L	0.932	ND	ND	1.146	ND	ND
RDX	ug/L	6.1	<0.526 U	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW9				
			12/21/04	12/1/06	3/27/07	6/5/07	9/18/07
Perchlorate	ug/L	10.9	0.21 B	<1.84 U	0.24	0.23	<0.2 U
2,4,6-TNT	ug/L	7.82	<0.0794 U	<0.075 U	<0.1 U	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	0.466	ND
RDX	ug/L	6.1	1.1 ,J,g	<0.16 U	<0.092 U	<0.092 U	<5 U

Chemical	Units	RG	54MW8				
			12/21/04	12/1/06	3/27/07	6/5/07	9/18/07
Perchlorate	ug/L	10.9	0.22 B	<1.84 U	0.26	0.7	0.37
2,4,6-TNT	ug/L	7.82	<0.0794 U	<0.075 U	14	<0.1 U	<5 U
DNT Mixture	ug/L	0.932	ND	ND	ND	ND	ND
RDX	ug/L	6.1	0.2 J,J,g	<0.16 U	8.1	6.3	<5 U

Chemical	Units	RG	54MW10				
			12/21/04*	12/1/06	3/27/07*	6/5/07	9/18/07
Perchlorate	ug/L	10.9	9.45	<1.84 U	2.9	0.37	2.9
2,4,6-TNT	ug/L	7.82	63.5	2.1 J	6.018	2.4 J	17
DNT Mixture	ug/L	0.932	ND	ND	0.898	ND	0.696
RDX	ug/L	6.1	28.5	3.3 J	3.87	1.6 J	8

Legend

- Approximate SWMU Boundary
- Monitoring Well Location (MW)
- Surface Water and Pore Water Sample Location (SW/PW)
- ug/L — Micrograms per Liter
- < — Less than Sample Method Detection Limit
- Exceeds Groundwater Remedial Goal (RG)
- ND — Non-Detect for Mixture
- NS — Not Sampled
- NR — New River
- Proposed Additional Monitoring Well

FIGURE 10-3

Enhanced *In Situ* Bioremediation
Permeable Reactive Barrier Configuration

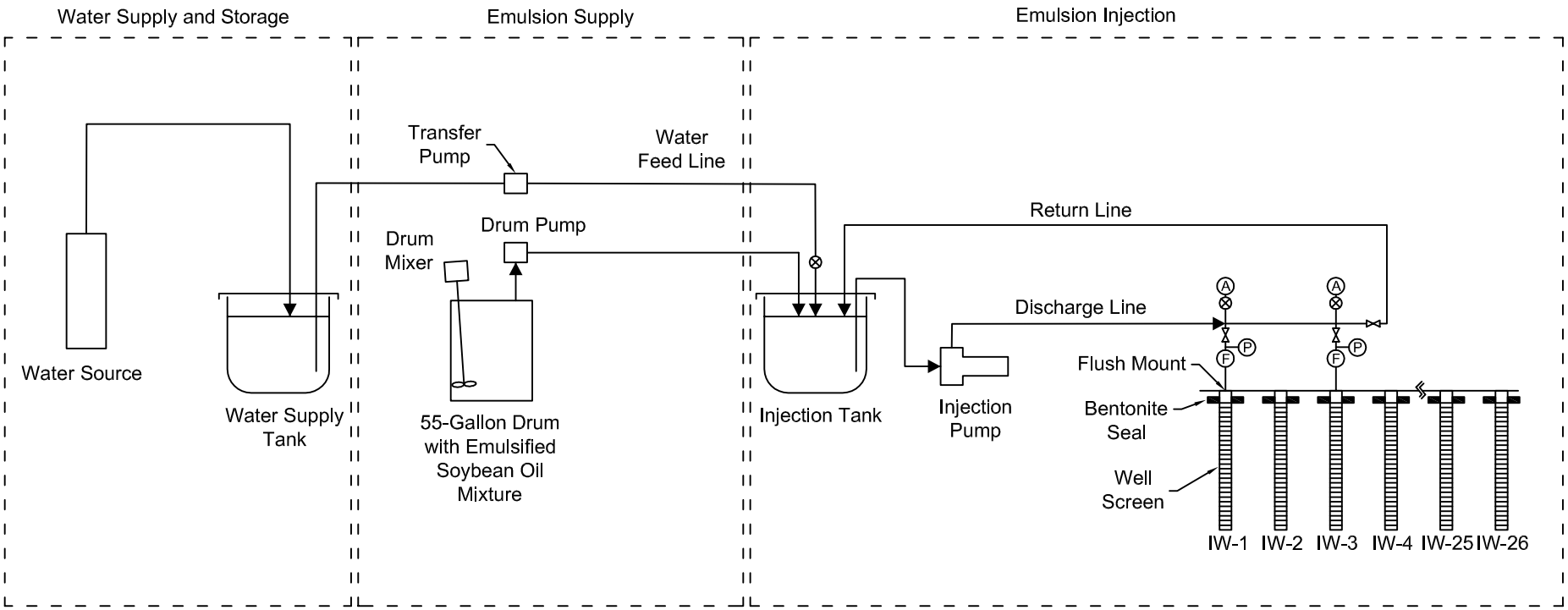
Date: January 2008	URS Project #: 21354893
Prepared by: DBC	Approved by: JOS
Scale: 1 inch = 100 feet	File Name: Fig.10-3 Bio Barrier

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Legend

- Ⓐ Air Release Valve
- ⊗ Ball Valve
- Ⓟ Pressure Gauge
- Ⓕ Flow Meter
- ⋈ Gate Valve

Figure 10-4

In-Situ Bioremediation System for Injection of Emulsified Soybean Oil

Date: August 2007	Job Number: 21354893
Prepared By: DBC	Reviewed By: JOS
Scale: Not to Scale	File Name: Fig.10-4 Sys. Diagram

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Table 10-1
Excavation Confirmatory Soil Sample Analytical Program
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Excavation Area	Excavation Area (ft^2)	No. of Samples	Sample Density	Analytical Parameters	Analytical Method	Sample Unit Cost
Area A	11730	43	Bottom: 1 sample per $625ft^2$ Sidewall: 1 sample per 25 linear ft	Explosives - SW-846 8330/8332 Lead - SW-846 6010B/6020 Dioxin/Furans - SW-846 8290 Perchlorate - SW-846 6850 Pesticides - SW-846 8081A	SW-846 8330/8322 SW-846 6010B/6020 SW-846 8290 SW-846 6850 SW-846 8081A	$1,093
Area B	17870	49	1 sample per $400ft^2$ Sidewall: 1 sample per 25 linear ft	Explosives SW-846 8330/8332 Lead SW-846 6010B/6020 Dioxin/Furans SW-846 8290 Perchlorate - SW-846 6850 Pesticides - SW-846 8081A PCBs - SW-846 8082	SW-846 8330/8322 SW-846 6010B/6020 SW-846 8290 SW-846 6850 SW-846 8081A SW-846 8082	$1,170

Table 10-2
Waste Characterization Analysis for Soil and Water
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Analytical Parameter	Media	Methods	Sample Unit Cost
pH	Soil	SW-846 9060	$40
pH	Water	SW-846 9060	$10
Full TCLP	Soil/Water	SW-846 Method 1311 (Extraction) VOCs - SW-846 Method 8260B SVOCs - SW-846 Method 8270C Pesticides - SW 846 Method 8081A Herbicides - SW 846 Method 8151A	$997
Paint Filter	Soil	SW-846 Method 9095A	$40
Chemical Oxidation Demand	Water	EPA Method 410.4	$30
Explosives 8330/8332	Soil	EPA Method 8330/8332	$289

Table 10-3
Monitored Natural Attenuation - Performance Monitoring Program
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Monitoring Locations

Location	Monitoring Locations	Location Type	Sampling Frequency
Upgradient	54MW1 (Area A) 54MW6 (Area B)	Existing Monitoring Wells	Quarterly
Disposal Area Point of Compliance	54MW2, 54MW3, 54MW5 (Area A) 54MW4, 54MW7 (Area B)	Existing Monitoring Wells	Quarterly
Downgradient Point of Compliance Adjacent to New River	54MW8, 54MW9, 54MW10	Existing Monitoring Wells	Quarterly
Between Disposal Area and Downgradient Wells at New River	54MW11, 54MW12, 54MW14 (Area A)	New Monitoring Wells	Quarterly
Between Disposal Area and Monitoring Well MW-9	54MW14	New Monitoring Wells	Quarterly
Between Disposal Area and Creek South of Area A	54MW13 (Area A)	New Monitoring Well	Quarterly
Receptor Point of Compliance at New River	NRSW-1/PW-1, NRSW-3/PW-3, NRSW-5/PW-5, NRSW-8/PW-8, NRSW-9/PW-9	Existing Sediment Pore Water/Surface Water Sample Stations	Annually

Analytical Parameters

Parameters	Analytical Method	Comment
Explosives	SW-846 Method 8330/8332	Chemicals of Interest
Perchlorate	SW-846 Method 6850	
Total Organic Carbon Dissolved Inorganic Carbon	EPA Method 415.1	Water Quality Parameters
Dissolved Ferrous Iron (Fe^{+2}) Dissolved Manganese (Mn^{+2})	Field	
Nitrate (NO_3)	353.2	
Sulfate (SO_4^{2+})	300	
pH, temperature, specific conductance, dissolved oxygen, oxidation/reduction potential (ORP), turbidity	Field	

Table 10-4
Monitored Natural Attenuation - Performance Monitoring Program Parameters
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Parameter	Data Use
Explosives and Perchlorate	COIs - Evaluate concentration trends and attenuation with respect to RGs. Used to document achievement of CMOs and RGs. Allows for evaluation of 2,4,6-TNT transformation processes to 4ADNT and 2ADNT.
Total Organic Carbon (TOC)	Allows for evaluation of immobilization potential of 2,4,6-TNT and RDX.
Dissolved Inorganic Carbon	Dissolved inorganic carbon is a by product organic compound oxidation and indicates the difference in microbial oxidation processes within versus outside the plume area.
Dissolved Ferrous Iron (Fe^{+2})	May indicate anaerobic degradation due to depletion of oxygen, nitrate, and manganese. Also allows for evaluation of immobilization potential of 2,4,6-TNT.
Dissolved Manganese (Mn^{+2})	May indicate anaerobic degradation due to depletion of oxygen and nitrate.
Nitrate (NO_3)	Substrate for microbial respiration if oxygen is depleted.
Sulfate (SO_4^{2-})	Substrate for anaerobic microbial respiration.
pH	Aerobic and anaerobic processes are pH sensitive. Stabilization parameter for groundwater purging and sampling.
Dissolved Oxygen	Concentrations indicate whether an aerobic or anaerobic pathway exists. Concentrations of <0.5 mg/L generally indicate an anaerobic pathway. Dissolved oxygen contributes to the potential of biodegradation and other attenuation mechanisms.
Oxidation Reduction Potential (ORP)	Reflects the relative oxidizing or reducing nature of the aquifer. ORP is influenced by the biologically mediated degradation of contaminants and ranges from 800 mV (oxygenated) to -400 mV (strongly reducing). Stabilization parameter for groundwater purging and sampling.
Specific Conductance	General parameters for water quality and stabilization parameter for groundwater purging and sampling.
Temperature and Turbidity	General parameters for water quality and stabilization parameter for groundwater purging and sampling.

Notes:

RG = Remedial Goal
ADNT = Aminodinotrotoluene
mg/L = Milligram per liter
mV = Millivolt
COI = Chemical of Interest
DNT = Dinitrotoluene

Table 10-5
In Situ Bioremediation - Performance Monitoring Program
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Monitoring Locations

Location	Monitoring Locations	Location Type	Sampling Frequency
Upgradient	54MW1 (Area A) 54MW6 (Area B)	Existing Monitoring Wells	Quarterly
Disposal Area Point of Compliance	54MW2, 54MW3, 54MW5 (Area A) 54MW4, 54MW7 (Area B)	Existing Monitoring Wells	Quarterly
Downgradient Point of Compliance Adjacent to New River	54MW8, 54MW9, 54MW10 (Area A)	Existing Monitoring Wells	Quarterly
Between Disposal Area and Downgradient Wells at New River	54MW11, 54MW12, 54MW15, 54MW16 (Area A)	New Monitoring Wells	Quarterly
Between Disposal Area and Monitoring Well MW-9	54MW14 (Area A)	New Monitoring Wells	Quarterly
Between Permeable Reactive Barrier and Stream South of Area A	54MW13 (Area A)	New Monitoring Wells	Quarterly
Receptor Point of Compliance at New River	NRSW-1/PW-1, NRSW-3/PW-3, NRSW-5/PW-5, NRSW-8/PW-8, NRSW-9/PW-9	Existing Sediment Pore Water/Surface Water Sample Stations	Annually

Analytical Parameters

Parameters	Analytical Method	Comment
Explosives	SW-846 Method 8330/8332	Chemicals of Interest
Perchlorate	SW-846 Method 6850	
Total Organic Carbon (TOC) Dissolved Inorganic Carbon	SW-846 Method 9060A	Water Quality Parameters
Oil Emulsion	Field (Visual Inspection)	
Dissolved Ferrous Iron (Fe^{+2}) Dissolved Manganese (Mn^{+2})	Field	
Nitrate (NO_3)	353.2	
Sulfate (SO_4^{2+})	300	
pH, temperature, specific conductance, dissolved oxygen, oxidation/reduction potential (ORP), turbidity	Field	

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11.0 EVALUATION OF CORRECTIVE MEASURES ALTERNATIVES

Criteria used to evaluate the three potential corrective measures alternatives include effectiveness, implementability, and cost as described below.

11.1 EVALUATION CRITERIA

11.1.1 Effectiveness

Effectiveness criteria evaluated for each alternative include:

- Protection of human health and the environment;
- Attain media cleanup standards and criteria;
- Control the source of releases;
- Compliance with any applicable standards for the management of wastes;
- Long-term reliability and effectiveness;
- Reduction in toxicity, mobility, and/or volume through treatment; and
- Short-term effectiveness.

11.1.2 Implementability

Implementability criteria evaluated for each alternative include:

- Technical factors including: constructability, time for implementation, and time for beneficial results;
- Administrative feasibility; and
- Availability of services and materials.

11.1.3 Cost

Cost factors that are used to evaluate alternatives include costs associated with implementation of each corrective measure alternative. The estimated cost for each alternative is based on a conceptual design for each alternative and includes both capital cost and O&M cost. The total estimated cost and present value of each alternative are presented. The actual cost of each alternative is dependent on a variety of factors including the scope of work, schedule, market conditions, and other variables.

11.2 EFFECTIVENESS

Alternative Two and Alternative Three have identical remedial components for soil and therefore, are discussed together in the following sections. The groundwater components for Alternative Two and Alternative Three are different and therefore, are discussed separately in the following sections.

11.2.1 Protection of Human Health and the Environment

Alternative One

Alternative One is not protective of human health because potential future leaching to groundwater at levels of potential concern is not addressed and identified risks to industrial and residential receptors are not addressed. Alternative One does not address potential ecological risks to wildlife identified for surface soil at Area B.

Alternative Two/Alternative Three - Soil

Alternative Two and Alternative Three provide for overall protection of human health and the environment by removal of soil containing COC concentrations above RGs under the most restrictive residential and soil-to-groundwater pathways. Ecological risks for explosives (Area A and Area B), lead (Area B), and dioxins (Area B) in surface soil will also be addressed by the removal of soil at the sites. Removal of soil at Area A will prevent further leaching of constituents to groundwater at levels of potential concern. At Area B, removal of soil will prevent leaching of constituents to groundwater at levels of potential concern.

Implementation of Alternative Two and Alternative Three is expected to further reduce site risks and hazards for soil from the levels shown in the residual risk and hazard analysis presented in Sections 8.4.1 and 8.4.2 due to the placement of clean fill within the excavated areas. At Area A, it is expected that these reductions will result in a decrease in overall maximum site risk to levels less than or equal to 3E-05 and hazards of less than or equal to 1E+00. At Area B, it is expected that these reductions will result in a decrease in overall maximum site risk to levels less than 5E-06 and hazards less 1E+00.

Alternative Two - Groundwater

Removal of the soil source areas under this alternative will prevent future leaching of COCs to groundwater and allow for continued attenuation of COCs in groundwater to levels at or below RGs; thereby restoring groundwater and preventing impacts to the New River at levels of potential concern. COC concentrations in groundwater have decreased since 2003 after initial source removal activities in 1999 and as of the September 2007 sampling event are below the RGs for perchlorate and DNT mixture. RDX and 2,4,6-TNT concentrations have also decreased in groundwater by 70% to 90% since 2003 and are approaching their RGs.

Alternative Three - Groundwater

Removal of the soil source areas under this alternative will prevent future leaching of COCs to groundwater and facilitate achievement of RGs in groundwater. Enhanced *in situ* bioremediation treatment will be used under this alternative by injecting emulsified edible oil to create a permeable reactive barrier to treat groundwater as it flows through the area. Explosives and perchlorate concentrations would be reduced in this zone through enhanced anaerobic degradation. The *in situ* treatment will compliment natural attenuation processes already occurring at the site and allow for a reduction of COC concentrations in groundwater to levels at or below RGs; thereby restoring groundwater and preventing an impact to the New River at levels of potential concern.

Human health and environmental considerations with implementation include the close proximity of the New River with respect to the disposal area (200 ft) and potential injection areas (150 ft or less) and potential migration of the dissolved organic reactive zone toward the New River. Limited migration of the dissolved organic reactive zone typically occurs for emulsified edible oil because it is significantly biodegradable. Monitoring data from existing sites using emulsified oil indicates impacts are limited to 50 ft or less downgradient of injection zones, which would leave a 100 ft buffer zone between the treatment zone and the New River. Secondary water parameters, such chemical oxygen demand (COD), BOD, total dissolved solids, and sulfides, are typically degraded within the dissolved organic reactive zone. In addition, the reduced groundwater environment in the reactive zone may increase the mobility of some naturally occurring metals, such as iron, manganese, and arsenic. Migration of these metals out of the reactive zone is often substantially retarded by adsorption to the aquifer matrix and/or precipitation as insoluble metal sulfides (Butler and Hayes 1999). In naturally aerobic aquifers such as at the site, groundwater typically returns to near background conditions within a relatively short distance downgradient of the reactive zone due to consumption of excess substrate by biological processes and the mixing of anaerobic groundwater with background aerobic groundwater (Borden 2006).

11.2.2 Compliance with Media Standards and Criteria

Alternative One

Media cleanup standards and criteria are not achieved by Alternative One because corrective measures are not implemented.

Alternative Two/Alternative Three - Soil

Alternative Two and Alternative Three are designed to achieve media cleanup standards and criteria for the soil-to-groundwater migration pathway and future residential exposure pathways for soil.

Alternative Two - Groundwater

This alternative is designed to achieve media standards and criteria to provide for restoration of groundwater upon achievement of RGs through source removal and MNA.

Alternative Three - Groundwater

This alternative is designed to achieve media standards and criteria to provide for restoration of groundwater after achievement of RGs through source removal and *in situ* treatment of groundwater to supplement natural attenuation processes occurring in groundwater. Degradation of secondary water quality parameters, such as total dissolved solids, iron, and manganese, is expected to occur within the reactive/treatment zone from the strongly anaerobic conditions. Restoration of the parameters is expected to occur after the organic carbon substrate is expended and water flows into the strongly aerobic conditions outside the treatment zone.

11.2.3 Control of Sources of Releases

Alternative One

Alternative One does not control soil source areas at the site because corrective measures are not implemented.

Alternative Two and Alternative Three

Alternative Two and Alternative Three include the removal of identified soil source areas at the site to prevent potential future releases and leaching of COCs at levels of potential concern.

11.2.4 Comply with any Applicable Standards for Management of Wastes

Alternative One

Alternative One does not include any waste management activities because corrective measures are not implemented.

Alternative Two/Alternatives Three – Soil

Alternative Two and Alternative Three will involve excavation and offsite transportation of non-hazardous soil and hazardous soil and related waste. Waste characterization testing will be conducted prior to excavation to appropriately characterize material and develop waste profiles for disposal as non-hazardous or hazardous waste. This will also allow for direct loading of excavated material into trucks so potential RCRA permitting requirements are avoided for temporarily staging or managing soil onsite before loading. A final disposal facility or facilities will be selected for the wastes based on the waste characterization data, treatment, storage, disposal, and facility permit requirements, compliance with the facility's RCRA permit, and compliance with Federal regulations and Commonwealth of Virginia hazardous waste management regulations and policy.

Alternative Two/Alternative Three – Groundwater

Excess soil cuttings and other investigative derived material will be generated during installation of borings, monitoring wells, injection points, and during groundwater monitoring. IDM will be appropriately placed in containers, labeled, and tested to determine disposal options in accordance with federal and state regulations. The IDM in containers will be placed in an appropriate designated RCRA container accumulation area at RFAAP, where it is permissible to accumulate such waste. IDM placed into a designated 90-day accumulation area will be properly sealed, labeled, and covered. All drums will be placed on pallets.

11.2.5 Long-Term Reliability and Effectiveness

Alternative One

Alternative One does not achieve long-term effectiveness and permanence because corrective measures are not implemented and CMOs and RGs are not achieved.

Alternative Two/Alternative Three - Soil

Alternative Two and Alternative Three provide for high long-term reliability and effectiveness because soil containing COC concentrations above risk-based RGs under the most restrictive residential and soil-to-groundwater pathways is excavated and disposed offsite. Land use controls will not be required for soil under this alternative.

Alternative Two - Groundwater

Complete source removal is expected to provide for long-term reliability and effectiveness of MNA. Performance monitoring will be required to demonstrate the COC concentrations in groundwater are reduced to levels at or below RGs and that these levels are maintained. If the MNA remedy component does not perform as expected due to unexpected changes in site conditions, then a contingency remedy for groundwater may be required (such as elements of Alternative Three) to provide for the necessary long-term reliability and effectiveness.

Alternative Three - Groundwater

The efficiency of the barrier treatment area will begin to decline over time as substrate is depleted from more permeable/contaminated zones. Typically an initial application will be effective for three to five years after which time an additional application or applications may be necessary if remedial objectives have not been achieved in order to maintain long-term reliability and effectiveness. Given the low levels of dissolved phase constituents detected at the site compared to other sites where the technology has been used (typically orders of magnitude higher) a second application of substrate may not be required.

Performance groundwater monitoring will be required to demonstrate the long-term reliability and effectiveness of *in situ* bioremediation.

11.2.6 Reduction in Toxicity, Mobility, and/or Volume through Treatment:

Alternative One

Alternative One does not reduce the toxicity, mobility, and volume of COCs in soil because corrective measures are not implemented.

Alternative Two and Alternative Three - Soil

Alternative Two and Alternative Three would provide for some reduction in toxicity, mobility, and/or volume of soil through treatment, for any hazardous D008 soil excavated, if the level of lead exceeds 10 times the universal treatment standard in 40 CFR §268.42 (greater than 7.5 mg/L). Other soil excavated would not provide for a reduction in toxicity or volume of COCs, as the COCs are not treated or

destroyed but are instead moved to a new location. However, a reduction of mobility of these COCs would be provided as the material will be placed in a RCRA landfill.

Alternative Two - Groundwater

COCs in groundwater will undergo treatment by naturally occurring physical, chemical and biological mechanisms. A variety of processes in the groundwater system are causing a reduction in the toxicity, mobility, and volume of 2,4,6-TNT through aerobic transformation processes.

Alternative Three - Groundwater

Engineering bioremediation processes will be used to reduce the toxicity, mobility, and volume of explosives and perchlorate in groundwater through reductive processes. These processes will enhance naturally occurring physical, chemical, and biological mechanisms.

11.2.7 Short-Term Effectiveness

Alternative One

Alternative One does not require protection of workers and the community during remedial implementation because corrective action is not implemented. However, CMOs and RGs are not met, which represents a current and future human health risk.

Alternative Two/Alternative Three

Under Alternative Two and Alternative Three, potential short-term risk to site workers, the environment, and community will be controlled and minimized by implementation of good construction and work practices, appropriate health and safety measures, standard dust suppression techniques, erosion and sediment control measures, personnel protection equipment, real-time air monitoring, and management of non-hazardous and hazardous soil in accordance with Department of Transportation, federal, and Commonwealth of Virginia requirements. The methodologies to safely perform these activities and mitigate short-term risks will be described in site-specific work plans and health and safety plans.

11.3 IMPLEMENTABILITY

11.3.1 Technical

Alternative One

Constructability would not be an issue for Alternative One because corrective measures are not implemented. Alternative One would not require time for implementation because corrective measures are not implemented; however, beneficial results would not be achieved.

Alternative Two/Alternative Three - Soil

Soil excavation and offsite disposal are well-proven, readily implementable technologies that are commonly used to remediate waste sites. The total duration of soil remedy implementation is expected to be six months or less from the start date of site activities. Beneficial results would be achieved immediately after soil excavation activities are completed, as source areas would be removed and RGs achieved.

Alternative Two – Groundwater

MNA is a well-proven, readily implementable technology that is commonly used for remediating waste sites. Most of the monitoring network is already in place for MNA implementation. This alternative has a short time for implementation after completion and approval of site work plans. MNA can be implemented immediately after installation of required additional monitoring wells.

Quarterly performance monitoring would continue until RGs are met and maintained for an appropriate period. COC concentrations in groundwater have generally decreased since 2003 after initial source

removal activities in 1999 and as of the September 2007 sampling event are below the RGs for perchlorate and DNT mixture. RDX and 2,4,6-TNT concentrations in groundwater have decreased by 70 to 90% since 2003 and are approaching their RGs. For the latest sampling event in September 2007, one downgradient well location (54MW10) had concentrations of RDX and 2,4,6-TNT above RGs. COC attenuation data are summarized in the following tables.

Attenuation of COC Concentrations in Source Area (54MW2 and 54MW3)

COC	Sample Results		Remedial Goal
	March 2003	September 2007	
DNT Mixture	ND	ND	0.932 µg/L
Perchlorate	12 to 59.2 µg/L	0.31 to 0.57 µg/L	10.9 µg/L
RDX	ND to 32 µg/L	ND	6.1 µg/L
2,4,6-TNT	ND to 38 µg/L	0.78 to 1.2 µg/L	7.82 µg/L

Notes: ND = Not detected.

Attenuation of COC Concentrations in Downgradient Area (54MW8, 54MW9, and 54MW10)

COC	Sample Results		Remedial Goal
	December 2004	September 2007	
DNT Mixture	ND	ND to 0.696	0.932 µg/L
Perchlorate	0.21 to 9.45 µg/L	ND to 2.9 µg/L	10.9 µg/L
RDX	0.2 to 28.5 µg/L	ND to 8 µg/L	6.1 µg/L
2,4,6-TNT	ND to 63.5 µg/L	0.78 to 17 µg/L	7.82 µg/L

Notes: ND = Not detected.

Continued beneficial results in groundwater will be observed after completion of the soil excavation activities, which will remove remaining source areas. It is anticipated that CMOs and RGs for groundwater will be achieved within 5 years after completion of soil excavation activities based on the following:

- Any remaining source areas will be removed during remedy implementation;
- The latest sampling event in September 2007 indicated concentrations of DNT mixture and perchlorate in groundwater below their RGs and COC concentrations in groundwater within the source area below RGs;
- RDX and 2,4,6-TNT concentrations for the latest sampling event in September 2007 indicated levels below their RGs, except in one downgradient well (54MW10);
- Perchlorate, RDX, and 2,4,6-TNT concentrations in groundwater have decreased 70 to 90% since 2003;
- The downgradient area where COC concentrations are above groundwater RGs is frequently subjected to inflow and extensive mixing of surface water from river as discussed in Section 2.7.4.2, which is expected to allow for continued attenuation of COC concentrations; and
- Evaluation of RDX and 2,4,6-TNT attenuation rates at the site using the AT123D groundwater model (see Appendix G.5) suggested that the COC levels observed at the site in September 2007 would attenuate to levels at or below RGs within 5 years of completing the source removal.

Alternative Three - Groundwater

Enhanced *in situ* bioremediation has been increasing implemented at waste sites and therefore constructability is not an issue. This alternative is expected to require a longer time for implementation because of required pilot studies, potential permitting requirements for groundwater injection, etc.

Quarterly performance monitoring would continue until RGs are met and maintained for an appropriate period. Based on the current site groundwater data and conditions, it is anticipated that CMOs and RGs will be achieved within 3 years after injection.

11.3.2 Administrative Feasibility

Alternative One

Alternative One would not require any permits or administrative actions because corrective measures are not implemented.

Alternative Two

This alternative is administratively feasible and is expected to be routine in terms of administrative requirements. It is anticipated that this alternative will be implemented as a final interim measure and therefore, it will not require a modification of the facility's RCRA Corrective Action Permit at the time of implementation. Implementation of this alternative will not require special permits for management, treatment, transportation, or disposal of waste. Facility-specific permits will be required to complete the work including an area entry permit and hot work permit. An approved erosion and sediment control plan (approval by Pulaski County) will be required prior to land disturbance activities given that more than a 10,000ft^2 area will be disturbed at the site.

Alternative Three

The soil component of this alternative is administratively feasible and is expected to be routine in terms of administrative requirements as described above for Alternative Two. The groundwater component may require a permit for groundwater injection and pilot studies to demonstrate the applicability to site conditions and that adverse impact to state waters will not occur from remedy implementation. It is anticipated that this alternative will be implemented as a final interim measure and therefore, it will not require a modification of the facility's RCRA Corrective Action Permit at the time of implementation. Implementation of this alternative will not require special permits for management, treatment, transportation, or disposal of waste. Facility-specific permits will be required to complete the work including an area entry permit and hot work permit.

11.3.3 Availability of Services and Materials

Alternative One

Alternative One would not require services and materials because corrective measures are not implemented.

Alternative Two

Services and materials, such excavation contractors, treatment, storage, and disposal facility capacity, disposal services, and drilling services are readily available to implement soil excavation and MNA activities.

Alternative Three

Services and materials, such excavation contractors, treatment, storage, and disposal facility capacity, disposal services, drilling services, injection equipment, and materials are readily available to implement soil excavation and enhance *in situ* bioremediation treatment activities.

11.4 COST

Alternative One does not involve any actions, so there is no cost for this alternative. Detailed cost estimates for Alternative Two and Alternative Three are presented in Tables 11-1 and 11-2, respectively, and are summarized below.

Summary of Cost for Corrective Measures Alternatives Two and Three

Corrective Measures Alternative	Total Capital Cost ($)	Annual O&M Cost ($)	Estimated Years of O&M	Estimated Total Cost with O&M ($)	PV @4.6% ($)
Alternative 1 – No Action	$0	$0	0	$0	$0
Alternative 2 – Excavation, Offsite Disposal, and Monitored Natural Attenuation of Groundwater	$2,930,534	$132,363	8	$3,989,435	$3,800,027
Alternative 3 - Excavation, Offsite Disposal, and Enhanced *In Situ* Bioremediation of Groundwater	$3,544,128	$141,112	6	$4,390,799	$4,269,622

Table 11-1
Cost Estimate: Corrective Measures Alternative Two
Excavation of Soil, Offsite Disposal, and Monitored Natural Attenuation of Groundwater
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Capital Costs				
Item	**Units**	**Unit Cost ($)**	**Quantity**	**Total ($)**
Task 1 Soil Removal Action				
Task 1.1 Pre-Characterization of Waste				
Driller Mobilization	EA	660	1	$660
Direct Push Rig with Crew	DAY	1,705	2	$3,410
Liners for Soil Sampling	EA	4	84	$370
Driller Per Diem	DAY	144	2	$288
Vehicle for Investigation and Sampling	DAY	58	3	$174
Vehicle Fuel for Investigation and Sampling	GAL	3.78	31	$117
Per Diem for Investigation and Sampling	DAY	152	3	$457
55 DOT Drum - Furnish and Fill and Move to Accumulation Area	EA	99	2	$198
Sample Cooler Shipping	EA	90	8	$741
Soil Sampling Equipment	EVENT	375	1	$375
IDM Waste Characterization - Soil (pH, Full TCLP, Explosives, and Paint Filter)	EA	1,503	43	$64,101
IDM Waste Characterization - Water (pH, Full TCLP, COD)	EA	1,141	3	$3,422
Non Hazardous IDM Transportation	EA	660	1	$660
Non Hazardous IDM Disposal	DRUM	78	2	$156
			Subtotal Task 1.1	$75,128
Task 1.2 Soil Excavation & Backfill				
Mobilization and Decontamination Station Setup	LS	1	15,000	$15,000
Access Roads	SY	15	1,000	$15,000
Sediment & Erosion Control	LF	10	1,000	$9,856
Water Truck	MONTH	3	6,900	$20,700
Excavation	BCY	7	8,610	$60,270
Sheet Piling (Installed, Pulled & Decontaminated)	SF	9	9,200	$82,800
Backfill (Offsite Material, Place and Compacted)	LCY	11	10,763	$118,388
Vehicle for Remedial Action Oversight	MONTH	1,445	3	$4,335
Vehicle Fuel for Remedial Action Oversight	GAL	3.78	376	$1,421
Per Diem for Remedial Action Oversight (for onsite 3 personnel)	DAY	152	150	$22,825
Sample Cooler Shipping	EA	90	28	$2,477
Excavation Monitoring and Sampling Equipment	MONTH	1,371	2.5	$3,427
Confimatory Soil Sample Analysis - Area A (Expl, Lead, Dioxins, Perchlorate, Pest.)	EA	1,093	43	$47,016
Confimatory Soil Sample Analysis - Area B (Expl.,Lead, Dioxins, Perchlorate, Pest., PCBs)	EA	1,170	49	$57,350
Non-Hazardous Soil Disposal (T&D)	TON	86	9,997	$857,743
Hazardous Soil Treatment and Disposal (T&D)	TON	260	2,057	$533,997
			Subtotal Task 1.2	$1,852,605
Task 1.3 Site Restoration				
Topsoil				
Hydroseeding	SF	0.21	31,310	$6,558
Erosion Control Matting	SY	1.86	4,175	$7,766
Vehicle for Site Restoration Oversight	WK	350	1	$350
Vehicle Fuel for Site Restoration Oversight	GAL	3.78	34	$128
Per Diem for Site Restoration Oversight	DAY	152	5	$761
Equipment and Supplies for Site Restoration Oversight	EVENT	174	1	$174
			Subtotal Task 1.3	$15,736
			Subtotal Task 1	$1,943,468
Task 2 Monitoring Well Installation for MNA				
Task 2.1 Additional Monitoring Wells (4)				
Driller Mobilization	EA	1,265	1	$1,265
Tractor w/Forks & Bucket to Move IDM Drums	WK	1,100	1	$1,100
6" Air Drilling: 4-40 ft monitoring wells	FT	20	160	$3,168
2" Monitoring Well Installation	FT	24	160	$3,872
6" Surface Casing	EA	165	4	$660
4' x 4' Concrete Pads	EA	330	4	$1,320
Bollards - Furnish and Install/Paint	EA	99	4	$396
Decontamination	HR	248	4	$990
Decontamination Equipment - Steam Cleaner and Water Tank	DAY	110	2	$220
Temporary Decontamination Structure	EA	660	1	$660
Initial Well Development: Air Lift with 1" Pipe	HR	303	4	$1,210
Driller Per Diem	DAY	144	2	$288
55 DOT Drum - Furnish and Fill and Move to Accumulation Area	EA	99	23	$2,277
Vehicle for Well Installation Oversight and Well Development	WK	350	1	$350
Vehicle Fuel for Well Installation Oversight and Well Development	GAL	3.78	62	$233
Per Diem for Well Installation Oversight and Well Development	DAY	152	6	$913
Equipment for Well Installation	DAY	232	2	$465
Final Well Development: Surge and Pump Equipment	EVENT	633	1	$633
IDM Waste Characterization - Cuttings (pH, Full TCLP, Explosives,Paint Filter, Explosives)	EA	1,503	1	$1,503
IDM Waste Characterization - Decon Water (pH, Full TCLP, COD)	EA	1,141	1	$1,141
Non-Hazardous IDM Transportation	EA	660	1	$660
Non-Hazardous IDM Disposal	DRUM	78	21	$1,640
			Subtotal Task 2.1	$24,964

Table 11-1 (Cont'd)
Cost Estimate: Corrective Measures Alternative Two
Excavation of Soil, Offsite Disposal, and Monitored Natural Attenuation of Groundwater
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Capital Costs

Item	Units	Unit Cost ($)	Quantity	Total ($)
Task 2.2 Site Close-Out/Monitoring Well Abandonment				
Driller Mobilization	EA	550	1	$550
2" Well Abandonment: Pressure Grout in Place	FT	11	600	$6,600
Remove of Stickup Surface Completion	EA	303	15	$4,538
Decontamination	HR	248	4	$990
Decontamination Equipment - Steam Cleaner and Water Tank	DAY	110	4	$440
Driller Per Diem	DAY	144	4	$576
Containerization and Disposal of Solid Waste	EA	165	15	$2,475
Vehicle for Well Abandonment	DAY	58	4	$232
Vehicle Fuel for Well Abandonment	GAL	3.78	4	$15
Per Diem for Well Abandonment	DAY	152	4	$609
			Subtotal Task 2.2	$17,025
			Subtotal Task 2	$41,988
			Subtotal Tasks 1 and 2	$1,985,457
	Project Management (5%)			$99,273
	Planning Documents (4%)			$79,418
	Construction Oversight (5.5%)			$109,200
	Reporting (1%)			$19,855
	As Built Drawings (1%)			$19,855
	Permitting (1%)			$19,855
	Other Direct Costs (10% of Labor)			$34,745
			Total - Tasks 1 and 2	$2,367,657
	Engineering Design (4.5%)			$89,346
	Contingency (20%)			$473,531
			Total Capital Costs	$2,930,534

Annual O&M Costs

Item	Units	Unit Cost ($)	Quantity	Total ($S)
Quarterly MNA Groundwater/Annual Surface Water & Sediment Pore Water Sampling				
Groundwater Sampling - Field Labor	HR	66	360	$23,760
Surface Water/Sediment Pore Water Sampling - Labor	HR	66	20	$1,320
Groundwater Sampling Equipment and Supplies	EVENT	729	4	$2,917
Hach Test Kit for Fe and Mg in Groundwater	EVENT	27	4	$107
Surface Water/Sediment Pore Water Equipment	EVENT	279	1	$279
Per Diem	DAY	152	42	$6,391
Vehicle	DAY	58	21	$1,218
Vehicle Fuel	GAL	3.78	134	$506
Sample Cooler Shipping	EA	90	46	$4,129
Groundwater Sample Analysis (Expl, Perchlorate, TOC, DIC, Nitrate, Sulfate)	EA	384	68	$26,105
Surface Water/Pore Water Sample Analysis (Expl, Perchlorate)	EA	257	12	$3,089
			Subtotal	$69,821
Reporting				
Quarterly Operational and Monitoring Report	EA	7500	4	$30,000
			Subtotal	$30,000
			Subtotal Annual O&M Cost	$99,821
	Project Management (10.5%)			$10,481
			Total Annual O&M Cost	$110,302
	Contingency (20%)			$22,060
			Total Annual O&M Cost	$132,363
			Estimated Total Cost with 8 Years of O&M	**$3,989,435**
			Present Value @ 4.6%	**$3,800,027**

Table 11-2
Cost Estimate: Corrective Measures Alternative Three
Excavation of Soil, Offsite Disposal, and Enhanced *In Situ* Bioremediation of Groundwater
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Capital Costs				
Item	**Units**	**Unit Cost ($)**	**Quantity**	**Total ($)**
Task 1 Soil Removal Action				
Task 1.1 Pre-Characterization of Waste				
Driller Mobilization	EA	660	1	$660
Direct Push Rig with Crew	DAY	1,705	2	$3,410
Liners for Soil Sampling	EA	4	84	$370
Driller Per Diem	DAY	144	2	$288
Vehicle for Investigation and Sampling	DAY	58	3	$174
Vehicle Fuel for Investigation and Sampling	GAL	3.78	31	$117
Per Diem for Investigation and Sampling	DAY	152	3	$457
55 DOT Drum - Furnish and Fill and Move to Accumulation Area	EA	99	2	$198
Sample Cooler Shipping	EA	90	8	$741
Soil Sampling Equipment	EVENT	375	1	$375
IDM Waste Characterization - Soil (pH, Full TCLP, Explosives, and Paint Filter)	EA	1,503	43	$64,101
IDM Waste Characterization - Water (pH, Full TCLP, COD)	EA	1,141	3	$3,422
Non Hazardous IDM Transportation	EA	660	1	$660
Non Hazardous IDM Disposal	DRUM	78	2	$156
			Subtotal Task 1.1	$75,128
Task 1.2 Soil Excavation & Backfill				
Mobilization and Decontamination Station Setup	LS	1	15,000	$15,000
Access Roads	SY	15	1,000	$15,000
Sediment & Erosion Control	LF	10	1,000	$9,856
Water Truck	MONTH	3	6,900	$20,700
Excavation	CY	7	8,610	$60,270
Sheet Piling (Installed, Pulled & Decontaminated)	SF	9	9,200	$82,800
Backfill (Offsite Material, Place and Compacted)	CY	11	10,763	$118,388
Vehicle for Remedial Action Oversight	MONTH	1,445	3	$4,335
Vehicle Fuel for Remedial Action Oversight	GAL	3.78	376	$1,421
Per Diem for Remedial Action Oversight (for onsite 3 personnel)	DAY	152	150	$22,825
Sample Cooler Shipping	EA	90	28	$2,477
Excavation Monitoring and Sampling Equipment	MONTH	1,371	2.5	$3,427
Confimatory Soil Sample Analysis - Area A (Expl, Lead, Dioxins, Perchlorate, Pest.)	EA	1,093	43	$47,016
Confimatory Soil Sample Analysis - Area B (Expl.,Lead, Dioxins, Perchlorate, Pest., PCBs)	EA	1,170	49	$57,350
Non-Hazardous Soil Disposal (T&D)	TON	86	9,997	$857,743
Hazardous Soil Treatment and Disposal (T&D)	TON	260	2,057	$533,997
			Subtotal Task 1.2	$1,852,605
Task 1.3 Site Restoration				
Topsoil				
Hydroseeding	SF	0.21	31,310	$6,558
Erosion Control Matting	SY	1.86	4,175	$7,766
Vehicle for Site Restoration Oversight	WK	350	1	$350
Vehicle Fuel for Site Restoration Oversight	GAL	3.78	34	$128
Per Diem for Site Restoration Oversight	DAY	152	5	$761
Equipment and Supplies for Site Restoration Oversight	EVENT	174	1	$174
			Subtotal Task 1.3	$15,736
			Subtotal Task 1	$1,943,468
Task 2 Enhanced *In Situ* Bioremediation of Groundwater				
Task 2.1 - Pilot Test				
Driller Mobilization	EA	1	1,265	$1,265
Tractor w/Forks & Bucket to Move IDM Drums	WK	1	1,000	$1,000
6" Air Drilling: 1-40 ft injection point and 10-40 ft points	FT	20	440	$8,712
2" Monitoring Well/Injection Well Installation	FT	24	440	$10,648
6" Surface Casing	EA	165	2	$330
4' x 4' Concrete Pads	EA	330	2	$660
Bollards - Furnish and Install/Paint	EA	99	2	$198
Flush Mount Well Completion	EA	165	9	$1,485
Decontamination	HR	248	11	$2,723
Decontamination Equipment - Steam Cleaner and Water Tank	DAY	110	4	$484
Temporary Decontamination Structure	EA	660	1	$660
Initial Well Development: Air Lift with 1" Pipe	HR	303	11	$3,328
Driller Per Diem	DAY	144	4	$576
55 DOT Drum - Furnish and Fill and Move to Accumulation Area	EA	99	55	$5,445
IDM Waste Characterization - Cuttings (pH, Full TCLP, Explosives,Paint Filter, Explosives)	EA	1,503	1	$1,503
IDM Waste Characterization - Decon Water (pH, Full TCLP, COD)	EA	1,141	1	$1,141
Non-Hazardous IDM Transportation	EA	660	1	$660
Non-Hazardous IDM Disposal	DRUM	78	55	$4,296
Vehicle for Well Installation Oversight and Well Development	DAY	58	8	$464
Vehicle Fuel for Well Installation Oversight and Well Development	GAL	3.78	62	$233
Per Diem for Well/Injection Point Installation Oversight and Well Development	DAY	152	12	$1,826
Equipment for Well/Injection Point Installation	WK	273	1	$273
Final Well Development: Surge and Pump Equipment	WK	871	1	$871

Table 11-2 (Cont'd)
Cost Estimate: Corrective Measures Alternative Three
Excavation of Soil, Offsite Disposal, and Enhanced *In Situ* Bioremediation of Groundwater
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Capital Costs (continued)

Item	Units	Unit Cost ($)	Quantity	Total ($)
Task 2.1 - Pilot Test (Cont'd)				
Injection Event Mobilization	EA	5,000	1	$5,000
Emulsified Soybean Oil	LB	4.31	600	$2,587
Water Truck Rental	DAY	820	2	$1,639
Mix and Injection Tank (250-Gallon Tank)	EA	440	1	$440
Miscellaneous Injection Materials	LS	1,100	1	$1,100
Vehicle for Injection Oversight	DAY	58	2	$116
Vehicle Fuel for Injection Oversight	GAL	3.78	29	$111
Per Diem for Injection Oversight	DAY	152	2	$304
Per Diem for Groundwater Monitoring (2 person team)	DAY	152	55	$8,369
Vehicle for Groundwater Monitoring	DAY	58	46	$2,668
Fuel for Groundwater Monitoring	GAL	3.78	296	$1,116
Groundwater Monitoring/Sampling Equipment (10 Weekly Events and 1 Final Sample Event)	MONTH	1481	3	$4,443
Sample Cooler Shipping	EA	90	28	$2,513
Groundwater Sample Analysis (Explosives, Perchlorate, TOC/DIC, Nitrate, and Sulfate)	EA	384	64	$24,570
			Subtotal Task 2.1	$103,756
Task 2.2 - Well/Injection Point Installation for Full Scale Implementation				
Driller Mobilization	EA	1,265	1	$1,265
Tractor w/Forks & Bucket to Move IDM Drums	WK	1,100	3	$3,300
6" Air Drilling: 25-40 ft injection points and 4 monitoring wells	FT	20	1,160	$22,968
2" Monitoring Well/Injection Point Installation	FT	24	1,160	$28,072
6" Surface Casing	EA	165	4	$660
4' x 4' Concrete Pads	EA	330	4	$1,320
Bollards - Furnish and Install/Paint	EA	99	4	$396
Flush Mount Well Completion	EA	165	25	$4,125
Decontamination	HR	248	29	$7,178
Decontamination Equipment - Steam Cleaner and Water Tank	DAY	110	15	$1,650
Temporary Decontamination Structure	EA	660	1	$660
Initial Well Development: Air Lift with 1" Pipe	HR	303	29	$8,773
Driller Per Diem	DAY	144	15	$2,162
55 DOT Drum - Furnish and Fill and Move to Accumulation Area	EA	99	165	$16,286
IDM Waste Characterization - Cuttings (pH, Full TCLP, Explosives,Paint Filter, Explosives)	EA	1,503	2	$3,005
IDM Waste Characterization - Decon Water (pH, Full TCLP, COD)	EA	1,141	1	$1,141
Non-Hazardous IDM Transportation	EA	660	1	$660
Non-Hazardous IDM Disposal	DRUM	78	165	$12,887
Vehicle for Well/Injection Point Installation Oversight and Well Development	MONTH	1,445	1	$1,445
Vehicle Fuel for Well/Injection Point Installation Oversight and Well Development	GAL	3.78	101	$383
Per Diem for Well/Injection Point Installation Oversight and Well Development	DAY	152	34	$5,174
Equipment for Well/Injection Point Installation	WK	273	3	$819
Final Well Development: Surge and Pump Equipment	WK	871	2	$1,742
			Subtotal Task 2.2	$126,069
Task 2.3 - Injection of Emulsified Edible Soybean Oil				
Injection Contractor Mobilization and Demobilization	EA	5500	1	$5,500
Emulsified Soybean Oil	DRUM	856	57	$48,806
Emulsified Soybean Oil Freight	LS	2,033	1	$2,033
Water Truck Rental	DAY	918	9	$8,261
Flatbed Truck Rental	DAY	326	9	$2,938
Generator Rental	DAY	246	9	$2,218
Injection Tank (1,000 Gallon)	EA	1,210	1	$1,210
Miscellaneous Injection Materials	LS	5,500	1	$5,500
Injection Contractor Per Diem	EA	152	18	$2,739
Vehicle for Injection Oversight	WK	350	2	$700
Vehicle Fuel for Well/Injection Point Installation Oversight and Well Development	GAL	3.78	68	$255
Per Diem for Injection Oversight	DAY	152	9	$1,370
Equipment for Injection Oversight	WK	174	2	$348
			Subtotal Task 2.3	$81,877
Task 2.4 Site Close-Out/Monitoring Well Abandonment				
Driller Mobilization	EA	550	1	$550
2" Well/Injection Point Abandonment: Pressure Grout in Place	FT	11	2,120	$23,320
Remove of Stickup Surface Completion	EA	303	15	$4,538
Removal of Flush Mount Surface Completion	EA	110	38	$4,180
Decontamination	HR	248	27	$6,559
Decontamination Equipment - Steam Cleaner and Water Tank	DAY	110	10	$1,100
Driller Per Diem	DAY	144	10	$1,441
Containerization and Disposal of Solid Waste	EA	165	53	$8,745
Vehicle for Well Abandonment Oversight	WK	350	2	$700
Vehicle for Well/Injection Point Abandonment	GAL	3.78	68	$255
Per Diem for Injection Oversight	DAY	152	9	$1,370
Equipment for Injection Oversight	WK	174	2	$348
			Subtotal Task 2.4	$53,106
			Subtotal Task 2	$364,808

Table 11-2 (Cont'd)
Cost Estimate: Corrective Measures Alternative Three
Excavation of Soil, Offsite Disposal, and Enhanced *In Situ* Bioremediation of Groundwater
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Capital Costs (continued)

Item	Units	Unit Cost ($)	Quantity	Total ($)
			Subtotal Tasks 1 and 2	$2,308,276
	Project Management (5%)			$115,414
	Planning Documents (5%)			$92,331
	Construction Oversight (9%)			$207,745
	Reporting (1%)			$23,083
	As Built Drawings (1%)			$23,083
	Permitting (2%)			$46,166
	Other Direct Costs (10% of Labor)			$50,782
			Total - Tasks 1 and 2	$2,866,879
	Engineering Design (4.5%)			$103,872
	Contingency (20%)			$573,376
			Total Capital Costs	$3,544,128

Annual O&M Costs

Item	Units	Unit Cost ($)	Quantity	Total ($S)
Performance Groundwater Monitoring				
Groundwater Sampling - Field Labor	HR	66	408	$26,928
Surface Water/Sediment Pore Water Sampling - Labor	HR	66	20	$1,320
Groundwater Sampling Equipment and Supplies	EVENT	729	4	$2,917
Hach Test Kit for Fe and Mg in Groundwater	EVENT	27	4	$107
Surface Water/Sediment Pore Water Equipment	EVENT	279	1	$279
Per Diem	DAY	152	42	$6,391
Vehicle	DAY	58	21	$1,218
Vehicle Fuel	GAL	3.78	134	$506
Sample Cooler Shipping	EA	90	50	$4,488
Groundwater Sample Analysis (Expl, Perchlorate, TOC, DIC, Nitrate, Sulfate)	EA	384	76	$29,176
Surface Water/Pore Water Sample Analysis (Expl, Perchlorate)	EA	257	12	$3,089
			Subtotal	$76,419
Reporting				
Quarterly Operational and Monitoring Report	EA	7500	4	$30,000
			Subtotal	$30,000
			Subtotal Annual O&M Cost	$106,419
	Project Management (10.5%)			$11,174
			Total Annual O&M Cost	$117,593
	Contingency (20%)			$23,519
			Total Annual O&M Cost	$141,112
			Estimated Total Cost with 6 Years of O&M	**$4,390,799**
			Present Value @ 4.6%	**$4,269,622**

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12.0 RANKING OF CORRECTIVE MEASURES ALTERNATIVES

The three corrective measures alternatives presented in Section 9.0 and evaluated in Section 10.0 are assessed in this section using a numerical ranking system. The alternatives are ranking according to the criteria discussed in Section 10.0 including effectiveness, implementability, and cost. Each selection criterion for each alternative is ranked 1 through 5. A score of 1 indicates a least favorable ranking value and a score of 5 indicates most favorable ranking value.

Criteria are also weighted based on importance. Effectiveness is given a weight factor of 3, because the primary purpose of the selected alternative is to be protective of human health and the environment. Implementability is given a weight factor of 2. Costs are given a weight factor of 1 because this criterion is considered the least important for selection of an alternative. The ranking for the three alternatives is presented in Table 12-1.

Based on the ranking, Alternative Two - Excavation of Soil, Offsite Disposal, and Monitored Natural Attenuation of Groundwater, is the selected alternative for SWMU 54.

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Table 12-1
Ranking Assessment of Corrective Measures Alternatives
SWMU 54 RFI/CMS Report
Radford Army Ammunition Plant, Radford, Virginia

Alternative	Effectiveness	Implementability	Cost	Total Score
Alternative One - No Further Action	Alternative One is not protective of human health because potential future leaching to groundwater at levels of potential concern is not addressed and identified risks to industrial and residential receptors are not addressed. Alternative One does not address potential ecological risks to wildlife identified for surface soil at Area B. 3 3X 1	The alternative does not include any actions which require implementation. Admistratively, this alternative would require the regulatory community waive risk standards and criteria and therefore, is not implementable. 2 2X 1	Capital Cost: $0 Annual O&M Cost: $0 Total Cost w/8 years of O&M: $0 PV @4.6%: $0 5 1X 5	10
Alternative Two - Excavation of Soil at Area A and Area B, Offsite Disposal, and Monitored Natural Attenuation of Groundwater	Alternative Two provides for overall protection of human health and the environment by removal of soil containing COI concentrations above risk-based RGs under the most restrictive residential and soil-to-groundwater pathways. It also addresses potential ecological risks for surface soil at Area B. Removal of soil source areas will prevent further impacts to groundwater at Area A, allow for continued natural attenuation of COIs in groundwater, and at Area B it will prevent leaching of constituents to groundwater at levels of concern. This alternative will provide for long-term reliability and effectiveness, with RGs in groundwater expected to be achieved within 5 years (plus 3 years of demonstrating achievement of RGs). If the MNA remedy does not perform as expected, then a contingency remedy (such as Alternative 3) may be required to provide for the necessary long-term effectiveness. Land use controls will not be required for this alternative. 12 3X 4	This alternative is easily implemented, all services and materials included in this alternative are readily available and represent well proven technologies. This alternative is administratively feasible and is expected to be routine in terms of administrative requirements. It is anticipated that this alternative will be implemented as a final interim measure and therefore, it will not require a modification of the facility's RCRA Corrective Action Permit at the time of implementation. Implementation of this alternative will not require special permits for management, treatment, transportation, or disposal of waste. Facility-specific permits will be required to complete the work including an area entry permit and hot work permit. An approved erosion and sediment control plan (approval by Pulaski County) will be required prior to land disturbance activities given that more than a 10,000ft^2 area will be disturbed at the site. 10 2X 5	Capital Cost: $2,930,534 Annual O&M Cost: $121,881 Total Cost w/8 years of O&M: $3,905,586 PV @4.6%: $3,731,176 4 1X 4	26
Alternative Three - Excavation of Soil at Area A and Area B, Offsite Disposal, and Enhanced *In Situ* Bioremediation of Groundwater	Alternative Three provides for overall protection of human health and the environment by removal of soil containing COI concentrations above risk-based RGs under the most restrictive residential and soil-to-groundwater pathways. It also addresses potential ecological risks for surface soil at Area B. Removal of soil source areas will prevent further impacts to groundwater at Area A and when coupled with enhanced *in situ* bioremediation of groundwater will compliment natural attenuation processes already occurring and allow for a reduction of COI concentrations to levels at or below RGs. Source removal at Area B will prevent leaching of constituents to groundwater at levels of concern. This alternative will provide for long-term reliability and effectiveness with RGs in groundwater expected to be achieved within 3 years (plus 3 years of demonstrating achievement of RGs). Land use controls will not be required for this alternative. 15 3X 5	The soil component of this alternative is readily implementable. All services and materials included in this alternative are readily available. The groundwater component may require a permit for groundwater injection and will require pilot studies to demonstrate the applicability to site conditions and that adverse impact to state waters will not occur from remedy implementation and therefore, the time for implementation will increase when compared to monitored natural attenuation performance monitoring. It is anticipated that this alternative will be implemented as a final interim measure and therefore, it will not require a modification of the facility's RCRA Corrective Action Permit at the time of implementation. Implementation of this alternative will not require special permits for management, treatment, transportation, or disposal of waste. Facility-specific permits will be required to complete the work including an area entry permit and hot work permit. An approved erosion and sediment control plan (approval by Pulaski County) will be required prior to land disturbance activities given that mor at the site. 6 2X 3	Capital Cost: $3,350,562 Annual O&M Cost: $129,938 Total Cost w/8 years of O&M: $4,130,189 PV @4.6%: $4,018,608 3 1X 3	24

Notes:

Ranking Value
1 - Least Favorable → 5 - Most Favorable

Weight Factor
Effectiveness 3
Implementabilit 2
Cost 1

Example
10 = Score
2 X 5 = weight factor X ranking value

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13.0 SUBSTANTATION/JUSTIFICATION OF FINAL REMEDY

The RFI/CMS conducted for SWMU 54 evaluated two non-contiguous disposal areas: Area A and Area B. At Area A, explosives were identified as the primary COC in soil for the soil-to-groundwater migration pathway, with explosives and perchlorate identified as COCs in groundwater. At Area B, lead, explosives, and dioxins were identified as the primary COCs in soil for human health. Potential ecological risks were identified in surface soil at Area B for exposure to lead and dioxins.

Based on the results of the RFI fate and transport analysis and risk assessments, the following CMOs were developed in the CMS for each disposal area:

Area A

- CMO No. 1 – Mitigate further leaching of explosives constituents from soil to groundwater at levels that would potentially increase observed concentrations and adversely impact future beneficial use of groundwater; and
- CMO No. 2 – To extent practicable, a goal of restoring site groundwater to the most beneficial use.

Area B

- CMO No. 1 – Mitigate the potential future risks that have been identified for exposure to soil under a future construction worker scenario for lead; and
- CMO No. 2 – Prevent leaching of COCs from soil to groundwater at levels that would potentially adversely impact future beneficial use of groundwater.

Five potentially applicable corrective measure technologies for the site were identified and screened in the CMS with respect to their potential effectiveness and implementability in achieving the identified CMOs and RGs. Three of these technologies, excavation of soil and offsite disposal, MNA of groundwater, and enhanced *in situ* bioremediation of groundwater, were retained for development of corrective measures alternatives based on the results of the technology screening. Two corrective measures alternatives were developed from these technologies in addition to a baseline no further action alternative including:

- Alternative No. 1: No Further Action;
- Alternative No. 2: Excavation of Soil at Area A and Area B, Offsite Disposal, and MNA of Groundwater; and
- Alternative No. 3: Excavation of Soil at Area A and Area B, Offsite Disposal, and Enhanced *In Situ* Bioremediation of Groundwater.

The three alternatives were evaluated with respect to criteria specified in Attachment D of the RFAAP RCRA Permit (EPA 2000) and criteria for evaluating corrective measures alternatives in Section IV Part E of the RCRA Corrective Plan guidance document (EPA 1994a). Alternatives Two and Three were found to achieve the CMOs and RGs, with both alternatives achieving unrestricted future use of the site after remedy completion. Alternatives Two and Three both have the same soil remedy component-excavation of soil and offsite disposal. For groundwater, Alternative Two and Alternative Three use MNA of groundwater and enhanced *in situ* treatment of groundwater as the remedies, respectively.

Alternative Two was selected as the final alternative for SWMU 54 because it will effectively achieve the CMOs and RGs while also providing for future unrestricted use of the site. Removal of the soil source areas will prevent future leaching of COCs to groundwater and allow for continued attenuation of COCs in groundwater to levels at or below RGs; thereby restoring groundwater. In addition, implementation of Alternative Two will not result in potential adverse effects to groundwater (i.e., degradation of secondary water quality parameters) from remedial implementation activities, which would occur with

implementation of Alternative Three. These potential effects along with groundwater injection proximate to surface water would make implementation of Alternative Three more difficult compared with Alternative Two. Alternative Three would likely require a longer duration to implement than Alternative Two due to potential permitting requirements for groundwater injection, and/or studies and monitoring that would be required to demonstrate that adverse impacts to surface water would not occur from groundwater injection. In combination with source removal, the low-levels of dissolved phase constituents detected in groundwater and observed attenuation of COC concentrations in groundwater since 2003 also support implementation of Alternative Two. Alternative Two is also more cost-effective in achieving the CMOs and RGs, with 17% lower capital cost, 9% lower total cost, and 11% lower present value cost.

Implementation of Alternative Two is expected to be completed in less than one year, with soil excavation and backfilling requiring approximately 3 months to complete. MNA of groundwater is expected to require five years or less of performance groundwater monitoring to demonstrate achievement of CMOs and RGs based on observed attenuation rates of COCs in groundwater relative to established RGs and source area removal. For purposes of the CMS, an additional three years of monitoring has been assumed to demonstrate continued achievement of CMOs and RGs before site closeout. This time frame is considered an estimate and the actual time to complete the corrective measures will be subject to site-specific conditions. In the event that the proposed MNA remedy does not perform as expected within timeframes specified in the remedy implementation plan, potential contingencies will be identified in the plan, which would include as one option, implementation of elements contained in Alternative Three to provide for enhanced bioremediation of groundwater in area or areas where the remedy is not performing as expected.

Implementation of Alternative Two will include the following:

- Pre-characterization of waste;
- Excavation of soil from Area A and Area B so that remaining soil is at or below the RGs;
- Transportation and offsite disposal of soil;
- Site restoration of excavation areas including backfilling, grading, seeding, etc.;
- Installation of supplemental monitoring network for MNA of groundwater;
- Quarterly performance groundwater monitoring and annual monitoring of surface water/sediment pore water of the New River until achievement and maintenance of RGs; and
- Closeout/abandonment of site monitoring wells.

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APPENDIX A

PHOTOGRAPHIC LOG

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PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
RFAAP	Radford, Virginia	11656351

Photo No.	Date:
1	7/21/2005

Direction Photo Taken:

S

Description:

SWMU 54: View looking south along fence line towards Area A; New River flows north to the left of the frame.



Photo No.	Date:
2	7/21/2005

Direction Photo Taken:

SSW

Description:

SWMU 54: View across SWMU 54; Area A is towards the left side of the frame and Area B is to the right.



PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
RFAAP	Radford, Virginia	11656351

Photo No.	Date:
3	7/21/2005

Direction Photo Taken:

W

Description:

SWMU 54: View of Area B in SWMU 54.



Photo No.	Date:
4	7/21/2005

Direction Photo Taken:

S

Description:

SWMU 54: View of Area A in SWMU 54.



PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
RFAAP	Radford, Virginia	11656351

Photo No.	Date:
5	7/21/2005

Direction Photo Taken:

W

Description:

SWMU 54: View of drainage running west-east to the New River south of SWMU 54. Drainage had flowing water during the time of the recon but does not appear to support a permanent aquatic community as no invertebrates nor fish were observed.



Photo No.	Date:
6	7/21/2005

Direction Photo Taken:

SE

Description:

SWMU 54: Overview of SWMU 54 from road on the top of the ridge to the west.



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APPENDIX B

STANDARD OPERATING PROCEDURES

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Standard Operating Procedures

SOP SERIES	TITLE
10.0	**DOCUMENTATION**
10.1	Field Logbook
10.2	Surface Water, Groundwater, and Soil/Sediment Field Logbooks
10.3	Boring Logs
10.4	Chain-of-Custody Forms
20.0	**SUBSURFACE INVESTIGATION**
20.1	Monitoring Well Installation
20.2	Monitoring Well Development
20.3	Well and Boring Abandonment
20.4	Test Pits
20.11	Drilling Methods and Procedures
20.12	Direct Push Groundwater Sampling
30.0	**SAMPLING**
30.1	Soil Sampling
30.2	Groundwater Sampling
30.3	Surface Water Sampling
30.4	Sediment Sampling with Scoop or Tube Sampler
30.7	Sampling Strategies
30.9	Collection of Soil Samples By USEPA SW 846 Method 5035 Using Disposable Samplers
40.0	**FIELD EVALUATION**
40.1	Multiparameter Water Quality Monitoring Instrument
40.2	Water Level and Well-Depth Measurements
40.3	Slug Tests
50.0	**SAMPLE MANAGEMENT**
50.1	Sample Labels
50.2	Sample Packaging
70.0	**INVESTIGATION-DERIVED MATERIAL**
70.1	Investigation-Derived Material
80.0	**DECONTAMINATION**
80.1	Decontamination
90.0	**AIR MONITORING EQUIPMENT**
90.1	Photoionization Detector (HNu Model PI-101 and HW-101)

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STANDARD OPERATING PROCEDURE 10.1
FIELD LOGBOOK

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for recording daily site investigation activities.

Records should contain sufficient information so that anyone can reconstruct the sampling activity without relying on the collector's memory.

2.0 MATERIALS

- Field Logbook;
- Indelible ink pen; and
- Clear tape.

3.0 PROCEDURE

Information pertinent to site investigations will be recorded in a bound logbook. Each page/form will be consecutively numbered, dated, and signed. All entries will be made in indelible ink, and all corrections will consist of line out deletions that are initialed and dated. If only part of a page is used, the remainder of the page should have an "X" drawn across it. At a minimum, entries in the logbook will include but not be limited to the following:

- Project name (cover);
- Name and affiliation of personnel on site;
- Weather conditions;
- General description of the field activity;
- Sample location;
- Sample identification number;
- Time and date of sample collection;
- Specific sample attributes (e.g., sample collection depth flow conditions or matrix);
- Sampling methodology (grab or composite sample);
- Sample preservation, as applicable;
- Analytical request/methods;
- Associated quality assurance/quality control (QA/QC) samples;

- Field measurements/observations, as applicable; and
- Signature and date of personnel responsible for documentation.

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

None.

6.0 REFERENCES

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STANDARD OPERATING PROCEDURE 10.2
SURFACE WATER, GROUNDWATER, AND SOIL/SEDIMENT FIELD LOGBOOKS

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for recording surface water, groundwater, and soil/sediment sampling information, as well as instrument calibration data in field logbooks.

2.0 MATERIAL

- Applicable field logbook (see attached forms); and
- Indelible ink pen.

3.0 PROCEDURE

All information pertinent to surface water, groundwater, or soil/sediment sampling will be recorded in the appropriate logbook. Each page/form of the logbook will be consecutively numbered. All entries will be made with an indelible ink pen. All corrections will consist of line out deletions that are initialed and dated.

3.1 SOIL/SEDIMENT

3.1.1 Field Parameters/Logbook (Form 10.2-a)

1. HIGH CONCENTRATION EXPECTED?: Answer "Yes" or "No.";
2. HIGH HAZARD?: Answer "Yes" or "No.";
3. INSTALLATION/SITE: Record the complete name of the installation or site;
4. AREA: Record the area designation of the sample site;
5. INST. NAME: Record the two-letter installation name for Radford Army Ammunition Plant – "RD";
6. SAMPLE MATRIX CODE: Record the appropriate sample matrix code. Common codes are "SD" for solid - sediment, "SI" for soil - gas, "SL for solid sludge, "SO" for surface other, "SS" for solid – soil, "SW" for surface wipe, "WD" for water – potable, "WG" for water – ground, "WS" water – surface, "WT" – water treated and "WW" water -waste;
7. SITE ID: Record a code up to 20 characters or numbers that is unique to the site;
8. ENV. FIELD SAMPLE IDENTIFIER: Record a code up to 20 characters specific for the sample;
9. DATE: Enter the date the sample was taken;
10. TIME: Enter the time (12-hour or 24-hour clock acceptable as long as internally consistent) the sample was taken;
11. AM PM: Circle "AM" or "PM" to designate morning or afternoon (12-hour clock);

12. SAMPLE PROG: Record "RFI" (RCRA Facility Investigation) or other appropriate sample program;
13. DEPTH (TOP): Record the total depth sampled;
14. DEPTH INTERVAL: Record the intervals at which the plug will be sampled;
15. UNITS: Record the units of depth (feet, meters);
16. SAMPLE MEASUREMENTS: Check the appropriate sampling method;
17. CHK: Check off each container released to a laboratory;
18. ANALYSIS: Record the type of analysis to be performed on each sample container;
19. SAMPLE CONTAINER: Record the sample container type and size;
20. NO.: Record the number of containers;
21. REMARKS: Record any remarks about the sample;
22. TOTAL NUMBER OF CONTAINERS FOR SAMPLE: Record the total number of containers;
23. SITE DESCRIPTION: Describe the location where the sample was collected;
24. SAMPLE FORM: Record the form of the sample (i.e., clay, loam, etc.) using The Unified Soil Classification System (USCS);
25. COLOR: Record the color of the sample as determined from standard Munsell Color Charts;
26. ODOR: Record the odor of the sample or "none";
27. PID: Record the measured PID values or other similar measurement instrument value;
28. UNUSUAL FEATURES: Record anything unusual about the site or sample;
29. WEATHER/TEMPERATURE: Record the weather and temperature; and
30. SAMPLER: Record your name.

3.1.2 Map File Form (refer to form 10.2-c)

1. SITE ID: Record the Site ID from the field parameter form;
2. POINTER: Record the field sample number for the sample being pointed to;
3. DESCRIPTION/MEASUREMENTS: Describe the location where the sample was taken, along with distances to landmarks;
4. SKETCH/DIMENSIONS: Diagram the surroundings and record the distances to landmarks;
5. MAP REFERENCE: Record which U.S.G.S. Quad Map references the site;
6. COORDINATE DEFINITION: Write the compass directions and the X- and Y-coordinates of the map run;
7. COORDINATE SYSTEM: Write "UTM" (Universal Transverse Mercator);
8. SOURCE: Record the 1-digit code representing the Map Reference;
9. ACCURACY: Give units (e.g., write "1-M" for 1 meter);
10. X-COORDINATE: Record the X-coordinate of the sample site location;
11. Y-COORDINATE: Record the Y-coordinate of the sample site location;
12. UNITS: Record the units used to measure the map sections;

13. ELEVATION REFERENCE: Record whether topography was determined from a map or a topographical survey;
14. ELEVATION SOURCE: Record the 1-digit code representing the elevation reference;
15. ACCURACY: Record the accuracy of the map or survey providing the topographical information;
16. ELEVATION: Record the elevation of the sampling site;
17. UNITS: Write the units in which the elevation is recorded; and
18. SAMPLER: Write your name.

3.2 SURFACE WATER

3.2.1 Field Parameter Logbook (Forms 10.2-b and 10.2-c)

1. CAL REF: Record the calibration reference for the pH meter;
2. pH: Record the pH of the sample;
3. TEMP: Record the temperature of the sample in degrees Celsius;
4. COND: Record the conductivity of the water;
5. Description of site and sample conditions (refer to 10.2-b);
6. Map File Form (refer to Section 3.1.2).

3.3 GROUNDWATER (FORMS 10.2- D)

3.3.1 Field Parameter Logbook (Form 10.2.b)

Refer to Section 3.2.1.

3.3.2 Map File and Purging Forms

1. WELL NO. OR ID: Record the abbreviation appropriate for where the sample was taken. Correct abbreviations can be found on pages 18-21 of the IRDMIS User's Guide for chemical data entry;
2. SAMPLE NO.: Record the reference number of the sample;
3. WELL/SITE DESCRIPTION: Describe the location where the sample was taken, along with distances to landmarks;
4. X-COORD AND Y-COORD: Record the survey coordinates for the sampling site;
5. ELEV: Record the elevation where the sample was taken;
6. UNITS: Record the units the elevation was recorded in;
7. DATE: Record the date in the form MM/DD/YY;
8. TIME: Record the time, including a designation of AM or PM;
9. AIR TEMP.: Record the air temperature, including a designation of C or F (Celsius or Fahrenheit);
10. WELL DEPTH: Record the depth of the well in feet and inches;
11. CASING HEIGHT: Record the height of the casing in feet and inches;
12. WATER DEPTH: Record the depth (underground) of the water in feet and inches;
13. WELL DIAMETER: Record the diameter of the well in inches;

14. WATER COLUMN HEIGHT: Record the height of the water column in feet and inches;
15. SANDPACK DIAM.: Record the diameter of the sandpack. Generally, this will be the same as the bore diameter;
16. EQUIVALENT VOLUME OF STANDING WATER: Use one of the following equations to determine one equivalent volume (EV);

    1 EV = volume in casing + volume in saturated sandpack. Or:

    $1\ EV = [\pi R_w^2 h_w + 0.30p(R_s^2 - R_w^2)h_s] * (0.0043)$

Where:

R_s = radius of sandpack in inches
R_w = radius of well casing in inches
h_s = height of sandpack in inches
h_w = water depth in inches

$0.0043 = gal/in^3$

and filter pack porosity is assumed as 30%, or

Volume in casing =
$(0.0043\ gal/in^3)(p)(12\ in/ft)(R_c^2)(W_h)$

Where:

R_c = radius of casing in inches, and
W_h = water column height in feet

Vol. in sandpack =
(0.0043 gal/in3)(p)(12 in/ft)(Rb2 - Rc2)(Wh)(0.30)

(if Wh is less than the length of the sandpack), or

Vol. in sandpack =
(0.0043 gal/in3)(p)(12 in/ft)(Rb2 - Rc2)(Sh)(0.30)

(if Wh is greater than the length of the sandpack).

where:

Rb = radius of the borehole, and
Sh = length of the sandpack.

Show this calculation in the comments section.

1. PUMP RATE: Record pump rate;
2. TOTAL PUMP TIME: Record total purge time and volume;
3. WELL WENT DRY? Write “YES” or “NO”;
4. PUMP TIME: Record pump time that made the well go dry;

5. VOLUME REMOVED: Record the volume of water (gal) removed before the well went dry;
6. RECOVERY TIME: Record the time required for the well to refill;
7. PURGE AGAIN?: Answer "YES" or "NO";
8. TOTAL VOL. REMOVED: Record the total volume of water (in gallons) removed from the well;
9. CAL REF.: Record the calibration reference for the pH meter;
10. TIME: Record time started (INITIAL T(0)), 2 times DURING the sampling and the time sampling ended (FINAL);
11. pH: Record the pH at start of sampling (INITIAL), twice DURING the sampling, and at the end of sampling (FINAL);
12. TEMP: Record the water temperature (Celsius) at the start of sampling, twice DURING the sampling, and at the end of sampling (FINAL);
13. COND: Record the conductivity of the water at the start of sampling, twice DURING the sampling, and at the end of sampling (FINAL);
14. D.O.: Record the dissolved oxygen level in the water at the start of sampling, twice DURING the sampling, and at the end of sampling (FINAL);
15. TURBIDITY: Record the readings from the turbidity meter (nephelometer) and units at the start of sampling, twice DURING the sampling, and at the end of sampling (FINAL);
16. ORD: Record the oxidation/reduction (RedOx) potential of the water sample at the start of sampling, twice DURING the sampling, and at the end of sampling (FINAL);
17. HEAD SPACE: Record any positive readings from organic vapor meter reading taken in well headspace before sampling;
18. NAPL: Record the presence and thickness of any non-aqueous phase liquids (LNAPL and DNAPL)
19. COMMENTS: Record any pertinent information not already covered in the form; and
20. SIGNATURE: Sign the form.

3.4 FIELD CALIBRATION FORMS (REFER TO FORM 10.2-E)

1. Record time and date of calibration;
2. Record calibration standard reference number;
3. Record meter ID number;
4. Record initial instrument reading, recalibration reading (if necessary), and final calibration reading on appropriate line;
5. Record value of reference standard (as required);
6. COMMENTS: Record any pertinent information not already covered on form; and
7. SIGNATURE: Sign form.

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

None.

6.0 REFERENCE

USEPA. 1991. *User's Guide to the Contract Laboratory Program*. EPA/540/O-91/002, Directive 9240.0-01D, Office of Emergency and Remedial Response, January.

FIELD PARAMETER/LOGBOOK FORM 10.2-a
SOIL AND SEDIMENT SAMPLES

HIGH CONCENTRATION EXPECTED? _____ HIGH HAZARD?

INSTALLATION/SITE _____ AREA _____

INST NAME _____ FILE NAME _____

SAMPLE MATRIX CODE _____ SITE ID _____
ENV. FIELD SAMPLE IDENTIFIER _____

DATE (MM/DD/YY) __/__/__ TIME _____ AM PM SAMPLE PROGRAM

DEPTH (TOP) _____ DEPTH INTERVAL _____ UNIT _____

SAMPLING METHOD:

SPLIT SPOON ___ AUGER ___ SHELBY TUBE ___ SCOOP ___ OTHER

CHK	ANALYSIS	SAMPLE CONTAINER	NO.	REMARKS

TOTAL NUMBER OF CONTAINERS FOR SAMPLE_____

DESCRIPTION OF SITE AND SAMPLE CONDITIONS

SITE DESCRIPTION:_____

_____

_____

SAMPLE FORM _____ COLOR _____ ODOR _____

PID (HNu)_____ UNUSUAL FEATURES_____

_____

WEATHER/TEMPERATURE

SAMPLER _____

FIELD PARAMETER/LOGBOOK FORM 10.2-b
GROUNDWATER AND SURFACE WATER SAMPLES

HIGH CONCENTRATION EXPECTED? _____ HIGH HAZARD?

INSTALLATION/SITE _____ AREA

INST CODE _____ FILE NAME _____ SITE TYPE

SITE ID _____ FIELD SAMPLE NUMBER

DATE (MM/DD/YY) __/__/__ TIME _____ AM PM SAMPLE PROG.

DEPTH (TOP) _____ DEPTH INTERVAL _____ UNITS

SAMPLING MEASUREMENTS

CAL REF. _____ pH _____ TEMPERATURE °C _____ CONDUCTIVITY _____ REDOX _____

DISSOLVED OXYGEN ____ TURBIDITY _____ OTHER

CHK	ANALYSIS	SAMPLE CONTAINER	NO.	REMARKS

TOTAL NUMBER OF CONTAINERS FOR SAMPLE_____

DESCRIPTION OF SITE AND SAMPLE CONDITIONS

SITE DESCRIPTION_____

SAMPLING METHOD_____

SAMPLE FORM _____ COLOR _____ ODOR _____

PID (HNu)_____

UNUSUAL FEATURES_____

WEATHER/TEMPERATURE_____ SAMPLER _____

EXAMPLE MAP FILE LOGBOOK FORM 10.2-c
SURFACE WATER, SOIL, AND SEDIMENT SAMPLES

SITE ID_____ POINTER_____

DESCRIPTION/MEASUREMENTS_____

SKETCH/DIMENSIONS :

MAP REFERENCE_____

COORDINATE DEFINITION (X is _____ Y is _____)

COORDINATE SYSTEM _____ SOURCE _____ ACCURACY_____

X-COORDINATE _____ Y-COORDINATE _____ UNITS_____

ELEVATION REFERENCE_____

ELEVATION SOURCE _____ ACCURACY _____ELEVATION_____

UNITS_____

SAMPLER_____

EXAMPLE MAP FILE AND PURGING LOGBOOK FORM 10.2-d
GROUNDWATER SAMPLES

WELL COORD. OR ID _____ SAMPLE NO._____

WELL/SITE DESCRIPTION_____

_____

X-COORD. _____ Y-COORD. _____ ELEV. _____ UNITS

DATE ____/____/____ TIME _____ AIR TEMP.

WELL DEPTH _____ FT. _____ IN. CASING HT. _____ FT. _____ IN.

WATER DEPTH _____ FT. _____ IN. WELL DIAMETER _____ IN.

WATER COLUMN HEIGHT _____ FT. _____ IN. SANDPACK DIAM. _____ IN.

EQUIVALENT VOLUME OF STANDING WATER _____ (GAL) (L)

VOLUME OF BAILER _____ (GAL) (L) or PUMP RATE _____ (GPM) (LPM)

TOTAL NO. OF BAILERS (5 EV) _____ or PUMP TIME _____ MIN.

WELL WENT DRY? [Yes] [No] NUM. OF BAILERS _____ or PUMP TIME

VOL. REMOVED _____ (GAL) (L) RECOVERY TIME

PURGE AGAIN? [Yes] [No] TOTAL VOL. REMOVED _____ (GAL) (L)

DATE & TIME	QUANTITY REMOVED	TIME REQ'D	pH	Cond	Temp	ORD	Turb	DO	Character of water (color / clarity / odor / partic.)
(before)									
(during)									
(during)									
(during									
(after)									

COMMENTS_____

SIGNATURE _____

EXAMPLE FIELD CALIBRATION FORM 10.2-e
FOR pH, CONDUCTIVITY, TEMPERATURE, TURBIDITY,
ORD, AND DISSOLVED OXYGEN METERS

INITIAL CALIBRATION	FINAL CALIBRATION
DATE:	**DATE:**
TIME:	**TIME:**

pH METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO:_____

METER ID_____

pH STANDARD	INITIAL READING	RECALIB. READING	FINAL READING
7.0			
10.0			
4.0			

CONDUCTIVITY METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO:_____

METER ID_____

COND. STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

TEMPERATURE METER CALIBRATION

METER ID_____

TEMP. STANDARD	INITIAL READING	RECALIB. READING	FINAL READING
ICE WATER			
BOILING WATER			
OTHER _____			

EXAMPLE FIELD CALIBRATION FORM 10.2-e
FOR pH, CONDUCTIVITY, TEMPERATURE, TURBIDITY,
ORD, AND DISSOLVED OXYGEN METERS

TURBIDITY METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO:_____

METER ID_____

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

ORD METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO:_____

METER ID_____

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

DISSOLVED OXYGEN METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO:_____

METER ID_____

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

COMMENTS_____

SIGNATURE_____

STANDARD OPERATING PROCEDURE 10.3
BORING LOGS

1.0 INTRODUCTION

The purpose of this standard operating procedure (SOP) is to describe the methods to be followed for classifying soil and rock, as well as preparing borehole logs and other types of soil reports.

2.0 MATERIALS

The following equipment is required for borehole logging:

- HTRW ENG Form 5056-R and 5056A-R boring log forms;
- Daily inspection report forms;
- Chain-of-custody forms;
- Request for analysis forms;
- ASTM D 2488 classification flow chart;
- Soil and/or Rock color chart (i.e., Munsell®);
- Grain size and roundness chart;
- Graph paper;
- Engineer's scale;
- Previous reports and boring logs;
- Pocketknife or putty knife;
- Hand lens;
- Dilute hydrochloric acid (10% volume);
- Gloves;
- Personal protective clothing and equipment, as described in work plan addenda health and safety plan;
- Photoionization detector or other appropriate monitoring equipment per site-specific health and safety plan; and
- Decontamination supplies (SOP 80.1).

3.0 PROCEDURE

Each boring log should fully describe the subsurface environment and the procedures used to obtain this description.

Boring logs should be prepared in the field on USACE Engineer Form 5056-R and 5056-R. Logs should be recorded in the field directly on the boring log form and not transcribed from a field book.

A "site geologist" should conduct borehole logging and soil/rock identification and description or other professional trained in the identification and description of soil/rock.

3.1 BORING LOG INFORMATION

As appropriate, the following information should be recorded on the boring log during the course of drilling and sampling activities:

- Project information including name, location, and project number;
- Each boring and well should be uniquely numbered and located on a sketch map as part of the log;
- Type of exploration;
- Weather conditions including events that could affect subsurface conditions;
- Dates and times for the start and completion of borings, with notations by depth for crew shifts and individual days;
- Depths/heights in feet and in decimal fractions of feet;
- Descriptions of the drilling equipment including rod size, bit type, pump type, rig manufacturer and model, and drilling personnel;
- Drilling sequence and descriptions of casing and method of installation;
- Description and identification of soils in accordance with ASTM Standard D 2488;
- Descriptions of each intact soil sample for the parameters identified in Section 3.2;
- Descriptions and classification of each non-intact sample (e.g., wash samples, cuttings, auger flight samples) to the extent practicable;
- Description and identification of rock;
- Description of rock (core(s)) for the parameters identified in Section 3.7;
- Scaled graphic sketch of the rock core (included or attached to log) according to the requirements identified in Section 3.7;
- Lithologic boundaries, with notations for estimated boundaries;
- Depth of water first encountered in drilling, with the method of first determination (any distinct water level(s) below the first zone will also be noted);
- Interval by depth for each sample taken, classified, and/or retained, with length of sample recovery and sample type and size (diameter and length);
- Blow counts, hammer weight, and length of fall for driven samplers;

- Rate of rock coring and associated rock quality designation (RQD) for intervals cored;
- Drilling fluid pressures, with driller's comments;
- Total depth of drilling and sampling;
- Drilling fluid losses and gains should be recorded;
- Significant color changes in the drilling fluid returned;
- Soil gas or vapor readings with the interval sampled, with information on instrument used and calibration;
- Depth and description of any in-situ test performed; and
- Description of other field tests conducted on soil and rock samples.

3.2 SOIL PARAMETERS FOR LOGGING

In general, the following soil parameters should be included on the boring log when appropriate:

- Identification per ASTM D 2488 with group symbol;
- Secondary components with estimated percentages per ASTM D 2488;
- Color;
- Plasticity per ASTM D 2488;
- Density of non-cohesive soil or consistency of cohesive soil;
- Moisture condition per ASTM D 2488 (dry, moist, or wet);
- Presence of organic material;
- Cementation and HCL reaction testing per ASTM D 2488;
- Coarse-grained particle description per ASTM D 2488 including angularity, shapes, and color;
- Structure per ASTM D 2488 and orientation;
- Odor; and
- Depositional environment and formation, if known.

ASTM D 2488 categorizes soils into 13 basic groups with distinct geologic and engineering properties based on visual-manual identification procedures. The following steps are required to classify a soil sample:

1. Observe basic properties and characteristics of the soil. These include grain size grading and distribution, and influence of moisture on fine-grained soil.
2. Assign the soil an ASTM D 2488 classification and denote it by the standard group name and symbol.
3. Provide a written description to differentiate between soils in the same group if necessary.

Many soils have characteristics that are not clearly associated with a specific soil group. These soils might be near the borderline between groups, based on particle distribution or plasticity characteristics. In such a case, assigning dual group names and symbols (e.g., GW/GC or ML/CL) might be an appropriate method of

describing the soil. The two general types of soils, for which classification is performed, coarse- and fine-grained soils, are discussed in the following sections.

3.3 COURSE-GRAINED SOIL IDENTIFICATION

For soils in the coarse-grained soils group, more than half of the material in the soil matrix will be retained by a No. 200 sieve (75-μm).

1. Coarse-grained soils are identified on the basis of the following:
   a) Grain size and distribution;
   b) Quantity of fine-grained material (i.e., silt and clay as a percentage); and
   c) Character of fine-grained material.
2. The following symbols are used for classification:

Basic Symbols			Modifying Symbols
G	=	gravel	W = well graded
S	=	sand	P = poorly graded
			M = with silty fines
			C = with clayey fines

3. The following basic facts apply to coarse-grained soil classification.

- The basic symbol G is used if the estimated percentage of gravel is greater than that for sand. In contrast, the symbol S is used when the estimated percentage of sand is greater than the percentage of gravel.
- Gravel ranges in size from 3-inch to 1/4-inch (No. 4 sieve) diameter. Sand ranges in size from the No. 4 sieve to No. 200 sieve. The Grain Size Scale used by Engineers (ASTM Standards D 422-63 and D 643-78) is the appropriate method to further classify grain size as specified by ASTM D 2488.
- Modifying symbol W indicates good representation of all particle sizes.
- Modifying symbol P indicates that there is an excess or absence of particular sizes.
- The symbol W or P is used only when there are less than 15% fines in a sample.
- Modifying symbol M is used if fines have little or no plasticity (silty).
- Modifying symbol C is used if fines have low to high plasticity (clayey).

Figure 10.03a is a flowchart for identifying coarse-grained soils by ASTM D 2488.

3.4 FINED-GRAINED SOIL IDENTIFICATON

If one-half or more of the material will pass a No. 200 sieve (75 μm), the soil is identified as fine-grained.

1. Fine-grained soils are classified based on dry strength, dilatancy, toughness, and plasticity.
2. Classification of fine-grained soils uses the following symbols:

Basic Symbols			Modifying Symbols		
M	=	silt (non plastic)	L	=	low liquid limit (lean)
C	=	clay (plastic)	H	=	high liquid limit (fat)
O	=	organic			
Pt	=	peat			

3. The following basic facts apply to fine-grained soil classification:
   - The basic symbol M is used if the soil is mostly silt, while the symbol C applies if it consists mostly of clay.
4. Use of symbol O (group name OL/OH) indicates that organic matter is present in an amount sufficient to influence soil properties. The symbol Pt indicates soil that consists mostly of organic material.

- Modifying symbols (L and H) are based on the following hand tests conducted on a soil sample:
  - — Dry strength (crushing resistance).
  - — Dilatancy (reaction to shaking).
  - — Toughness (consistency near plastic limit).
- Soil designated ML has little or no plasticity and can be recognized by slight dry strength, quick dilatency, and slight toughness.
- CL indicates soil with slight to medium plasticity, which can be recognized by medium to high dry strength, very slow dilatancy, and medium toughness.

Criteria for describing dry strength per ASTM D 2488 are as follows:

Description	Criteria
None	Dry sample crumbles into powder with pressure of handling
Low	Dry specimen crumbles into powder with some finger pressure
Medium	Dry specimen breaks into pieces or crumbles with considerable finger pressure
High	Dry specimen cannot be broken with finger pressure but will break into pieces between thumb and a hard surface
Very high	Dry specimen cannot be broken between the thumb and a hard surface stiffness

Criteria for describing dilatancy per ASTM D 2488 are as follows:

None	No visible change in the sample
Slow	Water appears slow on the surface of the sample during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the sample during shaking and disappears quickly upon squeezing

Criteria for describing toughness per ASTM D 2488 are as follows:

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit and the thread and lump are weak and soft
Medium	Medium pressure is required to roll the thread to near the plastic limit and the thread and lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit and the thread and lump have very high stiffness

Figure 10.03b is a flowchart for identifying fine-grained soils by ASTM D 2488.

3.5 DENSITY AND CONSISTENCY

Relative density for coarse-grained soils and consistency for fine-grained soils can be estimated using standard penetration test blow count data (ASTM D 1586). The number of blows required for each 6 inches of penetration or fraction thereof is recorded. If the sampler is driven less than 18 inches, the number of blows per each complete 6-inch interval and per partial interval is recorded.

For partial increments, the depth of penetration should be recorded to the nearest 1 inch. If the sampler advances below the bottom of the boring under the weight of rods (static) and/or hammer, then this information should be recorded on the log.

The following are some "rule-of-thumb" guidelines for describing the relative density of coarse-grained soils:

Blow Count	Relative Density for Sand
0–4	Very loose
4–10	Loose
10–30	Medium dense
30–50	Dense
>50	Very Dense

The following are some "rule-of-thumb" guidelines for describing the consistency of fine-grained soils:

Blow Count	Consistency for Clays	Description
0–2	Very Soft	Sample sags or slumps under its own weight
2–4	Soft	Sample can be pinched in two between the thumb and forefinger
4–8	Medium Stiff	Sample can be easily imprinted with fingers
8–16	Stiff	Sample can be imprinted only with considerable pressure of fingers
16–32	Very Stiff	Sample can be imprinted very slightly with fingers
>32	Hard	Sample cannot be imprinted with fingers; can be pierced with pencil

3.6 OTHER DESCRIPTIVE INFORMATION

The approximate percentage of gravel, sand, and fines (use a percentage estimation chart) should be recorded per ASTM D 2488 as follows:

Modifiers	Descriptions
Trace	Less than 5%
Few	5%–10%
Little	15%–25%
Some	30%–45%
Mostly	50%–100%

Color/discoloration should be recorded and described using a soil color chart, such as the Munsell® Soil Color Charts. A narrative and numerical description should be given from the color chart, such as Brown 10 YR, 5/3 (Munsell®). Odor should be described if organic or unusual.

Plasticity should be described as follows:

Description	Criteria
Non-plastic	A 1/8-inch thread cannot be rolled at any water content
Low	Thread can barely be rolled and lump cannot be formed when drier than plastic limit.
Medium	Thread is easy to roll; plastic limit can be reached with little effort and lump crumbles when drier than plastic limit.
High	Considerable time is required to reach the plastic limit and lump can be formed without crumbling when drier than plastic limit

Moisture condition should be recorded as dry (absence of moisture), moist (damp but no visible water) or wet (visible free water).

Cementation should be recorded (carbonates or silicates) along with the results of HCL reaction testing. The reaction with HCL should be described as none (no visible reaction), weak (some reaction with slowly forming bubbles) or strong (violent reaction with bubbles forming immediately).

Particle description information for coarse-grained soil should be recorded where appropriate per ASTM D 2488 including maximum particle size, angularity (angular, subangular, subrounded, or rounded), shape (flat, elongated or flat and elongated), and color.

Structure (along with orientation) should be reported using the following ASTM D 2488 descriptions:

Description	Criteria
Stratified	Alternating layers of varying material or color with layers greater than 6 millimeters thick
Laminated	Alternating layers of varying material or color with layers less than 6 millimeters thick
Fissured	Breaks along definite planes of fracture with little resistance
Slickensided	Fracture planes that appear polished or glossy, can be striated
Blocky	Inclusion of small pockets of different soils
Homogeneous	Same color and appearance throughout

3.7 ROCK CORE PARAMETERS FOR LOGGING

In general, the following parameters should be included on the boring log when rock coring is conducted:

- Rock type;
- Formation;
- Modifier denoting variety;
- Bedding/banding characteristics;
- Color;
- Hardness;
- Degree of cementation;
- Texture;
- Structure and orientation;
- Degree of weathering;
- Solution or void conditions;
- Primary and secondary permeability including estimates and rationale; and
- Lost core interval and reason for loss.

A scaled graphic sketch of the core should provided on or attached to the log, denoting by depth, location, orientation, and nature (natural, coring-induced, or for fitting into core box) of all core breaks. Where fractures are too numerous to be shown individually, their location may be drawn as a zone.

The RQD values for each core interval (run) should be calculated and included on the boring log. The method of calculating the RQD is as follows per ASTM D 6032:

RQD = [Σ length of intact core pieces > 100 mm (4-inches)] x 100%/total core length.

3.8 PROCEDURES FOR ROCK CLASSIFICATION

For rock classification record mineralogy, texture, and structural features (e.g., biotite and quartz fine grains, foliated parallel to relict bedding oriented 15 to 20 degrees to core axis, joints coated with iron oxide). Describe the physical characteristics of the rock that are important for engineering considerations such as fracturing (including minimum, maximum, and most common and degree of spacing), hardness, and weathering.

1. The following is to be used as a guide for assessing fracturing:

AEG Fracturing	Spacing
Crushed	up to 0.1 foot
Intense	0.1–0.5 foot
Moderate	0.5 foot–10 feet
Slight	1.0 foot–3.0 feet
Massive	>3.0 feet

2. Record hardness using the following guidelines:

Hardness	Criteria
Soft	Reserved for plastic material
Friable	Easily crumbled by finger pressure
Low	Deeply gouged or carved with pocketknife
Moderate	Readily scratched with knife; scratch leaves heavy trace of dust
Hard	Difficult to scratch with knife; scratch produces little powder and is often faintly visible
Very Hard	Cannot be scratched with knife

3. Describe weathering using the following guidelines:

Weathering	**Decomposition**	**Discoloration**	**Fracture Condition**
Deep	Moderate to complete alteration of minerals feldspars altered to clay, etc.	Deep and thorough	All fractures extensively coated with oxides, carbonates, or clay
Moderate	Slight alteration of minerals, cleavage surface lusterless and stained	Moderate or localized and intense	Thin coatings or stains
Weak	No megascopic alteration of minerals	Slight and intermittent and localized	Few strains on fracture surfaces
Fresh	Unaltered, cleavage, surface glistening		

3.9 PROCEDURE FOR LOGGING REFUSE

The following procedure applies to the logging of subsurface samples composed of various materials in addition to soil as may be collected from a landfill or other waste disposal site.

1. Observe refuse as it is brought up by the hollow stem auger, bucket auger, or backhoe.

2. If necessary, place the refuse in a plastic bag to examine the sample.

3. Record observations according to the following criteria:

- Composition (by relative volume), e.g., paper, wood, plastic, cloth, cement, or construction debris. Use such terms as “mostly” or “at least half.” Do not use percentages;
- Moisture condition: dry, moist, or wet;
- State of decomposition: highly decomposed, moderately decomposed, slightly decomposed, etc.;
- Color: obvious mottling and/or degree of mottling;
- Texture: spongy, plastic (cohesive), friable;
- Odor;

- Combustible gas readings (measure down hole and at surface); and
- Miscellaneous: dates of periodicals and newspapers, ability to read printed materials, degree of drilling effort (easy, difficult, and very difficult).

3.10 SUBMITTAL REQUIREMENTS

Each original boring log should be submitted to the Contracting Officer Representative (CRO) after completion of the boring. When a monitoring well will be installed in a boring, the boring log and well installation diagram should be submitted together.

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

Not applicable.

6.0 REFERENCES

ASTM Standard D 1586–84 (1992). 1992. *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.*

ASTM Standard D 2488-93. 1993. *Standard Practice for Description and Identification of Soils Visual-Manual Procedure).*

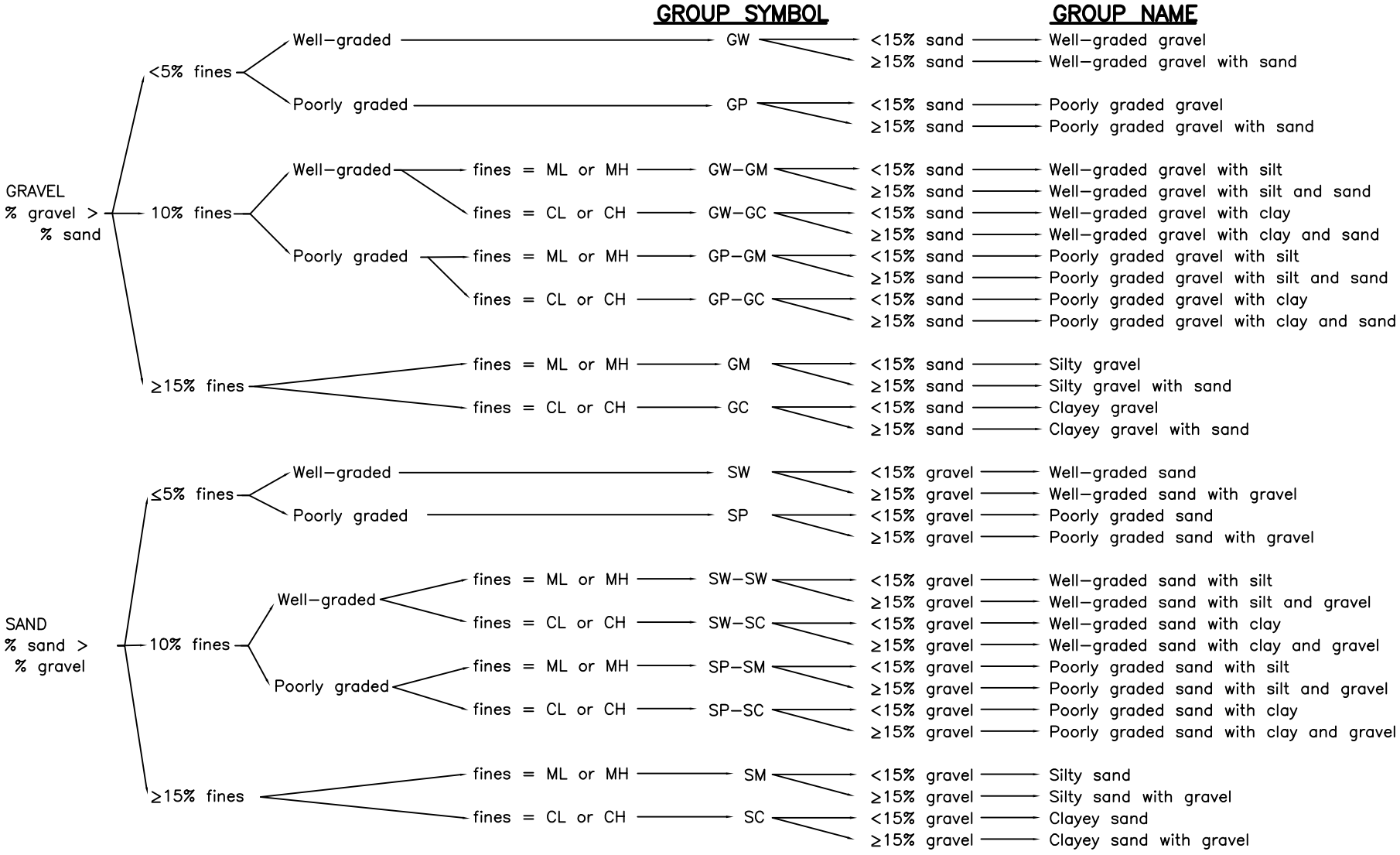
ASTM Standard D 5434-93. 1993. *Guide for Field Logging of Subsurface Explorations of Soil and Rock.*

ASTM Standard D 6032-96. 1996. *Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core.*

Compton, R. R. 1962. *Manual of Field Geology.* John Wiley & Sons, Inc., New York.

USACE. 1998. *Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites.* EM 1110-1-4000, 1, November.

U.S. Department of the Interior. 1989. *Earth Manual.* Water and Power Resources Service, Washington, DC.



NOTE: PERCENTAGES ARE BASED ON ESTIMATING AMOUNTS OF FINES, SAND, AND GRAVEL TO THE NEAREST 5%.

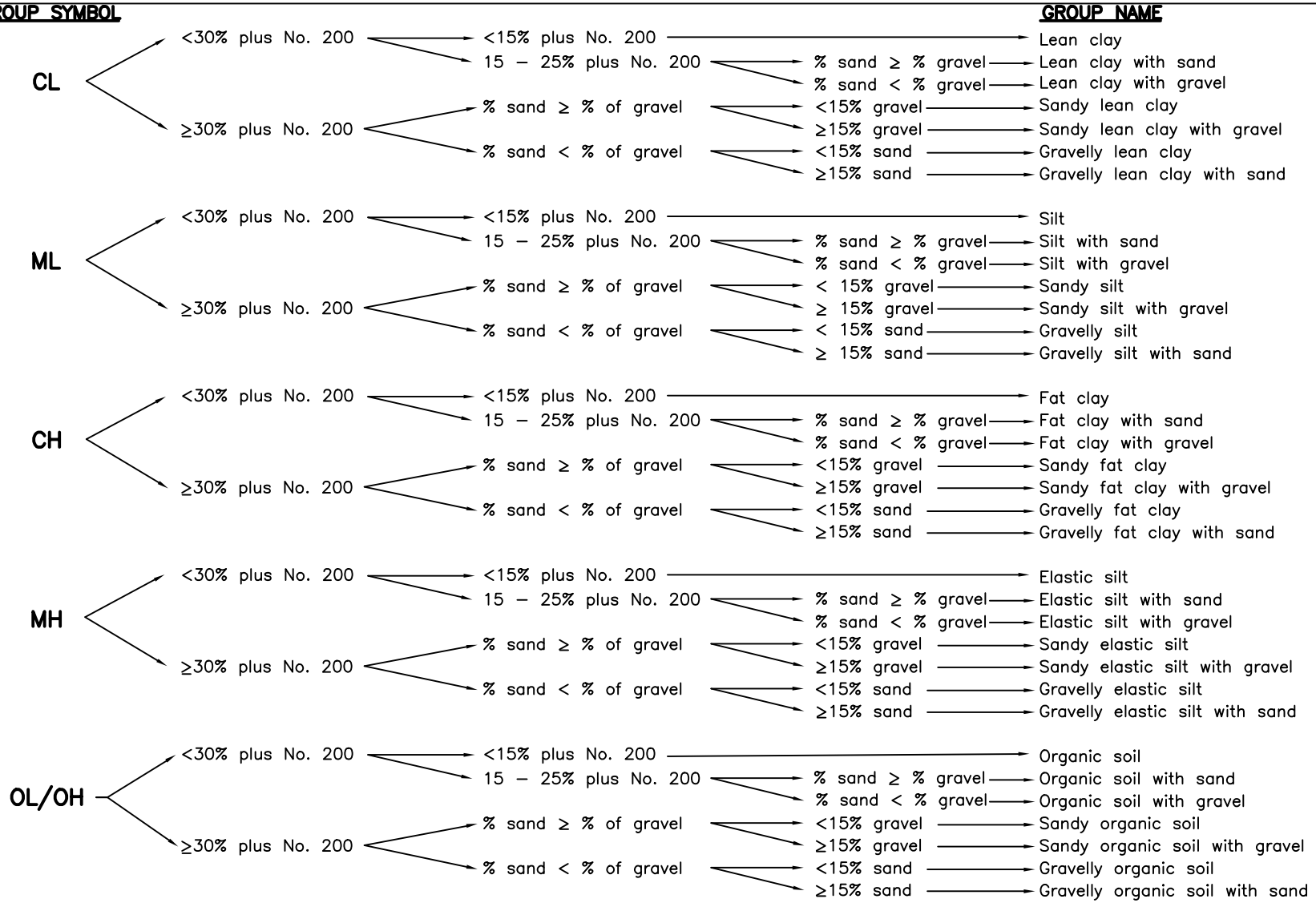
SOURCE: ASTM D 2488

RFAAP
SSP REPORT

Date: *06/13/01*	**Prepared By:** *URS Corp./DRT*
Scale: *NO SCALE*	**File Name:** *P:\...\Figure XXX.x..*

FIGURE 10.03a

FLOW CHART FOR IDENTIFYING COARSE-GRAINED SOILS



NOTE: PERCENTAGES ARE BASED ON ESTIMATING AMOUNTS OF FINES, SAND, AND GRAVEL TO THE NEAREST 5%.

SOURCE: ASTM D 2488

RFAAP
SSP REPORT

Date:	Prepared By:
06/13/01	*URS Corp./DRT*
Scale:	**File Name:**
NO SCALE	*P:\...\Figure XXX.x..*

FIGURE 10.03b

FLOW CHART FOR IDENTIFYING FINE-GRAINED SOILS

STANDARD OPERATING PROCEDURE 10.4
CHAIN-OF-CUSTODY FORM

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for use of the chain-of-custody form. An example is provided as part of this SOP. Other formats with similar levels of detail are acceptable.

2.0 MATERIALS

- Chain-of-custody form; and
- Indelible ink pen.

3.0 PROCEDURE

1. Record the project name and number.
2. Record the project contact's name and phone number.
3. Print sampler's names in "Samplers" block.
4. Enter the Field Sample No.
5. Record the sampling dates for all samples.
6. List the sampling times (military format) for all samples.
7. Indicate, "grab" or "composite" sample with an "X."
8. Record matrix (e.g., aqueous, soil).
9. List the analyses/container volume across top.
10. Enter the total number of containers per Field Sample No. in the "Subtotal" column.
11. Enter total number of containers submitted per analysis requested.
12. State the carrier service and airbill number, analytical laboratory, and custody seal numbers.
13. List any comments or special requests in the "Remarks" section.
14. Sign, date, and time the "Relinquished By" section when the cooler is relinquished to the next party.
15. Upon completion of the form, retain the shipper copy and place the forms and the other copies in a zip seal bag to protect from moisture. Affix the zip seal bag to the inside lid of the sample cooler to be sent to the designated laboratory.

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

None.

6.0 REFERENCES

USEPA. 1990. *Sampler's Guide to the Contract Laboratory Program.* EPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, DC, December 1990.

USEPA. 1991. *User's Guide to the Contract Laboratory Program..* EPA/540/O-91/002, Directive 9240.0-01D, Office of Emergency and Remedial Response, January 1991.

USEPA. 1998. *EPA Requirements for Quality Assurance Project Plans.* EPA/600/R-98/018, QA/R5, Final, Office of Research and Development, Washington, D.C.

FIGURE 10.4-a
EXAMPLE CHAIN-OF-CUSTODY FORM

Project Number	Project Name				Matrix	A N A L Y S E S									LAB :
Project Contact (Name and Phone Number)															AIRBILL No:
Samplers:															Courier:
Field Sample No.	Date (MM-DD-YY)	Time	Comp	Grab										Subtotal	REMARKS
TOTAL															

Relinquished by:	Date/time	Received by:	Relinquished by:	Date/Time	Received by:
Relinquished by:	Date/time	Received by: (for lab)	Date/Time	Remarks	

STANDARD OPERATING PROCEDURE 20.1
MONITORING WELL INSTALLATION

1.0 SCOPE AND APPLICATION

The installation of monitoring wells is contingent upon the existing conditions at the project site. The purpose of this standard operating procedure (SOP) is to delineate the quality control measures required to ensure the accurate installation of monitoring wells. For a particular site investigation, the associated work plan addenda should be consulted for specific installation instructions. The term "monitoring wells", as used herein is defined to denote any environmental sampling well.

2.0 MATERIALS

2.1 DRILLING EQUIPMENT

- Appropriately sized drill rig adequately equipped with augers, bits, drill stem, etc;
- Steam cleaner and approved source water for decontamination of drilling equipment, etc.;
- Source of approved water;
- Photoionization detector or other appropriate monitoring instrument per the site-specific Health and Safety plan;
- Water level indicator (electrical);
- Weighted steel tape measure;
- Steel drums and other appropriate containers for investigation-derived materials (drill cuttings, contaminated PPE, decontamination solutions, etc.);
- Absorbent pads and/or logs;
- Personal protective equipment and clothing (PPE) per site-specific health and safety plan; and
- Decontamination supplies, pad with heavy plastic sheeting (SOP 80.1).

2.2 WELL INSTALLATION MATERIALS

Technical information on all installed materials (screens, riser pipe, filter pack, bentonite, cement, etc.) and representative samples of the proposed filter pack will be supplied to the Contracting Officer's Representative (COR) before initiating well installation.

Well screen slot size and filter pack gradation will be determined based on existing site geology before initiating site-specific investigations.

- Well screen :

  Polyvinyl Chloride (PVC): JOHNSON (or equivalent); PVC commercially slotted continuous slot, wire wrapped screen; 4-in. diameter.; SCH 40; SCH 80; flush-threaded (leak-proof) joints; PVC should conform to National Sanitation Foundation (NSF) Standard 14 for potable water usage or ASTM Standard Specification F 480 and bear the appropriate rating logo. PVC should be free of ink markings, cleaned, and prepackaged by manufacturer;

Stainless Steel: JOHNSON (or equivalent); stainless steel Vee-Wire continuous slot, wire wrapped screen; 304 stainless steel (unless the sum concentration of Cl^-, F^-, and Br^- is <1000 ppm, case type 316 should be used); ASTM F 480 flush threads; cleaned, wrapped, and heat-sealed by manufacturer;

- Riser pipe:
  - PVC: JOHNSON (or equivalent); STD. PVC; 4-in. diameter.; SCH 40; SCH 80; flush-threaded (leak-proof) joints; PVC should conform to NSF Standard 14 or F 480; free of ink markings; cleaned and prepackaged by manufacturer;
  - Stainless Steel: JOHNSON (or equivalent); SCH 5; 304 stainless steel; ASTM type A312 material; 4-in. diameter.; cleaned, wrapped and heat-sealed by manufacturer;
- Plugs/Caps: JOHNSON (or equivalent); standard PVC or stainless steel;
- Filter pack: MORIE, clean sorted gravel (or equivalent);
- Bentonite seal: BAROID, bentonite pellets (3/8-in. diameter.);
- Cement: Type II Portland Cement; if sulfate concentrations are higher than 1500 ppm, Type IV Portland Cement will be used;
- Bentonite powder: BAROID, Aquagel Gold Seal;
- Steel Protective Casing: BRAINARD-KILMAN (or equivalent) zinc-plated steel, lockable, painted;
- Containers for purged water, as required;
- Submersible pump or bailer of appropriate capacity, and surge block sized to fit well;
- Hach DREL 2000 portable laboratory (or equivalent);
- Multiprobe Electronic Water Quality Recorder (Hydrolab);
- Electric well sounder and measuring tape;
- Portland Type II cement (see footnote); and
- Steel Posts (pickets), painted (see footnote).

2.3 DOCUMENTATION

- Copy of work plans and health and safety plan;
- Copy of USACE EM 110-1-4000 Monitoring Well Requirements.;
- Copies of permits (area entry, hot work, well, and utility clearance);
- Boring log forms;
- Well completion diagram form; and
- Field logbook.

2.4 GEOLOGIST'S PERSONAL EQUIPMENT

- Boring log materials per SOP 10.3; and
- Personal protective equipment and clothing (PPE) as required by the site-specific health and safety plan.

3.0 PROCEDURE

3.1 MATERIALS APPROVAL

3.1.1 Source Water

Water sources for drilling, grouting, sealing, filter pack placement, well installation, and equipment decontamination must be approved by the COR before arrival of the drilling equipment. Information required for the water source includes:

- Water source;
- Manufacturer/owner and their address and telephone number;
- Type of treatment and filtration prior to tap;
- Time of access;
- Cost per gallon (if applicable); and
- Dates and results associated with all available chemical analyses over the past 2 years, and the name and address of the analytical laboratory (if applicable).

3.1.2 Bentonite

Pure sodium bentonite with no additives (bentonite) will be the only drilling fluid additive allowed, and its use must be approved by the COR before the arrival of the drilling equipment. The information required for evaluation includes brand name, manufacturer, manufacturer's address and telephone number, product description, and intended use for the product, and potential effects on chemical analysis of water samples.

3.1.3 Granular Filter Pack

Granular filter pack material must be approved by the COR before drilling. A one-pint representative sample must be supplied to the COR. Information required includes lithology, grain size distribution, brand name, source, processing method, and size of intended screen.

3.1.4 Cement

Portland Type II cement will be used for grout (or Type IV, as noted in Section 2.2).

3.2 DRILLING

The objective of the selected drilling technique used at given site is to ensure that the drilling method provides representative data while minimizing subsurface contamination, cross contamination, and drilling costs.

Drilling methods that are appropriate for boring or monitoring well installation will depend on the subsurface geology most likely to be encountered in the boring. The geology for each site should be determined by reviewing previous investigation data (boring data, geophysics, etc.) from the site or nearby areas. Specific drilling methods that will be used to support site activities will be incorporated into work plan addenda.

Section 5.2.2 of the Master Work Plan discusses the different drilling methods that may be appropriate for installation of monitoring wells at the Radford Army Ammunition Plant (RFAAP) based on the different types of conditions encountered. The different drilling methods discussed in this section of the Master Work Plan including:

- Hollow Stem Auger (for soil);
- Air Rotary (soil and rock);
- Water Rotary and wire-line casing advancement (soil and rock);
- Drill-Through-Casing Driver (soil and rock); and
- Sonic (soil and rock).

3.2.1 Responsibilities of the Site Geologist

A Site Geologist will be present during all well drilling and installation activities and will fully characterize all tasks performed in support of these activities in the monitoring well logbook. The Site Geologist will be responsible for the logging samples, monitoring drilling operations, recording water losses/gains and groundwater data, preparing the boring logs and well diagrams, and recording the well installation procedures for one operating rig. The Site Geologist will have sufficient equipment in operable condition on-site to perform efficiently his/her duties.

3.2.2 Additives

No lubricants will be used on down hole drilling equipment. Additives containing either lead or copper will not be allowed. In addition, polychlorinated biphenyls will not be permitted in hydraulic fluids or other fluids used in the drilling rig, pumps, or other field equipment and vehicles.

Surface runoff or other fluids will not be allowed to enter any boring or well during or after drilling/construction.

Antifreeze used to keep equipment from freezing will not contain rust inhibitors and sealants. Antifreeze is prohibited in any areas in contact with drilling fluid. Absorbent pillows will be placed to catch any obvious leaks from the drill rig.

3.2.3 Boring Logs and Field Notes

Borings for monitoring wells will be logged by a geologist as described in SOP 10.3. Logs will be recorded on USACE HTRW ENG Form 5056-R and 5056A-R boring log forms.

Daily investigation activities at the site related to drilling should be recorded in field logbooks as described in SOPs 10.1 and 10.2.

3.3 WELL CONSTRUCTION AND INSTALLATION

Specifications for monitoring well construction and installation for a given site being investigated are to be included in work plan addenda. In case the previously defined criteria have not been met before the depth range for a given hole is reached, the geologist will stop the drilling and confer with the supervisor. The current boring conditions (depth, nature of the stratigraphic unit, and water-table depth) will be compared to those of other wells nearby to decide whether to continue drilling or to terminate and complete the well.

3.3.1 Overburden Wells

Overburden wells at the RFAAP are typically designed as a 4-inch diameter, single cased well (see Figure 20-1a) installed into a surficial aquifer, which is present above bedrock. For this type of well, the well boring would be terminated before penetrating any underlying confining unit and/or bedrock.

Section 5.2.2 of the Master Work Plan discusses the different drilling methods that may be appropriate for installation of overburden wells.

If dense, non-aqueous liquid (DNAPL) is encountered during drilling, the well boring will be terminated and completed at the base of the overburden aquifer being monitored.

3.3.2 Bedrock Wells

Multi-cased wells or wells with an outer casing installed into competent bedrock should be specified for wells that are designed to monitor groundwater within bedrock (see Figure 20-1c). The installation of a multi-cased well or outer casing will isolate the zone(s) monitored from overburden and will minimize the potential for cross-contamination during and after drilling.

The general procedure to be followed for installation of a multi-cased well is as follows. This procedure assumes the installation of a 4-inch diameter monitoring well. Specific procedures, drilling techniques and design of monitoring wells will be presented in work plan addenda for site-specific investigations.

1. If soil sampling is required within overburden, use appropriate drilling techniques to advance the boring and collect the soil samples.

2. A minimum 10-inch drill bit should be advanced from the surface into competent bedrock a distance not less than 2 feet. A drilling technique appropriate for penetrating overburden and bedrock should be used such as air rotary.

3. After the borehole has been advanced to the target depth within competent bedrock, a 6-inch diameter steel or Schedule 80 PVC outer casing should be lowered to the bottom of the boring.

4. Once the outer casing has been lowered to the bottom of the boring, the casing should be grouted in-place using a decontaminated tremie pipe equipped with a side discharge. The annulus between the outer casing and borehole wall will be injected with grout until undiluted grout reaches the surface.

5. The grouting mixture, specification, and placement should be consistent with the requirements identified in Section 3.3.8.

6. The grout should be allowed to cure a minimum of 24 hours before further drilling.

7. After adequate curing time for outer casing, drilling with a 5-5/8-inch bit until the desired total depth is reached should complete the well boring.

8. Once the well boring is completed, an appropriate bedrock well will be constructed based on site-specific conditions. The types of wells that may be installed may include a constructed well with screen, casing, filter pack, seal, and grout; an open-bedrock well; or a lined open bedrock well (see Section 3.3.3).

3.3.3 Well Screen Usage

Well screen usage for a given site should be specified in work plan addenda based on expected site conditions.

In general, wells installed within overburden will be installed with a screen as per Figure 20.01-a or 20.01-b. Bedrock wells may be installed with or without a screen depending on site specific conditions such as the depth of water bearing zones, stability of bedrock, occurrence of karst zones, and construction of existing wells at the site being investigated.

In general, bedrock wells installed within karst zones will be completed as open-hole construction (see Figure 20.01c). If evidence of potential or severe borehole collapse (unstable bedrock) is indicated during drilling, casing and screen will be installed in the borehole as a removable lining. If desired, multiple flow zones may be monitored in an open bedrock well by installing a multiport well, which has monitoring/sampling intervals sealed off from the rest of the boring and from each other by packers.

3.3.4 Beginning Well Installation

Schedule

Monitoring well installation should begin within 12 hours of boring completion for holes that are uncased or partially cased with temporary drill casing. In the case where a partially cased hole into bedrock is to be partially developed prior to well insertion, the well installation should begin within 12 hours of this initial development. For holes that are fully cased, installation should begin within 48 hours. Once begun, well installation should not be interrupted.

Placement of Materials

Temporary casing and hollow stem augers may be removed from the boring prior to well installation if the potential for cross contamination is low and if the borehole will remain stable during the time required for installation.

Where borehole conditions are unstable, some or all of the well materials may need to be installed prior to removal of the temporary casing or hollow stem augers. The casing or hollow stem augers should have an inside diameter sufficient to allow the installation of the screen and casing plus annular space for a pipe through which to place filter pack and grout.

Any materials blocking the bottom of the drill casing or hollow stem auger should be dislodged and removed from the casing prior to well insertion.

3.3.5 Screens, Casing, and Fittings

Borehole Specifications

The borehole for each well should be of sufficient diameter to provide for at least 2 inches of annular space between the borehole wall and all sides of the casing.

Well Screens

Material specifications for well screens, casings, and fittings are discussed in Section 2.2.
Screen bottoms should be securely fitted with a threaded cap or plug of the same composition as the screen. The cap/plug should be within 0.5 feet of the open portion of the screen. A sediment trap/sump will not be used.

Screen slot size will be appropriately sized to retain 90%–100% of the filter pack material, the size of which will be determined by sieve analysis of formation material.

Well screen lengths should be specified in work plan addenda and will be based on various site-specific factors such as environmental setting, subsurface conditions, analytes of concern, regulatory considerations, etc.

Assembly and Placement of Well Screen and Casing

Personnel should take precautions to assure that grease, oil, or other contaminants do not contact any portion of the well screen and casing assembly. Clean latex or nitrile gloves should be worn when handling the screen and casing assembly. Flush, threaded joints usually can be tightened by hand. If necessary, steam cleaned wrenches may be used to tighten joints.

In general, each section of the well assembly is lowered into the borehole, one section at a time, screwing each section securely into the section below it. No grease, lubricant, polytetrafluoroethylene (PTFE) tape, or glue may be used in joining the sections of screen and casing.

The assembly should be lowered to its predetermined level and held in position for placement of the filter pack. It is essential that the assembly be installed straight (with centralizers as appropriate) to allow for appropriate sampling. Buoyant forces associated with fluids in the borehole may require that the assembly be installed with the aid of hydraulic rams of the drill rig. When the well assembly is placed to predetermined level, a temporary cap should be place on the well to prevent foreign material from entering the well.

The bottoms of well screens should be placed no more than 3 feet above the bottom of the drilled borehole. If significant overdrilling is required, a pilot boring should be used. Sufficient filter pack should be placed at the bottom of the borehole

The well casing should be pre-cut (square) to extend 2 to 2.5 feet above the ground surface. Before placement of the last piece of well casing, a notch or other permanent reference point will be cut, filed, or scribed into the top edge of the casing.

The tops of all well casing will be capped with covers composed of materials compatible with the products used in the well installation. Caps will be loose fitting, constructed to preclude binding to the well casing caused by tightness of fit, unclean surfaces, or weather conditions. In either case, it should be secure enough to preclude the introduction of foreign material into the well, yet allow pressure equalization between the well and the atmosphere.

The top of each well casing should be level so that the maximum difference in elevation between the highest and lowest points of the casing is less than or equal to 0.02 ft.

3.3.6 Filter Pack

The volume of filter pack that is required to fill the annular between the well screen/casing and borehole should be computed, measured, and recorded.
Granular filter packs will be chemically and texturally clean, inert, and siliceous. The gradation of filter packs will be selected based on the screen size used and will be specified in the work plan addenda for the site being investigated.

Primary Filter Pack

Filter pack material should be placed in the borehole using a decontaminated tremie pipe. An appropriate amount of primary filter pack should be placed in the borehole prior to final positioning of the well screen to provide an appropriate barrier between the bottom of the borehole and the bottom of the screen. Once the

initial filter pack has been placed and the well assembly is appropriately positioned and centered in the borehole, the remaining primary filter pack should be placed in increments (and tamped) as the tremie pipe is gradually raised.

As the primary filter pack is placed, approved source water may need to be added to help move the filter pack. A weighted tape should be used to measure the top of the filter pack as it is being placed. If bridging of the filter pack occurs, then this bridging should be broken mechanically prior to adding additional filter pack.

When temporary casing or hollow stem augers are used, the casing or augers should be removed in increments such that lifting of the well assembly is minimal. After removal of each increment, it should be confirmed by direct measurement that the primary filter pack has not been displaced during the removal.
The primary filter pack should extend from the bottom of the borehole to 3 to 5 ft above the top of the screen.

Secondary Filter Pack

The primary filter pack may be capped with 1 to 2 feet of feet of secondary filter pack to prevent the intrusion of the bentonite seal into the primary filter pack. The need for this filter pack (and specifications) should be addressed in work plan addenda for the site being investigated. Such factors as the gradation of the primary filter pack, the potential for grout extrusion, and site hydrogeology should be considered when evaluating the need for this filter pack.

3.3.7 Bentonite Seal

A bentonite seal, consisting of hydrated 3/8-inch diameter. bentonite pellets, will be installed immediately above the filter pack. The seal may be installed with a tremie pipe, which is lowered to the top of the filter pack and slowly raised as the pellets fill the annular space. In deep wells, the pellets may bridge and block the tremie pipe; in this case, pellets may be placed by free fall into the borehole. A weighted tape should be used to measure the top of seal as it is installed.

When cement grout is to be used above the bentonite seal, a minimum of 3 to 4 hours should be allowed for hydration of the pellets.

When installing a seal above the water table, water should be added to the bentonite for proper hydration. In this case, the seal should be placed in lifts of 0.5 to 1 foot with each lift hydrated for a period of 30 minutes.
If the bentonite seal is to be installed far below the water table, a bentonite slurry seal will be installed. Cement-bentonite grout will not be used below the water table. The slurry will be mechanically blended aboveground to ensure a lump-free mixture. The slurry will consist of bentonite powder and approved water mixed to a minimum of 20 percent solids by weight of pumpable slurry with a density of 9.4 pounds per gallon or greater. The slurry will be pumped into place through a tremie pipe and measured as installed.
Bentonite seals should be 3 to 5 ft thick as measured immediately after placement. The final depth to the top of the bentonite seal will be measured and recorded before grouting.

3.3.8 Grout

Cement grout used in construction will be composed of the following:

- Type II Portland Cement (or Type IV as noted in Section 2.2);
- Bentonite (2 to 5% dry bentonite per 94-lb sack of dry cement); and
- A maximum of 6 to 7-gallons of approved water per 94-lb sack of cement

Neither additives nor borehole cuttings will be mixed with the grout. Bentonite will be added after the required amount of cement is mixed with the water.

All grout material will be combined in an aboveground container and mechanically blended to produce a thick, lump-free mixture. The mixed grout will be recirculated through the grout pump before placement. Grout placement should be performed as follows:

1. Grout should be placed from a rigid tremie pipe located just over the top of the bentonite seal. The tremie pipe should be decontaminated prior to use.
2. The tremie pipe should be kept full of grout from start to finish with the discharge end of the pipe completely submerged as it is slowly and continuously lifted.
3. The annulus between the drill casing and well casing should be filled with sufficient grout to allow for the planned drill casing removal. Grout should not penetrate the well screen or filter pack.

- For incremental removal of drill casing, grout should be pumped to maintain at least 10 ft of grout in the drill casing remaining in the borehole after removing the selected length of casing. After each section of casing is removed, the tremie pipe may be reinserted to the base of the casing not yet removed.
- In the case where drill casing will be removed all at once, grout should be pumped from the tremie pipe until undiluted grout flows from the annulus at the ground surface.

4. If the un-grouted portion of a borehole is less than 15 feet and without fluids after drill casing removal, then the un-grouted portion may be filled by pouring grout from the surface.
5. If drill casing was not used for well installation, grouting should proceed to the surface in one continuous operation.
6. For grout placement in a dry and open hole less than 15 ft deep, grout may be manually mixed and poured in from the surface providing that integrity of the bentonite seal is maintained.
7. Protective casing should be installed immediately after completion of grouting.
8. Grout settlement should be checked within 24 hours of the initial grout placement. Additional grout should be added grout should be added to fill any observed depressions.

The following will be noted in the boring logs: (1) exact amounts of cement, bentonite, and water used in mixing grout and (2) actual volume of grout placed in the hole.

3.3.9 Well Protection

The major elements of well protection will include:

- A protective casing;
- Protective concrete pad around the well; and
- Protective steel posts set around the well outside of the concrete pad.

Well Protective Casing

Well protective casings will be installed around all monitoring wells immediately after grouting. The protective casing should consist of a minimum 5-ft long, steel pipe (protective casing) installed over the well casing and into the grout. The protective casing should be installed to a depth of approximately 2.5-feet below ground surface (extending approximately 2.5 feet above ground surface). The internal well casing (riser) and protective casing will not be separated by more than 0.2 feet of height.

An internal mortar collar will be placed within the protective steel casing and outside the well casing to a height of 0.5 above ground surface.

After placement and curing of the mortar collar, an internal drainage hole will be drilled through the protective casing, which is centered no more 1/8 inch above the grout filled annulus between the well riser and the protective casing.

Any annulus formed between the outside of the protective casing and the borehole will be filled to ground surface with cement.

Concrete Pad

After the grout has thoroughly set and the well protective casing has been installed, a protective concrete pad will be installed around the well. This pad will be at least 4 inches thick and 4 feet square and sloped away from the well to provide for adequate drainage.

Protective Posts

Additional protection will be provided at each well location by the installation of four steel posts outside of each corner of the concrete pad. The installation of protective posts should occur before the well is sampled. The posts should have a minimum diameter of 3 inches, be placed 2 to 3 feet below ground surface, and extend at least 3 feet above ground surface. Posts should be painted orange using a brush.

Posts should be set in post holes, which are backfilled with concrete. For additional protection, the posts can be filled with concrete.

3.3.10 Well Construction Diagram and Field Notes

The construction of each well will be depicted as built in a well construction diagram (see Figure 20.1a). The diagram will be attached to the boring log and the following will be graphically denoted:

- Bottom of boring;
- Screen location, length, and size;
- Coupling locations;
- Granular filter pack;
- Seal;
- Grout;
- Cave-in;
- Centralizers;
- Height of riser;
- Protective casing detail;
- Water level 24 hours after completion with date and time of measurement;
- Quantity and composition of materials used; and
- Material between bottom of boring and bottom of screen.

Daily activities at the site related to monitoring well installation should be recorded in the field logbooks as described in SOPs 10.1 and 10.2.

3.4 GENERAL SEQUENCE OF MONITORING WELL COMPLETION

The following is a general sequence of monitoring well completion with reference to the specific details included in Section 3.3.

1. Completion of borehole;
2. Assembly and placement of well assembly as described in Section 3.3.5;
3. Placement of the appropriate filter pack(s) as discussed in Section 3.3.6;
4. Installation of an appropriate bentonite seal as discussed in Section 3.3.7;
5. Grouting the remaining annular space of the borehole as discussed in Section 3.3.8;
6. Set the protective casing for the well as discussed in Section 3.3.9;
7. Complete the protective concrete pad as discussed in Section 3.3.9; and
8. Install the protective posts as discussed in Section 3.3.9.

3.5 INVESTIGATION-DERIVED MATERIAL

Investigation-derived material will be managed in accordance with procedures defined in the work plan addenda for the site being investigated and SOP 70.1.

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

Refer to the site-specific health and safety plan.

6.0 REFERENCES

ASTM Standard D 5092-90. 1990. *Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers.*

ASTM Standard D 5717-95. 1995. *Standard Guide for Design of Ground-Water Monitoring Systems in Karst and Fractured Rock Aquifers.*

USACE. 1998. *Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites.* EM 1110-1-4000, 1, November.

EXAMPLE WELL DEVELOPMENT FORM

WELL DESIGNATION:_____ DATE(S) OF INSTALLATION:_____/_____/_____

SITE GEOLOGIST:_____ DEVELOPMENT DATE(S):_____/_____/_____

STATIC WATER LEVELS BEFORE AND AFTER DEVELOPMENT * :

BEFORE _____ DATE _____ 24 HR. AFTER _____ DATE_____

DEPTH TO SEDIMENT BEFORE AND AFTER DEVELOPMENT * :

BEFORE _____ DATE _____ 24 HR. AFTER _____ DATE_____

DEPTH TO WELL BOTTOM *: _____ SCREEN LENGTH _____

HEIGHT OF WELL CASING ABOVE GROUND SURFACE: _____

QUANTITY OF MUD/WATER:

LOST DURING DRILLING	(+)_____gallons
REMOVED PRIOR TO WELL INSERTION	(-)_____gallons
LOST DURING THICK FLUID DISPLACEMENT	(+)_____gallons
ADDED DURING FILTER PACK PLACEMENT	(+)_____gallons
TOTAL LOSSES	_____gallons

(a) Water column ht. (ft.) _____ (b) Well radius (in.)_____

(c) Screen length (ft.) _____ (d) Borehole radius (in.)_____

(e) QUANTITY OF FLUID STANDING IN WELL

Install Equation Editor and double-click here to view equation.

1 _____ gallons
(Show Calculation)

(f) QUANTITY OF FLUID IN ANNULUS Install Equation Editor and double-click here to view equation. 1_____gallons
(Show Calculation)

DEVELOPMENT VOLUME = (5 * TOTAL LOSSES) + [5 * (e + f)] = _____ gallons
(Show Calculation)

* **ALL DEPTHS MEASURED FROM TOP OF WELL CASING**

EXAMPLE WELL DEVELOPMENT RECORD

WELL DESIGNATION _____ DATE(S) OF DEVELOPMENT: _____/_____/_____

TYPE AND SIZE OF PUMP:_____

TYPE AND SIZE OF BAILER:_____

DESCRIPTION OF SURGE TECHNIQUE:_____

RECORD OF DEVELOPMENT

DATE & TIME	QUANTITY REMOVED	TIME REQ'D	pH	Cond	Temp	ORD	Turb	DO	Character of water (color/clarity/ odor/partic.)
(before)									
(during)									
(during)									
(during									
(after)									

TYPICAL PUMPING RATE_____ GAL./HR. EST. RECHARGE RATE_____

TOTAL QUANTITY OF WATER REMOVED_____ TIME REQUIRED_____

REMARKS_____

SIGNATURE OF SITE GEOLOGIST_____

STANDARD OPERATING PROCEDURE 20.2
MONITORING WELL DEVELOPMENT

1.0 SCOPE AND APPLICATION

Well development is the process by which drilling fluids, solids, and other mobile particulates within the vicinity of the newly installed monitoring well are removed, while ensuring proper hydraulic connection to the aquifer. Development stabilizes the formation and filter pack sands around the well screen to ensure aquifer water moves freely to the well.

Well development will be initiated not less than 48 consecutive hours but no longer than 7 calendar days following grouting and/or placement of surface protection.

2.0 MATERIALS

- Work Plans;
- Well Development Form;
- Field Logbook;
- Boring Log and Well Completion Diagram for the well;
- Submersible pump, control box, associated equipment, etc;
- Photoionization detector or other appropriate monitoring instrument as specified in site-specific health and safety plan;
- Personal protective equipment and clothing (PPE) as specified in site-specific health and safety plan;
- Flow-through-cell and probes measuring specific conductance, pH, temperature, oxidation/reduction potential, dissolved oxygen, and turbidity;
- Decontamination supplies (SOP 80.1);
- Electric well level indicator and measuring tape;
- Appropriate containers for purged water and other investigation-derived material, as required; and
- Drilling tools for reverse-air circulation development, as appropriate.

3.0 PROCEDURE

3.1 SELECTING METHOD OF DEVELOPMENT

The type of subsurface conditions encountered should determine the method of well development used at a particular site at the Radford Army Ammunition Plant (RFAAP).

When monitoring wells are installed within overburden material, fractured bedrock or karst aquifers producing little sediment, a combination of mechanical surging and pumping (over pumping) or bailing is generally appropriate for well development. In general, over-pumping is the method of pumping the well at a rate

higher than recharge occurs. Moving a tight-fitting surge block along the inside of the well screen to create a vacuum completes surging.

When monitoring wells are installed with solution features containing excessive amounts of sediment, reverse-circulation airlifting should be used as the initial step of development. Because reverse-circulation tools airlift methods avoid forcibly exposing the annular space to air, reverse-circulation tools can be run throughout the entire water column in the wells being developed.

After the excessive sediment has been removed by reverse-circulation airlifting, conventional pumping techniques may be used as appropriate to complete the well development.

3.2 DEVELOPMENT AND SAMPLING TIMING

Final development of monitoring wells should not be initiated any sooner than 48 hours after or more than 7 days beyond the final grouting of the well. Pre-development or preliminary development may be initiated before this 48-hour minimum period. Preliminary development may be conducted for open wells or for screened wells after installation of the well screen, casing, and filter pack but before installation of the annular seal. Pre-development is recommended when the natural formation will be used as a filter pack.
Well development should be completed at least 14 days prior to sampling.

3.3 SUMMARY OF PROCEDURES

In general, the following procedure should be followed when developing a well using the pump and surge technique:

1. Prepare the work area outside the well by placing plastic sheeting on the ground to avoid cross-contamination.
2. Calibrate water quality meters (refer to SOP 40.1).
3. Determine the depth to water and total depth of well (refer to SOP 40.2).
4. Calculate the equivalent volume (EV) of water in well to be developed (refer to SOP 30.2).
5. Pump or bail the well to ensure that water flows into it and to remove some of the fine materials from the well. Removal of a minimum of one EV is recommended at this point. The rate of removal should be high enough to stress the well by lowering the water level to approximately one-half its original level.
6. Remove pump or bailer, slowly lower a close-fitting surge block into the well until it rests below the static water level but above the screened interval. (NOTE: The latter is not required in the case of an LNAPL well.)
7. Begin a gentle surging motion along top on-third length of the screen, which will allow any material blocking the screen to break up, go into suspension, and move into the well. Note that development should always begin above or at the top of the screen and move progressively downward to prevent the surge block from becoming sand locked in the well casing. Continue surging for 5-10 minutes, remove surge block, and pump or bail the well, rapidly removing at least one EV.
8. Repeat previous step at successively lower levels within the well screen, until the bottom of the well is reached. As development progresses, successive surging can be more vigorous and of longer duration as long as the amount of sediment in the screen is kept to a minimum.
9. Development should continue until the well development criteria listed in Section 3.1.3 have been achieved.
10. All water removed must be managed as directed by the site investigation plan.

3.3.1 Well Development Criteria

In general, well development should proceed until the following criteria are met:

1. At a minimum, removal of three EV of water from the well.
2. Removal of three times of the amount of fluid (mud and/or water) lost during drilling.
3. Removal of three times the fluid used for well installation.
4. The following indicator parameters should be stabilized as indicated by three successive readings within:
    - ± 0.2 for pH;
    - ±3% for specific conductance;
    - ±10 mV for oxidation/reduction potential;
    - ± 1 degree Celsius for temperature; and
    - ±10% for turbidity and dissolved oxygen (except for wells installed in karst aquifers).
5. Well water is clear to the unaided eye (except for wells installed in karst aquifers).
6. The sediment thickness remaining within the well is less than one percent of the screen length or less than 0.1 ft for screens equal to or less than 10 feet.
7. Site specific factors should be evaluated to determine appropriate well development criteria have been if:
    - Well recharge is so slow that the required volume of water cannot be removed during 48 consecutive hours of development;
    - Water discoloration persists after the required volumetric development; and
    - Excessive sediment remains after the required volumetric development.

3.4 WELL DEVELOPMENT RECORD

Record all data as required on a Well Development Record Form (see example), which becomes a part of the complete Well Record. These data include the following:

- Project name, location;
- Well designation, location;
- Date(s) and time(s) of well installation;
- Static water level from top of well casing before and 24 hours after development;
- Depths and dimensions of the well, the casing, and the screen, obtained from the Well Diagram;
- Water losses and uses during drilling, obtained from the boring log for the well;
- Water contained in the well, obtained from calculations using the depth of the water column and the well radius, plus the radius and height of the filter pack and an assumed 30% porosity;
- Measurements of the following indicator parameters: pH, conductivity, oxidation/reduction potential, temperature, and turbidity before and after development and once during each EV;
- Notes on characteristics of the development water;
- Data on the equipment and technique used for development; and
- Estimated recharge rate and rate/quantity of water removal during development.

Well development records shall be submitted to the COR after the development has been completed.

3.5 INVESTIGATION-DERIVED MATERIAL

Investigation-derived material will be managed in accordance with procedures defined in the work plan addendum for the site being investigated and SOP 70.1.

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

Refer to the site-specific health and safety plan.

6.0 REFERENCES

Aller, Linda, et al. 1989. *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells.* National Water Well Association.

EPA Groundwater Handbook. 1989.

Nielsen, David M. 1993. *Correct Well Design Improves Monitoring,* in "Environmental Protection," Vol. 4, No.7, July, 1993.

USACE. 1998. *Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites.* EM 1110-1-4000, 1 November.

ASTM Standard D 5092-90. 1990. *Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers*.

ASTM Standard D 5717-95. 1995. *Standard Guide for Design of Ground-Water Monitoring Systems in Karst and Fractured Rock Aquifers*.

EXAMPLE WELL DEVELOPMENT FORM

WELL DESIGNATION:_____ DATE(S) OF INSTALLATION:_____/_____/_____

SITE GEOLOGIST:_____ DEVELOPMENT DATE(S):_____/_____/_____

STATIC WATER LEVELS BEFORE AND AFTER DEVELOPMENT :

BEFORE _____ DATE _____ 24 HR. AFTER _____ DATE_____

DEPTH TO SEDIMENT BEFORE AND AFTER DEVELOPMENT:

BEFORE _____ DATE _____ 24 HR. AFTER _____ DATE_____

DEPTH TO WELL BOTTOM *: _____ SCREEN LENGTH _____

HEIGHT OF WELL CASING ABOVE GROUND SURFACE: _____

QUANTITY OF MUD/WATER:

LOST DURING DRILLING	(+)_____	gallons
REMOVED PRIOR TO WELL INSERTION	(-)_____	gallons
LOST DURING THICK FLUID DISPLACEMENT	(+)_____	gallons
ADDED DURING FILTER PACK PLACEMENT	(+)_____	gallons
TOTAL LOSSES	_____	gallons

(a) Water column ht. (ft.) _____ (b) Well radius (in.)_____

(c) Screen length (ft.) _____ (d) Borehole radius (in.)_____

(e) QUANTITY OF FLUID STANDING IN WELL

$$1(12 * a * \pi * b^2 * 0.0043) = _____ \text{ gallons}$$

(Show Calculation)

(f) QUANTITY OF FLUID IN ANNULUS

$$[12 * c * \pi 8(d^2 - b^2) * 0.0043 * 0.30]\ 1_____ \text{gallons}$$

(Show Calculation)

DEVELOPMENT VOLUME = (3 * TOTAL LOSSES) + [5 * (e + f)] = _____ gallons

(Show Calculation)

* **ALL DEPTHS MEASURED FROM TOP OF WELL CASING**

EXAMPLE WELL DEVELOPMENT RECORD

WELL DESIGNATION _____ DATE(S) OF DEVELOPMENT: _____/_____/_____

TYPE AND SIZE OF PUMP:_____

TYPE AND SIZE OF BAILER:_____

DESCRIPTION OF SURGE TECHNIQUE:_____

RECORD OF DEVELOPMENT

DATE & TIME	QUANTITY REMOVED	TIME REQ'D	pH	Cond	Temp	ORD	Turb	DO	Character of water (color/clarity/ odor/partic.)
(before)									
(during)									
(during)									
(during									
(after)									

TYPICAL PUMPING RATE_____ GAL./HR. EST. RECHARGE RATE_____

TOTAL QUANTITY OF WATER REMOVED_____ TIME REQUIRED_____

REMARKS_____

SIGNATURE OF SITE GEOLOGIST_____

STANDARD OPERATING PROCEDURE 20.3
WELL AND BORING ABANDONMENT

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to establish the protocols by which all borings and wells will be abandoned. The primary objective of boring or well abandonment activities is to permanently abandon the boring or well so that the natural migration of groundwater or soil vapor is not significantly influenced.

2.0 MATERIALS

- Well abandonment equipment including appropriate grout mixing/placement equipment, and heavy equipment as appropriate (drill rig, crane, backhoe, etc.);
- Pure sodium bentonite powder with no additives (bentonite);
- Bentonite pellets (seal);
- Cement (Portland Type II); and
- Approved source water.

3.0 PROCEDURE

The volume of grout required for borehole or well abandonment should be calculated prior to proceeding with abandonment. These calculations should consider loss of material to the formation, changes in borehole diameter, potential zones of washout, and shrinkage of material. Calculations should be recorded on an abandonment record (see Section 3.1.4).

In general, cement grout should be used for boring and well abandonment per the specifications in Section 3.1 and procedures identified in the following sections. Specialized narrow diameter soil borings (3-inches or less) associated with direct push methods or hand augers may be abandoned using bentonite pellets or chips (see Section 3.5).

Any replacement borings or wells associated with the abandonment should be offset at least 20 feet from any abandoned site in a presumed up- or cross-gradient direction.

3.1 GROUT

Grout used in construction will be composed by weight of the following:

- Type II Portland cement (Type IV Portland Cement if sulfate concentrations are greater than 1,500 ppm);
- Bentonite (2 to 5% dry bentonite per 94-lb sack of dry cement); and
- A maximum of 6 to 7 gallons of approved water per 94-lb sack of cement.

Neither additives nor borehole cuttings will be mixed with the grout. Bentonite will be added after the required amount of cement is mixed with the water.

All grout material will be combined in an aboveground container and mechanically blended to produce a thick, lump-free mixture. The mixed grout will be recirculated through the grout pump before placement.

Grout placement will be performed using a commercially available grout pump and a rigid tremie pipe. Removal and grouting will be accomplished in stages, aquifer by aquifer, sealing the boring from the bottom to ground surface. This will be accomplished by placing a grout pipe to the bottom and pumping grout through the pipe until undiluted grout reaches the bottom of the next higher section of casing or, for the top-most section, until grout flows from the boring at ground surface.

After 24 hours, the abandoned drilling site will be checked for grout settlement. Any settlement will be filled with grout and rechecked 24 hours later. This process will be repeated until firm grout remains at the ground surface.

3.2 BORINGS

The term "borings" as used in this SOP applies to any drilled hole made that is not completed as a well. This includes soil test borings, soil sampling borings, and deep stratigraphic borings. Whether completed to the planned depth or aborted for any reason before reaching that depth, borings will be grouted and will be normally closed within 12 hours.

To achieve an effective seal, the borehole to be abandoned should be free of debris and foreign matter that may restrict the adhesion of the grout to the borehole wall. Borehole flushing with a tremie pipe may be required to remove such materials prior to grouting.

Each boring to be abandoned should be sealed by grouting from the bottom of the boring to the ground surface. This will be accomplished by placing a tremie pipe to the bottom of the borehole and pumping grout through the pipe at a steady rate. The grouting should be completed slowly and continuously to prevent channeling of material. The tremie pipe should be raised when pumping pressure increases significantly or when undiluted grout reaches the surface.

After 24 hours of completing the abandonment, the abandoned boring or well should be checked for any grout settlement. The settlement depression should be filled with grout and rechecked 24 hours later. Grout should be placed with a tremie pipe if the open hole is 15 feet or deeper or if the hole is not dry. Otherwise, the grout may be poured from the surface.

3.3 NARROW BORINGS

Narrow borings, those with diameter less than 3 inches, advanced by hand auger or direct push methods, may be sealed using bentonite pellets or chips rather than a grout mixture. Often times a grout pump is not available to mix the grout when these methods have been used. Bentonite pellets or chips will be poured into the boring from the ground surface. Then bentonite will hydrate by absorbing moisture from the ground; unapproved water should not be added to the boring. After 24 hours, the abandoned boring will be checked, and any grout settlement will be topped off with more bentonite. The process will be repeated until bentonite remains at ground surface unless site condition indicates otherwise.

3.4 WELLS

The following procedure applies to wells aborted before completion and existing wells determined to be ineffective or otherwise in need of closure.

<u>General Considerations</u>

A number of techniques are available for abandoning monitoring wells and other monitoring devices including:

- Abandonment in place by grouting the well screen and casing in place;
- Removal of the well by pulling; and
- Overdrilling.

The particular method used for abandonment should be specified in the work plan addenda developed for a site-specific investigation. Several factors must be considered when selecting the appropriate abandonment technique including well construction, well condition, and subsurface conditions.
In general the preferred method for abandonment of wells is to remove all existing well materials to:

- Reduce the potential for the formation of a vertical conduit to occur at the contact between the casing and annular seal;
- Reduce the potential for well materials interfering with the abandonment procedures; and
- Decrease the potential for reaction between the well materials and grout used for abandonment.

In general, all well materials will be removed during abandonment (including screen and casing) by either pulling out the casing, screen, and associated materials or by overdrilling using a rotary or hollow stem auger drilling procedure.

Abandonment with Well Materials In Place

In the event that it is not possible to remove the casing and screen, the casing and screen will be perforated using a suitable tool. A minimum of four rows of perforations several inches long and a minimum of five perforations per linear foot of casing or screen is recommended.

After the screen and casing have been appropriately perforated, the well should be abandoned by grouting from the bottom of the well to the ground surface using a tremie pipe as described in Section 3.2. The tremie pipe should be raised when pumping pressure increases significantly or when undiluted grout reaches the surface.

After 24 hours of completing the abandonment, the abandoned well should be checked for any grout settlement. The settlement depression should be filled with grout and rechecked 24 hours later. Grout should be placed with a tremie pipe if the open hole is 15 feet or deeper or if the hole is not dry. Otherwise, the grout may be poured from the surface.

Abandonment by Removal

Site conditions permitting, relatively shallow monitoring wells may be successfully abandoned by removal providing that the well is generally good condition and sections of casing (including screen) can be successfully removed with materials intact.

This method of abandonment is generally accomplished by removing (pulling) sections of casing and screen out of the subsurface using a drill rig, backhoe, crane, etc. of sufficient capacity. Materials with lower tensile strength such as polyvinyl chloride (PVC) generally cannot be removed by pulling if they have been appropriately cemented in place.

Once the well materials have been removed from the borehole, the borehole should be abandoned by grouting in the same manner discussed for borings in Section 3.2. If the borehole collapses after removal of well materials, then the borehole should be over drilled to remove all material and then grouted to the surface.

Overdrilling

With this method of abandonment, the well materials are removed by overdrilling (overreaming) the well location. Overdrilling using rotary techniques may be accomplished using an overreaming tool. This tool consists of a pilot bit that is approximately the same size as the inner diameter of well casing and a reaming bit that is slightly larger than the diameter of the borehole. As drilling proceeds, all well materials are destroyed and returned to the surface. After completion of the overdrilling, the borehole should be immediately grouted with a tremie pipe as described in Section 3.2.

In the case of overburden wells, a hollow stem auger may be used for overdrilling providing that this method of drilling appropriate for the subsurface conditions. The hollow stem auger should be equipped with outward facing carbide-cutting teeth with a diameter 2 to 4 inches larger than the well casing. With this method, the casing guides the cutting head and remains inside the auger. When the auger reaches the bottom of the well boring and the well materials have been removed, the borehole may be grouted with a tremie pipe (Section 3.2) through the augers as the augers are gradually withdrawn.

Considerations for Fractured Bedrock and Karst Wells

Multi-cased wells completed into bedrock as screened wells, open wells, or open-lined wells may be abandoned with the outer casing left in place providing that the integrity of this casing and associated annular seal is good. A cement bond log (acoustic amplitude boring geophysical log) may be used to evaluate the integrity of the casing and annular seal, if the outer casing is to be left in place.

Borings or wells completed in karst zones may be difficult to abandon because of the potential presence of large conduits, which may make it difficult to grout. Where large conduits exist or difficulties are encountered when abandoning a boring or well, fill the portion of the borehole penetrating the solution cavity with inert gravel (quartz, claystone, etc.). Packers can be used to isolate critical intervals for filling with grout above and below these zones.

3.5 RESTORATION

All work areas around the borings or wells abandoned should be restored to a condition essentially equivalent to that before the borings and wells were installed.

3.6 INVESTIGATION-DERIVED MATERIAL

Investigation-derived material should be managed in accordance with the requirements of SOP 70.1 and the work plan addenda associated with the site investigation

3.7 DOCUMENTATION

For each abandoned boring or well, a record should be prepared to include the following as appropriate:

- Project and boring/well designation;
- Location with respect to replacement boring well (if any);
- Open depth of well/annulus/boring prior to grouting;
- Casing or items left in hole by depth, description, composition, and size;
- Copy of the boring log;

- Copy of construction diagram for abandoned well;
- Reason for abandonment;
- Description and total quantity of grout used initially;
- Description and daily quantities of grout used to compensate for settlement;
- Disposition of investigation-derived material;
- Water or mud level prior to grouting and date measured; and
- Remaining casing above ground surface, height above ground surface, size, and disposition of each.

Daily investigation activities at the site related to boring and well abandonment should be recorded in field logbooks as described in SOPs 10.1 and 10.2.

4.0 PRECAUTIONS

Refer to the health and safety plan associated with the Work Plan Addenda and the Master Health and Safety Plan.

5.0 REFERENCES

ASTM Standard D 5299-92. 1992. *Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities.*

USACE. 1998. *Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites.* EM 1110-1-4000, 1 November.

STANDARD OPERATING PROCEDURE 20.4
TEST PITS

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for the excavation of test pits and provide general guidelines for sample collection from the test pits.

Test pit excavations are conducted to investigate and identify possible areas of contamination. Thus, samples taken from the excavation will be positively biased according to visual inspection (i.e., soil discoloration, soil staining) and field screening. Areas showing evidence of possible contamination will be sampled directly. If no evidence of contamination is present during excavation, then samples will be collected in two equally spaced intervals or at intervals specified in work plan addenda for site-specific investigations. In either case, no less than two representative samples per excavation site should be collected. Excavation (and sampling) shall terminate if the water table is encountered before terminal depth.

2.0 MATERIALS

- Master Work Plan;
- Work Plan Addenda;
- Field log books;
- Appropriate health and safety equipment for monitoring conditions in the work zone and excavation area including a photoionization detector (PID) or other types of monitoring equipment;
- Personal protective equipment and clothing (PPE) per the site-specific health and safety plan;
- Backhoe and associated equipment;
- Appropriate soil sampling equipment such as stainless steel scoops, trowels, spoons, and bowls/trays SOP 30.1);
- Appropriate sample bottles, labels, chain-of-custody forms, and sample shipping supplies etc;
- Tarps or plastic sheeting;
- Measuring tape;
- Camera and film; and
- Decontamination equipment and supplies.

3.0 PROCEDURE

3.1 DOCUMENTATION

Field activities and sampling information should be recorded in the field logbooks as outlined in SOPs 10.1 and 10.2.

Cross-sections and sketches of the layout will be prepared upon completion of the excavation. The sketches will indicate soil horizons and geologic observations. Soil horizons will be differentiated based upon

variations in soil color (i.e., Munsell Chart), texture, coarse fragment content, structure, and consistence. Refer to SOP 10.3 for boring log completion procedures. In addition, depth and thickness of horizontal depth to bedrock (if encountered) and indicators of seasonal high water table (presence of redoximorphic features) will be recorded. Sketches will also indicate the location of any samples collected. Photographs of the excavation will be taken and locations noted on the field map.

3.2 DECONTAMINATION

Decontamination of the backhoe, trowels or spoons, bowls, field tape measure, and other associated equipment will be carried out before use and between each test pit as outlined in work plan addenda and SOP 80.1.

3.3 SITE PREPARATION

Mark out dimensions of excavation and possible hazards (e.g., utilities, former structures). The backhoe must be equipped with a protective shield and the operator properly trained in the use of level B respiratory and dermal protection. The backhoe bucket and arm must be thoroughly decontaminated by steam cleaning before use and between each test pit location as described in work plan addenda and SOP 80.1. Discuss all hazards with equipment operator before any intrusive activities.

Set up exclusion zone with caution tape and position backhoe upwind of excavation site. All activities must be conducted in accordance with the health and safety plan developed for work plan addenda.

3.4 EXCAVATION AND SAMPLING

The backhoe operator shall be directed to excavate until the sampler indicates the desired depth has been reached. If the pit is less than 3 ft deep, the sampler can enter the pit and collect the samples using a decontaminated stainless steel trowel or spoon as described in SOP 30.1. As the pit becomes deeper, the sampler will collect the soil samples directly from the center of the bucket of the backhoe in an area not in contact with the sides of the bucket. The samples will then be transferred from the bucket into the appropriate sample container following sampling techniques outlined in SOP 30.1. Screening processes and analytical parameters for field screening soil samples will vary from site to site as specified per scope of work.

Begin excavating in increments of 6 to 12 inches per pass. Deeper passes may be necessary if the soil is rocky. Total excavation width will be of adequate dimensions to visually characterize the soil profile as observed on the excavation walls, typically not exceeding the width of the backhoe bucket. However, total width of the excavation will be dependent on the depth of the excavation, thus wider dimensions may be necessary for characterization of deeper pits. Excavation will be continuously monitored with health and safety monitoring equipment. Safety measures must be exercised when working near and around the backhoe arm and excavation pit. Health and safety procedures and any installation safety procedures must be strictly followed.

All soil removed during excavation shall be placed on a tarp or plastic sheeting. Soil exhibiting signs of contamination based on visual or olfactory observations, as well as monitoring results, will be separated from uncontaminated soil and containerized for site removal.

Samples will be collected at desired intervals as specified in work plan addenda. Sampling procedures will follow the requirement of work plan addenda and SOP 30.1.

3.5 BACK FILL

Once the terminal depth of the excavation is reached or the water table is encountered and all samples are collected, the trench will be backfilled with certified clean fill. Soils removed during excavation shall be containerized and disposed of at an approved landfill or moved to an approved storage area for subsequent disposal. All backfilled material will be tamped to a proper compacted level to ensure no major settling will

occur. After all backfilling and compacting procedures are complete, the area will be raked and seeded or resurfaced with asphalt, as appropriate. When the area is properly secured, decontamination procedures shall begin.

4.0 PRECAUTIONS

Refer to the site-specific health and safety plan.

5.0 REFERENCE

USEPA. 1987. *A Compendium of Superfund Field Operations Methods.* December.

STANDARD OPERATING PROCEDURE 20.11
DRILLING METHODS AND PROCEDURES

1.0 SCOPE AND APPLICATION

The use of an appropriate drilling procedure is contingent upon the existing conditions at the project site. The purpose of this standard operating procedure (SOP) is to outline procedures for the various methods of soil and rock drilling identified in the Master Work Plan. In addition it provides procedures for using sampling devices commonly used during soil and rock drilling such as split-barrel sampling, thin walled tube sampling, direct push samplers, and rock coring. For a particular site investigation, the associated work plan addendum will identify the appropriate drilling method and method of sampling, along with proposed sampling depths and intervals and any special procedures or methods.

2.0 MATERIALS

The following types of materials are generally appropriate for drilling:

2.1 SPLIT-BARREL SAMPLING

- Split barrel sampler;
- Borehole logging materials per SOP 10.3 and sampling equipment and materials, as appropriate per SOP 30.1;
- Containers to manage investigation-derived material per SOP 70.1; and
- Decontamination supplies and equipment per SOP 80.1.

2.2 THIN WALLED TUBE SAMPLING

- Thin walled tubes;
- Sealing materials for sample such as sealing wax, metal disks, wood disks, tape, cheesecloth, caps, etc;
- Borehole logging materials per SOP 10.3 and sampling equipment and materials, as appropriate per SOP 30.1;
- Containers to manage investigation-derived material per SOP 70.1; and
- Decontamination supplies and equipment per SOP 80.1.

2.3 DIRECT PUSH SAMPLING

- Direct push unit with hydraulic ram, hammer, etc;
- Sample collection devices, associated equipment and expendable supplies such as sample liners, sample retainers, appropriate lubricants, etc;
- Hollow extension rods;
- Auxiliary tools for handling, assembling, and disassembling tools and samplers;

- Borehole logging materials per SOP 10.3 and sampling equipment and materials, as appropriate per SOP 30.1;
- Containers to manage investigation-derived material per SOP 70.1; and
- Decontamination supplies and equipment per SOP 80.1.

2.4 HOLLOW-STEM AUGER DRILLING

- Drill rig and associated equipment;
- Hollow stem auger assemblies for drilling to appropriate depth including auger heads, drive assembly, pilot assembly, and hollow-stem auger sections;
- Auxiliary devices such as wrenches, auger forks, hoisting hooks, swivels, and adaptors;
- Borehole logging materials per SOP 10.3 and sampling equipment and materials, as appropriate per SOP 30.1;
- Containers to manage investigation-derived material per SOP 70.1; and
- Decontamination supplies and equipment per SOP 80.1.

2.5 DIRECT AIR ROTARY DRILLING

- Drill rig with rotary table and Kelly or top-head drive unit;
- Drill rods, bits, and core barrels (as appropriate);
- Casing;
- Sampling devices and equipment, as appropriate;
- Air compressor and filters, pressure lines, discharge hose, swivel, dust collector, and air-cleaning device (cyclone separator);
- Auxiliary tools for handling, assembling, and disassembling tools and samplers;
- Borehole logging materials per SOP 10.3 and sampling equipment and materials, as appropriate per SOP 30.1;
- Containers to manage investigation-derived material per SOP 70.1; and
- Decontamination supplies and equipment per SOP 80.1.

2.6 DRILL-THROUGH CASING DRIVER

- Drill rig equipped with a mast-mounted, percussion driver;
- Casing, drill rods, and drill bits or hammers;
- Air compressor and filters, pressure lines, discharge hose, swivel, dust collector, and air-cleaning device (cyclone separator);
- Sampling devices and equipment, as appropriate;
- Auxiliary tools for handling, assembling, and disassembling tools and samplers;
- Welding equipment and materials for installation of casing;
- Borehole logging materials per SOP 10.3 and sampling equipment and materials, as appropriate per SOP 30.1;

- Containers to manage investigation-derived material per SOP 70.1; and
- Decontamination supplies and equipment per SOP 80.1.

2.7 DIRECT WATER-BASED ROTARY DRILLING

- Drill rig with derrick, rotary table and Kelly or top-head drive unit;
- Drill rods, bits, and core barrels (as appropriate);
- Casing;
- Water based drilling fluid, with approved additives as appropriate;
- Mud tub, suction hose, cyclone de-sander(s), drilling fluid circulation pump, pressure hose, and swivel;
- Auxiliary tools for handling, assembling, and disassembling tools and samplers;
- Borehole logging materials per SOP 10.3 and sampling equipment and materials, as appropriate per SOP 30.1;
- Containers to manage investigation-derived material per SOP 70.1.
- Decontamination supplies and equipment per SOP 80.1.

2.8 DIRECT ROTARY WIRELINE-CASING ADVANCEMENT DRILLING

- Drill rig with either hollow spindle or top-head drive;
- Drill rods, coring or casing bits, overshot assembly, pilot bit, and core barrel;
- Water based drilling fluid, with approved additives as appropriate;
- Mud tub, suction hose, drilling fluid circulation pump, pressure hose, and swivel;
- Auxiliary tools for handling, assembling, and disassembling tools and samplers;
- Borehole logging materials per SOP 10.3 and sampling equipment and materials, as appropriate per SOP 30.1;
- Containers to manage investigation-derived material per SOP 70.1; and
- Decontamination supplies and equipment per SOP 80.1.

2.9 DIAMOND CORE DRILLING

- Direct rotary drill rig and associated equipment (see Sections 2.4, 2.5 or 2.6);
- Core barrels and core bits;
- Core lifters;
- Core boxes, engineers scale, permanent marking pen, and camera for photographing cores;
- Auxiliary tools for handling, assembling, and disassembling tools and samplers;
- Borehole logging materials per SOP 10.3 and sampling equipment and materials, as appropriate per SOP 30.1;
- Containers to manage investigation-derived material per SOP 70.1; and
- Decontamination supplies and equipment per SOP 80.1.

3.0 PROCEDURES

3.1 PENETRATION TEST AND SPLIT-BARREL SAMPLING OF SOILS

The following general procedure may be followed as outlined in ASTM Standard Test Method D 1586-84.

1. Advance the boring to the desired sampling depth using an appropriate drilling method (see sections below) and remove excessive cuttings from the borehole.
2. Attach the split-barrel sampler to the sampling rods and lower into the borehole. Do not allow the sampler to drop onto the soil to be sampled.
3. Position the hammer above and attach the anvil to the top of the drilling rods.
4. Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the boring and apply a seating blow. If excessive cuttings are encountered at the bottom of the borehole, remove the sampler and rods from borehole and remove the cuttings.
5. Mark the drill rods in three successive 6-inch increments so that the advance of the sampler can be observed.
6. Drive the sampler with blow from the 140 pound hammer and count the number of blows applied in each 6-inch increment until:
   a. Fifty (50) blows have been applied during one of the three 6-inch increments.
   b. A total of 100 blows have been applied.
   c. There is no observed advance of the sampler during the application of 10 successive blows of the hammer.
7. The sampler is advanced the complete 18-inches without the limiting blow counts occurring as described above.
8. Record the number of blows that is required to achieve each 6-inch increment of penetration or fraction of this increment on the boring.
   a. The first 6 inches is considered the seating driver.
   b. The sum of the second and third 6-inch penetration intervals is termed the “standard penetration resistance” or “N-value.”
   c. If the sampler is driven less than 18 inches as discussed in No. 6, then the number of blow for each partial increment will be recorded.
   d. For partial increments, the depth of penetration should be recorded to the nearest 1-inch on the boring log.
   e. If the sampler advances below the bottom of the boring under the weight of rods (static) and/or hammer, then this information will be recorded on the boring log.
9. The raising and dropping of the 140 pound hammer may be accomplished by:
   a. Using a trip, automatic, or semi-automatic hammer drop system that lifts the hammer and allows it to drop 30± 1 inches.
   b. Using a cathead shall be essentially free of rust, oil, or grease and have a diameter in the range of 6 to 10 inches. The cathead should be operated at a minimum speed of rotation of 100 revolutions per minute. No more than 2-1/4 rope turns on the cathead may be used when conducting the penetration test.

10. For each hammer blow, a 30-inch lift and drop shall be used.
11. After completing the penetration test, retrieve the sampler and open. Record the percent recovery or the length of sample recovered. Following the procedures outlined in SOP 30.1 when collecting environmental soil samples.
12. Borehole logging should be completed per SOP 10.3.
13. Split-barrel samples must be decontaminated before and after each use per the requirements of SOP 80.1.

3.2 THIN WALLED TUBE SAMPLING

The following general procedure may be followed for collection of relatively undisturbed, thin walled tube samples (e.g., Shelby tube) as outlined in ASTM Standard Practice D 1587-94.

1. Clean out the borehole to targeted sampling depth using most appropriate method, which avoids disturbing the material to be sampled. If groundwater is encountered, maintain the liquid level in the borehole at or above the groundwater level during sampling.
2. Place the sample tub so that its bottom rests on the bottom of the borehole.
3. Advance the sampler without rotation by a continuous relatively rapid motion.
4. Determine the length of the advance by the resistance and condition of the formation, the length of the advance should never exceed 5 to 10 diameters of the tube in sands and 10 to 15 diameters of the tube in clay.
5. When the formation is too hard for push type of sampling, the tube may be driven or the practice used for ring-lined barrel sampling may be used per ASTM Standard D 3550-84 (1995). When a sample is driven, the weight and fall of the hammer must be recorded along with the penetration achieved.
6. The maximum length of sample advance will be no longer than the sample-tube length minus an allowance for the sample head and a minimum of 3-inches for sludge-end cuttings.
7. Upon removal of the tube, measure the length of the sample in the tube. Remove the disturbed material in the upper end of the tube and re-measure the sample length.
8. Remove at least one-inch of material from the lower end of the tube for soil description and identification per SOP 10.3. Measure the overall sample length. Seal the lower end of the tube. If directed, the material from the end of the tube will not be removed for soil identification and description; in this case the tube will be sealed promptly.
9. Prepare sample labels and affix (or markings) on the tube.

3.3 DIRECT PUSH SOIL BORING

The following general procedures outlined in this section may be followed as described in ASTM Standard Test Method D 6282-98.

General considerations for this method include the following:

- A variety of direct push drive systems may be used to advance soil borings based on the intended sampling depths and subsurface conditions and include the following:

  <u>Shallower Depths and Less Difficult Conditions</u>

  - Percussive driving systems – use hydraulically operated hammers and mechanically operated hammers.

- Static push drive systems – use hydraulic rams to apply pressure and exert static pull (e.g., cone penetrometer systems).
- Vibratory/sonic systems – use a vibratory device, which is attached to the top of the sampler extension rods.

Greater Depths and More Difficult Conditions

- Sonic or resonance drilling systems – use a high power vibratory system to advance larger diameter single or dual tube systems.
- Rotary drilling equipment – use hydraulic system of drill rig for direct push.

- The equipment used for direct push must be capable of apply sufficient static force, or dynamic force, or both, to advance the sampler to the required depth of collection. Additionally, this equipment must have adequate retraction force to remove the sampler and extension/drive rods once the sample has been collected.
- Avoid using excessive down pressure when advancing the drilling tools/sampler. Excessive pressure may cause the direct push unit to offset from the boring location and may damage drilling tools and samplers.
- Sample liners should be compatible with the material being sampled and the type of analysis to be conducted on the sample. Sealing of liners for submittal to the laboratory for physical testing should be accomplished according to ASTM Standard D 4220-95 (Standard Practice for Preserving and Transporting Soil Samples).
- The general procedure for completing direct push soil borings is the following:

1. Stabilize direct push unit and raise mast at desired location.
2. Attach the hammer assembly to the drill head if not permanently attached. Attach the anvil assembly in the prescribed manner, slide the direct push unit the position over the borehole, and ready the tools for insertion.
3. Inspect the direct push tools before and after use. Decontaminate all down hole tools before and after use per SOP 80.1.
4. Inspect drive shoes for damaged cutting edges, dents or thread failures and these conditions could cause loss of sample recovery and slow the rate of advancement.
5. Assemble samplers and install where required, install sample retainers where needed, and install and secure sampler pistons to ensure proper operation where needed (see Steps 14 through 20 for the various sampler assembly procedures, etc.).
6. After sampler has been appropriately installed (see Steps 14 through 20 for installation procedures, etc.) advance the boring to the target sampling depth using an appropriate direct push technique, as identified above under general considerations.
7. Collect the soil sample from the target sampling depth using one of the methods identified in Steps 14 through 20.
8. Retrieve the sampler and appropriately process the soil sample as identified in Steps 14 through 20 below and in SOP 30.1.
9. Log the borehole per the requirements of SOP 10.3.
10. If collecting another soil sample, decontaminate the sampler for reuse per the requirements of SOP 80.1 or use another decontaminated sampler.
11. Appropriately manage investigation-derived material (discarded samples, decontamination fluids, etc.) per SOP 70.1.

12. Upon completion of the boring and collection of the desired soil samples, abandon the boring per the requirements of SOP 20.2.
13. The following single tube sampling systems (generally piston rod) may be used to collect soil samples (see Steps 14 through 16 below):
    a. Open Solid Barrel Sampler;
    b. Closed Solid Barrel Sampler (e.g. Geoprobe Macro-Core® Piston Rod Sampler); and
    c. Standard Split Barrel Sampler (see Section 3.1).
14. The following two tube sampling systems may be used to collect soil samples (see Steps 17 through 20 below):
    a. Split Barrel Sampler;
    b. Thin Wall Tubes;
    c. Thin Wall Tube Piston Sampler; and
    d. Open Solid Barrel Samplers.
15. Sampling with the single tube, open solid barrel sampler:
    a. Attach the required liner to the cutting shoe by insertion into the machined receptacle are or by sliding over the machined tube.
    b. Insert the liner and shoe into the solid barrel and attach the shoe.
    c. Attach the sampler head to the sampler barrel.
    d. Attach the sampler assembly to the drive rod and the drive head to the drive rod.
    e. Position the sampler assembly under the hammer anvil and advance the sampler assembly into the soil at a steady rate slow enough to allow the soil to be cut by the shoe and move up into the sample barrel.
    f. At the completion of the sampling interval, removal the sampler from the borehole. Remove the filled sampler liner from the barrel by unscrewing the shoe. Cap the liner for laboratory testing or split open for field processing (see SOP 30.1).
    g. Log the borehole per the requirements of SOP 10.3.
16. Sampling with the closed, solid barrel sampler (e.g., Macro-Core® sampler).
    a. Insert or attach the sample liner to the shoe and insert the assembly into the solid barrel sampler. Install the sample, retaining basket, if desired.
    b. Attach the latch coupling or sampler head to the sampler barrel, and attach the piston assembly with point and "O" rings if free water is present, to the latching mechanism.
    c. Insert the piston or packer into the liner to its proper position so that the point leads the sampler shoe. Set latch, charge packer, or install locking pin, and attach assembled sampler to drive rod.
    d. Add drive head and position under the hammer anvil. Apply down pressure, and hammer if needed, to penetrate the soil strata above the targeted sampling interval.
    e. When the sampling interval is reached, insert the piston latch release and recovery tool, removing the piston, or insert the locking pin removal/extension rods through the drive rods, turn counter clockwise, and remove the piston locking pin so the piston can float on top of the sample, or release any other piston holding device.
    f. Direct push or activate the hammer to advance the sampler the desired interval.
    g. Retrieve the sampler from the borehole by removing the extension/drive rods. Remove the shoe, and withdraw the sample line with sample for processing (see SOP 30.1).

h. Clean and decontaminate the sampler, reload as described above and repeat the same procedure for collection of addition samples.

i. Log the borehole per the requirements of SOP 10.3.

17. Sampling with standard split barrel (split spoon) sampler generally consists of the following:

a. Attach the split barrel sampler to an extension rod or drill rod.

b. Using a mechanical or hydraulic hammer drive the ampler into the soil the desired interval. The maximum interval that should be driven is equal to the sample chamber length of the split barrel sampler, which is either 18-inches or 24-inches.

c. Retrieve the sampler from the borehole by removing the extension/drive rods.

d. Split the sampler open for field processing (see SOP 30.1).

e. Clean and decontaminate the sampler (SOP 80.1), re-attach and repeat the same procedure for collection of additional samples.

f. Log the borehole per the requirements of SOP 10.3.

18. Sampling with a two tube, split barrel sampler generally consists of the following:

a. Assemble the outer casing with the drive shoe on the bottom, attach the drive head to the top of the outer casing, and attach the sampler to the extension rods.

b. Connect the drive head to the top of the sampler extension rods, and insert the sampler assembly into the outer casing.

c. The cutting shoe of the sampler should contact the soil ahead of the outer casing to minimize sample disturbance.

d. The sample barrel should extend a minimum of 0.25 inches ahead of the outer casing.

e. Mark the outer casing to identify the required drive length, position the outer casing and sampler assembly under the drill head.

f. Move the drill head downward to apply pressure on the tool string. Advance the casing assembly into the soil at a steady rate, which is slow enough to allow the soil to be cut by the shoe and move up inside the sample barrel.

g. Occasional hammer action during the push may assist recovery.

h. If smooth push advancement is not possible because of subsurface conditions, use the hammer to advance the sampler.

i. Stop the application of pressure or hammering when target interval has been sampled. Move the drill head off the drive head. Attach a pulling device to the extension rods or position the hammer bail and retrieve the sampler from the borehole.

j. At the surface, remove the sampler from the extension rods and process the sample per Section 3.01 and SOP 30.1.

k. Log the borehole per the requirements of SOP 10.3.

19. Sampling with a two tube, thin wall tube sampler generally consists of the following:
    a. Attach the tube to the tube head using removable screws.
    b. Attach the tube assembly to the extension rods and position at the base of the outer casing shoe protruding a minimum of 0.25 inches to contact the soil ahead of the outer casing.
    c. Advance the tube with or without the outer casing at a steady rate.
    d. After completing the sampling interval, let the tube remain stationary for one minute. Rotate the tube slowly two revolutions to shear off the sample.
    e. Remove the tube from the borehole and measure the recovery, and log the borehole per the requirements of SOP 10.3.
    f. For field processing, extrude the sample from the tube sampler and process per SOP 30.1. Alternatively, the tube may be sealed and shipped to the laboratory.
20. Sampling with two tube, thin wall tube, piston sampler generally consists of the following:
    a. Check the fixed piston sampling equipment for proper operation of the cone clamping assembly and the condition of the "O" rings.
    b. Slide the thin wall tube over the piston, and attach it to the tube head. Position the piston at the sharpened end of the thin wall tube just above the sample relief bend.
    c. Attach the tube assembly to the extension rods and lower the sampler into position through the outer casing. Install the actuator rods through the extension rod, and attach to the actuator rod in the sampler assembly.
    d. Attach a holding ring to the to top of the actuator rod string and hook the winch cable or other hook to the holding ring to hold the actuator rods in a fixed position.
    e. Attach the pushing fork to the drill head/probe hammer and slowly apply downward pressure to the extension rods advancing the thin wall tube over the fixed piston into the soil for the length of the sampling interval.
    f. After completing the sampling interval, let the tube remain stationary for one minute. Rotate the tube slowly one revolution to shear off the sample.
    g. Remove the tube sampler from the borehole and measure the recovery, and log the borehole per the requirements of SOP 10.3.
    h. For field processing, extrude the sample from the tube sampler and process per SOP 30.1.
21. Sampling with an two tube, open solid barrel sampler generally consists of the following:
    a. This sampling technique may be used when soil conditions prevent advancement of a split barrel sampler or advancement of an outer casing.
    b. The solid, single, or segmented barrel sampler requires the use of a liner.
    c. Use sampler in advance of outer casing when this casing cannot be advanced.
    d. Follow the procedures outlined for two tube, split barrel sampling.

3.4 HOLLOW-STEM AUGER DRILLING

The following general procedure may be followed as outlined in ASTM Standard Guide D 5784.

1. Stabilize drill rig and raise mast at desired location.
2. Attach an initial assembly of hollow-stem auger components (hollow stem auger, hollow auger head, center rod and pilot assembly, as appropriate) to the rotary drive of the drill rig.
3. Push the auger assembly below the ground surface and initiate rotation at a low velocity.

4. Decontamination of auger head may be necessary after this initial penetration if this surface soil is contaminated.
5. Continue drilling from the surface, usually at a rotary velocity of 50 to 100 rotations per minute to the depth where sampling or in-situ testing is required or until the drive assembly is within approximately 6- to 18 inches of the ground surface.
6. As appropriate, collect a soil sample from the required depth interval. The sample may be conducted by
    a. Removing the pilot assembly, if used, and inserting and driving a sampler through the hollow stem auger of the auger column; or
    b. Using a continuous sampling device within the lead auger section, where the sampler barrel fills with material as the auger is advanced.
7. Additional sections of hollow stems augers may be added to drill to a greater depth. After these auger sections are added, rotation of the hollow-stem auger assembly may be resumed.
8. When drilling through material suspected of being contaminated, the installation of single or multiple (nested) outer casings may be required to isolate zones suspected contamination (see SOP 20.1). Outer casings may be installed in a pre-drilled borehole or using a method in which casing is advanced at the same of drilling.

    Monitoring wells or piezometers may be installed using hollow-stem augers by:

    a. Drilling with or without sampling to the target depth.
    b. Removal of the pilot assembly, if used, and insertion of the monitoring well (or piezometer) assembly.
    c. The hollow stem auger column should be removed incrementally as the monitoring well (or piezometer) completion materials are placed (see SOP 20.1 for grouting).
9. If materials enter the bottom of the auger hollow stem during the removal of the pilot assembly, it should be removed with a drive sampler or other appropriate device.
10. If sampling or *in-situ* testing is not required during completion of the boring, the boring may be advanced with an expendable knock out plate or plug of an appropriate material instead of a pilot assembly.
11. Drill cuttings should be appropriately controlled and contained as IDM per SOP 70.1. It may be necessary to drill through a hole of sheet of plywood or similar material to prevent cuttings from contacting the ground surface.
12. The hollow-auger assembly and sampling devices must be decontaminated before and after each use per the methods specified in SOP 80.1.
13. Borehole logging should be completed per SOP 10.3.
14. Borehole abandonment, when required, should be conducted according to SOP 20.3.

3.5 DIRECT AIR ROTARY DRILLING

The following general procedure may be followed as outlined in ASTM Standard Guide D 5784-95.

1. Stabilize drill rig and raise mast at desired location. Appropriately position the cyclone separator and seal it to the ground surface considering the prevailing wind direction (exhaust).
2. Establish point for borehole measurements.
3. Attach an initial assembly of a bit, down hole hammer, or core barrel with a single section of drill rod, below the rotary table or top-head drive unit, with the bit placed below the top of the dust collector.
4. Activate the air compressor to circulate air through system.
5. Initiate rotation of bit.

6. Continue with air circulation and rotation of the drill-rod column to the depth where sampling or in-situ testing is required or until the length of the drill rod section limits further penetration.
7. Monitor air pressure during drilling operations. Maintain low air pressure at bit to prevent fracturing of surrounding material.
8. Stop rotation and lift the bit slightly off the bottom of the hole to facilitate removal of drill cuttings and continue air circulation until the drill cuttings are removed from the borehole annulus.
9. Open reaching a desired depth of sampling, stop the air circulation and rest bit on bottom of hole to determine the depth. Record the borehole depth and any resultant caving in. If borehole caving is apparent set a decontaminated casing to protect the boring.
10. When sampling, remove the drill rod column from the borehole or leave the drill rod assembly in place if the sampling can be performed through the hollow axis of the drill rods and bit.
11. Compare the sampling depth to clean-out depth by first resting the sampler on the bottom of the hole and compare that measurement with the clean-out depth measurement.
12. If bottom-hole contamination is apparent (indicated by comparison of sample depth to clean-out depth), it is recommended that the minimum depth below the sampler/bit be 18 inches for testing. Record the depth of sampling or in-situ testing and the depth below the sampler/bit.
13. The procedure described in Steps 8 through 12 should be conducted for each sampling or testing interval.
14. Drilling to a greater depth may be accomplished by attaching an additional drill rod section to the top of the previously advanced drill-rod column and resuming drilling operations as described above.
15. When drilling through material suspected of being contaminated, the installation of single or multiple (nested) outer casings may be required to isolate zones suspected contamination (see SOP 20.1 for grouting requirements). Outer casings may be installed in a pre-drilled borehole or using a method in which casing is advanced at the same of drilling.
16. Monitoring wells or piezometers may be installed by:
    a. Drilling with or without sampling to the target depth.
    b. Removal of the drill rod assembly and insertion of the monitoring well (or piezometer) assembly.
    c. Addition of monitoring well (or piezometer) completion materials (see SOP 20.1).
17. Drill cuttings should be appropriately controlled and contained as IDM per SOP 70.1.
18. The drill rod assembly, sampling devices, and other drilling equipment contacting potentially contaminated material must be decontaminated before and after each use per the methods specified in SOP 80.1.
19. Borehole logging should be completed per SOP 10.3.
20. Borehole abandonment, when required, should be conducted according to SOP 20.3

3.6 DRILL-THROUGH CASING DRILLING

The following general procedure may be followed as outlined in ASTM Standard Guide D 5872-95.

1. Stabilize drill rig and raise mast at desired location. Appropriately position the cyclone separator and seal it to the ground surface considering the prevailing wind direction (exhaust).
2. Establish point for borehole measurements.
3. Attach an initial assembly of a bit or down hole hammer with a single section of drill rod and casing to the top-head drive unit.
4. Activate the air compressor to circulate air through system.
5. Drilling may be accomplished by

a. Method 1- the casing will fall, or can be pushed downward behind the bit.

b. To drill using Drive the casing first followed by drilling out the plug inside the casing.

c. Method 2 - Advancing the casing and bit as a unit, with the drill bit or hammer, extending up to 12-inches below the casing.

6. Method 3 - Under reaming method where bit or hammer pens a hole slightly larger than the casing so that Method 1, drive the casing first and drill out the plug in the casing by moving the bit or hammer beyond the casing and then withdrawing it into the casing. Air exiting the bit will remove the cuttings up the hole. Separate cuttings from the return air with a cyclone separator or similar device.

7. To drill using Method 2, advance casing and bit as unit with the bit or hammer extending up to 12-inches beyond the casing depending on the conditions. While drilling, occasionally stop the casing advancement, retract the bit or hammer inside the casing to clear and maintain air circulation to clear cuttings.

8. To drill using Method 3, use a special down hole bit or hammer to open a hole slightly larger than the outside diameter of the casing so that the casing will fall or can be pushed downward immediately behind the bit. After advancing the casing, retract the radial dimension of the drill bit to facilitate removal of the down hole bit or hammer and drill tools inside the casing. Cuttings are removed from the borehole with the air that operates the bit or hammer and can be separated from the air with a cyclone separator or similar device.

9. Monitor air pressure during drilling operations. Maintain low air pressure at bit or hammer to prevent fracturing of surrounding material.

10. Continue air circulation and rotation of the drill rod column until drilling is completed to the target depth (for sampling, in-situ sampling, etc.) or until the length of the drill-rod section limits further penetration.

11. Stop rotation and lift bit or hammer slightly off the bottom of the hole to facilitate removal of drill cuttings and continue air circulation until the drill cuttings are removed from the borehole annulus.

12. After reaching a desired depth of sampling, stop the air circulation and rest the bit on bottom of hole to determine the depth. Record the borehole depth and any resultant caving in. If borehole caving is apparent set a decontaminated casing to protect the boring.

13. When sampling, remove the drill rod column from the borehole. Compare the sampling depth to clean-out depth by first resting the sampler on the bottom of the hole and compare that measurement with the clean-out depth measurement.

14. If bottom-hole contamination is apparent (indicated by comparison of sample depth to clean-out depth), it is recommended that the minimum depth below the sampler/bit be 18 inches for testing. Record the depth of sampling or in-situ testing and the depth below the sampler/bit.

15. The procedure described in Steps 11 through 14 should be conducted for each sampling or testing interval.

16. Drilling to a greater depth may be accomplished by attaching an additional drill rod section and casing section to the top of the previously advanced drill-rod column/casing and resuming drilling operations as described above.

17. Monitoring wells or piezometers may be installed by:

a. Casing advancement in increments, with or without sampling to the target depth.

b. Removal of the drill rods and the attached drill bit while the casing is temporarily left in place to support the borehole wall.

c. Insertion of the monitoring well (or piezometer) assembly.

d. Addition of monitoring well (or piezometer) completion materials (see SOP 20.1).

18. Drill cuttings should be appropriately controlled and contained as IDM per SOP 70.1.

19. The drill rod assembly, casing, sampling devices, and other drilling equipment contacting potentially contaminated material must be decontaminated before and after each use per the methods specified in SOP 80.1.
20. Borehole logging should be completed per SOP 10.3.
21. Borehole abandonment, when required, should be conducted according to SOP 20.3.

3.7 DIRECT WATER-BASED ROTARY DRILLING

The following general procedure may be followed as outlined in ASTM Standard Guide D 5783-95.

1. Stabilize drill rig and raise mast at desired location. Appropriately position the mud tub and install surface casing and seal at the ground surface.
2. Establish point for borehole measurements.
3. Attach an initial assembly of a bit or core barrel with a single section of drill rod, below the rotary table or top-head drive unit, with the bit placed with the top of the surface casing.
4. Activate the drilling-fluid circulation pump to circulate drill fluid through the system.
5. Initiate rotation of bit and apply axial force to bit.
6. Document drilling conditions and sequence (fluid loss, circulation pressures, depths of lost circulation, etc.) as described in SOP 10.3.
7. Continue with drill fluid circulation as rotation and axial force are applied to the bit until drilling to the depth
    a. Where sampling or in-situ testing is required;
    b. Until the length of the drill rod section limits further penetration; or
    c. Until core specimen has completely entered the core barrel (when coring) or blockage has occurred.
8. Stop rotation and the lift bit slightly off the bottom of the hole to facilitate removal of drill cuttings and continue fluid circulation until the drill cuttings are removed from the borehole annulus.
9. After reaching a desired depth of sampling, stop the fluid circulation and rest the bit on bottom of hole to determine the depth. Record the borehole depth and any resultant caving in. If borehole caving is apparent set a decontaminated casing to protect the boring.
10. When sampling, drill rod removal is not necessary if the sampling can be performed through the hollow axis of the drill rods and bit.
11. Compare the sampling depth to clean-out depth by first resting the sampler on the bottom of the hole and compare that measurement with the clean-out depth measurement.
12. If bottom-hole contamination is apparent (indicated by comparison of sample depth to clean-out depth), it is recommended that the minimum depth below the sampler/bit be 18 inches for testing. Record the depth of sampling or in-situ testing and the depth below the sampler/bit.
13. The procedure described in Steps 8 through 11 should be conducted for each sampling or testing interval.
14. Drilling to a greater depth may be accomplished by attaching an additional drill rod section to the top of the previously advanced drill-rod column and resuming drilling operations as described above.
15. When drilling through material suspected of being contaminated, the installation of single or multiple (nested) outer casings may be required to isolate zones suspected contamination (see SOP 20.1 for grouting requirements). Outer casings may be installed in a pre-drilled borehole or using a method in which casing is advanced at the same of drilling.
16. Monitoring wells or piezometers may be installed using hollow-stem augers by:
    a. Drilling with or without sampling to the target depth.

b. Removal of the drill rod assembly and insertion of the monitoring well (or piezometer) assembly.

c. Addition of monitoring well (or piezometer) completion materials (see SOP 20.1).

17. Drill cuttings and fluids should be appropriately controlled and contained as IDM per SOP 70.1.

18. The drill rod assembly, sampling devices, and other drilling equipment contacting potentially contaminated material must be decontaminated before and after each use per the methods specified in SOP 80.1.

19. Borehole logging should be completed per SOP 10.3.

20. Borehole abandonment, when required, should be conducted according to SOP 20.3.

3.8 DIRECT ROTARY WIRELINE CASING ADVANCEMENT DRILLING

The following general procedure may be followed as outlined in ASTM Standard Guide D 5876-95.

1. Stabilize drill rig and raise mast at desired location. Appropriately position the mud tub (for water based rotary) and install surface casing and seal at the ground surface.

2. Record the hole depth by knowing the length of the rod-bit assemblies and comparing its position relative to the established surface datum.

3. Attach an initial assembly of a lead drill rod and a bit or core barrel below the top-head drive unit, with the bit placed with the top of the surface casing.

4. Activate the drilling-fluid circulation pump to circulate drill fluid through the system.

5. Initiate rotation of bit and apply axial force to bit.

6. Document drilling conditions and sequence (fluid loss, circulation pressures, depths of lost circulation, down feed pressures etc.) as described in SOP 10.3.

7. In general, the pilot bit or core barrel can be inserted or removed at any time during the drilling process and the large inside diameter rods can act as a temporary casing for testing or installation of monitoring devices.

8. Continue with drill fluid circulation as rotation and axial force are applied to the bit until drilling to the depth

   a. Where sampling or in-situ testing is required;

   b. Until the length of the drill rod section limits further penetration; or

   c. Until core specimen has completely entered the core barrel (when coring) or blockage has occurred.

9. Stop rotation and lift the bit slightly off the bottom of the hole to facilitate removal of drill cuttings and continue fluid circulation until the drill cuttings are removed from the borehole annulus.

10. After reaching a desired depth of sampling, stop the fluid circulation and rest the bit on bottom of hole to determine the depth. Record the borehole depth and any resultant caving in. If borehole caving is apparent set a decontaminated casing to protect the boring.

11. When sampling, drill rod removal is not necessary if the sampling can be performed through the hollow axis of the drill rods and bit.

12. Compare the sampling depth to clean-out depth by first resting the sampler on the bottom of the hole and compare that measurement with the clean-out depth measurement.

13. If bottom-hole contamination is apparent (indicated by comparison of sample depth to clean-out depth), it may be necessary to further clean the hole by rotary recirculation.

14. Continuous sampling may be conducted with a soil core barrel or rock core barrel (see Section 1.7).

15. The pilot bit or core barrel may need to be removed during drilling such as when core barrels are full or there is evidence of core blocking. Before the drill string is reinserted, the depth of the boring should be rechecked to evaluate hole quality and determine whether casing may be required.
16. Water testing may be performed in consolidated deposits by pulling back on the drill rods and passing inflatable packer(s) with pressure fitting to test the open borehole wall (see ASTM Standards D 4630 and D 4631).
17. Drilling to a greater depth may be accomplished by attaching an additional drill rod section to the top of the previously advanced drill-rod column and resuming drilling operations as described above.
18. When drilling through material suspected of being contaminated, the installation of single or multiple (nested) outer casings might be required to isolate zones suspected contamination (see SOP 20.1 for grouting requirements). Outer casings may be installed in a pre-drilled borehole or using a method in which casing is advanced at the same of drilling.
19. Monitoring wells or piezometers may be installed by:
    a. Drilling with or without sampling to the target depth.
    b. Removal of the pilot bit or core barrel and insertion of the monitoring well (or piezometer) assembly.
    c. Addition of monitoring well (or piezometer) completion materials (see SOP 20.1).
20. Drill cuttings and fluids should be appropriately controlled and contained as IDM per SOP 70.1.
21. The drill rod assembly, sampling devices, and other drilling equipment contacting potentially contaminated material must be decontaminated before and after each use per the methods specified in SOP 80.1.
22. Borehole logging should be completed per SOP 10.3.
23. Borehole abandonment, when required, should be conducted according to SOP 20.3.

3.9 DIAMOND CORE DRILLING

The following general procedure may be followed as outlined in ASTM Standard Practice D 2113-83 (1993).

1. Use core-drilling procedures, such as the water-rotary drilling method outlined in Section 3.6.
2. Seat the casing on bedrock or firm formation to prevent raveling of the borehole and to prevent loss of drilling fluid. Level the formation that the casing will be seated on as needed.
3. Begin core drilling using an N-size double-tube, swivel-type core barrel or other approved size or type. Continue core drilling until core blockage occurs or until the net length of the core has been drilled.
4. Remove the core barrel from the borehole, and dis-assemble the core barrel as necessary to remove the core.
5. Reassemble the core barrel and return it to hole.
6. Continue core drilling.
7. Place the recovered core in the core box with the upper (surface) end of the core at the upper-left corner of the core box. Wrap soft or friable cores, etc. as needed or required. Use spacer blocks or slugs properly marked to indicate any noticeable gap in recovered core that might indicate a change or void in the formation. Fit fracture, bedded, or jointed pieces of core together as they naturally occurred.
8. The core within each completed box should be photographed after core surface has been cleaned or peeled, as appropriate, and wetted. Each photo should be in sharp focus and contain a legible scale in feet and tenths of feet (or metric if appropriate). The core should be oriented so that the top of the core is at the top of the photograph. A color chart should be included in the photograph frame as a check on photographic accuracy. The inside lid of the box should also be shown.
9. The inside of the box lid should be labeled at a minimum with the facility name, project name, boring number, box number, and core interval.

10. A preliminary field log of the core must be completed before the core box has been packed for transport (see SOP 10.3). Detailed logging may be conducted at a later time providing the core is appropriately handled and transported.
11. Four levels of sample protection may be used depending on character of the rock and the intended use of the rock core including:
    a. *Routine care* – for rock cored in 5 to 10 foot runs. Consists of placing in structurally sound boxes. Lay flat tubing may be used prior to placing the core.
    b. *Special care* – for rock samples to be tested that are potentially moisture sensitive, such as shale. This care consists of sealing with a tight fitting wrapping of plastic film and application of wax at the ends of the sample.
    c. *Critical care* – for rock samples that may be sensitive to shock and vibration and/or temperature. Protect by encasing each sample in cushioning material, such as sawdust, rubber, polystyrene, foam, etc. A minimum one-inch thick layer of cushioning material should be used. Thermally insulate samples that are potentially sensitive to changes in temperature.
    d. *Soil-Like care* – handle per ASTM Standard D 4220-95.
12. Drilling conditions and sequence (fluid loss, circulation pressures, depths of lost circulation, down feed pressures, core blockage etc.) should be documented on the boring log as described in SOP 10.3.
13. Drill cuttings and fluids should be appropriately controlled and contained as investigation-derived material per SOP 70.1.
14. The drill rod assembly, sampling devices, and other drilling equipment contacting potentially contaminated material must be decontaminated before and after each use per the methods specified in SOP 80.1.
15. Borehole logging should be completed per SOP 10.3.
16. Borehole abandonment, when required, should be conducted according to SOP 20.3.

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

Refer to site-specific health and safety plan included in work plan addenda.

6.0 REFERENCES

ASTM Standard D 2113-83 (1993). 1993. *Standard Practice for Diamond Core Drilling for Site Investigation.*

ASTM Standard D 1586-84 (1992). 1992. *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.*

ASTM Standard D 1587-94. 1994. *Standard Practice for Thin-Walled Tube Geotechnical Sampling of Soils.*

ASTM Standard D 4220-95. 1995. *Standard Practices for Preserving and Transporting Soil Samples.*

ASTM Standard D 5079-90. 1995. *Standard Practices for Preserving and Transporting Rock Core Samples.*

ASTM Standard D 5782-95. 1995. *Standard Guide for Use of Direct Air-Rotary Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices.*

ASTM Standard D 5783-95. 1995. *Standard Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices.*

ASTM Standard D 5784-95. 1995. *Standard Guide for Use of Hollow-Stem Augers for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices.*

ASTM Standard D 5872-95. 1995. *Standard Guide for Use of Casing Advancement Drilling Methods for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices.*

ASTM Standard D 5876-95. 1995. *Standard Guide for Use of Direct Rotary Wireline Casing Advancement Drilling Methods for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices.*

ASTM Standard D 6282-98. 1998. *Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations.*

USACE. 1998. *Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites.* EM 1110-1-4000. 1, November.

STANDARD OPERATING PROCEDURE 20.12
DIRECT PUSH GROUNDWATER SAMPLING

1.0 SCOPE AND APPLICATION

The use of direct push groundwater sampling is contingent upon the existing conditions at the project site. The purpose of this standard operating procedure (SOP) is to outline procedures for the collecting groundwater samples using direct push sampling. For a particular site investigation, the associated work plan addendum will identify the appropriate drilling method and method of groundwater sampling, along with proposed sampling depths and intervals and any special procedures or methods.

2.0 MATERIALS

The following types of materials are generally appropriate for direct push groundwater sampling with a protected screen sampler:

- Direct push unit with hydraulic ram, hammer, etc;
- Groundwater sampling system consisting of expendable sampling tips, well screen with protective sleeve, connector assembly, probe rods (riser pipe), drive cap, grab sampling devices (bailers, if used), sample tubing and check valve assembly (if used), and sampling pump (if used);
- As needed, soil sampling devices and associated equipment and expendable supplies such as sample liners, sample retainers, appropriate lubricants, etc;
- Auxiliary tools for handling, assembling, and disassembling tools and probe rods;
- Borehole logging materials per SOP 10.3 and sampling equipment and materials, as appropriate per SOP 30.1;
- Containers to manage investigation-derived material per SOP 70.1; and
- Decontamination supplies and equipment per SOP 80.1.

3.0 PROCEDURES

Static probing systems, penetrometer systems, or rotary drilling equipment can be used for inserting direct-push groundwater sampling devices.

The following general procedures outlined in this SOP may be followed as described in ASTM Standard Test Method D 6001-96.

General considerations for this method include the following:

- A variety of direct push drive systems may be used to advance borings based on the intended sampling depths and subsurface conditions and include the following:

Shallower Depths and Less Difficult Conditions

- *Percussive driving systems* – use hydraulically operated hammers and mechanically operated hammers;
- *Static push drive systems* – use hydraulic rams to apply pressure and exert static pull (e.g., cone penetrometer systems); and
- *Vibratory/sonic systems* – use a vibratory device, which is attached to the top of the sampler extension rods.

Greater Depths and More Difficult Conditions

- *Sonic or resonance drilling systems* – use a high power vibratory system to advance larger diameter single or dual tube systems; and
- *Rotary drilling equipment* – use hydraulic system of drill rig for direct push.

- The equipment used for direct push must be capable of apply sufficient static force, or dynamic force, or both, to advance the sampler to the required depth of collection. Additionally, this equipment must have adequate retraction force to remove the sampler and extension/drive rods once the sample has been collected.
- Avoid using excessive down pressure when advancing the drilling tools/sampler. Excessive pressure may cause the direct push unit to offset from the boring location and may damage drilling tools and samplers.
- Direct push sampling materials should be compatible with the material being sampled and the type of analysis to be conducted on the sample. A variety of materials are available including stainless steel, rigid polyvinyl chloride (PVC) and polytetrafluorethylene (PTFE).

The following general procedure involves the advancement of a direct push boring and collection of a groundwater sample using a protected screen sampler:

1. Stabilize direct push unit and raise mast at desired location.
2. Attach the hammer assembly to the drill head if not permanently attached. Attach the anvil assembly in the prescribed manner, slide the direct push unit the position over the borehole, and ready the tools for insertion.
3. Inspect the direct push tools before and after use. Decontaminate all down hole tools before and after use per SOP 80.1.
4. If soil samples will be collected to characterize soil stratigraphy and/or identify zones of groundwater for sampling, the drilling and soil sampling procedures outlined in SOP 20.11 (Section 3.3) should be followed.
5. Connect the sampler assembly (well screen enclosed in sheath), with drive point to probe rods along with any subassemblies such as friction reducers.
6. Prior to driving, measure the length of the sampling assembly and probe rod(s) to determine the depth of sampling.
7. After the sampling assembly has been appropriately installed to the probe rod, advance the assembled sampler using the drill rigs hydraulic rams (smooth quasi static push) or the drill rig hammer (percussive driving), or both.
8. Add additional probe rods as the sampling assembly is advanced and greater depths are reached. As the sampling assembly is advanced, the number of rod sections (riser) added should be recorded to ensure that groundwater sampling occurs at the targeted depth.
9. Once the sampling assembly is advanced to the desired depth check the system for leakage before exposing the screen for sampling. The leakage test does not have to be performed if the sampling system allows for direct connection to the screened sampling area (using a sealed chamber or tubing).

10. If appropriate, the leakage test will be conducted by checking for the presence of water inside the riser with an electronic water level meter. If no leakage is observed, then sampling may proceed. If water is present in the riser pipe from an unknown source, it should be purged before sampling; otherwise the sampling effort should be abandoned.
11. Extension rods are used to hold the screen in position as the casing puller assembly is used to retract the probe rods. The extension rods pass through the sampler to the bottom of the screen.
12. Groundwater sampling may be completed once the well screen is fully exposed. The extension rods are then removed and polyethylene or Teflon tubing with a check valve is then inserted inside the probe rods to the bottom of the screen.
13. The sampling tube assembly may then be oscillated up and down to bring water to the surface for sample collection.
14. Alternatively, if permitted by the sampling plan, a sampling pump (e.g., peristaltic) may be connected to the tubing to draw in the sample.
15. In lieu of using sampling tubing, a small diameter bailer may be lowered inside the probe rods to the interval of the screen to collect a grab sample of groundwater.
16. Collect groundwater samples directly from the end of tubing into clean laboratory-prepared (preserved) containers, as specified in work plan addenda prepared for site-specific investigations. Allowing the discharge from the tubing or bailer to flow gently down the inside of the container with minimal turbulence should fill all samples. Volatile organic compounds (VOCs) and gas sensitive parameter samples should be collected first followed by other parameters.
17. In general, samples should be collected and containerized in the order of the volatilization sensitivity of the parameters. A preferred collection order for some common parameters is VOCs, extractable organics, metals, cyanide, sulfate and chloride, turbidity, and nitrate and ammonia. The parameters to be collected at any well location are site-specific and are specified in work plan addenda.
18. Depending on the screen used and site conditions; samples may contain sediment and may require filtration before placement into containers. Refer to the site-specific sampling and analysis plan for requirements for filtration.
19. After sampling, the boring may be abandoned by incrementally removing the screen assembly and probe rods and pumping grout into the probe through the tubing used for sample collection. Other abandonment methods for direct push borings are described in SOP 20.3.
20. Samples should be handled and shipped as specified in SOPs 50.1 and 50.2 and the work plan addenda prepared for site-specific investigations.
21. Log the borehole per the requirements of SOP 10.3.
22. Appropriately manage investigation-derived material (discarded samples, decontamination fluids, etc.) per SOP 70.1.

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

Refer to site-specific health and safety plan included in work plan addenda.

6.0 REFERENCES

ASTM Standard D 6001. 1996. *Standard Guide for Direct-Push Water Sampling for Geoenvironmental Investigations.*

ASTM Standard D 6282-98. 1998. Standard Guide for Direct Push Soil Sampling for Environmental Site Characterization.

STANDARD OPERATING PROCEDURE 30.1
SOIL SAMPLING

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for sampling surface and subsurface soils.

2.0 MATERIALS

- Stainless steel scoop, spoon, trowel, knife, spatula, (as needed);
- Split-spoon, Shelby tube, or core barrel sampler;
- Hand auger or push tube sampler;
- Drill rig and associated equipment (subsurface soil);
- Stainless steel bowls;
- Photoionization detector or other appropriate instrument as specified in site-specific health and safety plan;
- Sampling equipment for collection of volatile organic samples;
- Appropriate sample containers;
- Appropriate sample labels and packaging material.;
- Personal protective equipment and clothing (PPE) per site-specific health and safety plan; and
- Decontamination equipment and supplies (SOP 80.1).

3.0 PROCEDURE

3.1 DOCUMENTATION

Soil sampling information should be recorded in the field logbooks as described in SOPs 10.1 and 10.2.

3.2 SURFICIAL SOIL SAMPLES

The targeted depths for surficial soil samples (surface and near surface) will be specified in the work plan addenda developed for site-specific investigations.

1. All monitoring equipment should be appropriately calibrated before beginning sampling according to the requirements of the work plan addenda and SOP 90.1 or 90.2.
2. All sampling equipment should be appropriately decontaminated before and after use according to the requirements of the work plan addendum and SOP 80.1.
3. Use a spade, shovel, or trowel or other equipment (manufactured from material, which is compatible with the soil to be sampled) to remove any overburden material present (including vegetative mat) to the level specified for sampling.
4. Measure and record the depth at which the sample will be collected with an engineers scale or tape.

5. Remove the thin layer that was in contact with the overburden removal equipment using a clean stainless steel scoop or equivalent and discard it.
6. Begin sampling with the acquisition of any discrete sample(s) for analysis of volatile organic compounds (VOCs), with as little disturbance as possible. VOC samples will not be composited or homogenized.
7. When a sample will not be collected with a core type of sampler (push tube, split spoon, etc.), the sample for VOC analysis will be collected from freshly exposed soil. The method of collection will follow the procedures specified in SOP 30.8 (Methanol Preservation Method) or 30.9 (En Core® Method) based on the requirements of the work plan addenda.
8. Field screen the sample with properly calibrated photoionization detector (PID) or other appropriate instrument. Cut a cross-sectional slice from the core or center of the sample and insert the monitoring instrument(s). Based on the screening results, collect the VOC fraction, as applicable.
9. Collect a suitable volume of sample from the targeted depth with a clean stainless steel scoop (or similar equipment), push tube sampler, or bucket auger
10. For core type of samplers, rough trimming of the sampling location surface should be considered if the sampling surface is not fresh or other waste, different soil strata, or vegetation may contaminate it. Surface layers can be removed using a clean stainless steel, spatula, scoop, or knife. Samples collected with a bucket auger or core type of sampler should be logged per the requirements of SOP 10.3.
11. If homogenization or compositing of the sampling location is not appropriate for the remaining parameters, the sample should be directly placed into appropriate sample containers with a stainless steel spoon or equivalent.
12. If homogenization of the sample location is appropriate or compositing of different locations is desired, transfer the sample to a stainless steel bowl for mixing. The sample should be thoroughly mixed with a clean stainless steel spoon, scoop, trowel, or spatula and then placed in appropriate sample containers per the requirements for containers and preservation specified in work plan addenda. Secure the cap of each container tightly.
13. Appropriately, label the samples (SOP 50.1), complete the chain-of-custody (SOP 10.4), and package the samples for shipping (SOP 50.2).
14. Return any remaining unused soil to the original sample location. If necessary, add clean sand to bring the subsampling areas back to original grade. Replace the vegetative mat over the disturbed areas.

3.3 SUBSURFACE SAMPLES

All sampling equipment should be appropriately decontaminated before and after use according to the requirements of the work plan addendum and SOP 80.1.

1. All monitoring equipment should be appropriately calibrated before sampling according to the requirement of the work plan addendum and SOP 90.1 or SOP 90.2.
2. All sampling equipment should be appropriately decontaminated before and after use according to the requirements of the work plan addendum and SOP 80.1.
3. Collect split-spoon; core barrel, Shelby tube, sonic core or other similar samples during drilling.
4. Upon opening sampler or extruding sample, immediately screen soil for VOCs using a PID or appropriate instrument. If sampling for VOCs, determine the area of highest concentration; use a

stainless steel knife, trowel, or lab spatula to cut the sample; and screen for VOCs with monitoring instrument(s).

5. Log the sample on the boring log before extracting from the sampler per the requirements of SOP 10.3.
6. Any required VOC samples will be collected first followed by the other parameters. VOC samples will not be composited or homogenized and will be collected from the area exhibiting the highest screening level. The method of VOC sample collection will follow the procedures specified in SOP 30.8 (Methanol Preservation Method) or 30.9 (En Core® Method) based on the requirements of the work plan addenda.
7. Field screen the sample with properly calibrated photoionization detector (PID) or other appropriate instrument. Cut a cross-sectional slice from the core or center of the sample and insert the monitoring instrument(s). Based on the screening results, collect the VOC fraction, as applicable.
8. Rough trimming of the sampling location surface should be considered if the sampling surface is not fresh or other waste, different soil strata, or vegetation may contaminate it. Surface layers can be removed using a clean stainless steel, spatula, scoop, or knife.
9. If homogenization or compositing of the sampling location is not appropriate for other parameters, the sample should be directly placed into appropriate sample containers with a stainless steel spoon or equivalent.
10. If homogenization of the sample location is appropriate or compositing of different locations is desired, transfer the sample to a stainless steel bowl for mixing. The sample should be thoroughly mixed with a clean stainless steel spoon, scoop, trowel, or spatula and placed in appropriate sample containers per the requirements for containers and preservation specified in work plan addenda. Secure the cap of each container tightly.
15. Appropriately, label the samples (SOP 50.1), complete the chain-of-custody (SOP 10.4), and package the samples for shipping (SOP 50.2).
16. Discard any remaining sample into the drums used for collection of cuttings.
17. Abandon borings according to procedures outlined in SOP 20.2.

3.4 INVESTIGATION-DERIVED MATERIAL

Investigation-derived material will be managed in accordance with procedures defined in the work plan addenda for the site being investigated and SOP 70.1.

NOTES: If sample recoveries are poor, it may be necessary to composite samples before placing them in jars. In this case, the procedure will be the same except that two split-spoon samples (or other types of samples) will be mixed together. The boring log should clearly state that the samples have been composited, which samples were composited, and why the compositing was done. In addition, VOC fraction should be collected from the first sampling device.

When specified, samples taken for geotechnical analysis (e.g., percent moisture, density, porosity, and grain size) will be undisturbed samples, such as those collected using a thin-walled (Shelby tube) sampler, sonic core sampler, etc.

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

Refer to the site-specific health and safety plan.

Soil samples will not include vegetative matter, rocks, or pebbles unless the latter are part of the overall soil matrix.

6.0 REFERENCES

ASTM Standard D 1586-84. 1984. *Penetration Test and Split-Barrel Sampling of Soils.*

ASTM Standard D 1587-83. 1983. *Thin Walled Sampling of Soils.*

ASTM Standard D 5633-94. 1994. *Standard Practice for Sampling with a Scoop.*

USACE. 2001. *Requirements for the Preparation of Sampling and Analysis Plans.* EM 200-1-3. 1 February.

STANDARD OPERATING PROCEDURE 30.2
GROUNDWATER SAMPLING

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for the collection of groundwater samples from monitoring wells.

2.0 MATERIALS

- Work Plans;
- Field logbooks and field parameter forms;
- Plastic sheeting;
- Decontamination equipment and supplies (SOP 80.1);
- Variable-speed, low-flow submersible pump with safety drop cable;
- Nylon stay-ties;
- Generator;
- Dedicated Teflon tubing or Teflon lined polyethylene tubing;
- Flow-through-cell and probes for measuring pH, temperature, specific conductance, oxidation/reduction potential, dissolved oxygen, and turbidity (SOP 40.1);
- Electronic water-level indicator;
- Appropriate sample bottles, labels, chain-of-custody forms, and sample shipping supplies etc;
- Cooler with ice;
- Silicone tubing;
- 0.45-micron disposable filters (as appropriate).
- Personal protective equipment and clothing (PPE) per site-specific health and safety plan;
- Photoionization detector (PID) or other appropriate monitoring instrument per the site-specific health and safety plan; and
- Appropriate containers for investigation-derived material.

3.0 PROCEDURE

3.1 DOCUMENTATION

Groundwater sampling information should be recorded in the field logbooks as described in SOPs 10.1 and 10.2.

The following are general rules for the field parameter logbook for groundwater, as described in SOP 10.2:

- Only information for one site or installation per logbook. The same book maybe used for more than one sampling event.
- The first five pages will be reserved for index, general notes, etc. Sign and date each entry.
- Fill in the forms.
- Duplicate copies, index pages, and calibration sheets remain intact.

3.2 OVERVIEW OF SAMPLING TECHNIQUES

In general, two different techniques may be used to sample groundwater from monitoring wells at Radford Army Ammunition Plant (RFAAP):

- Low flow purging and sampling (Type I); and
- Conventional purging and low-flow sampling (Type II).

These two sampling techniques are intended to address the different groundwater conditions that may be encountered at RFAAP.

The Type I sampling technique will be used in the following situations:

- In wells where only one discrete water-producing zone is encountered;
- In wells with no discrete water bearing zone and a low yield (generally < 0.5 liters per minute); and
- In wells sampled during seasonal low groundwater conditions with greatly reduced yield.

The Type II sampling technique will be used in the following situations:

- In a well with potential or documented multiple flow zones and where individual flow zones will not be evaluated;
- In moderately producing wells (> 0.5 liters per minute) where no discrete flow zones were documented during drilling; and
- In wells sampled during seasonal high groundwater conditions with enhanced yield (and potentially additional flow zones).

Groundwater samples should be collected no sooner than 14 days after well development. Information from the boring logs, well completion records, and well development records should be reviewed before sampling a well to determine the most appropriate sampling technique. Pertinent information for each well to be sampled includes:

- Well construction;
- Depth and nature of water producing zones;
- Sustainable pumping rate of the well to be sampled;
- Well recharge characteristics; and
- Baseline turbidity.

Because of the heterogeneous nature of the fracture and solution-enhanced fractured bedrock at RFAAP, monitoring well purging and sampling techniques will need to be flexible. This flexibility is necessary to

obtain representative samples that meet the data quality objectives (DQOs) specified in site-specific work plan addenda.

In general, when using the pumps specified in the following sections, situate any gasoline-powered generator on level ground approximately 15 ft downwind from the well. All generator maintenance (oil and fueling) is to be performed off site. If the hose(s) and/or power cord of the pump is not on a reel, place the pump with its hose and power cord on the plastic sheeting downhill from the well.

3.3 TYPE I SAMPLING PROCEDURES

Type I low flow purging and sampling procedures include the following:

- The work area outside the well will be prepared by placing plastic sheeting on the ground around the well casing to avoid cross-contamination.
- All equipment used to purge and sample the wells will be thoroughly decontaminated before and after use according to the requirements of the work plan addenda and SOP 80.1.
- All equipment to be used for monitoring water quality parameters will be calibrated before beginning purging according to the requirements of the work plan addenda and SOP 40.1.
- Note the condition of the well and well head.
- Monitor the headspace of the well with a photoionization detector as the well cap is removed.
- Measure and record the depth to water with an electronic water level indicator. The measurement of well depth will not be taken until after sampling is completed so that potential re-suspension of any settled solids at the bottom of the well is avoided.
- Well depth at the time of purging will be obtained from well construction and existing data.
- Slowly lower a clean, stainless steel, adjustable flow rate, submersible pump and dedicated Teflon or Teflon-lined polyethylene tubing to the desired depth. As the pump is slowly lowered into the well, secure the safety drop cable, tubing, and electrical lines to each other using nylon stay-ties.
- For wells with very low sustainable pumping rates ($\leq$ 0.5 liters per minute), the pump should be set in the middle of the saturated screen section of the well or middle of the water column for open wells. The pump should be set 12 hours prior to purging so that the depth to water equilibrates and sediments disturbed during pump placement have time to settle.
- For wells with sustainable pumping rates ($>$ 0.5 liters per minute), the pumps will be set at a desired depth prior to purging, allowing for the depth to water to equilibrate before sampling. The desired depth will be specified in work plan addenda based on site-specific conditions and DQOs.
- Connect the pump tubing to an in-line flow-through cell(s) and connect the multi-parameter probe to the cell(s). The end of the tubing exiting the in-line flow-through cell should be placed to discharge into a appropriate container(s) to collect purge water.
- Immediately prior to purging, the depth to water will be measured and record. Start pumping the water at a rate of 100 to 400 milliliters per minute. Avoid surging. The pumping rate should cause minimal drawdown (less than 0.2 ft). Water level measurements should be collected continuously to document stabilization of the water level. Pumping rates should, if needed, be reduced to the minimal capabilities of the pump to avoid dewatering the screen interval and ensure stabilization of indicator parameters.

- During purging, water quality indicator parameters will be monitored at the in-line flow-through cell(s) every 3 to 5 minutes. The parameters to be monitored include pH, specific conductance, oxidation/reduction potential (Eh), dissolved oxygen, and turbidity.
- Continue purging until stabilization of indicator parameters is achieved. Stabilization is defined as three consecutive readings that are within the following criteria:
  - ± 0.1 for pH;
  - ±3% for specific conductance;
  - ±10 mV for oxidation/reduction potential (Eh); and
  - ±10% for turbidity and dissolved oxygen.
- If the parameters have stabilized, but the turbidity is not in the range of 5 to 10 NTU, then both filtered and unfiltered samples should be collected for any metals analysis. Filter metal samples should be collected with an in-line filter using a high capacity 0.45-micron particulate filter. This filter should be pre-rinsed according to the manufacturer's instructions.
- Once purging is completed, reduce the pumping rate to its lowest steady rate and disconnect the tubing from the in-line flow-though cell(s).
- Collect groundwater samples directly from the end of the tubing into clean containers provided by the laboratory. The container requirements and preservatives for groundwater samples are specified in work plan addenda. Allowing the pump discharge to flow gently down the inside of the container with minimal turbulence should fill all sample containers. Volatile organic compound (VOC) and gas sensitive parameter samples should be collected first followed by other parameters.
- In general, samples should be collected and containerized in the order of the volatilization sensitivity of the parameters. A preferred collection order for some common parameters is VOCs, extractable organics, metals, cyanide, sulfate and chloride, turbidity, and nitrate and ammonia. The parameters to be collected at any well location are site-specific and are specified in work plan addenda.
- Appropriately, label the samples (SOP 50.1), complete the chain-of-custody (SOP 10.4), and package the samples for shipping (SOP 50.2).
- After the sample collection is complete, remove the pump, tubing, and associated lines. **Note:** sample tubing will be dedicated to each well.
- Measure and record the total depth of the well.
- Secure the well be replacing and locking the lid.

3.4 TYPE II SAMPLING PROCEDURES

- The work area outside the well will be prepared by placing plastic sheeting on the ground around the well casing to avoid cross-contamination.
- All equipment used to purge and sample the wells will be thoroughly decontaminated before and after use according to the requirements of the work plan addenda and SOP 80.1.
- All equipment to be used for monitoring water quality parameters will be calibrated before beginning purging according to the requirements of the work plan addenda and SOP 40.1.
- Note the condition of the well and well head.
- Monitor the headspace of the well with a photoionization detector as the well cap is removed.

- Measure and record the depth to water with an electronic water level indicator. The measurement of well depth will not be taken until after sampling is completed so that potential re-suspension of any settled solids at the bottom of the well is avoided.
- Well depth at the time of purging will be obtained from well construction and existing data.
- Calculate the standing water column in the well by subtracting the depth to water from the total depth of the well as recorded during completion of the well.
- From the water depth, well diameter, sand pack length, etc., calculate the equivalent volume (1 EV) of water in the well.

  1 EV = volume in casing + volume in saturated sand pack. Therefore; if the water table lies below the top of the sand pack, use the following equation:

  $1\ EV = (pR_w^2h_w) + (0.30p(R_s^2-R_w^2)h_w) * (0.0043)$

  If the water table lies above the top of the sand pack use this equation:

  $1\ EV = [(pR_w^2h_w) + (0.30p(R_s^2-R_w^2)h_s)] * (0.0043)$

  Where: R_s = radius of sand pack in inches
  R_w = radius of well casing in inches
  h_s = height of sand pack in inches
  h_w = water depth in inches

  $0.0043\ gal/in^3$
  Assumed filter pack porosity = 30%

Tables and graphs showing equivalent volumes for typical well constructions are available.

- Slowly lower a clean, stainless steel, adjustable flow rate, submersible pump and dedicated Teflon or Teflon-lined polyethylene tubing to the middle of the saturated screen interval or water column in an open borehole. As the pump is slowly lowered into the well, secure the safety drop cable, tubing, and electrical lines to each other using nylon stay-ties.
- Connect the pump tubing to an in-line flow-through cell(s) and connect the multi-parameter probe to the cell(s). The end of the tubing exiting the in-line flow-through cell should be placed to discharge into an appropriate container to collect purge water.
- Start purging the well at the minimally achievable pumping rate. Gradually increase the pumping rate to achieve the maximum flow rate of the pump or the maximum sustainable flow rate that does not draw down the static water level to a point below the top of the first water bearing zone, whichever is achieved first.
- During purging, water level measurements should be collected periodically to verify water levels in the well.
- During purging, water quality indicator parameters will be monitored at the in-line flow-through cell(s) every 3 to 5 minutes. The parameters to be monitored include pH, specific conductance, oxidation/reduction potential (Eh), dissolved oxygen, and turbidity.
- Note when each indicator parameter stabilizes. Stabilization is defined as three consecutive readings that are within the following criteria:
  - ± 0.1 for pH;
  - ±3% for specific conductance;

- ±10 mV for oxidation/reduction potential (Eh); and
- ±10% for turbidity and dissolved oxygen.

- Three calculated eVs of water in the will be purged prior to sampling. It will be documented if stabilization of the indicator parameters has not occurred after three calculated well volumes have been removed and sampling procedures begin.
- If the turbidity is not in the range of 5 to 10 NTU when purging has been completed, then both filtered and unfiltered samples should be collected for any metals analysis. Filter metal samples should be collected with an in-line filter using a high capacity 0.45-micron particulate filter. This filter should be pre-rinsed according to the manufacturer's instructions.
- Once purging is completed, reduce the pumping rate to its lowest steady rate and disconnect the tubing from the in-line flow-though cell(s).
- Collect groundwater samples directly from the end of the tubing into clean containers provided by the laboratory. The container requirements and preservatives for groundwater samples are specified in work plan addenda. Allowing the pump discharge to flow gently down the inside of the container with minimal turbulence should fill all sample containers. Volatile organic compound (VOC) and gas sensitive parameter samples should be collected first followed by other parameters.
- Appropriately, label the samples (SOP 50.1), complete the chain-of-custody (SOP 10.4), and package the samples for shipping (SOP 50.2).
- After the sample collection is complete, remove the pump, tubing, and associated lines. **Note:** sample tubing will be dedicated to each well.
- Measure and record the total depth of the well.
- Secure the well be replacing and locking the lid.

3.5 INVESTIGATION-DERIVED MATERIAL

Investigation-derived material will be managed in accordance with procedures defined in the work plan addendum for the site being investigated and SOP 70.1.

4.0 MAINTENANCE

Refer to manufacturer's requirements for maintenance of pumps and generators.

5.0 PRECAUTIONS

Refer to the site-specific health and safety plan.

6.0 REFERENCES

USACE. 2001. R*equirements for the Preparation of Sampling and Analysis Plans.* EM 200-1-3, 1 February.

USEPA. 1997. *Recommended Procedure for Low-flow Purging and Sampling of Groundwater Monitoring Wells.* Bulletin No. QAD023, October.

STANDARD OPERATING PROCEDURE 30.3
SURFACE WATER SAMPLING

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for collecting grab samples of surface water. This procedure can be applied to the collection of surface water samples from streams, rivers, ditches, lakes, ponds, and lagoons.

2.0 MATERIALS

- Work Plans;
- Field logbooks;
- Photoionization detector (PID) or other appropriate monitoring instrument as specified site-specific health and safety plan;
- Appropriate sample bottles, labels, chain-of-custody forms, and sample shipping supplies etc;
- Long-handled dip sampler (polytetrafluoroethylene (PTFE) or stainless steel), as applicable;
- Short-handled dip sampler (PTFE or stainless steel), as applicable;
- Pond sampler (PTFE or stainless steel), as applicable;
- Boat, other stable working platform, personal flotation device, as applicable;
- Sample filtration apparatus, as applicable;
- Peristaltic pump with 0.45-µm filters and disposable PTFE tubing, as applicable;
- Personal protective equipment and clothing (PPE) per site specific health and safety plan; and
- Appropriate containers for investigation-derived material.

3.0 PROCEDURE

3.1 CONSIDERATIONS

Factors that will need to be considered for selection of a surface water sampler include the width, depth, and flow of the surface water body, and whether the sample will be collected from the shore or a vessel. The most appropriate method(s) of sample collection and the appropriate depths of sampling (sampling strategies) will be specified in work plan addenda based on site-specific conditions and data quality objectives (DQOs).

3.2 DOCUMENTATION

Surface water sampling information should be recorded in the field logbooks as described in SOPs 10.1 and 10.2. This information should include a description of the water body characteristics (size, depth, flow, etc.).

Sampling locations should be marked on a site map. Describe each location and place a numbered stake above the visible high water mark on the bank closest to the sampling location and/or mark adjacent trees with surveyor's flagging. The descriptions must be adequate to allow the sampling station to be relocated at some future date by someone other than the original sampling crew.

3.3 SAMPLE LOCATION AND TIMING

Sampling should proceed from downstream locations to upstream locations so that disturbance related to sampling does not affect the samples collected upstream. In addition, if sediment samples are to be collected at the same locations as the surface water samples, the water samples must be collected first.
Sampling should be performed quickly and in a manner that minimizes disturbance of bottom sediments to ensure a representative sample.

In general, surface water samples should be collected and containerized in the order of the volatilization sensitivity of the parameters. A preferred collection order for some common parameters is volatile organic compounds (VOCs), extractable organics, metals, cyanide, sulfate and chloride, turbidity, and nitrate and ammonia. The parameters to be collected at any location are site-specific and are specified in work plan addenda.

3.4 SAMPLING METHODS

Various methods may be used to collect samples of surface water and the method used will depend on the considerations discussed in Section 3.1. Some of the more common methods used to collect surface water samples from shallow depths include:

- Submergence of sampling containers;
- Dipper and pond sampler; and
- Peristaltic pump (for non-volatile parameters).

Submergence of Sampling Container

Direct filling the sample containers by submergence is advantageous when the sample might be significantly altered during transfer from a collection device into another container. This method would not be appropriate for sampling at depth.

1. All sampling equipment should be appropriately decontaminated before and after use according to the requirements of the work plan addendum and SOP 80.1.
2. Spread new plastic sheeting on the ground at each sampling location to prevent cross-contamination. If sample access is restricted, use appropriate vessel or another stable working platform adjacent to the area to be sampled.
3. Samples should be collected in order specified in the work plan addenda prepared for the site-specific investigation (also see Section 3.3).
4. Submerge an appropriate sample container with the cap in place with minimal surface disturbance so that the open end is pointing upstream. Sample container requirements are specified in work plan addenda.
5. Allow the container to fill slowly and continuously using the cap to regulate the inflow of water.
6. Retrieve the sample from the surface water with minimal disturbance.
7. Preserve the sample as specified in work plan addenda. Secure the cap on the sample container tightly.
8. Appropriately, label the samples (SOP 50.1), complete the chain-of-custody (SOP 10.4), and package the samples for shipping (SOP 50.2).

Sampling with Dip and Pond Sampler

Dipper and pond samplers prevent unnecessary contamination of the outer surface of the sample container that would occur with the direct submergence method of sampling.

A long handled dipper sampler or a pond sampler can be used to remotely obtain samples where access is poor or non-contact with water is suggested in the health and safety plan.
Sampling with the PTFE or stainless steel dipper or pond sampler (long-handled or measuring cup type):

1. All sampling equipment should be appropriately decontaminated before and after use according to the requirements of the work plan addendum and SOP 80.1.
2. Spread new plastic sheeting on the ground at each sampling location to prevent cross-contamination. If sample access is restricted, use appropriate vessel or another stable working platform adjacent to the area to be sampled.
3. Assemble the sampler.
4. Samples should be collected in order specified in the work plan addenda prepared for the site-specific investigation (also see Section 3.3).
5. Collect samples by slowly submerging the pre-cleaned dipper or pond sampler with minimal surface disturbance. Make sure the open end is pointing upstream.
6. Remove the cap from the sample container and slightly tilt the mouth of the bottle below the edge of the sampler. Sample container requirements are specified in work plan addenda.
7. Empty the sampler slowly. Allow the sample stream to flow gently down the side of the bottle with entry turbulence. Avoid aerating the sample.
8. Continue filling the sample container until the container is filled.
9. Preserve the sample as specified in work plan addenda. Secure the cap on the sample container tightly.
10. Appropriately, label the samples (SOP 50.1), complete the chain-of-custody (SOP 10.4), and package the samples for shipping (SOP 50.2).

Sampling with a Peristaltic Pump

Sampling with a peristaltic pump will extend the lateral reach of the sampler and allow sampling from depths below the water surface. A disadvantage of this method is that it cannot be used to sample for volatile organic compounds because of potential degassing effects.

1. All sampling equipment should be appropriately decontaminated before and after use according to the requirements of the work plan addendum and SOP 80.1.
2. Spread new plastic sheeting on the ground at each sampling location to prevent cross-contamination. If sample access is restricted, use appropriate vessel or another stable working platform adjacent to the area to be sampled.
3. Install clean medical grade silicone tubing in the pump head, as instructed by the manufacturer.
4. Select the length of appropriate suction tubing (PFTE or other) necessary to reach the required sample location/depth and attach to the pump intake or extended section of silicone tubing emanating from the intake side of the pump head.
5. Turn on pump and adjust flow to draw water through tubing. If possible, allow several liters of sample to pass through the system before actual sample collection.
6. Samples should be collected in order specified in the work plan addenda prepared for the site-specific investigation (also see Section 3.3).
7. VOC samples, if required, will be collected using another type of sampling device, as specified in the work plan addenda.

8. Collect surface water samples directly from the end of the tubing into clean laboratory-prepared (preserved) containers. Allowing the pump discharge to flow gently down the inside of the container with minimal turbulence should fill all sample containers. Sample container requirements are specified in work plan addenda.
9. Preserve the sample as specified in work plan addenda. Secure the cap on the sample container tightly.
10. Appropriately, label the samples (SOP 50.1), complete the chain-of-custody (SOP 10.4), and package the samples for shipping (SOP 50.2).

3.5 SAMPLE FILTRATION

If specified in work plan addenda, certain parameters such as metals may need to be collected for both total and dissolved fractions. In this case, filtration will be performed immediately after collecting sample. Set up filtration equipment before collecting sample. Filtration may be accomplished by gravity or, if necessary, due to slow filtering, a peristaltic pump can be used to pressure filter the sample. Vacuum filtration will not be used due to the possibility of analyte volatilization.

3.6 GRAVITY FILTRATION

1. Using decontaminated forceps, place a 0.45-µm membrane in a decontaminated filter funnel.
2. Slowly pour sample into the funnel and collect filtrate directly into appropriate sample container(s).
3. Preserve the sample as specified in work plan addenda. Secure the cap on the sample container tightly.
4. Appropriately, label the samples (SOP 50.1), complete the chain-of-custody (SOP 10.4), and package the samples for shipping (SOP 50.2).
5. Appropriately dispose of filter membrane.

Filter with a Peristaltic Pump

1. Using previously assembled disposable tubing, 0.45-µm in-line filter, and peristaltic pump, filter sample from collection bucket into appropriate container.
2. Adjust pump rate to avoid aeration of sample.
3. Preserve the sample as specified in work plan addenda. Secure the cap on the sample container tightly.
4. Appropriately, label the samples (SOP 50.1), complete the chain-of-custody (SOP 10.4), and package the samples for shipping (SOP 50.2).

4.0 MAINTENANCE

Refer to manufacturer's specifications for maintenance procedures on generators and pumps.

5.0 PRECAUTIONS

Refer to the site-specific health and safety plan.

6.0 REFERENCES

ASTM Standard D 5358-93. 1993. *Standard Practice for Sampling with a Dipper or Pond Sampler.*

Environmental Monitoring System Laboratory (EMSL), ORD, U.S. Environmental Protection Agency. *Characterization of Hazardous Waste Site-A Method Manual, Volume II-Available Sampling Methods.* 1983.

USACE. 2001. *Requirements for the Preparation of Sampling and Analysis Plans.* EM 200-1-3. 1 February.

STANDARD OPERATING PROCEDURE 30.4
SEDIMENT SAMPLING WITH SCOOP OR TUBE SAMPLER

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for obtaining representative sediments sampling using a scoop or hand corer.

Sediments include solid matter derived from rocks or biological materials that are suspended in, or settled from, water. This procedure can be applied to the collection of sediment samples from areas of deposition such as streams, rivers, ditches, lakes, ponds, and lagoons.

SOP 30.5 describes two methods of grab sampling (Ekman and Ponar) that are suitable for sampling surface or deep sediments. SOP 30.12 describes a method of sampling deep sediments by using a Vibracore sampler.

2.0 MATERIALS

- Work Plans;
- Field logbooks;
- Photoionization detector (PID) or other appropriate monitoring instruments as specified in site-specific health and safety plan;
- Appropriate sample bottles, labels, chain-of-custody forms, and sample shipping supplies etc;
- Stainless steel bowls;
- Stainless steel or polytetrafluoroethylene (PTFE) scoops, trowels, spoons, and knives;
- Hand core sediment sampler, liners (optional) and extensions;
- Hand auger with buckets, rods, and T-handles;
- Rubber boots/waders;
- Decontamination equipment and supplies (SOP 80.1);
- Plastic sheeting;
- Utility knife;
- Boat or other stable work platform, and personal flotation devices, as applicable; and
- Personal protective equipment and clothing (PPE) as specified in site-specific health and safety plan.

3.0 PROCEDURE

The water content of the sediment may vary greatly. Likewise, the sediments themselves may range from very soft to dense. It may be necessary to use a variety of equipment to obtain the required samples, even at a single site.

3.1 CONSIDERATIONS

Factors that determine the type of sediment water sampler used are primarily related to project objectives of surficial versus subsurface samples, site constraints of the water depth, sampling and sediment conditions, and cost-effectiveness of the sampler.

The most appropriate method(s) of sample collection and the appropriate depths of sampling (sampling strategies) will be specified in the work plan addendum based on site-specific conditions and data quality objectives (DQOs).

3.2 DOCUMENTATION

Sediment sampling information should be recorded in the field logbooks as described in SOPs 10.1 and 10.2. This information should include a description of the water body characteristics (size, depth, flow, etc.) and nature of sediments.

Sampling locations should be marked on a site map. Describe each location and place a numbered stake above the visible high water mark on the bank closest to the sampling location and/or mark adjacent trees with surveyor's flagging. The descriptions must be adequate to allow the sampling station to be relocated at some future date by someone other than the original sampling crew.

3.3 SAMPLE LOCATION AND TIMING

Sampling should proceed from downstream locations to upstream locations so that disturbance related to sampling does not affect the samples collected upstream. In addition, if surface water samples are to be collected at the same locations as the sediment samples, the surface water samples must be collected first.
Sampling should be conducting using appropriate sampling devices that minimize disturbance and sample washing as the sample is retrieved through the liquid column.

In general, sediment samples should be collected and containerized in the order of the volatilization sensitivity of the parameters. A preferred collection order for some common parameters is volatile organic compounds (VOCs), extractable organics, metals, cyanide, sulfate and chloride, turbidity, and nitrate and ammonia. The parameters to be collected at any location are site-specific and are specified in work plan addenda.

3.4 LOCATION

For all samples, mark the sampling location on a site map. Photograph (optional, recommended) and describe each location, and place a numbered stake above the visible high water mark on the bank closest to the sampling location. The photographs and description must be adequate to allow the sampling station to be relocated at some future date.

3.5 GENERAL PROCEDURES

1. All sampling equipment should be appropriately decontaminated before and after use according to the requirements of work plan addenda and SOP 80.1.
2. Spread new plastic sheeting on the ground at each sampling location to prevent cross-contamination. If sample access is restricted, use appropriate vessel or another stable working platform adjacent to the area to be sampled.
3. Document sample location and conditions appropriately in the field logbooks and on site maps.
4. Collect surface water sample as described in the work plan addenda and SOP 30.3, as necessary.
5. Collect sediment sample using the appropriate sampling device as described in the following sections.

3.6 SCOOP OR TROWEL METHOD

The scoop or trowel method is a very accurate procedure for collecting representative samples, but is limited to sampling exposed sediments or sediments in surface water less than 6-inches deep, with nominal flow.

1. Insert scoop or trowel into material and remove sample.
2. Begin sampling with the acquisition of any discrete sample(s) for analysis of volatile organic compounds (VOCs), with as little disturbance as possible. VOC samples will not be composited or homogenized.
3. The method of collection for VOC samples will follow the procedures specified in SOP 30.8 (Methanol Preservation Method) or 30.9 (En Core® Method) based on the requirements of the work plan addenda and sampling conditions.
4. Field screen the sample with properly calibrated photoionization detector (PID) or other appropriate instrument. Based on the screening results collect the VOC fraction, as applicable.
5. If homogenization or compositing of the sampling location is not appropriate for the remaining parameters, the sample should be directly placed into appropriate sample containers with a stainless steel spoon or equivalent.
6. If homogenization of the sample location is appropriate or compositing of different locations is desired, transfer the sample to a stainless steel bowl for mixing. The sample should be thoroughly mixed with a clean stainless steel spoon, scoop, trowel, or spatula and then placed in appropriate sample containers. Secure the cap of each container tightly. Sample container requirements are specified in work plan addenda.
7. Appropriately, label and package the samples according to the requirements specified in SOPs 50.1 and 50.2, respectively, and with any additional sample handling requirements specified in work plan addenda.

3.7 TUBE SAMPLER

Tube samplers are a simple and direct method for obtaining sediment samples. The tube sampler is forced into the sediment and then withdrawn and the sample collected. Non-cohesive sediments may limit the effectiveness of this type of sampler.

1. Ensure that the corers and (optional) liners are properly cleaned.
2. Gradually force the corer into the sediment.
3. Carefully retrieve the tube sampler.
4. Remove the sediment core from the tube sampler and place core on a clean working surface.
5. Begin sampling with the acquisition of any discrete sample(s) for analysis of VOCs, with as little disturbance as possible. VOC samples will not be composited or homogenized.
6. The method of collection for VOC samples will follow the procedures specified in SOP 30.8 (Methanol Preservation Method) or 30.9 (En Core® Method) based on the requirements of the work plan addenda and sampling conditions.
7. Field screen the sample with properly calibrated photoionization detector (PID) or other appropriate instrument. Based on the screening results collect the VOC fraction, as applicable.

8. If homogenization or compositing of the sampling location is not appropriate for the remaining parameters, the sample should be directly placed into appropriate sample containers with a stainless steel spoon or equivalent.
9. If homogenization of the sample location is appropriate or compositing of different locations is desired, transfer the sample to a stainless steel bowl for mixing. The sample should be thoroughly mixed with a clean stainless steel spoon, scoop, trowel, or spatula and then placed in appropriate sample containers. Secure the cap of each container tightly. Sample container requirements are specified in work plan addenda.
10. Appropriately, label and package the samples according to the requirements specified in SOPs 50.1 and 50.2, respectively, and with any additional sample handling requirements specified in work plan addenda.

3.8 HAND AUGER AND TUBE SAMPLER

In general, the use of a hand auger and tube sampler will allow for sampling deeper sediments than possible with the tube sampling method described in Section 3.7. A potential disadvantage of using this method is that it limited to use for water bodies of limited depth and hand augers may not be an effective method for penetrating soft sediments since the borehole may collapse prior to sampling.

1. Attach the auger bucket to a drill rod extension and attach the T-handle to the drill rod.
2. Begin drilling with the auger. Periodically remove accumulated sediment from the bucket.
3. After reaching the desired depth, slowly and carefully remove the auger from the boring.
4. Remove the auger bucket from the drill rod(s) and replace with a clean thin-wall tube sampler.
5. Remove the sediment core from the tube sampler and place core on a clean working surface.
6. Carefully lower the tube sampler down the borehole and gradually force it into the sediment, avoiding scraping the borehole sides.
7. Carefully retrieve the tube sampler and unscrew the drill rod(s).
8. Begin sampling with the acquisition of any discrete sample(s) for analysis of VOCs, with as little disturbance as possible. VOC samples will not be composited or homogenized.
9. The method of collection for VOC samples will follow the procedures specified in SOP 30.8 (Methanol Preservation Method) or 30.9 (En Core® Method) based on the requirements of the work plan addenda and sampling conditions.
10. Field screen the sample with properly calibrated photoionization detector (PID) or other appropriate instrument. Based on the screening results collect the VOC fraction, as applicable.
11. If homogenization or compositing of the sampling location is not appropriate for the remaining parameters, the sample should be directly placed into appropriate sample containers with a stainless steel spoon or equivalent.
12. Appropriately, label and package the samples according to the requirements specified in SOPs 50.1 and 50.2, respectively, and with any additional sample handling requirements specified in work plan addenda.

3.9 INVESTIGATION-DERIVED MATERIAL

Investigation-derived material will be managed in accordance with procedures defined in the work plan addenda for the site being investigated and SOP 70.1.

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

Refer to the site-specific health and safety plan.

6.0 REFERENCES

ASTM Standard D 4700-91. 1991. *Standard Guide for Soil Sampling from the Vadose Zone.*

ASTM Standard D 5633-94. 1994. *Standard Practice for Sampling with a Scoop.*

USEPA. 1987. *A Compendium of Superfund Field Operations Methods.* EPA/540/P-87/001.

USACE. 2001. *Requirements for the Preparation of Sampling and Analysis Plans.* EM 200-1-3. 1 February.

STANDARD OPERATING PROCEDURE 30.7
SAMPLING STRATEGIES

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate sampling strategies for sampling various media.

2.0 MATERIALS

- Historical site data;
- Site topography;
- Soil types; and
- Sampled media.

3.0 PROCEDURE

The primary goal of any investigation is to collect samples representative of existing site conditions. Statistics are generally used to ensure samples are as representative as possible. Sampling plans may employ more than one approach to ensure project data quality objectives are adequately addressed. A comparison of sampling strategies is presented in Table 1.

3.1 CLASSICAL STATISTICAL SAMPLING

Classical statistical sampling strategies are appropriately applied to either site where the source of contamination is known or small sites where the entire area is remediated as one unit. Primary limitations of this sampling approach include (1) inability to address media variability; (2) inadequate characterization of heterogenous sites; and (3) inadequate characterization of sites with unknown contamination characteristics.

3.1.1 Simple Random Sampling

Simple random sampling is generally more costly than other approaches because of the number of samples required for site characterization. This approach is generally used when minimal site information is available and visible signs of contamination are not evident and includes the following features:

- Sampling locations are chosen using random chance probabilities.
- This strategy is most effective when the number of sampling points is large.

3.1.2 Stratified Random Sampling

This sampling approach is a modification to simple random sampling. This approach is suited for large site investigations that encompass a variety of soil types, topographic features, and/or land uses. By dividing the site into homogenous sampling strata based on background and historical data, individual random sampling techniques are applied across the site. Data acquired from each stratum can be used to determine the mean or total contaminant levels and provide these advantages:

- Increased sampling precision results due to sample point grouping and application of random sampling approach.

- Control of variances associated with contamination, location, and topography.

3.1.3 Systematic Grid

The most common statistical sampling strategy is termed either systematic grid or systematic random sampling. This approach is used when a large site must be sampled to characterize the nature and extent of contamination.

Samples are collected at predetermined intervals within a grid pattern according to the following approach:

- Select the first sampling point randomly; remaining sampling points are positioned systematically from the first point.
- Determine the grid design: one or two-dimensional. One-dimensional sample grids may be used for sampling along simple man-made features. Two-dimensional grid systems are ideal for most soil applications.
- Determine the grid type: square or triangular. Sampling is usually performed at each grid-line intersection. Other strategies include sampling within a grid center or obtaining composite samples within a grid.
- Each stratum is sampled based on using the simple random sampling approach but determined using a systematic approach.

3.1.4 Hot-Spot Sampling

Hot spots are small, localized areas of media characterized by high contaminant concentrations. Hot-spot detection is generally performed using a statistical sampling grid. The following factors should be addressed:

- Grid spacing and geometry. The efficiency of hot-spot searches is improved by using a triangular grid. An inverse relationship exists between detection and grid point spacing, e.g., the probability of hot-spot detection is increased as the spacing between grid points is decreased.
- Hot-spot shape/size. The larger the hot spot, the higher the probability of detection. Narrow or semicircular patterns located between grid sampling locations may not be detected.
- False-negative probability. Estimate the false negative (β-error) associated with hot-spot analysis.

3.1.5 Geostatistical Approach

Geostatistics describe regional variability in sampling and analysis by identifying ranges of correlation or zones of influence. The general two-stage approach includes the following:

- Conducting a sampling survey to collect data defining representative sampling areas.
- Defining the shape, size, and orientation of the systematic grid used in the final sampling event.

3.2 NON-STATISTICAL SAMPLING

3.2.1 Biased Sampling

Specific, known sources of site contamination may be evaluated using biased sampling. Locations are chosen based on existing information.

3.2.2 Judgmental Sampling

This sampling approach entails the subjective selection of sampling locations that appear to be representative of average conditions. Because this method is highly biased, it is suggested that a measure of precision be included through the collection of multiple samples.

4.0 MAINTENANCE

Not applicable.

5.0 REFERENCES

USACE. 2001. *Requirements for the Preparation of Sampling and Analysis Plans.* EM200-1-3. 1 February.

TABLE 1
SAMPLING STRATEGIES

SAMPLING STRATEGY	DESCRIPTION	APPLICATION	LIMITATIONS
Classical Statistical Sampling Strategies			
Simple Random Sampling	Representative sampling locations are chosen using the theory of random chance probabilities.	Sites where background information is not available and no visible signs of contamination are present.	May not be cost-effective because samples may be located too close together. Does not take into account spatial variability of media.
Stratified Random Sampling	Site is divided into several sampling areas (strata) based on background or site survey information.	Large sites characterized by a number of soil types, topographic features, past/present uses, or manufacturing storage areas.	Often more cost-effective than random sampling. More difficult to implement in the field and analyze results. Does not take into account spatial variability of media.
Systematic Grid Sampling	Most common statistical strategy; involves collecting samples at predetermined, regular intervals within a grid pattern.	Best strategy for minimizing bias and providing complete site coverage. Can be used effectively at sites where no background information exists. Ensures that samples will not be taken too close together.	Does not take into account spatial variability of media.
Hot-Spot Sampling	Systematic grid sampling strategy tailored to search for hot spots.	Sites where background information or site survey data indicate that hot spots may exist.	Does not take into account spatial variability of media. Tradeoffs between number of samples, chance of missing a hot spot, and hot spot size/shape must be weighed carefully.
Geostatistical Approach	Representative sampling locations are chosen based on spatial variability of media. Resulting data are analyzed using kriging, which creates contour maps of the contaminant concentrations and the precision of concentration estimates.	More appropriate than other statistical sampling strategies because it takes into account spatial variability of media. Especially applicable to sites where presence of contamination is unknown.	Previous investigation data must be available and such data must be shown to have a spatial relationship.
Non-Statistical Sampling Strategies			
Biased Sampling	Sampling locations are chosen based on available information.	Sites with known contamination sources.	Contaminated areas can be overlooked if background information or visual signs of contamination do not indicate them. Best used if combined with a statistical approach, depending on the project objectives.
Judgmental Sampling	An individual subjectively selects sampling locations that appear to be representative of average conditions.	Homogenous, well-defined sites.	Not usually recommended due to bias imposed by individual, especially for final investigations.

STANDARD OPERATING PROCEDURE 30.9
COLLECTION OF SOIL SAMPLES BY USEPA SW 846 METHOD 5035 USING DISPOSABLE SAMPLERS

1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) outlines the recommended protocol and equipment for collection of representative soil samples to monitor potential volatile organic contamination in soil samples.

This method of sampling is appropriate for surface or subsurface soils contaminated with low to high levels of volatile organic compounds (VOCs). This sampling procedure may be used in conjunction with any appropriate determinative gas chromatographic procedure, including, but not necessarily limited to, SW-846 Method 8015, 8021, and 8260.

2.0 MATERIALS

- Work Plans;
- Field Logbook;
- Photoionization Detector (PID) or other monitoring instrument(s) per site-specific health and safety plan;
- Personal protective equipment and clothing per site-specific health and safety plan;
- Soil sampling equipment, as applicable (SOP 30.1);
- Disposable sampler;
- T-handle and/or Extrusion Tool; and
- Decontamination equipment and supplies (SOP 80.1).

3.0 PROCEDURE

3.1 METHOD SUMMARY

Disposable samplers are sent to the field to be used to collect soil samples. Three samplers must be filled for each soil sampling location, two for the low-level method (sodium bisulfate preservation) and one for the high level method (methanol preservation). After sample collection, disposable samplers are immediately shipped back to the laboratory for preservation (adding soil sample into methanol and sodium bisulfate solution). The ratio of volume of methanol to weight of soil is 1:1 as specified in SW-846 Method 5035 (Section 2.2.2). The amount of preservative in the solution corresponds to approximately 0.2 g of preservative for each 1 g of sample. Enough sodium bisulfate should be present to ensure a sample pH of ≤ 2.

If quality assurance/quality control (QA/QC) samples are needed, seven samplers will be needed for the original, matrix spike, and matrix spike duplicate analysis. Soil samples are collected in the field using the disposable samplers, sealed and returned to the laboratory. A separate aliquot of soil is collected in a 125-mL container for dry weight determination.

3.2 SAMPLE CONTAINERS, PRESERVATION, HANDLING AND STORAGE

After sample collection, the disposable samplers must be cooled to and maintained at 4°C. The contents of the samplers will be analyzed using EPA methods 8015, 8021, and/or 8260. The **disposable** sampler is a single use device. It cannot be cleaned and/or reused.

Disposable samplers have a 48 hour holding time from sample collection to sample preparation in the laboratory. Return the samplers to the laboratory immediately after sampling.

3.3 SAMPLE PROCEDURES

Before sampling, the disposable sampler should be prepared as follows:

1. Unpack the cooler/sampling kit received from the laboratory. Disposable samplers are packed in sealed aluminized bags. These should be over packed in plastic zip lock bags. A T-Handle will also be needed to collect samples with the disposable sampler.
2. Hold coring body and push plunger rod down until small 0-ring rests against tabs. This will assure that plunger moves freely.
3. Depress locking lever on the sampler T-Handle (or other extraction device). Place coring body, plungers end first, into the open end of the T-Handle, aligning the two slots on the coring body with the two locking pins in the T-Handle. Twist the coring body clockwise to lock the pins in the slots. Check to ensure the sampler is locked in place. Sampler is ready for use.

The following procedure should be followed when using a disposable sampler to sample for VOCs in soil:

1. After the soil-sampling device (split spoon, corer, etc.) is opened, the sampling process should be completed in a minimum amount of time with the least amount of disruption.
2. Visual inspection and soil screening should be conducted after the sampler is opened and a fresh surface is exposed to the atmosphere. Soil screening should be conducted with an appropriate instrument (PID or FID).
3. Rough trimming of the sampling location surface should be considered if the sampling surface is not fresh or other waste, different soil strata, or vegetation may contaminate it. Surface layers can be removed using a clean stainless steel, spatula, scoop, or knife.
4. Orient the T-Handle with the T-up and the coring body down. This positions the plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using T-Handle, push sampler into soil until the coring body is completely full taking care not to trap air behind the sampler. When full, the small o-ring will be centered in the T-Handle viewing hole. Remove sampler from soil. Wipe excess soil from coring body exterior with a clean disposable paper towel.
5. Cap coring body while it is still on the T-Handle. ***Push*** cap over flat area of ridge ***and twist*** to lock cap in place. ***Cap must be seated to seal sampler.***
6. Remove the capped sampler by depressing locking lever on T-Handle while twisting and pulling sampler from T-Handle.
7. Lock plunger by rotating extended plunger rod fully counterclockwise until wings rest firmly against tabs.
8. Fill the 125-mL wide mouth jar for the non-preserved portion of the sample to be used for a moisture determination. These may be in a cardboard box. Retain all packaging to return the samples.
9. The disposable sampler should collect approximately 5 grams of soil (not necessary to weigh in the field). After a sample has been collected and capped, tear off the identification tag found at the bottom of the label on the aluminized bag. This tag is added to the sampler on the cap used to seal the sampler.

10. Place the sampler back in the aluminized bag and seal the top (a zip-lock seal). Make sure all the appropriate information is on the label. Record the sampler ID number on the chain-of-custody. Make sure each sampler and 125-mL container is labeled with the same location identification. The sampler should be placed inside the plastic zip-lock bags.
11. Place the 125-mL wide mouth jars in the cooler with the sampler on top. These should be sandwiched between bags of ice to maintain the correct temperature. If sent with the jars and samplers, a temperature bottle (used to evaluate the temperature on receipt) should be placed in the middle of the jars. The sample temperature should be 4ºC during shipment.
12. Ship the samples so that they will be received within 24 hours of sampling. The laboratory must receive the sampler within 40 hours of the collection so that they can be correctly preserved.

3.4 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

1. All data must be documented on chain-of-custody forms, field data sheets and in the field logbook.
2. An equipment blank is a QA/QC sample that will determine potential contamination from sampling equipment used to collect and transfer samples from the point of collection to the sample container. An equipment blank is performed by pouring demonstrated analyte free water from one sample container, over a sampler, and into a separate set of identical sample containers. The equipment blank is optional when sampling with the methanol preservation technique. It may be required on a site-specific basis if elevated analytical results are suspected to be due to cross contamination from sampling equipment.
3. A trip blank is a QA/QC sample, which will determine additional sources of contamination that may potentially influence the samples. The sources of the contamination may be from the laboratory, sample containers, or during shipment. The laboratory prepares a trip blank at the same time and in the same manner as the sample containers. The trip blank must accompany the sample containers to the field and back to the laboratory along with the collected samples for analysis. It must remain sealed at all times until it is analyzed at the laboratory. The frequency of collection for the trip blank must be at a rate of one per sample shipment.

3.5 LIMITATIONS IN SAMPLING

This sampling protocol will not be applicable to all solid environmental matrices, such as those that cannot be cored including non-cohesive granular material, gravel, or hard dry clay. In this case, the procedure for collecting VOC samples using Methanol Preservation should be used (see SOP 30.8).

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

None.

6.0 REFERENCES

En Novative Technologies, Inc. 2000. Users Manual for En Core® Sampler. February 2001.

USACE. 2001. *Requirements for the Preparation of Sampling and Analysis Plans.* EM 200-1-3, 1 February.

USEPA. 1997. *Test Methods for Evaluating Solid Waste, Volume IB: Laboratory Manual Physical/Chemical Methods,* Third Edition, (as updated through update IIIA). Office of Solid Waste and Emergency Response, Washington, DC.

STANDARD OPERATING PROCEDURE 40.1
MULTIPARAMETER WATER QUALITY MONITORING INSTRUMENT

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for field operation with the multiparameter water quality logging system (data transmitter and visual display). This system can monitor up to eleven basic parameters, including dissolved oxygen, percent saturation, temperature, pH, specific conductance, resistivity, salinity, total dissolved solids, redox, level, and depth.

2.0 MATERIALS

- Visual display;
- Data transmitter;
- Underwater cables; and
- Field logbooks.

3.0 PROCEDURE

3.1 CALIBRATION

Calibration will be performed in the field daily before use according to manufacturer's specifications. The following parameters are calibrated to the following standards:

- Temperature—none required;
- Specific conductance—KCl or seawater standards;
- pH—pH 7 buffer plus a slope buffer;
- Dissolved oxygen—saturated air or saturated water;
- Redox—quinhydrone or transfer;
- Depth—set zero in air;
- Level—set zero in air; and
- Salinity—uses calibration for specific conductance.

3.2 OPERATION

1. Attach the cable to the transmitter.
2. Connect the other end of the cable to the display.
3. Press the On/Off key on the display panel. Allow a few seconds for the transmitter to start sending data to the display screen.
4. Calibrate the transmitter.
5. Deploy the sensor into a minimum of 4 in. of water.

6. Write data values from the display screen in the appropriate field logbook.
7. Retrieve sensor and clean the transmitter to prevent cross-contamination.
8. Move to the next sampling location. If travel time is great, turn off display by pressing On/Off key. Check condition of probes after each deployment.
9. Disconnect the transmitter when finished sampling for the day.

4.0 MAINTENANCE

Maintain according to specific manufacturer's specifications.

5.0 PRECAUTIONS

- Check condition of probes frequently between sampling; and
- Don't force pins into the connectors; note the keying sequence.

STANDARD OPERATING PROCEDURE 40.2
WATER LEVEL AND WELL-DEPTH MEASUREMENTS

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for measuring water level and well depth. This procedure is applicable to the sampling of monitoring wells and must be performed before any activities that may disturb the water level, such as purging or aquifer testing.

2.0 MATERIALS

- Work Plans;
- Well construction diagrams;
- Field logbook;
- Photoionization detector (PID) or other monitoring instruments per site-specific health and safety plan;
- Decontamination equipment and supplies (SOP 80.1);
- Electric water level indicator (dipmeter) with cable measured at 0.01 ft increments;
- Oil-water interface probe (if non-aqueous phase liquid (NAPLs) are suspected to be present); and
- Plastic sheeting.

3.0 PROCEDURE

3.1 PRELIMINARY STEPS

1. Locate the well and verify its position on the site map. Record whether positive identification was obtained, including the well number and any identifying marks or codes contained on the well casing or protective casing. Gain access to the top of the well casing.
2. Locate the permanent reference mark at the top of the casing. This reference point will be scribed, notched, or otherwise noted on the top of the casing. If no such marks are present, measure to the top of the highest point of the well casing and so note this fact in field logbook. Determine from the records and record in the notebook the elevation of this point.
3. Record any observations and remarks regarding the completion characteristics and well condition, such as evidence of cracked casing or surface seals, security of the well (locked cap), and evidence of tampering.
4. Keep all equipment and supplies protected from gross contamination; use clean plastic sheeting. Keep the water level indicator probe in its protective case when not in use.

3.2 OPERATION

1. Sample the air in the well head for gross organic vapors by lifting the well cap only high enough for an organic vapor meter (PID or FID) probe to be entered into the well casing. This will indicate the presence of gross volatile contaminants as well as indicating potential sampler exposure.
2. Remove cap. Allow well to vent for 60–90 seconds. Resample headspace. Record both readings. If the second reading is lower than the first, use the second reading to determining whether respiratory

protection will be required during subsequent water level and well depth determinations and sampling.

3. Note that all headspace sampling must be performed at arm's length and from the upwind side of the well if possible.

4. If NAPL contamination is suspected, use an interface probe to determine the existence and thickness of NAPLs.

   - Open the probe housing, turn the probe on, and test the alarm. Slowly lower the probe into the well until the alarm sounds. A continuous alarm indicates a NAPL, while an intermittent alarm indicates water. If a NAPL is detected, record the initial level (first alarm). Mark the spot by grasping the cable with the thumb and forefingers at the top of the casing. If a mark is present on the casing, use the mark as the reference point. If no mark is present, use the highest point on the casing as the reference point. Withdraw the cable sufficiently to record the depth.

   - Continue to slowly lower the probe until it passes into the water phase. Slowly retract the probe until the NAPL alarm sounds and record that level in the manner as described above.

   - Record the thickness of the LNAPL (see Section 3.3.1).

   - Continue to slowly lower the interface probe through the water column to check for the presence of DNAPL.

   - Measure and record the thickness of the DNAPL layer (if any) as described above.

   - Slowly raise the interface probe, recording the depth to each interface as the probe is withdrawn. If there is a discrepancy in depths, clean the probe sensors and re-check the depths.

   - NOTE: Air-liquid interface depth is more reliable if probe is lowered into liquid. NAPL-water depths are more accurate if probe is moved from water into NAPL.

   - Always lower and raise interface probe slowly to prevent undue mixing of media.

   - Always perform NAPL check in wells installed in areas with suspected NAPL contamination. Always perform NAPL check if headspace test reveals presence of volatiles. Always perform NAPL check the first time a well is sampled. If a well has been sampled previously and no NAPLs were present and none of the proceeding conditions are met, the NAPL check may be omitted.

5. If no NAPL is present, use an electronic water level detector as follows.

   - Remove the water level indicator probe from the case, turn on the sounder, and test check the battery and sensitivity scale by pushing the red button. Adjust the sensitivity scale until you can hear the buzzer.

   - Slowly lower the probe and cable into the well, allowing the cable reel to unwind. Continue lowering until the meter buzzes. Very slowly, raise and lower the probe until the point is reached where the meter just buzzes. Marking the spot by grasping the cable with the thumb and forefingers at the top of the casing. If a mark is present on the casing, use the mark as the reference point. If no mark is present, use the highest point on the casing as the reference point. Withdraw the cable and record the depth.

6. To measure the well depth, lower electric water level indicator probe or tape until slack is noted. Very slowly raise and lower the cable until the exact bottom of the well is “felt.” Measure (cable) or read the length (tape) and record the depth.

7. Note that if the electric water level indicator is used to determine depth of well, the offset distance between the tip of the probe and the electrode must be added to the reading to determine actual depth.
8. Withdraw the probe or tape.
9. Decontaminate the probe(s) and cable(s), in accordance with SOP 80.1.

3.3 DATA RECORDING AND MANIPULATION

Record the following information in the field logbook and appropriate sampling forms:

- Date and time;
- Weather;
- Method of measurement;
- Casing elevation;
- NAPL surface elevation = casing elevation - depth to NAPL;
- Apparent measured LNAPL thickness = depth to bottom of NAPL - depth to top of NAPL;
- Water level elevation = casing elevation - depth to water; and
- Well bottom elevation = casing elevation - depth to bottom (or read directly from tape).

4.0 CALIBRATION

No calibration is required. Ensure operability of electric water level indicator by testing sounder before use.

5.0 PRECAUTIONS

- Depending upon the device used, correction factors may be required for some measurements;
- Check instrument batteries before each use; and
- Exercise care not to break the seals at the top of the electric water level indicator probe.

6.0 REFERENCES

ASTM Standard D 4750-87. 1987. *Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well).*

M^{c}Alary, T. A., and Barker, J.F. 1987. "Volatilization Losses of Organics During Ground Water Sampling from Low Permeability Materials" in *Ground Water Monitoring Review.* Fall 1987.

Thornhill, Jerry T. 1989. *Accuracy of Depth to Groundwater Measurements;* in "EPA Superfund Ground Water Issue" EPA/540/4-89/002.

STANDARD OPERATING PROCEDURE 40.3
SLUG TESTS

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide information and technical guidance for performing falling- and rising-head *in situ* hydraulic conductivity tests and data analyses. The slug test method involves causing a sudden change in head in a control well and measuring the water level response within that control well. Head change may be induced by suddenly injecting into the well or removing from the well a known quantity of water, rapid removal of a mechanical "slug" from below the water level, increasing or decreasing the air pressure in the well casing, or emplacement of a mechanical slug into the water column.

The water level response in the well is a function of the mass of water in the well and the transmissivity and coefficient of storage of the aquifer. The results of the slug test may be used to determine an estimate of the hydraulic conductivity of the aquifer material near the well.

2.0 MATERIALS

- Work Plans;
- Field logbook;
- Well construction information and boring log;
- Photoionization detector (PID) or other monitoring instruments per site-specific health and safety plan;
- Decontamination equipment and supplies (SOP 80.1);
- Aquifer test data sheets;
- Personal protective equipment and clothing (PPE) per site-specific health and safety plan; and
- Slug-inducing equipment (solid slug, line, etc.) large enough to displace groundwater beyond the well filter pack.

3.0 PROCEDURE

Initially, an appropriate test methodology should be chosen. The selection of the appropriate test method (rising or falling head) is dependent primarily on saturated screen length, the well diameter, and the estimated hydraulic conductivity. If the screen extends above the water table, a rising-head test (water removal) should be used. The performance of a falling-head test (water added) in this circumstance would overstate the hydraulic conductivity value, as the measured response would reflect the equilibration rate of previously unsaturated material; unsaturated materials would equilibrate faster than saturated materials. When the measured water level in a monitoring well is above the screened portion of the well, a falling-head test methodology should be employed. A rising-head test may also be performed, but only if the initial water level reading (after the slug is removed) is above the screened interval.

For larger diameter and deeper wells, as a general rule and particularly for high conductivity materials, it

is not feasible to remove a large enough slug or water volume to cause a sufficient change in head. In these cases the falling-head test method should be used.

It is recommended that a pressure transducer be used whenever possible to record water levels and time. A pressure transducer is required to record useful data when the hydraulic conductivity is high (greater than 10^{-3} cm/sec). The standard stopwatch and water-level indicator method is adequate for lower conductivity units.

The procedures outlined below assume use of a pressure transducer. Readings should be collected at intervals set on the data logger if used. If manual readings are collected, the following intervals should be applied:

- 0 to 5 minutes, every 10 seconds;
- 5 to 10 minutes, every 30 seconds;
- 10 to 30 minutes, every 1 minute; and
- 30 to 60 minutes, every 2 minutes.

3.1 Falling-Head Tests

1. Install pressure transducer near the total well depth and permit transducer and water levels to equilibrate to ambient conditions. Secure transducer cable to prevent movement during the test. Begin transducer readings.
2. Manually measure the static water level.
3. Insert slug completely below static water level or add a water "slug."
4. Intermittently measure water level and note the time of measurement with reference to the data logger.
5. Continue monitoring until water level is within 90% of the static level.

If a solid slug was used, stop the falling-head test recording at this point and begin a rising-head test by removing the solid slug from the well. If a solid slug was not used, simply end recording by the data logger at the completion of the falling-head test.

3.2 Rising-Head Tests

1. Install pressure transducer near the total well depth and permit transducer and water levels to equilibrate to ambient conditions. Secure transducer cable to prevent movement during testing.
2. Manually measure the static water level.
3. Remove sufficient volume of water to lower the water level a minimum of 1 ft below static water level, or
4. Install the solid slug fully below water level; permit static conditions to return and then remove the solid slug.
5. Begin readings with data logger.
6. Intermittently measure water level and note time of measurement with reference to data logger.
7. Continue monitoring until the water level is within 90% of the static level.

As a check on equipment operation and in the event that test data for a particular well are not usable, the data should be printed out in the field. If there is equipment failure (e.g., a non-attainment of a 1-foot

minimum head change, unexplained fluctuations in water levels, etc.), the test can be rerun with minimum time lost.

The well numbers, static and subsequent water levels, programmed test numbers, and general comments should be recorded in the field notebook.

4.0 PRECAUTIONS

Not applicable.

5.0 REFERENCES

ASTM Standard D 4043-91. *Standard Guide for Selection of Aquifer-Test Method in Determining of Hydraulic Properties of Well Techniques.*

Hvorslev, M.J. 1951. *Time-Lag and Soil Permeability in Ground Water Observations.* U.S. Army Engineers, Bulletin 36 - This method can be applied to both unconfined and confined aquifers but provides only approximate conductivity values (Freezer R.A. and J.A. Cherry, 1979, Groundwater, Prentice-Hall, Inc.).

Cooper, H.H., J.D. Bredehoeft, I.S. Papadopulos. 1967. *Response of a Finite-Diameter Well to an Instantaneous Charge of Water.* Water Resources Division, U.S. Department of the Interior Geological Survey, Vol. 3, No. 1 - This method can be applied to aquifers under confined conditions and requires that the well completely penetrate the aquifer. This method is believed to produce most reliable data when applied to low-permeability materials.

Bouwer, H. 1989. *The Bouwer and Rice Slug Test -- An Update.* Ground Water, Vol. 27, No. 3; and Bouwer, H. and R.C. Rice. 1976. *A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells.* Water Resources Research, Vol. 12, No. 3 - This method takes into account additional well and aquifer configuration data points not considered by Hvorslev's more simplistic method. Computer analyses are available.

Nguyen, V., G.F. Pinder. 1984. *Direct Calculation of Aquifer Parameters in Slug Test Analyses, Groundwater Hydraulics.* American Geophysical Union Water Resources Monograph 9 - This method can be applied to partially penetrating wells in both confined and unconfined aquifers it produces better values for low- to moderate-permeability materials.

STANDARD OPERATING PROCEDURE 50.1
SAMPLE LABELS

1.0 SCOPE AND APPLICATION

Every sample will have a sample label uniquely identifying the sampling point and analysis parameters. The purpose of this standard operating procedure (SOP) is to delineate protocols for the use of sample labels. An example label is included as Figure 50.1-A. Other formats with similar levels of detail are acceptable.

2.0 MATERIALS

- Sample label; and
- Indelible marker.

3.0 PROCEDURE

The use of preprinted sample labels is encouraged and should be requested from the analytical support laboratory during planning activities.
As each sample is collected, fill out a sample label ensuring the following information has been collected:

- Project name;
- Sample ID: enter the SWMU number and other pertinent information concerning where the sample was taken. This information should be included in site-specific work plan addenda;
- Date of sample collection;
- Time of sample collection;
- Initials of sampler(s);
- Analyses to be performed (NOTE: Due to number of analytes, details of analysis should be arranged with lab *a priori*); and
- Preservatives (water samples only).

Double-check the label information to make sure it is correct. Detach the label, remove the backing and apply the label to the sample container. Cover the label with clear tape, ensuring that the tape completely encircles the container.

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

None.

6.0 REFERENCES

USEPA. 1998. *EPA Requirements for Quality Assurance Project Plans.* EPA/600/R-98/018, QA/R5, Final, Office of Research and Development, Washington, D.C.

FIGURE 50.1-A
SAMPLE LABEL

PROJECT NAME _____

SAMPLE ID _____

DATE: ____/____/____ TIME: _____:_____

ANALYTES: VOC SVOC P/P METALS CN
PAH D/F HERBs ANIONS TPH
ALK TSS

PRESERVATIVE: [HCl] [HNO_3] [NaOH] [H_2SO_4]

SAMPLER: _____

STANDARD OPERATING PROCEDURE 50.2
SAMPLE PACKAGING

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for the packing and shipping of samples to the laboratory for analysis.

2.0 MATERIALS

- Waterproof coolers (hard plastic or metal);
- Metal cans with friction-seal lids (e.g., paint cans);
- Chain-of-custody forms;
- Chain-of-custody seals (optional);
- Packing material;
- Sample documentation;
- Ice;
- Plastic garbage bags;
- Clear Tape;
- Zip-top plastic bags; and
- Temperature blanks provided by laboratory for each shipment.

3.0 PROCEDURE

1. Check cap tightness and verify that clear tape covers label and encircles container.
2. Wrap sample container in bubble wrap or closed cell foam sheets. Samples may be enclosed in a secondary container consisting of a clear zip-top plastic bag. Sample containers must be positioned upright and in such a manner that they will not touch during shipment.
3. Place several layers of bubble wrap, or at least 1 in. of vermiculite on the bottom of the cooler. Line cooler with open garbage bag, place all the samples upright inside the garbage bag and tie.
4. Double bag and seal loose ice to prevent melting ice from soaking the packing material. Place the ice outside the garbage bags containing the samples.
5. Pack shipping containers with packing material (closed-cell foam, vermiculite, or bubble wrap). Place this packing material around the sample bottles or metal cans to avoid breakage during shipment.
6. A temperature blank (provided by laboratory) will be included in each shipping container to monitor the internal temperature. Samples should be cooled to 4 degrees C on ice immediately after sampling.
7. Enclose all sample documentation (i.e., Field Parameter Forms, Chain-of-Custody forms) in a waterproof plastic bag and tape the bag to the underside of the cooler lid. If more than one cooler is

being used, each cooler will have its own documentation. Add the total number of shipping containers included in each shipment on the chain-of-custody form.

8. Seal the coolers with signed and dated custody seals so that if the cooler were opened, the custody seal would be broken. Place clear tape over the custody seal to prevent damage to the seal.
9. Tape the cooler shut with packing tape over the hinges and place tape over the cooler drain.
10. Ship all samples via overnight delivery on the same day they are collected if possible.

4.0 MAINTENANCE

Not applicable.

5.0 PRECAUTIONS

5.1 PERMISSIBLE PACKAGING MATERIALS

- Non-absorbent
  - — Bubble wrap; and
  - — Closed cell foam packing sheets.
- Absorbent
  - — Vermiculite.

5.2 NON-PERMISSIBLE PACKAGING MATERIALS

- Paper;
- Wood shavings (excelsior); and
- Cornstarch “peanuts”.

6.0 REFERENCES

USEPA. 1990. *Sampler's Guide to the Contract Laboratory Program.* EPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, D.C., December 1990.

USEPA. 1991. *User's Guide to the Contract Laboratory Program.* EPA/540/O-91/002, Directive 9240.0-01D, Office of Emergency and Remedial Response. January 1991.

USEPA. 1998. *EPA Requirements for Quality Assurance Project Plans.* EPA/600/R-98/018, QA/R5, Final, Office of Research and Development, Washington, D.C

STANDARD OPERATING PROCEDURE 70.1
INVESTIGATION-DERIVED MATERIAL

1.0 SCOPE AND APPLICATION

Management of investigation-derived material (IDM) minimizes the potential for the spread of waste material onsite or offsite through investigation activities. The purpose of this standard operating procedure (SOP) is to provide general guidelines for appropriate management of potentially contaminated materials derived from the field investigations. Specific procedures related to the transportation and disposal of hazardous waste are beyond the scope of this SOP.

2.0 INTRODUCTION

Investigation derived material (IDM) consists of waste materials that are known or suspected to be contaminated with waste substances through the actions of sample collection or personnel and equipment decontamination. These materials include decontamination solutions, disposable equipment, drill cuttings and fluids, and water from groundwater monitoring well development and purging. To the extent possible, the site manager will attempt to minimize the generation of these materials through careful design of decontamination schemes and groundwater sampling programs. Testing conducted on soil and water investigation-derived material will show if they are also hazardous wastes as defined by RCRA. This will determine the proper handling and ultimate disposal requirements.

The criteria for designating a substance as hazardous waste according to RCRA is provided in 40 CFR 261.3. If IDM meet these criteria, RCRA requirements will be followed for packaging, labeling, transporting, storing, and record keeping as described in 40 CFR 262.34. Those materials that are judged potentially to meet the criteria for a regulated solid or hazardous waste will be placed in DOT-approved 55-gallon steel drums or another type of DOT approved container; based on waste characteristics and volume.
Investigation-derived material will be appropriately placed in containers, labeled, and tested to determine disposal options in accordance with RCRA regulations and Virginia Hazardous Waste Management Regulations.

3.0 INVESTIGATION-DERIVED MATERIAL MANAGEMENT

Procedures that minimize potential for the spread of waste material include minimizing the volume of material generated, material segregation, appropriate storage, and disposal according to RCRA requirements.

3.1 WASTE MINIMIZATION

In the development of work plan addenda, each aspect of the investigation will be reviewed to identify areas where excess waste generation can be eliminated. General procedures that will eliminate waste include avoidance of unnecessary exposure of materials to hazardous material and coordination of sampling schedules to avoid repetitious purging of wells and use of sampling equipment.

3.2 WASTE SEGREGATION

Waste accumulation and management procedures to be used depend upon the type of material generated. For this reason, IDM described below are segregated into separate 55-gallon storage drums or other appropriate

DOT containers. Waste materials that are known to be free of potential hazardous waste contamination (such as broken sample bottles or equipment containers and wrappings) must be collected separately for disposal to municipal systems. Large plastic garbage or "lawn and leaf" bags are useful for collecting this trash. Even "clean" sample bottles or Tyvek should be disposed of with care. Although they are not legally a problem, if they are discovered by the public they may cause concern. Therefore, items that are known to be free from contamination but are also known to represent "hazardous or toxic waste" to the public must not be disposed of in any public trash receptacle, such as found at your hotel or park.

3.2.1 Decontamination Solutions

Solutions considered investigation-derived materials range from detergents, organic solvents, and acids used to decontaminate small hand samplers to steam-cleaning rinsate used to wash drill rigs and other large equipment. These solutions are to be placed in 55-gallon drums with bolt-sealed lids or other appropriate DOT approved containers. Residual liquid IDM from decontamination pads will be removed and appropriately placed in container(s) at the end of each field day.

3.2.2 Soil Cuttings and Drilling Muds

Soil cuttings are solid to semi-solid soils generated during trenching activities or drilling for the collection of subsurface soil samples or the installation of monitoring wells. Depending on the type of drilling, drilling fluids known as "muds" may be used to remove soil cuttings. Drilling fluids flushed from the borehole must be directed into a settling section of a mud pit. This allows reuse of the decanted fluids after removal of the settled sediments. Drill cuttings, whether generated with or without drilling fluids, are to be removed with a flat-bottomed shovel and placed in 55-gallon drums with bolt-sealed lids or other appropriate DOT containers, as conditions or volume of IDM dictate.

3.2.3 Well Development and Purge Water

Well development and purge water is removed from monitoring wells to repair damage to the aquifer following well installation, obtain characteristic aquifer groundwater samples, or measure aquifer hydraulic properties. The volume of groundwater to be generated will determine the appropriate container to be used for accumulation of IDM.

For well development and purging, 55-gallon drums are typically an efficient container for accumulation. When larger volumes of water are removed from wells, such as when pumping tests are conducted, the use of large-volume portable tanks such as "Baker Tanks" should be considered for IDM accumulation.

Analytical data for groundwater samples associated with the well development and purge water will be used to assist in characterizing IDM and evaluating disposal options.

3.2.4 Personal Protective Equipment and Disposable Sampling Equipment

Personal protective equipment and clothing (PPE) may include such items as Tyvek coveralls, gloves, booties, and APR cartridges. Disposable sampling equipment may include such items as plastic sheeting, bailers, disposable filters, disposable tubing and paper towels. PPE and disposable sampling equipment that have or may have contacted contaminated media (soil, water, etc.) will be segregated and placed in 55-gallon drums separate from soil and water IDM. Disposition of this type of IDM will be determined by the results of IDM testing of the media in which the PPE and sampling equipment contacted.

3.3 MATERIAL ACCUMULATION

The IDM in containers must be placed in an appropriate designated RCRA container accumulation area at RFAAP, where it is permissible to accumulate such waste. IDM placed into a designated 90-day accumulation area will be properly sealed, labeled and covered. All drums will be placed on pallets.

A secure and controlled waste staging area will be designated by the installation prior the commencement of field sampling activities. Per the facility's requirements as a RCRA large quantity generator, waste accumulation cannot exceed 90 days for materials presumed or shown to be RCRA-designated hazardous wastes; waste which is known not to be RCRA-designated waste should be promptly disposed to municipal waste systems or appropriate facility.

3.3.1 IDM Accumulation Containers

Containers will be DOT-approved (DOT 17H 18/16GA OH unlined) open-head steel drums or other DOT approved container, as appropriate.

Container lids should lift completely off be secured by a bolt ring (for drum). Order enough containers to accumulate all streams of expected IDM including soil, PPE and disposable sampling equipment, decontamination water, purge water, etc.

Solid and liquid waste streams will not be mixed in a container. PPE and expendable sampling equipment will be segregated from other IDM and placed in different containers than soil. Containers inside containers are not permitted. PPE must be placed directly in a drum not in a plastic bag.

Pallets are often required to allow transport of filled drums to the staging area with a forklift. Normal pallets are 3×4 ft and will hold two to three 55-gallon drums depending on the filled weight. If pallets are required for drum transport or storage, field personnel are responsible for ensuring that the empty drums are placed on pallets before they are filled and that the lids are sealed on with the bolt-tighten ring after the drums are filled. Because the weight of one drum can exceed 500 lbs, under no circumstances should personnel attempt to move the drums by hand.

3.3.2 Container Labeling

Each container that is used to accumulate IDM will be appropriately labeled at the time of accumulation and assigned a unique identification number for tracking purposes. The following information will be written in permanent marker on a drum label affixed on the exterior side at a location at least two-thirds of the way up from the bottom of the drum.

- Facility name.
- Accumulation start date and completion date.
- Site identifier information (SWMU, boring, well, etc.).
- Description of IDM.
- Drum ID No.

4.0 MATERIAL CHARACTERIZATION AND DISPOSAL

IDM will be characterized and tested to determine whether it is a hazardous waste as defined by 40 CFR Part 261 and to determine what disposal options exist in accordance with RCRA regulations and the Virginia Hazardous Waste Management Regulations (VHWMR).

In general, IDM will be considered a hazardous waste if it contains a listed hazardous waste or if the IDM exhibits a characteristic of hazardous waste.

Work plan addenda will identify the appropriate characterization and testing program for IDM based on the following:

- Site-specific conditions related to chemicals of concern, etc.
- The nature and quantity of expected IDM to be generated during site-specific investigations.
- Applicable Federal, State, and local regulations, such as RCRA, VHWMR regulations and policies and procedures, and Army Regulation 200-1.
- RFAAP specific requirements and policies for IDM characterization and disposal at the time of the investigation.

In general, appropriate USEPA SW 846 Test Methods for Evaluating Solid Waste will be used for testing IDM and will be specified in work plan addenda. Other appropriate test methods may be specified by RFAAP in addition to SW 846 Methods that are specific to installation operations, the site of interest (percent explosive content, reactivity, etc.), or requirements for disposal at RFAAP water treatment facilities or publicly owned treatment works.

Responsibility for the final disposal of IDM will be determined before field activities are begun and will be described in work plan addenda. Off-site disposal of IDM will be coordinated with RFAAP (generator) to ensure appropriate disposition. The contractor will coordinate IDM transportation and disposal activities for RFAAP (generator).

At the direction of RFAAP, appropriate waste manifests will be prepared by the USACE contractor or Alliant Techsystems subcontractor for transportation and disposal. Alliant Techsystems or other appropriate RFAAP entity will be listed as the generator and an appointed representative from RFAAP will review and sign the manifest for offsite disposal.

RFAAP will make the final decision on the selection of the transporter, storage, and disposal facility (TSDFs) or recycling facility. RFAAP will provide the contractor a listing of previously used TSDFs for priority consideration. Proposed facilities that are not included on the listing are required to provide a copy of the TSDFs most recent state or federal inspection to the installation. Waste characterization and testing results will be submitted to RFAAP (generator) for review and approval before final disposition of the material.

Hazardous waste: Prior to final disposition, a hazardous waste manifest will be furnished by the TSDF to accompany transport to the disposal facility. Following final disposition, a certificate of disposal will be furnished by the disposal facility. Copies of the manifests and certificates of disposal are to be provided to RFAAP and retained on file by the contractor or subcontractor.

5.0 PRECAUTIONS

- Because the weight of one drum can exceed 500 lbs, under no circumstances should personnel attempt to move drums by hand.
- Refer to the site-specific health and safety plan when managing IDM.

6.0 REFERENCES

Safety Rules for Contractors and Subcontractors, 1995. Alliant Techsystems, Incorporated, Radford Army Ammunition Plant.

STANDARD OPERATING PROCEDURE 80.1
DECONTAMINATION

1.0 SCOPE AND APPLICATION

Before leaving the site, all personnel or equipment involved in intrusive sampling or having entered a hazardous waste site during intrusive sampling must be thoroughly decontaminated to prevent adverse health effects and minimize the spread of contamination. Equipment must be decontaminated between sites to preclude cross-contamination. Decontamination water will be free of contaminants as evidenced through either chemical analyses or certificates of analysis. This standard operating procedure (SOP) describes general decontamination requirements for site personnel and sampling equipment. Decontamination procedures for contaminants requiring a more stringent procedure, e.g., dioxins/furans, will be included in site-specific addenda.

2.0 MATERIALS

- Plastic sheeting, buckets or tubs, pressure sprayer, rinse bottles, and brushes;
- U.S. Army Corps of Engineers or installation approved decontamination water source;
- Deionized ultra-filtered, HPLC-grade organic free water (DIUF);
- Non-phosphate laboratory detergent;
- Nitric Acid, 0.1 Normal (N) solution;
- Pesticide-grade solvent, Methanol;
- Aluminum foil;
- Paper towels;
- Plastic garbage bags; and
- Appropriate containers for management of investigation-derived material (IDM).

3.0 PROCEDURE

3.1 SAMPLE BOTTLES

At the completion of each sampling activity the exterior surfaces of the sample bottles must be decontaminated as follows:

- Be sure that the bottle lids are on tight.
- Wipe the outside of the bottle with a paper towel to remove gross contamination.

3.2 PERSONNEL DECONTAMINATION

Review the site-specific health and safety plan for the appropriate decontamination procedures.

3.3 EQUIPMENT DECONTAMINATION

3.3.1 Drilling Rigs

Drilling rigs and associated equipment, such as augers, drill casing, rods, samplers, tools, recirculation tank, and water tank (inside and out), will be decontaminated before site entry, after over-the-road mobilization and immediately upon departure from a site after drilling a hole. Supplementary cleaning will be performed before site entry. There is a likelihood that contamination has accumulated on tires and as spatter or dust en route from one site to the next.

1. Place contaminated equipment in an enclosure designed to contain all decontamination residues (water, sludge, etc.).
2. Steam-clean equipment until all dirt, mud, grease, asphaltic, bituminous, or other encrusting coating materials (with the exception of manufacturer-applied paint) has been removed.
3. Water used will be taken from an approved source.
4. When cross-contamination from metals is a concern, rinse sampling components such as split spoons, geo-punch stems, and augers with nitric acid, 0.1N.
5. Rinse with DIUF water.
6. When semi-volatile and non-volatile organics may be present, rinse the sampling components with pesticide-grade solvent methanol.
7. Double rinse the sampling components with DIUF water.
8. Decontamination residues and fluids will be appropriately managed as IDM per work plan addenda and SOP 80.1.

3.3.2 Well Casing and Screen

Prior to use, well casing and screen materials will be decontaminated. This activity will be performed in the leak proof, decontamination pad, which will be constructed prior to commencement of the field investigation. The decontamination process will include:

- Steam cleaning with approved source water.
- Rinse with DUIF water.
- Air-dry on plastic sheeting.
- Wrap in plastic sheeting to prevent contamination during storage/transit.

3.3.3 Non Dedicated Submersible Pumps Used for Purging and Sampling

1. Scrub the exterior of the pump to remove gross (visible) contamination using appropriate brushes, approved water, and non-phosphate detergent (steam cleaning may be substituted for detergent scrub).
2. Pump an appropriate amount of laboratory detergent solution (minimum 10 gallons) to purge and clean the interior of the pump.
3. Rinse by pumping no less than 10 gallons of approved water to rinse.
4. Rinse the pump exterior with approved decontamination water.
5. When cross-contamination from metals is a concern, rinse the pump exterior with approved nitric acid 0.1N solution.
6. Rinse the pump exterior with DIUF water.

7. When semi-volatile and non-volatile organics may be present, rinse the pump exterior with pesticide-grade solvent methanol.
8. Double rinse the pump exterior with DIUF water.
9. Air-dry on aluminum foil or clean plastic sheeting.
10. Wrap pump in aluminum foil or clean plastic sheeting, or store in a clean, dedicated PVC or PTFE storage container.
11. Solutions and residuals generated from decontamination activities will be managed appropriately as IDM per work plan addenda and SOP 80.1.

3.3.4 Sample Equipment and Measuring Water Level Devices

1. Scrub the equipment to remove gross (visible) contamination using appropriate brush (es), approved water, and non-phosphate detergent.
2. Rinse with approved source water.
3. When cross-contamination from metals is a concern, rinse the sampling equipment with approved nitric acid 0.1N solution.
4. Rinse equipment with DIUF water.
5. When semi-volatile and non-volatile organics may be present, rinse the sampling equipment with pesticide-grade solvent methanol.
6. Double rinse the sampling equipment with DIUF water.
7. Air-dry on aluminum foil or clean plastic sheeting.
8. Wrap in aluminum foil, clean plastic sheeting, or zip top bag or store in a clean, dedicated PVC or PTFE storage container.
9. Solutions and residuals generated from decontamination activities will be managed appropriately as IDM per work plan addenda and SOP 80.1.

3.3.5 Other Sampling and Measurement Probes

Temperature, pH, conductivity, Redox, and dissolved oxygen probes will be decontaminated according to manufacturer's specifications. If no such specifications exist, remove gross contamination and triple-rinse probe with DIUF water.

4.0 PRECAUTIONS

- Manage IDM appropriately according to the requirements specified in work plan addenda.
- Follow appropriate procedures as specified in the site-specific health and safety plan.

5.0 REFERENCES

USACE. 2001. Requirements for the Preparation of Sampling and Analysis Plans. EM 200-1-3. 1 February.

STANDARD OPERATING PROCEDURE 90.1
PHOTOIONIZATION DETECTOR (HNu Model PI–101 and HW–101)

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for field operations with a photoionization detector (HNu Systems Model PI–101 or HW–101). The photoionization detector (PID) detects total ionizables; hence it is used to monitor both organic and inorganic vapors and gases to determine relative concentrations of air contaminants. This information is used to establish level of protection and other control measures such as action levels. The PID cannot effectively detect compounds having ionization potentials above the photon energy level of the lamp used; therefore, methane, which has an ionization potential of 12.98 eV, is undetectable by PIDs because the lamps produce 9.5, 10.2, or 11.7 eV.

Use of brand names in this SOP is in not intended as an endorsement or mandate that a given brand be used. Alternate equivalent brands of detectors, sensors, meters, etc., are acceptable. If alternate equipment is to be used, the contractor shall provide applicable and comparable SOPs for its maintenance and calibration.

2.0 MATERIALS

- HNu Systems Model PI–101 or HW–101 survey probe with 9.5, 10.2, or 11.7 eV lamp;
- Lead-acid gel-cell battery;
- Calibration gas (e.g., isobutylene, 101 ppm) with regulator;
- Tygon tubing;
- Tedlar bag (optional);
- Instrument logbook; and
- Field logbook.

3.0 PROCEDURE

These procedures are to be followed when using the HNu in the field.

3.1 STARTUP

1. Before attaching the probe, check the function switch on the control panel to ensure that it is in the off position. Attach the probe by plugging it into the interface on the top of the readout module.
2. Turn the function switch to the battery check position. The needle on the meter should read within or above the green battery arc on the scale; if not, recharge the battery. If the red indicator light comes on, the battery needs recharging or service may be indicated.
3. Turn the function switch to any range setting. Listen for the hum of the fan motor. Check meter function by holding a solvent-based marker pen near the sample intake. If there is no needle deflection, look briefly into the end of the probe (no more than 1 or 2 sec) to see if the lamp is on; if it is on, it will give a

purple glow. Do not stare into the probe any longer than 2 sec. Long-term exposure to UV light can damage the eyes. (See further information in Section 5.)

4. To zero the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed since this is an electronic zero adjustment. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted if necessary. Allow the instrument to warm up for 3–5 min to ensure that the zero reading is stable. If necessary, readjust the zero.

3.2 OPERATIONAL CHECK

Follow the startup procedure in Section 3.1.
With the instrument set on the 0–20 range, hold a solvent-based marker near the probe tip. If the meter deflects upscale, the instrument is working.

3.3 FIELD CALIBRATION PROCEDURE

1. Follow the startup procedures in Section 3.1 and the operational check in Section 3.2.
2. Set the function switch to the range setting for the concentration of the calibration gas.
3. Attach a regulator HNu P/N 101-351 or equivalent (flow = 200 to 300 ml/min) to a disposable cylinder of isobutylene (HNu 101-351 or equivalent). Connect the regulator to the probe of the HNu with a piece of clean Tygon tubing. Turn on the valve of the regulator.
4. After 5 sec, adjust the span dial until the meter reading equals the benzene concentration of the calibration gas used, corrected to its equivalence, which should be marked on the canister (Isobutylene ~0.7X benzene).
5. Record in the field log the instrument ID No., serial No., initial and final span settings, date, time, location, concentration and type of calibration gas used, and the signature of the person who calibrated the instrument.
6. If the HNu does not function or calibrate properly, the project equipment manager is to be notified as soon as possible. Under no circumstances is work requiring monitoring with a PI–101 or HW–101 to be done with a malfunctioning instrument.

3.4 CALIBRATION TO A GAS OTHER THAN ISOBUTYLENE

The HNu may be calibrated to any certified calibration gas. However, after calibration, all subsequent instrument readings will be relative to the calibration gas used. General procedures include the following:

1. Calibrate according to procedure 3.3.
2. Partially fill and flush one-to-two times a gas bag (Tedlar recommended) with the certified National Institute of Standards and Technology (NIST) (formerly NBS) traceable calibration gas. Then fill the bag with 1–3 L of the calibration gas. If the gas is toxic, this must be done in a fume hood.
3. Feed the calibration gas into the probe with the range set for the value of the gas. After 5 sec, adjust the span control until the meter reads the value of the calibration gas.
4. Record the results of the calibration on the calibration/maintenance log and attach a new calibration sticker (if available) or correct the existing sticker to reflect the new calibration data. All subsequent readings will be relative to the new calibration gas.

3.5 OPERATION

1. Follow the startup procedure, operational check, and calibration check (refer to Section 3.1).

2. Set the function switch to the appropriate range. If the concentration of gas vapors is unknown, set the function switch to 0-20 ppm range. Adjust if necessary.
3. Prevent exposing the HNu to excessive moisture, dirt, or contaminant while monitoring the work activity as specified in the Site Health and Safety Plan.
4. When the activity is completed, or at the end of the day, carefully clean the outside of the HNu with a damp disposable towel to remove all visible dirt. Return the HNu to a secure area and place on charge. Charge after each use; the lead acid batteries cannot be ruined by over charging.
5. With the exception of the probe's inlet and exhaust, the HNu can be wrapped in clear plastic to prevent it from becoming contaminated and to prevent water from getting inside in the event of precipitation. If the instrument becomes contaminated, make sure to take necessary steps to decontaminate it. Call the Equipment Administrator if necessary; under no circumstances should an instrument be returned from the field in a contaminated condition.

4.0 MAINTENANCE

Calibration/maintenance logs are to be filled in completely whenever a PI-101 or HW-101 receives servicing. This is true of both contractor-owned and rental instruments.

The equipment manager should be called to arrange for a fresh instrument when necessary. The contractor's equipment facility is responsible for arranging all repairs that cannot be performed by the project equipment manager.

4.1 ROUTINE SERVICE

The PID's performance is affected by a number of factors. These include but are not limited to the decay of the UV lamp output over time and the accumulation of dust and other particulate material and contaminates on the lamp and in the ion chamber. Because of these factors, the PID should not be left in the field for a period of more than 2 weeks before being replaced with a fresh instrument. If a site is going to be inactive for a period of more than a week, all monitoring instruments are to be returned to the project equipment manager or his trained designee for servicing and/or reassignment. The following procedures are to be performed at the designated intervals for routine service.

Procedure	Frequency
Operational check	Before use and at instrument return
Field calibration	Before use and at instrument return
Full calibration	Bi-weekly (return instrument to equipment manager for replacement with a fresh unit)
Clean UV lamp and	Bi-weekly or as needed ion chamber
Replace UV Lamp	As needed

4.1.1 UV Lamp and Ion Chamber Cleaning

During periods of analyzer operation, dust and other foreign materials are drawn into the probe forming deposits on the surface of the UV lamp and in the ion chamber. This condition is indicated by meter readings that are low, erratic, unstable, non-repeatable, or drifting and show apparent moisture sensitivity. These deposits interfere with the ionization process and cause erroneous readings. Check for this condition regularly to

ensure that the HNu is functioning properly. If the instrument is malfunctioning, call your equipment manager to arrange to have a fresh replacement.

4.1.2 Lamp eV Change

If different applications for the analyzer would require different eV lamps, separate probes, each with its own eV lamp, must be used. A single readout assembly will serve for any of the probes (9.5, 10.2, and 11.7 eV). A change in probe will require resetting of the zero control and recalibrating the instrument. The 11.7 eV lamp will detect more compounds than either of the two lower eV lamps. However, the 11.7 eV probe needs more frequent calibration; it burns out much faster than the lower eV lamps.

5.0 PRECAUTIONS

- The HNu PI–101 and HW–101 are designed to sample air or vapors only. *Do not allow any liquids or low boiling vapors to get into the probe or meter assembly.*
- High concentrations of any gas can cause erroneous readings. High humidity can also cause the instrument readings to vary significantly from the actual concentration of gases or vapors present. This is true even through the HNu cannot react to water vapor.
- High humidity, dust, and exposure to concentrations of low boiling vapors will contaminate the ion chamber, causing a steady decrease in sensitivity.
- Continued exposure to ultraviolet light generated by the light source can be harmful to eyesight. If a visual check of the UV lamp is performed *do not look at the light source from a distance closer than 6 inches with unprotected eyes.* Use eye protection (UV-blocking sunglasses or safety glasses). Only look briefly—never more than about 2 sec.
- Place the instrument on charge after each use; the lead batteries cannot be ruined by over charging.
- If at any time the instrument does not check out or calibrate properly in the field, the equipment manager is to be notified immediately and a replacement obtained for the malfunctioning instrument. Under no circumstances should fieldwork requiring continuous air monitoring for organic vapors and/or gases be done with a malfunctioning Hnu or without a HNu or an approved comparable instrument.

6.0 REFERENCES

Manufacturer's Equipment Manual.

PORE WATER SAMPLING GUIDANCE

Pushpoint Sampling for Defining Spatial and Temporal Variations in Contaminant Concentrations in Sediment Pore Water near the Ground-Water/ Surface-Water Interface (USGS 2005)

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Pushpoint Sampling for Defining Spatial and Temporal Variations in Contaminant Concentrations in Sediment Pore Water near the Ground-Water/ Surface-Water Interface

By Marc J. Zimmerman, Andrew J. Massey, and Kimberly W. Campo

In cooperation with the
U.S. Environmental Protection Agency
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Conversion Factors and Miscellaneous Abbreviations

Multiply	By	To obtain
centimeter (cm)	0.3937	inch (in.)
centimeter (cm)	0.03281	foot (ft)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
liter (L)	33.82	ounce, fluid (fl. oz)
liter (L)	2.113	pint (pt)
liter (L)	1.057	quart (qt)
liter (L)	0.2642	gallon (gal)
liter (L)	61.02	cubic inch (in^3)
kilometer	0.6214	mile (mi)
meter (m)	3.281	foot (ft)
meter (m)	1.094	yard (yd)
milliliter (mL)	0.03382	ounce, fluid (fl. oz)
millimeter (mm)	0.03937	inch (in.)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\times°C)+32$$

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

1,2-DCB	1,2-dichlorobenzene
1,2-DCE	1,2-dichloroethene
1,2,3-TCB	1,2,3-trichlorobenzene
LDPE	low-density polyethylene
PCE	tetrachloroethene
PDB	passive-diffusion-bag sampler
PPS	pushpoint sampler
RPD	relative percent difference
TCE	trichloroethene
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

Pushpoint Sampling for Defining Spatial and Temporal Variations in Contaminant Concentrations in Sediment Pore Water near the Ground-Water/Surface-Water Interface

By Marc J. Zimmerman, Andrew J. Massey, and Kimberly W. Campo

Abstract

During four periods from April 2002 to June 2003, pore-water samples were taken from river sediment within a gaining reach (Mill Pond) of the Sudbury River in Ashland, Massachusetts, with a temporary pushpoint sampler to determine whether this device is an effective tool for measuring small-scale spatial variations in concentrations of volatile organic compounds and selected field parameters (specific conductance and dissolved oxygen concentration). The pore waters sampled were within a subsurface plume of volatile organic compounds extending from the nearby Nyanza Chemical Waste Dump Superfund site to the river. Samples were collected from depths of 10, 30, and 60 centimeters below the sediment surface along two 10-meter-long, parallel transects extending into the river. Twenty-five volatile organic compounds were detected at concentrations ranging from less than 1 microgram per liter to hundreds of micrograms per liter (for example, 1,2-dichlorobenzene, 490 micrograms per liter; *cis*-1,2-dichloroethene, 290 micrograms per liter). The most frequently detected compounds were either chlorobenzenes or chlorinated ethenes. Many of the compounds were detected only infrequently. Quality-control sampling indicated a low incidence of trace concentrations of contaminants. Additional samples collected with passive-water-diffusion-bag samplers yielded results comparable to those collected with the pushpoint sampler and to samples collected in previous studies at the site.

The results demonstrate that the pushpoint sampler can yield distinct samples from sites in close proximity; in this case, sampling sites were 1 meter apart horizontally and 20 or 30 centimeters apart vertically. Moreover, the pushpoint sampler was able to draw pore water when inserted to depths as shallow as 10 centimeters below the sediment surface without entraining surface water. The simplicity of collecting numerous samples in a short time period (routinely, 20 to 30 per day) validates the use of a pushpoint sampler as a highly effective tool for mapping the extent of contaminated subsurface plumes, determining their constituents and loadings, and performing technical studies that may be relevant to bioremediation and other activities.

Introduction

The environmental risk posed by contaminants in stream- and lake-bed sediments is affected, in part, by small-scale (meters or less) lateral and vertical variations in concentrations in pore water and by changes in those concentrations with time. The technologies available to collect pore-water samples, including screened well points, passive-water-diffusion-bag samplers (PDBs), and seepage meters are typically (1) unsuitable for collecting water in shallow, biologically active zones; (2) too cumbersome or expensive to define small-scale variations; or (3) too difficult to maintain or reinstall for time-series sampling. For these reasons, lateral and vertical variations of contaminants in pore water are often poorly defined, and temporal variations with changing hydrologic conditions are rarely evaluated. Therefore, the U.S. Geological Survey, in cooperation with the U.S. Environmental Protection Agency (USEPA), began a study in 2002 to determine the effectiveness of a temporary pushpoint sampler for collecting pore-water samples from shallow sediments to measure concentrations of various constituents. Samples were collected at Mill Pond on the Sudbury River in Ashland, MA.

Purpose and Scope

This report documents the testing of a temporary pushpoint sampler, the PushPoint Extreme Sampler (MHE Products, East Tawas, Michigan; U.S. Pat. No. 6,470,967) (fig. 1) at Mill Pond on the Sudbury River in Ashland, MA

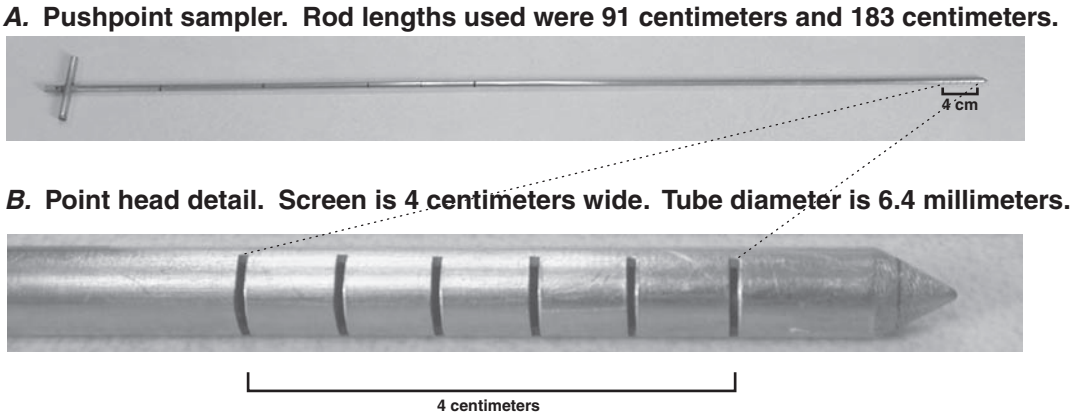
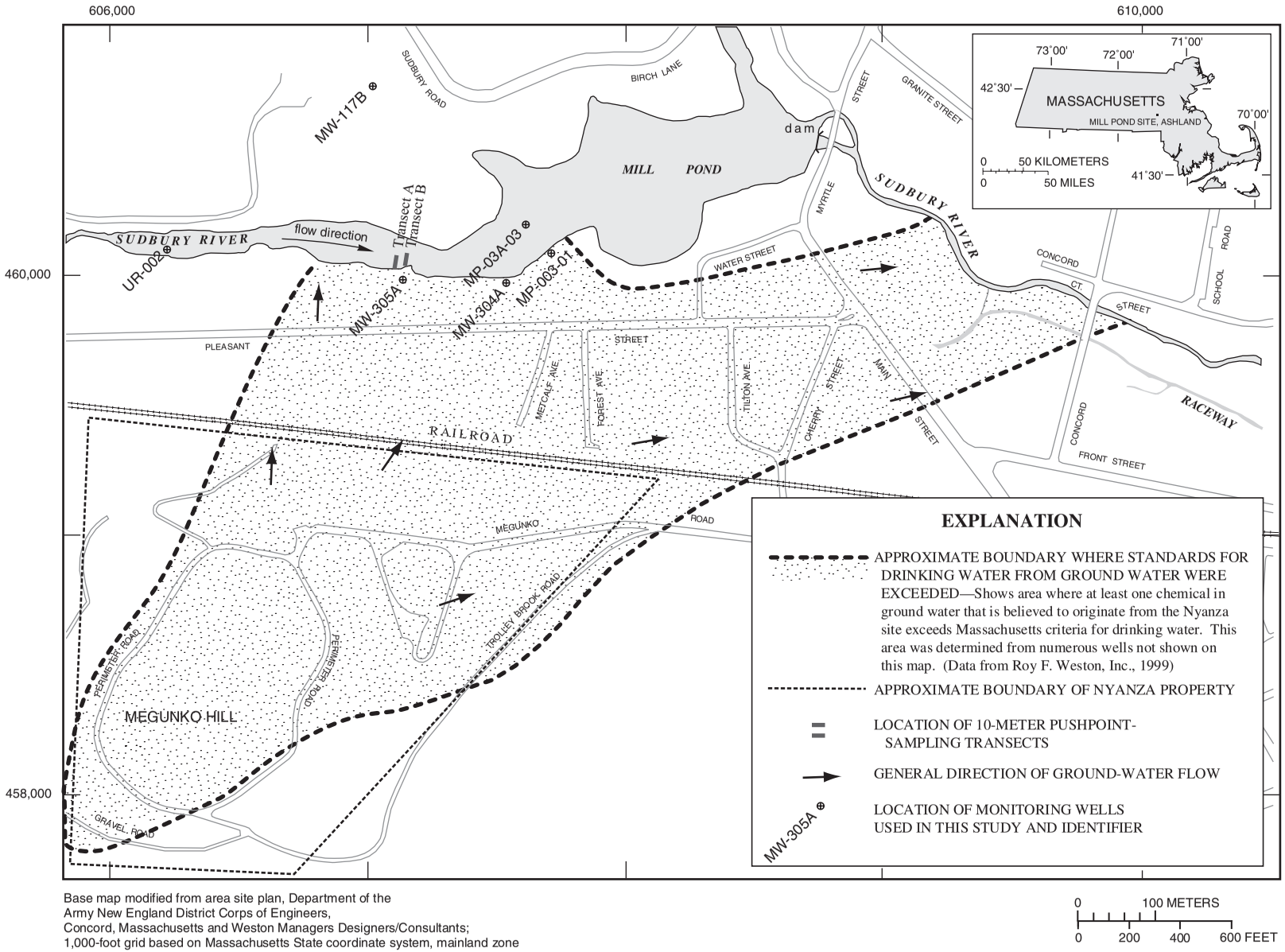


Figure 1. *A*, the 91-centimeter-long PushPoint Extreme Sampler, and *B*, closeup of the slotted screen at the tip.

(fig. 2), to determine its effectiveness as a tool for collecting samples to measure concentrations of volatile organic compounds (VOCs) and other water-quality constituents in pore water from shallow sediments. A positive determination required meeting two objectives as described in the report: first, a successful field demonstration of the minimum sediment depth from which the pushpoint sampler (PPS) could collect pore-water samples without introducing surface water, and second, a field demonstration that the PPS could collect samples clearly differentiating the small-scale spatial and temporal variations in specific conductance, pH, dissolved oxygen, ferrous iron, and VOCs. To collect samples during a range of normal-, high-, and low-flow periods, four study periods were scheduled: June 2002 and April 2003 (normal flow), June 2003 (high flow), and September 2002 (low flow). Finally, the report describes how the data provided by the field demonstration proved useful for screening and interpretation.

Study-Area Description

The Mill Pond on the Sudbury River in Ashland, Massachusetts, was selected as the study site (fig. 2) because ground-water discharge into the pond includes a contaminant plume known to contain VOCs, semivolatile organic compounds, and other constituents, such as metals, from the Nyanza Chemical Waste Dump Superfund site located approximately 0.6 km upgradient (Church and others, 2002a; Campbell and others, 2002; U.S. Army Corps of Engineers, 1999.) The plume flows northward to reach the study site, the closest area of the plume's interaction with the river. The sediments at the study site generally consist of fine-grained sand, silt, and organic matter.



Base map modified from area site plan, Department of the Army New England District Corps of Engineers, Concord, Massachusetts and Weston Managers Designers/Consultants; 1,000-foot grid based on Massachusetts State coordinate system, mainland zone

Figure 2. The study area, Mill Pond, Sudbury River, Ashland, Massachusetts.

The Pushpoint Sampler

The PPS is a 6.4-mm-diameter stainless-steel tube with a machined point and 4-cm-long slotted-screen zone at the tip (Henry, 2001); 91-cm and 183-cm models were used in this study. An internal guard rod positioned through the bore adds rigidity to the sampler during insertion. After setting the PPS in the sediment at the desired depth, the guard rod is withdrawn. The PPS is designed to sample pore water with minimal disturbance to the site.

During this study, a peristaltic pump was used to draw water samples through the PPS. Approximately 2 m of Norprene tubing connected the pump directly to the PPS. Samples were collected from a boat braced against or lashed to the transect structure (fig. 3).

The PPS has features that make its use attractive when time is limited and a large number of samples is needed:

- Only one site visit is needed to collect one or more samples;
- Many samples can be collected easily to define discharge zones laterally and vertically;
- No onsite installation of equipment is required;
- Substrate disturbance is minimal; and
- Differential heads (water levels) can be measured easily with a manometer.

Those features should be weighed against some of the PPS's potential limitations:

- A sample represents conditions at a point in time and space, not an integration of changes over a longer time period;
- Without semipermanent installation (multilevel sampler, for example), a sample may not be drawn from the identical spot on return visits;
- The physical characteristics of the substrate may prevent sample collection;
- Low yield can make it difficult to obtain flow sufficient for measurement of field properties.

Study Design

To ensure that surface water was not drawn into a pore-water sample, specific conductance was monitored while approximately 2 L of pore water were collected from 10 cm beneath the sediment surface. To demonstrate the utility of the PPS to collect discrete shallow pore-water samples, two 10-m transects were selected that extended perpendicular to the shore. Sampling sites were distributed at 1-m intervals along the transects and samples were collected from 10, 30, and 60 cm beneath the sediment surface at these sites. In addition, PDBs were installed and sampled to provide a basis to compare the results from this study with previous investigations (Church and others, 2002a; Lyford and others, 2000).



Figure 3. Sample collection from boat on the Mill Pond, Sudbury River, Ashland, Massachusetts.

Initial Testing

On June 13, 2002, preliminary testing was done to ensure that pumping did not introduce surface water into the pore-water sample. First, the surface-water specific conductance was measured. Then, the PPS was carefully inserted 10 cm into the riverbed sediment; this insertion placed the uppermost slot of the screen 5 cm below the sediment surface. The pump was turned on and, once the flow became steady, the conductance and volume were monitored until approximately 2 L had flowed through the system. Results from two separate sampling tests show stable pore-water specific-conductance values of 482 ±1 and 610 ±8 µS/cm were maintained and were clearly different from the surface-water values of 367 and 382 µS/cm, respectively. If the pumping were inducing surface water to flow into the PPS, a decrease in the specific conductance would become apparent. During this study, comparing the surface-water specific conductance with the values from all samples collected from 10 cm below the sediment surface confirmed that surface water did not affect the pore-water samples.

Only specific conductance was used to test for surface-water infiltration, although temperature also may have indicated infiltration (Conant, 2004). Measurements of other properties in the field, for example, the concentrations of dissolved oxygen, are not as stable at concentrations lower than 0.5 mg/L. Measurements may also be affected by chemical interactions and the effects are likely to be difficult to quantify accurately in the field. Two examples are oxidation-reduction reactions betweeen dissolved oxygen and iron and pH changes resulting from oxidation of organic matter (Stumm and Morgan, 1996).

Field Study

In April 2002, the Mill Pond study site was outfitted with a staff gage, arbitrarily referenced to a nearby concrete dock, for visual determination of river stage; two parallel, fixed transects extending into the river (figs. 4 and 5); and two piezometers in the river bed for routine confirmation that the area is a gaining reach, where VOC-contaminated ground water discharges to the river. During all four study periods, the water levels inside the piezometers were higher than the external levels as measured down from the tops of the piezometers (table 1), indicating ground-water discharge to the river. The site also has two previously installed monitoring wells on the shore.

The two 10-m-long fixed transects, A and B, were constructed approximately 10 m apart and perpendicular to the shoreline. First, 4-ft steel posts were driven vertically into the bed sediments. The distances of the ends of the transects from the shoreline depended on the river stage: transect A was about 2–3 m from the shoreline and transect B about 0.5–2.5 m from the shoreline (fig. 5). Second, aluminum guide rails were attached horizontally to the posts with clamps for stable anchoring of the small aluminum rowboat during sampling. The horizontal guide rails were removed between sampling events to prevent debris accumulation during high flows. A fiberglass tape measure was attached to each transect to ensure that sampling would take place at the same locations during the four sampling periods from June 17, 2002, to June 26, 2003. Eleven sampling locations 1 m apart were designated along each transect's horizontal rails (fig. 5).

Planned sampling periods were scheduled to target periods of the year that were likely to include a range of streamflows in the study reach of the Sudbury River. Relative to this study site, two periods of moderate, or normal, discharge and one period each of low and high discharge were sought. Based on the hydrological data provided by reading the staff gage, such a range of flows occurred during the four sampling study periods (table 1). Additional corroboration of the flow condition was obtained by comparing the stage with mean daily discharges at a continuous stream-discharge monitoring station located 6.5 km downstream; however, the discharge at that station is subject to the influence of reservoir regulation and flow diversions, and may not closely mirror discharge at the study site.

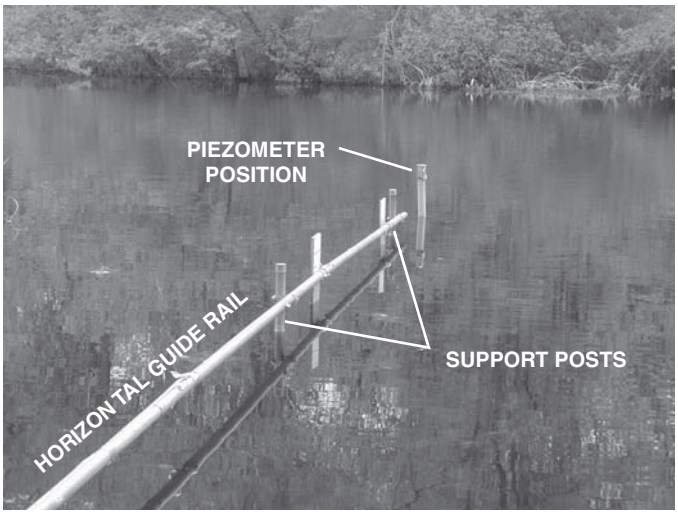


Figure 4. Transect A extending from near shore into the Sudbury River, Ashland, Massachusetts. Surface water flows from left to right.

Sampling Procedures

Samples were collected from 10, 30, and 60 cm below the riverbed at 1-m intervals along the upstream side of each transect. Care was taken to avoid disturbing the sampler during sample collection. Any accidental movement of the sampler while inserted a short distance (centimeters) into the sediment could open a pathway for surface water to flow downward and mix with and dilute the pore-water sample. If the specific conductance of the sample was at or near that of surface water, the sampler was reinserted and the "well" was developed again.

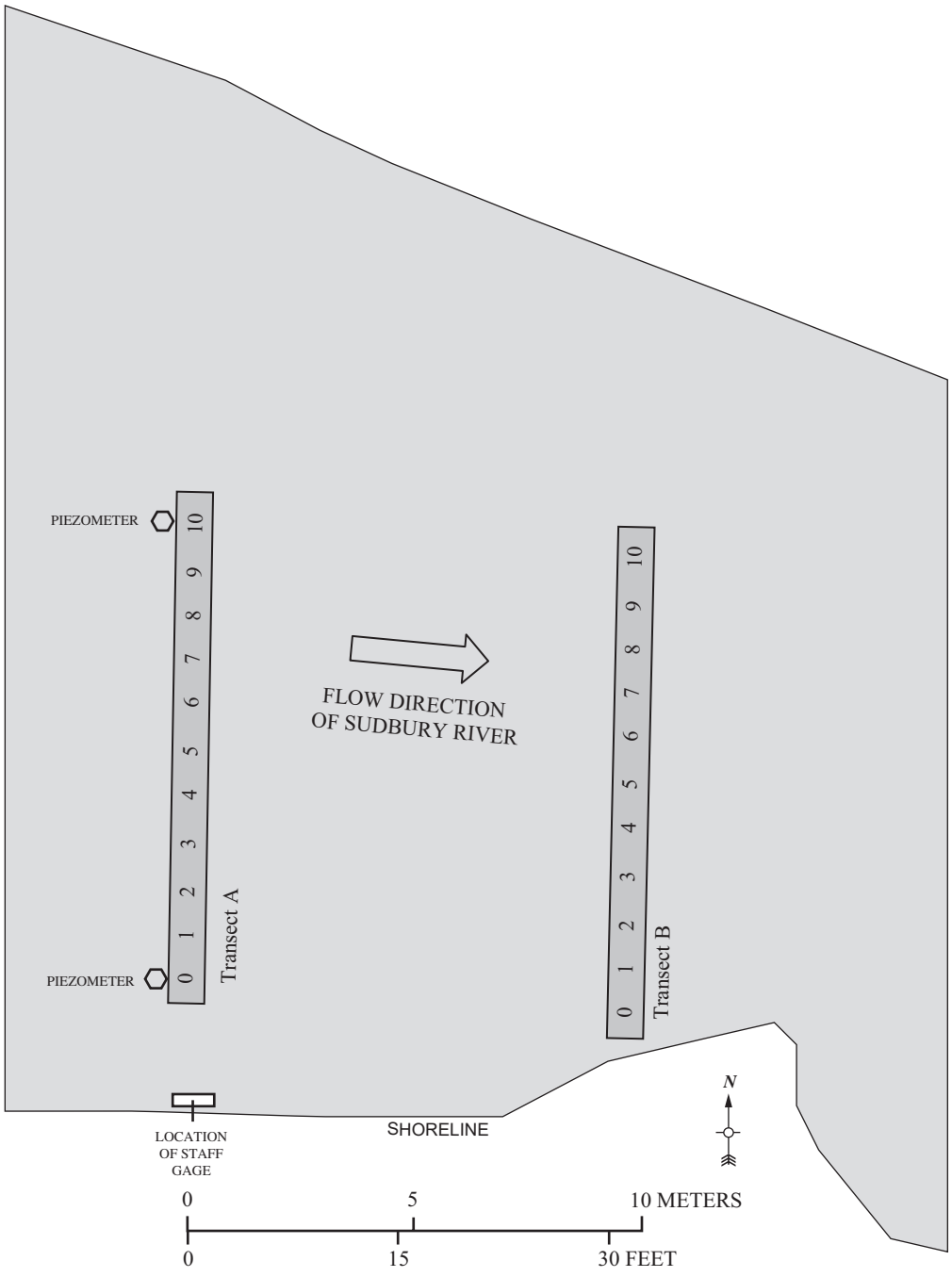


Figure 5. Schematic diagram depicting layout of transects A and B in relation to Sudbury River shoreline at the Mill Pond and flow direction, Ashland, Massachusetts. Numbers along the transects denote sampling locations and distance along transect, in meters.

Table 1. Staff-gage height, streamflow, and piezometer readings during study periods, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.

[**Streamflow:** In cubic feet per second, approximately 6.5 kilometers (4.0 miles) downstream at Saxonville, Massachusetts, U.S. Geological Survey station number 01098530. Piezometer measurements are distances, in feet, from the top of the piezometer to the water surface. NA, not available]

Date	Flow condition	Staff-gage height ft	Streamflow	Nearshore piezometer water levels		Distant piezometer water levels	
				Inside	Outside	Inside	Outside
June 2002							
6-17-2002	Normal	0.5	245	1.03	1.24	0.90	1.14
6-18-2002	Normal	.48	258	NA	NA	.89	1.13
6-19-2002	Normal	.46	227	1.02	1.40	.95	1.11
September 2002							
9-04-2002	Low	0.18	123	1.55	1.62	1.38	1.44
9-05-2002	Low	NA	120	NA	NA	NA	NA
9-06-2002	Low	NA	129	NA	NA	NA	NA
9-09-2002	Low	NA	135	NA	NA	NA	NA
April–May 2003							
4-29-2003	Normal	0.62	269	0.90	1.18	1.06	1.12
4-30-2003	Normal	.58	238	.90	1.23	1.10	1.23
5-01-2003	Normal	.54	220	.98	1.26	1.10	1.25
5-02-2003	Normal	.54	209	1.00	1.25	1.11	1.28
June 2003							
6-23-2003	High	1.07	611	0.39	0.73	0.53	0.74
6-24-2003	High	1.06	600	.43	.75	.53	.76
6-25-2003	High	.92	548	.56	.90	.66	.88
6-26-2003	High	.78	463	.69	1.03	.86	1.03

Occasionally, fine sediment and organic matter clogged the sampler screen; however, repeated flushing and pumping usually cleared the obstruction. If the obstruction did not yield after various attempts to dislodge it, the sampler was removed from the sediment, cleaned, and reinserted within 30 cm of its initial position. Three sampling attempts were made at a specific depth before the effort was abandoned. Approximately 21 percent of the sampling attempts failed because of obstructions by fine-grained materials or organic matter. The use of a screen cover consisting of a fine nylon mesh, a product unavailable at the time of this study, has reduced the failure rate since the study end.

When stable flow at a low pumping rate was established, sampling proceeded. During initial purging of the PPS, specific conductance, pH, dissolved oxygen concentration, and temperature were measured. (Although interpretation of temperature data was not part of this study, Conant (2004) has shown streambed temperature measurement to be a valid approach for delineation and quantification of ground-water discharge zones.) VOC samples were taken once turbidity had visibly dropped and specific conductance and dissolved oxygen had stabilized within a range indicative of pore water. For samples with dissolved oxygen concentrations less than 0.8 mg/L, dissolved oxygen was remeasured colorimetrically (American Public Health Association and others, 1998). Field measurements of dissolved oxygen at concentrations less than 1.0 mg/L by the colorimetric method are more reliable than those made by using an oxygen electrode.

If dissolved oxygen concentrations were near zero (generally, less than 0.02 mg/L, using the colorimetric method), ferrous iron was often measured by using a colorimetric analysis (McCobb and others, 2003). However, measurements were not made consistently throughout the study. Thus, detectable ferrous iron concentrations served primarily to provide additional evidence of a reducing environment, and corroborated the dissolved oxygen measurements. Highly reducing environments can be associated with microbially mediated transformations of hazardous organic contaminants, such as tetrachloroethene (PCE), through processes coupled with iron (III) reduction (Haggblom and others, 2000).

VOC samples were collected in triplicate after the field parameters had been recorded and the dissolved oxygen and ferrous iron colorimetric measurements had been made. The three, 40-mL, amber-glass vials were filled, acidified with HCl, placed in foam sleeves, inserted in plastic bags, and then chilled to below 4ºC for transport to the USEPA laboratory in Chelmsford, MA, where the samples were analyzed for VOCs (U.S. Environmental Protection Agency, 1998). In all, 148 samples were collected along transect A and 159 along transect B; these totals include quality-control replicates and blanks.

In order to compare the results obtained by using the PPS with results obtained by using an alternative approach to porewater sampling, an array of PDBs was deployed at the conclusion of the April–May 2003 round of sampling. Eleven samplers were deployed along the two transects where pushpoint sampling was conducted. The PDB method has been used to sample VOCs plumes in wells and ground-water discharge zones throughout the United States (Vroblesky, 2001), including the Nyanza site in 1999 (Lyford and others, 2000).

The PDBs were constructed from heat-sealed, low-density polyethylene (LDPE) lay-flat tubing filled with deionized water, as described in Vroblesky (2001). Over time, VOCs will diffuse through the plastic membrane into the deionized water inside so that concentrations inside the sampler equilibrate to concentrations in the sediment pore water. Henry's Law predicts how equilibration is affected by temperature, pressure, and the molecular weight of the VOC (Stumm and Morgan, 1996). It is generally recommended that PDBs be deployed for approximately 14 days in most field environments, in order to help ensure equilibration. VOC concentrations from passive sampling are integrated over the time of deployment and, therefore, results from this method are not directly comparable to the results from pushpoint sampling, which is done at a discrete point in time. Vroblesky (2001) has reported that 3 (acetone, methyl *tert*-butyl ether, and styrene) of 40 VOCs had poor recovery levels when PDBs were tested in laboratory conditions.

Insertion of the 20-cm-long, polyethylene-membrane diffusion samplers followed a modification of the method described in Church and others (2002b). The bottom of the sampler was placed approximately 45 cm below the sediment surface. Engineer's flagging tape was attached to the sampler for identification and easy relocation.

These samplers were retrieved after the last round of pushpoint sampling in June 2003, when they had spent 55 days in the sediment. The exterior surfaces of the samplers were cleaned with deionized water to remove any clinging sediment. Then, a corner of the sample bag was cut with clean scissors, and sample water was transferred into 40-mL VOC-sample vials, preserved, and transported to the USEPA laboratory for analysis.

Quality Control

Fifteen trip blanks, 9 field-equipment blanks, and 64 sequential-replicate VOC samples were collected to provide quality-control analyses for the method during the 4 sampling periods; in addition, the USEPA laboratory did its own internal quality-control analyses. The blank samples were analyzed only for VOCs. Trip blanks are analyzed for any VOC contamination that may have resulted from sample handling, transportation, or laboratory contamination; field-equipment blanks are analyzed to verify that sampling equipment was adequately cleaned by showing that no chemical analytes were carried over between samples.

Trip Blanks

Acetone (2-propanone) was the only compound detected in more than two trip blanks (tables 4 and 5, at the back of this report); acetone was also detected in most of the environmental samples collected in 2002 and April and May 2003; it was not detected in the June 2003 samples. The laboratory ascribed nearly all the detections in 2002 to laboratory- or trip-blank contamination, or failure to meet calibration criteria; thus, many of the acetone concentrations are estimates. For those reasons, acetone is not considered further in this report. Only two other compounds were detected in trip blanks: bromomethane (two detections) and chloromethane (one detection). These compounds were rarely detected in environmental

samples, and most of those detections were also ascribed to laboratory contamination; thus, these compounds, too, are not discussed further in this report.

Equipment Blanks

VOCs were detected in only one field-equipment blank. The sample collected on transect B, 8 m from shore, on May 2, 2003, was associated with three VOCs: 1,2-dichlorobenzene (0.52 µg/L), acetone (1.9 µg/L), and chlorobenzene (0.53 µg/L). As noted previously, acetone from other sources commonly contaminates the samples. The other concentrations were estimated and less than their reporting limits. The environmental samples collected at the same site and on the same date from a depth of 30 cm were characterized by high concentrations of both 1,2-dichlorobenzene (43 µg/L) and chlorobenzene (37 µg/L), so it is possible that the sampling equipment was inadequately cleaned between samples. In any event, these individual, low-concentration VOC detections do not indicate that sample handling or equipment had a substantial effect on concentrations measured in environmental samples.

Replicates

In most samples, replicate pairs matched closely. Rarely, replicate samples varied noticeably in their chemical characteristics; for example, see the data for the replicate sample collected at 30 cm on transect B, at a distance of 5 m, on June 19, 2002. Field notes indicate difficulties in drawing water for the original sample (dissolved oxygen = 2.85 mg/L), whereas the replicate had a dissolved oxygen concentration of 0.7 mg/L; five of the VOC concentrations in the replicate sample were approximately double their values in the original sample. Because of the consistent results in replicate field-parameter measurements during sampling events in 2002, replicate field-parameter measurements were not made in 2003. Calculations of relative percent difference (RPD) revealed only two samples with RPD values exceeding 30 percent; one of the samples had a single compound for which the RPD exceeded 30 percent. Two other samples had RPD values greater than 20 percent; three of these four samples were associated with slow pumping rates. RPDs as high as these values, although uncommon, point to the importance of sustaining steady pumping rates; difficulty in pumping results in air being drawn into the sampler, which increases the concentration of dissolved oxygen and compromises the sample.

Overview of Data Collection

Specific conductance can serve as a surrogate tracer for other compounds in ground water; relatively high values would indicate the presence of contaminants at levels above background concentrations and would warrant further investigation. The ability to track conductance changes over space and time can substitute for potentially expensive chemical analyses and can be used to differentiate water sources.

The analytical method can detect as many as 73 different VOCs (see appendix at back of this report). In the analyses reported for this study, 27 were detected (table 2). The commonly detected compounds match those reported in previous studies of the Nyanza Chemical Waste Dump Superfund site (Church and others, 2002a; Campbell and others, 2000). Additional studies (Roy F. Weston, Inc., 2003; ICF Consulting, 2003), some of which took place at the same time as the present investigation, provide context for this study (fig. 2; table 3). At a reference site (UR-002) upstream from the plume-discharge zone, VOCs were rarely detected in the surface or ground water or at the sediment-water interface in samples collected in 2001; ground water in samples collected in 1998 from a monitoring well (MW-117B) on the north side of the river contained no detectable VOCs. Ground-water, surface-water, and ground-water/surface-water interface samples collected in 2001 from monitoring wells in the river (MP-03A-03 and MP-003-01) differed in the number of detections; water from well MP-003-01 on the side of the river closest to the Nyanza Chemical Waste Dump Superfund site yielded more VOC detections than well MP-03A-03 closer to the far shore of the river. Ground-water samples collected from monitoring wells MW-304B and MW-305B, which were on the shore and screened in the plume, yielded the highest numbers of detections. Commonly detected VOCs in these studies included chloroethenes, chlorobenzenes, toluene, and acetone.

Many of the detections were rare, or their detection was ascribed to laboratory or trip-blank contamination. Acetone (2-propanone) was the only frequently detected VOC that was primarily a sample contaminant. Many of the rare detections were in concentrations at or below their nominal 1.0 µg/L reporting levels; occasionally, the reporting level varied for specific analytes because of sample dilution or other analytical-instrumentation adjustments.

Table 2. Number, frequency of detection, and concentration ranges of volatile organic compounds detected in primary (that is, not including quality-control replicates) samples reported in this study, Mill Pond, Sudbury River, Ashland.

[n, number of detections; ND, not detected; µg/L, microgram per liter; *, single detection in replicate quality-control sample with estimated concentration of 1.0 microgram, per liter]

Compound	Transect A (107 samples)			Transect B (103 samples)		
	n	Percentage of detections	Concentration range (µg/L)	n	Percentage of detections	Concentration range (µg/L)
1,1,1-Trichloroethane	1	1	ND–1.2	0	0	ND
Tetrachloroethene	3	3	ND–1.2	0	0	ND
Trichloroethene	104	97	ND–43	91	88	ND–83
1,1-Dichloroethene	2	2	0.88–1.0	3	3	ND–1.1
1,1-Dichloroethane	1	1	ND–1.2	9	9	ND–1.9
cis-1,2-Dichloroethene	105	98	ND–41	103	100	1.9–290
trans-1,2-Dichloroethene	0	0	ND	7	7	ND–1.6
Vinyl chloride	9	8	ND–17	59	57	ND–80
Chloroethane	1	1	ND–1.7	3	3	ND–1.4
1,2,3-Trichlorobenzene	98	92	ND–7.3	51	50	ND
1,2,4-Trichlorobenzene	105	98	ND–32	82	80	ND–18
1,2-Dichlorobenzene	107	100	0.82–100	103	100	3.8–490
1,3-Dichlorobenzene	78	73	ND–10	52	50	ND–15
1,4-Dichlorobenzene	105	98	0.63–21	84	82	ND–100
Chlorobenzene	99	93	ND–64	97	94	ND–120
Benzene	2	2	ND–0.94	18	17	ND–2.5
Toluene	0	0	ND	4	4	ND–0.74
Naphthalene	1	1	ND–0.68	1	1	ND–0.51
Bromomethane	4	4	ND–7.3	13	13	ND–3.8
Dichlorodifluoromethane	0*	0	ND	1	1	ND–1.2
1,2,3-Trichloropropane	3	3	ND–26	2	2	ND–21
Butanone (MEK)	0*	0	ND	9	9	ND–2.1
Chloromethane	2	2	ND–11	17	17	ND–2.1
2-Propanone (acetone)	68	64	1.1–130	67	65	ND–24
Carbon disulfide	6	6	ND–19	2	2	ND–4.6
Methyl *tert*-butyl ether	7	7	ND–1.4	3	3	ND–2.2
Tetrahydrofuran	1	1	ND–1.3	0	0	ND

Table 3. Volatile organic compounds detected in selected monitoring locations for the Nyanza Superfund site, Ashland, Massachusetts, 1998, 2000–2003.

[Sources: ICF Consulting, 2003; Monitoring locations shown in figure 2. All units are micrograms per liter. Values separated by a semicolon represent two reported samples. Values separated by a dash represent a range of values for more than two samples reported. GW, ground water; SW, surface water; nd, not detected]

Compound	Sampling location and time period represented in sampling											
	UR-002 (June 2001)			MP-03A-03 (June 2001)			MP-003-01 (June 2001)			MW-117B (March 1998)	MW-304B (April 2002–July 2003)	MW-305B (June–April 2001)
	SW	SW/GW interface	GW	SW	SW/GW interface	GW	SW	SW/GW interface	GW	GW	GW	GW
Trichloroethene	nd	nd	nd	nd–0.31	nd–0.26	nd	nd–1.8	nd–2.8	4.7–89	nd	330–6,000	3.3
1,1-Dichloroethene	nd	nd	nd	nd	nd	nd	nd	nd	nd–0.92	nd	nd	nd
cis-1,2-Dichloroethene	nd	nd	nd	nd	nd	16–37	nd–2.3	nd–3.3	13–160	nd	250–440	0.85
trans-1,2-Dichloroethene	nd	nd	nd	nd	nd	nd–0.34	nd	nd	nd–1.4	nd	nd	nd
1,2-Dichloroethene (total)	nd	nd	nd	nd	nd	16; 40	nd–2.4	nd–3.5	14–170	nd	nd	0.89–13
Methylene chloride	nd–0.65	nd	nd	nd	nd–0.21	nd–0.42	nd–0.21	nd–0.22	nd–1.4	nd	nd–7	nd
Vinyl chloride	nd	nd	nd	nd	nd	4.6–12	nd	nd	1.5–6.9	nd	11–46	nd
1,2,4-Trichlorobenzene	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	13–37	nd–4.4
1,2-Dichlorobenzene	nd	nd	nd	nd–0.32	nd–0.31	nd	nd–3.8	nd–4.9	nd	nd	210–300	nd–29
1,3-Dichlorobenzene	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	4.2–13	nd
1,4-Dichlorobenzene	nd	nd	nd	nd	nd	nd	nd–0.87	nd–0.78	nd	nd	30–84	nd–6.2
Chlorobenzene	nd	nd	nd	nd	nd	1; 1.5	nd–1.6	nd–2.6	6.8–65	nd	190–370	0.92
Benzene	nd	nd	nd	nd	nd	4.2; 6.6	nd	nd	nd–2	nd	nd	nd–3.4
Nitrobenzene	nd	nd	nd	nd–0.92	nd–0.61	nd	nd–2.3	nd–3.2	nd	nd	46–91	nd–16
3,3-Dimethoxybenzidine	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.46
3,3-Dimethylbenzidine	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd–6.6	nd
Aniline	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd–3.8	nd
Toluene	nd	nd	0.9–1.6	nd	nd	17; 19	nd–0.37	nd–0.6	nd	nd	nd	nd
Naphthalene	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Xylene	nd	nd	nd	nd	nd	nd	nd	nd–0.23	nd	nd	nd	nd
Chloromethane	nd	nd–0.37	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Butanone (MEK)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Propanone (acetone)	nd–3.2	2.5–4.8	3.1–8.2	nd–5.9	nd–6.6	110; 110	nd–4.5	nd–4.2	50–1,800	nd	nd–110	nd
Pentachlorophenol	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd–0.37	nd

Spatial and Temporal Variability of Specific Conductance and VOC Concentrations

Pore-water samples were collected four times from June 2002 to June 2003 during periods representing a range of streamflow conditions. The samples in June 2002 and April and May 2003 were taken under normal flow conditions; samples collected in June 2003 represented high flows; and samples collected in September 2002 represented low flows based on stage measurements (table 1). Discharges measured 6.5 km downstream: (1) rose from 227 to 245 ft^3/s at the start of June 2002 sampling; (2) rose from 29 to 123 ft^3/s at the start of the September 2002 sampling period and remained stable; (3) declined from 360 to 269 ft^3/s before the April and May 2003 sampling and continued to decline; and (4) peaked at 611 ft^3/s at the start of the June 2003 sampling period and subsequently declined. The results for specific conductance and two VOCs frequently detected in this study, trichloroethene (TCE) and 1,2-dichlorobenzene (1,2-DCB), demonstrate the applicability of the PPS as a device for obtaining reliable samples to determine concentrations of contaminants in plumes.

Specific Conductance

Of all the field parameters measured in the pore water (temperature, dissolved oxygen, specific conductance), specific conductance is the parameter whose measurements are least likely to be affected by the sampling method. In particular, measurements of dissolved oxygen concentrations were unreliable when pumping difficulties interrupted the sample discharges during this study.

During a given sampling period, specific-conductance values were similar at each sampling site along the transect at all depths (tables 4 and 5; figs. 6 and 7). In general, the lowest specific-conductance values were found in samples collected closest to shore. Overall, there seemed to be a weak, upward trend in specific conductance extending away from shore along both transects during all sampling periods, although, along transect A, values declined at sites farthest from shore. The nearshore upward trends seemed consistent with the discharge of ground water toward the center of the river, whereas discharge from the other side of the river could have caused the offshore decline.

The range and overall variability was greater along transect A (approximately from 400 to 1,300 µS/cm) than along transect B (approximately 450 to 1,150 µS/cm) for all sampling periods. The April and May 2003 samples produced spikes in concentrations at the 3- and 6-m points on transect A. The temporal changes that occurred during the four study periods are generally consistent among the three depths studied. Along both transects, values were generally lowest in June and September 2002. Along transect A, the highest values were observed in samples collected during April and May 2003 followed by June 2003; along transect B, the order of the sampling periods corresponding to the two highest values is reversed.

Volatile Organic Compounds

The most commonly detected VOCs may be grouped into two classes. The first class includes the ethene compounds that are breakdown products of PCE: TCE, 1,1-dichloroethene, *trans*-1,2-dichloroethene, *cis*-1,2-dichloroethene (*cis*-1,2-DCE), and vinyl chloride. The second class includes various chlorinated benzenes: chlorobenzene, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, and 1,4-dichlorobenzene. The data indicate that the detection of any compound from either of these classes is accompanied by other detections from the same class. The concentrations of a VOC representative of each class and selected on the basis of high frequency of detection and high concentration are shown in figures 8–11.

During the four sampling periods, 307 VOC samples were collected and analyzed. The results not only provide detailed information on the spatial and temporal variations in specific conductance and VOC concentrations in the plume beneath the river, but also demonstrate the versatility of the PPS in collecting discrete samples from locations closely spaced both vertically and horizontally (figs. 8–11).

Along transect A, TCE detections were evenly distributed and concentrations were generally highest in samples collected from a depth of 10 cm (figs. 8*A–D*). Along transect B, the TCE detections were grouped at locations closest to and farthest from the shore (figs. 9*A–D*); in general, the highest concentrations were measured in the 30-cm samples taken closest to the shore. The distribution of 1,2-DCB detections and concentrations (figs. 10 and 11) differed substantially from those of TCE. The detections of 1,2-DCB were distributed somewhat more evenly along transect A than those of TCE. Moreover, the concentrations of 1,2-DCB tended to increase with depth and distance from the shore. These results demonstrate that PPS sampling can reveal considerable variation in VOC concentrations over short distances (meters or centimeters).

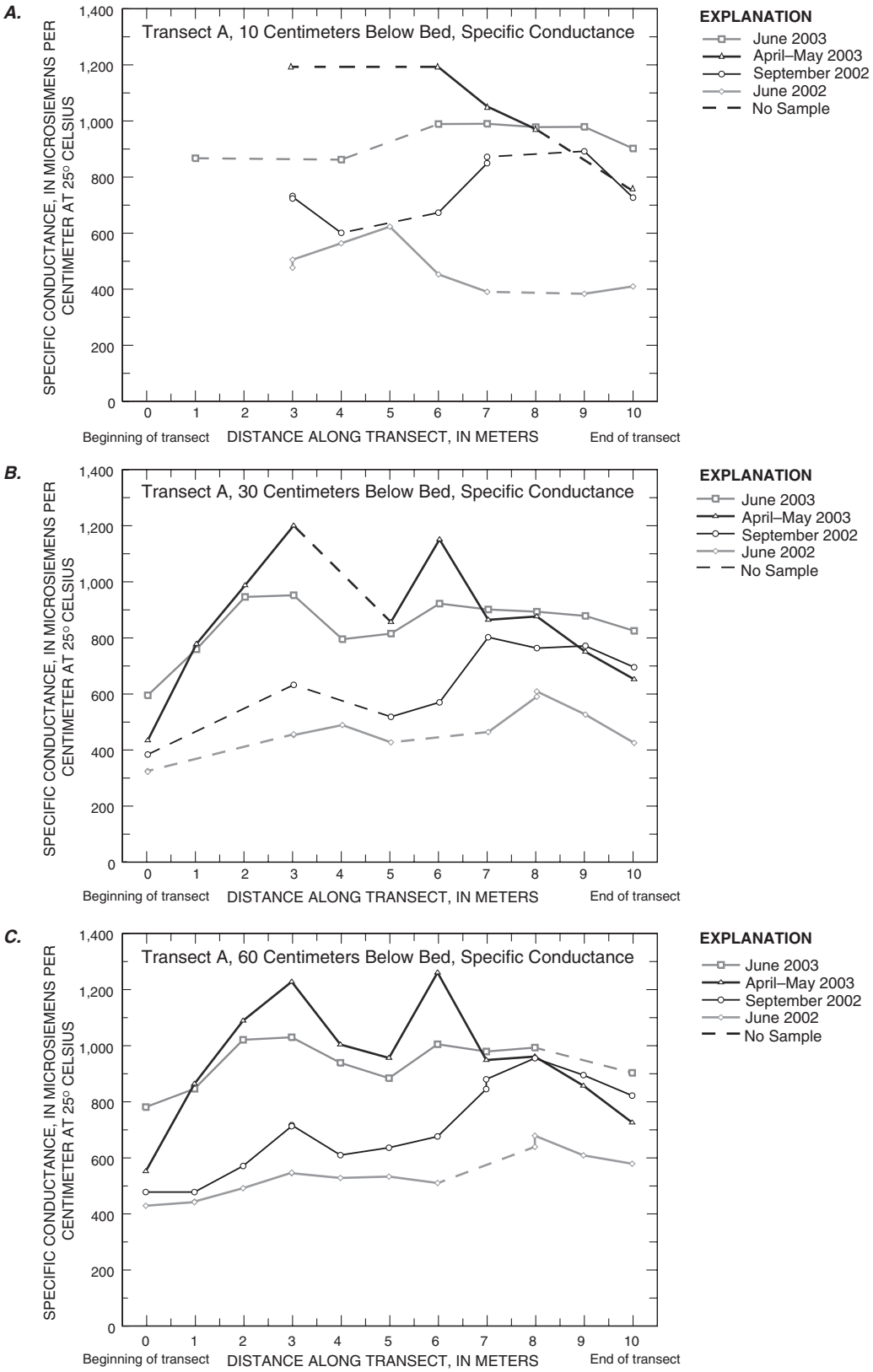


Figure 6. Specific conductance at depths of *A*, 10 centimeters; *B*, 30 centimeters; and *C*, 60 centimeters below sediment surface along transect A. Dashed lines indicate data missing because of failure to draw water at points located between successful sampling points. Data points connected by vertical lines indicate duplicate samples. Transect location shown in figure 2.

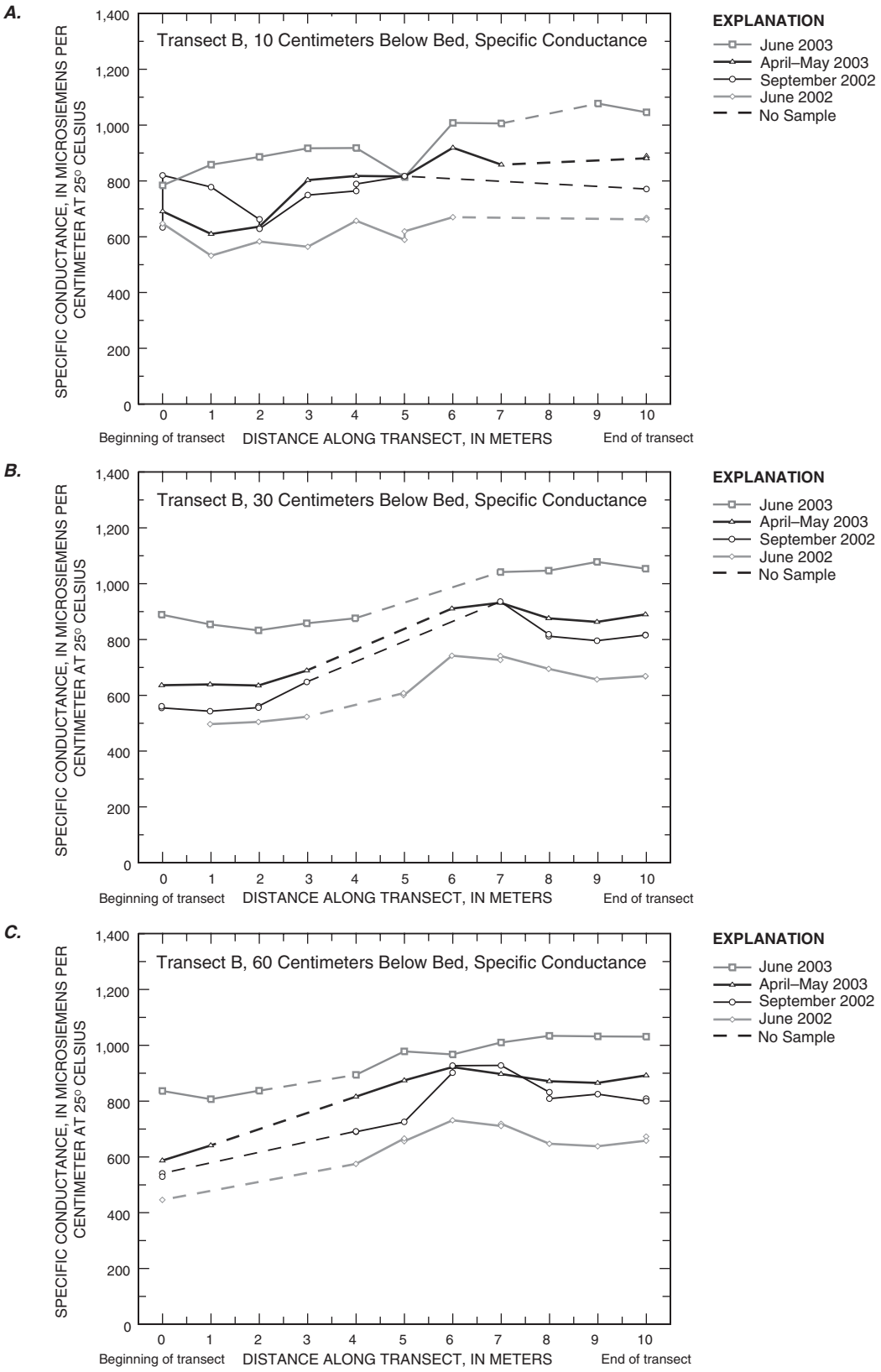


Figure 7. Specific conductance at depths of *A*, 10 centimeters; *B*, 30 centimeters; and *C*, 60 centimeters below the sediment surface along transect B. Dashed lines indicate data missing because of failure to draw water at intermediate points. Data points connected by vertical lines indicate duplicate samples. Transect location shown in figure 2.

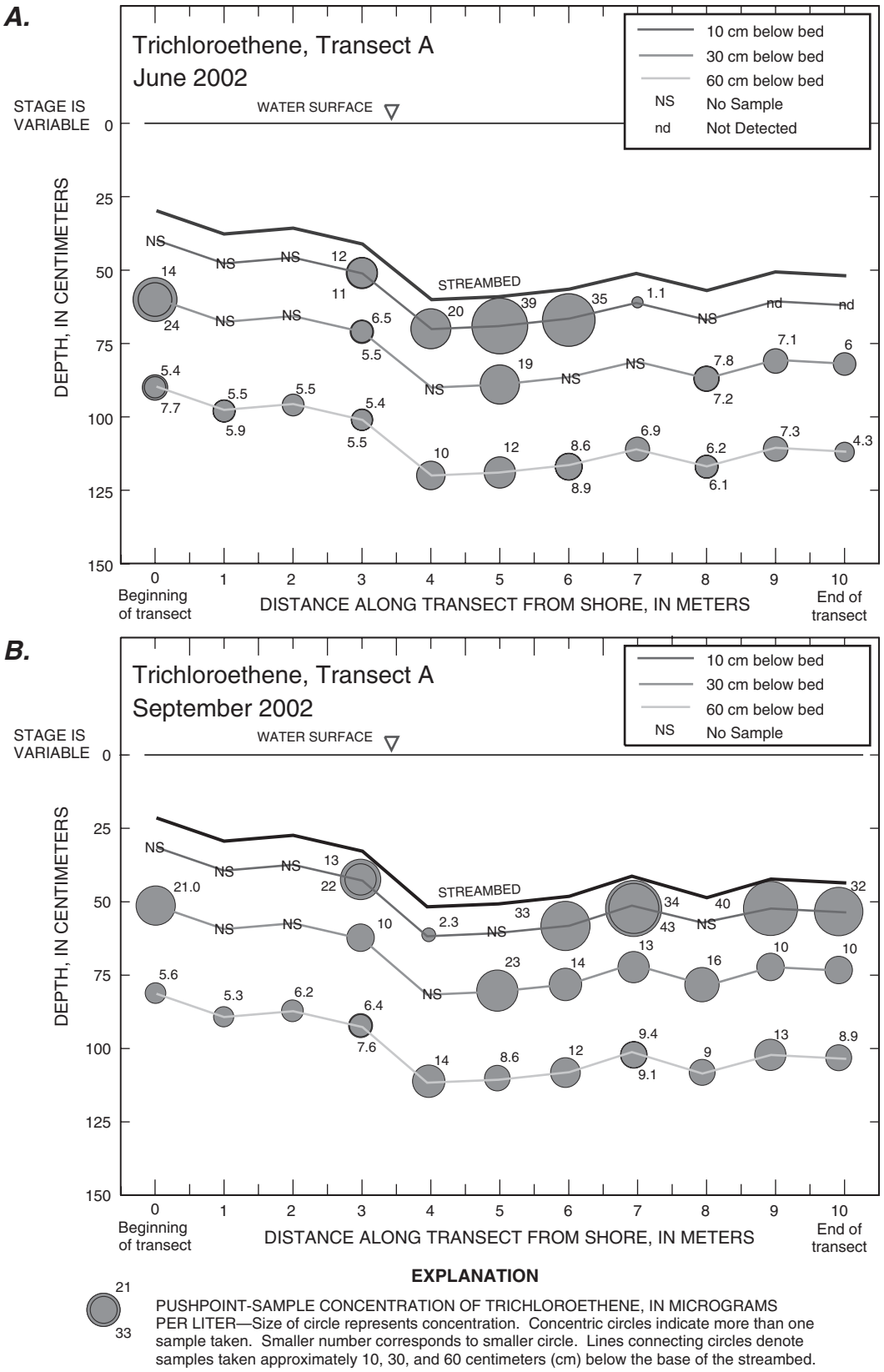


Figure 8. Concentrations of trichloroethene (TCE) at three depths below the sediment surface along transect A in *A*, June 2002; *B*, September 2002; *C*, April–May 2003; and *D*, June 2003, Mill Pond, Sudbury River, Ashland, Massachusetts.

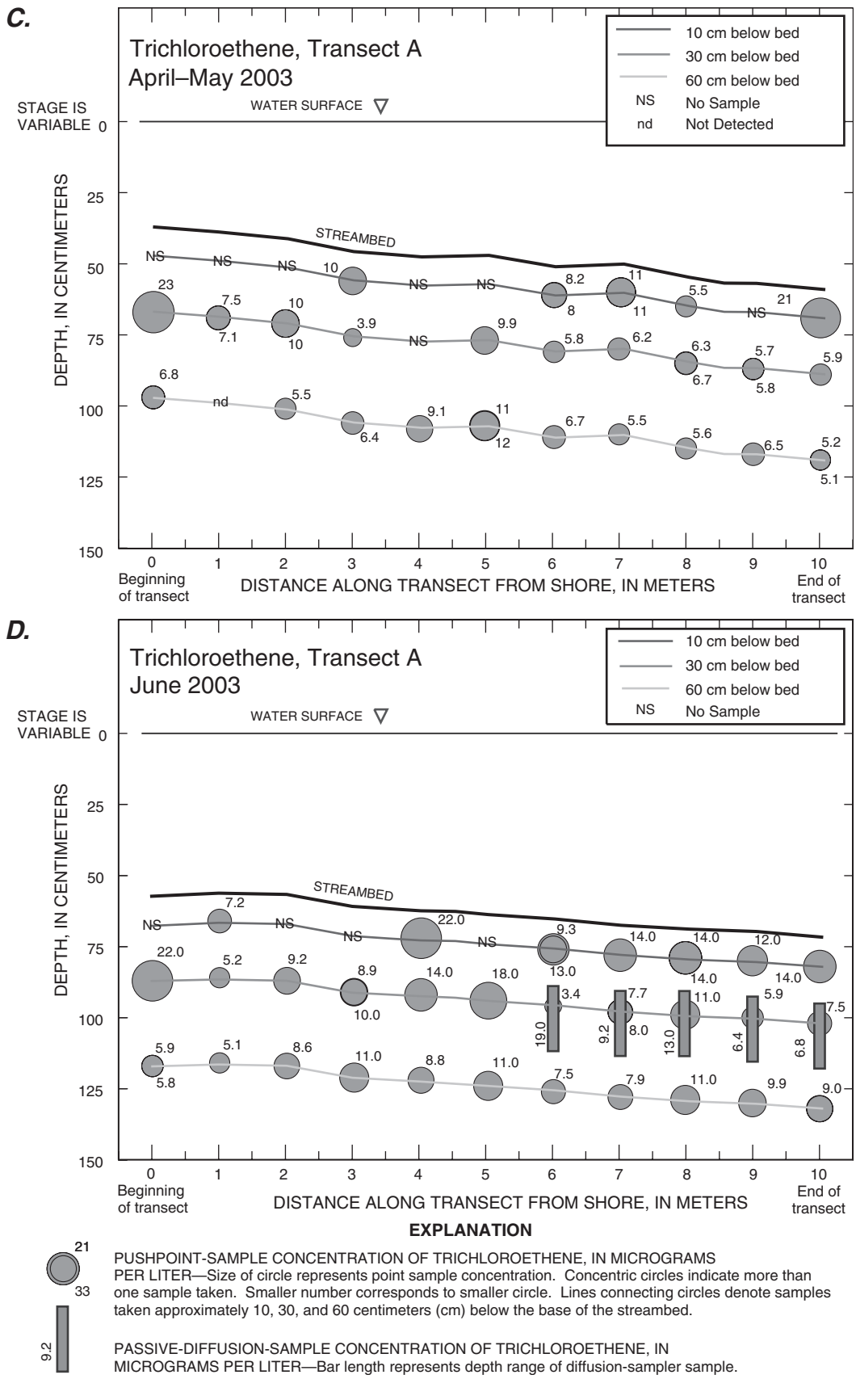


Figure 8—Continued. Concentrations of trichloroethene (TCE) at three depths below the sediment surface along transect A in *A*, June 2002; *B*, September 2002; *C*, April–May 2003; and *D*, June 2003, Mill Pond, Sudbury River, Ashland, Massachusetts.

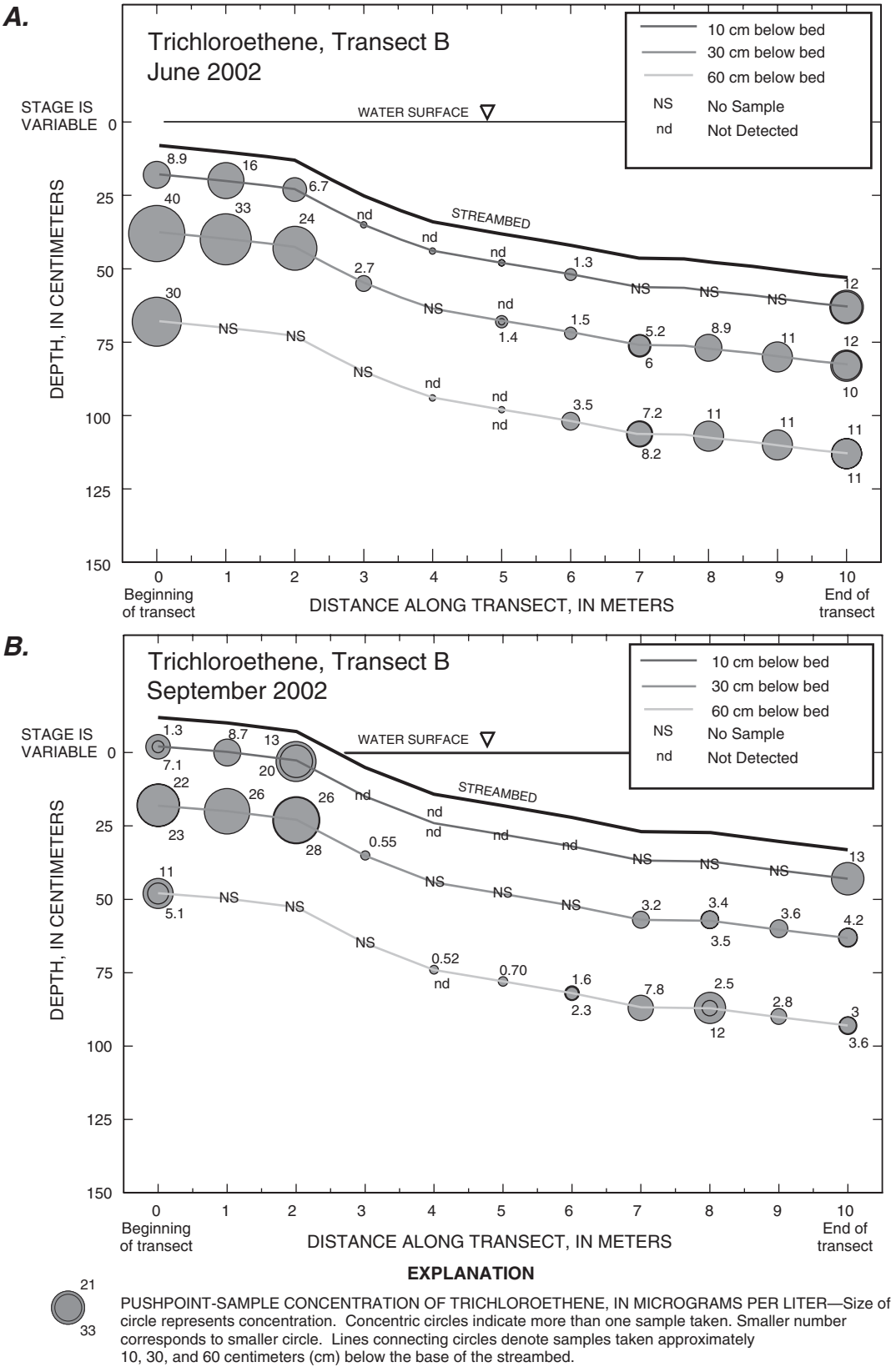
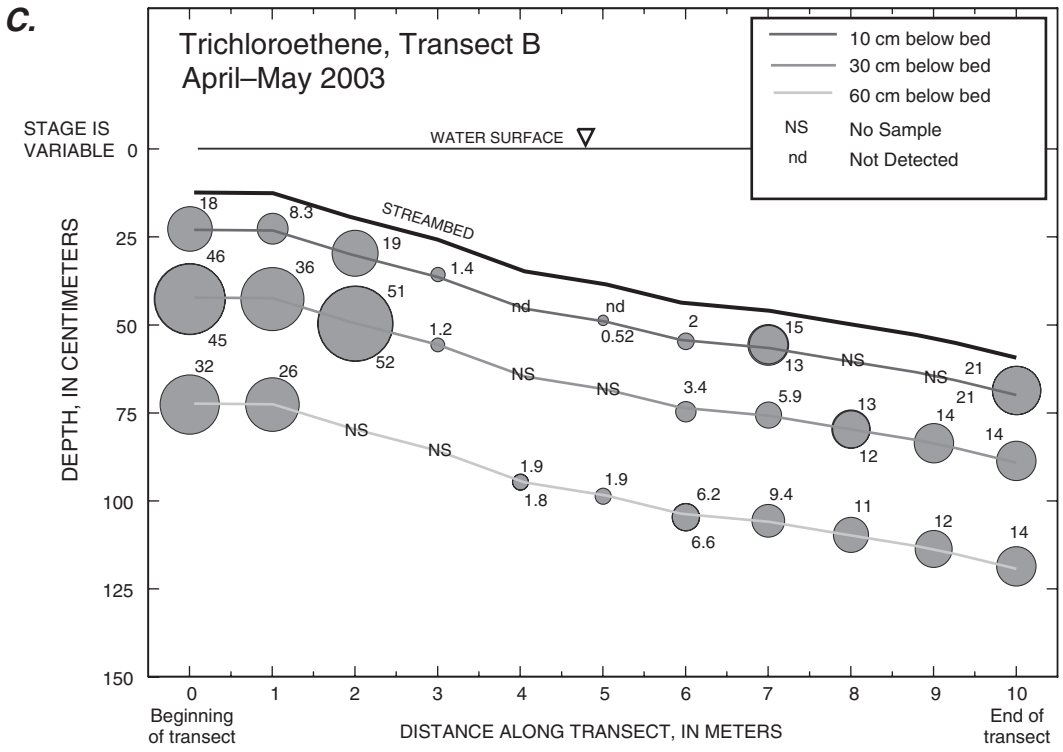
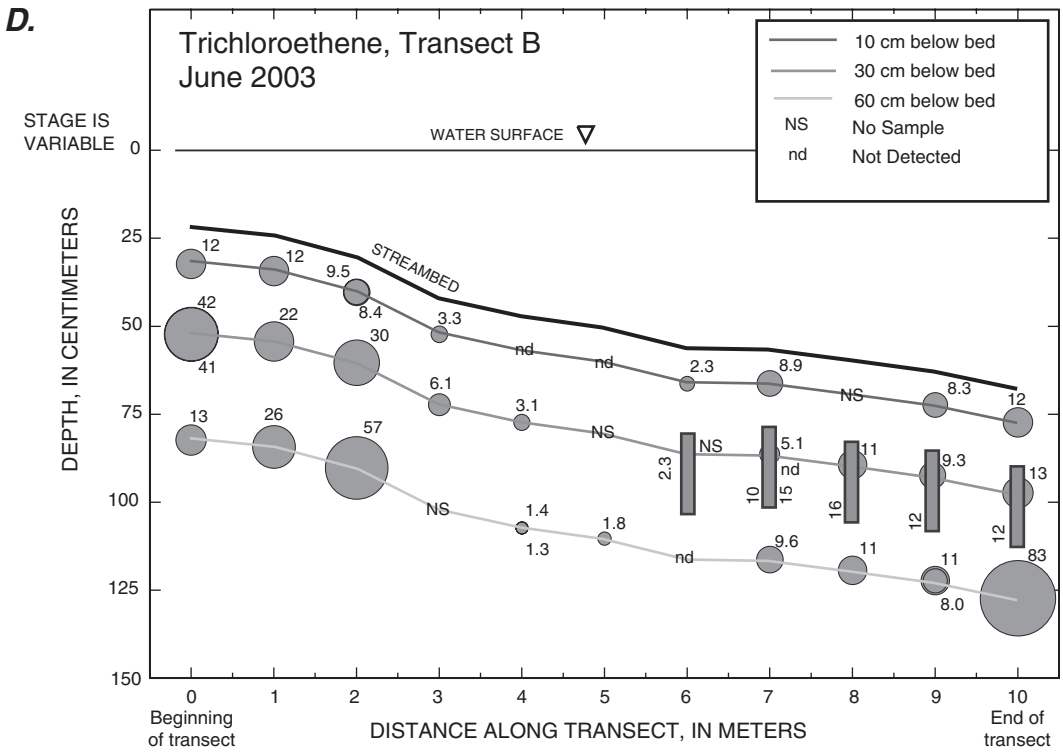


Figure 9. Concentrations of trichloroethene (TCE) at three depths below the sediment surface along transect B in *A*, June 2002; *B*, September 2002; *C*, April–May 2003; and *D*, June 2003, Mill Pond, Sudbury River, Ashland, Massachusetts.





EXPLANATION

21
33

PUSHPOINT-SAMPLE CONCENTRATION OF TRICHLOROETHENE, IN MICROGRAMS PER LITER—Size of circle represents point concentration. Concentric circles indicate more than one sample taken. Smaller number corresponds to smaller circle. Lines connecting circles denote samples taken approximately 10, 30, and 60 centimeters (cm) below the base of the streambed.

10
15

PASSIVE-DIFFUSION-SAMPLE CONCENTRATION OF TRICHLOROETHENE, IN MICROGRAMS PER LITER—Bar length represents depth range of sample. Two numbers indicate two samples taken.

Figure 9—Continued. Concentrations of trichloroethene (TCE) at three depths below the sediment surface along transect B in *A*, June 2002; *B*, September 2002; *C*, April–May 2003; and *D*, June 2003, Mill Pond, Sudbury River, Ashland, Massachusetts.

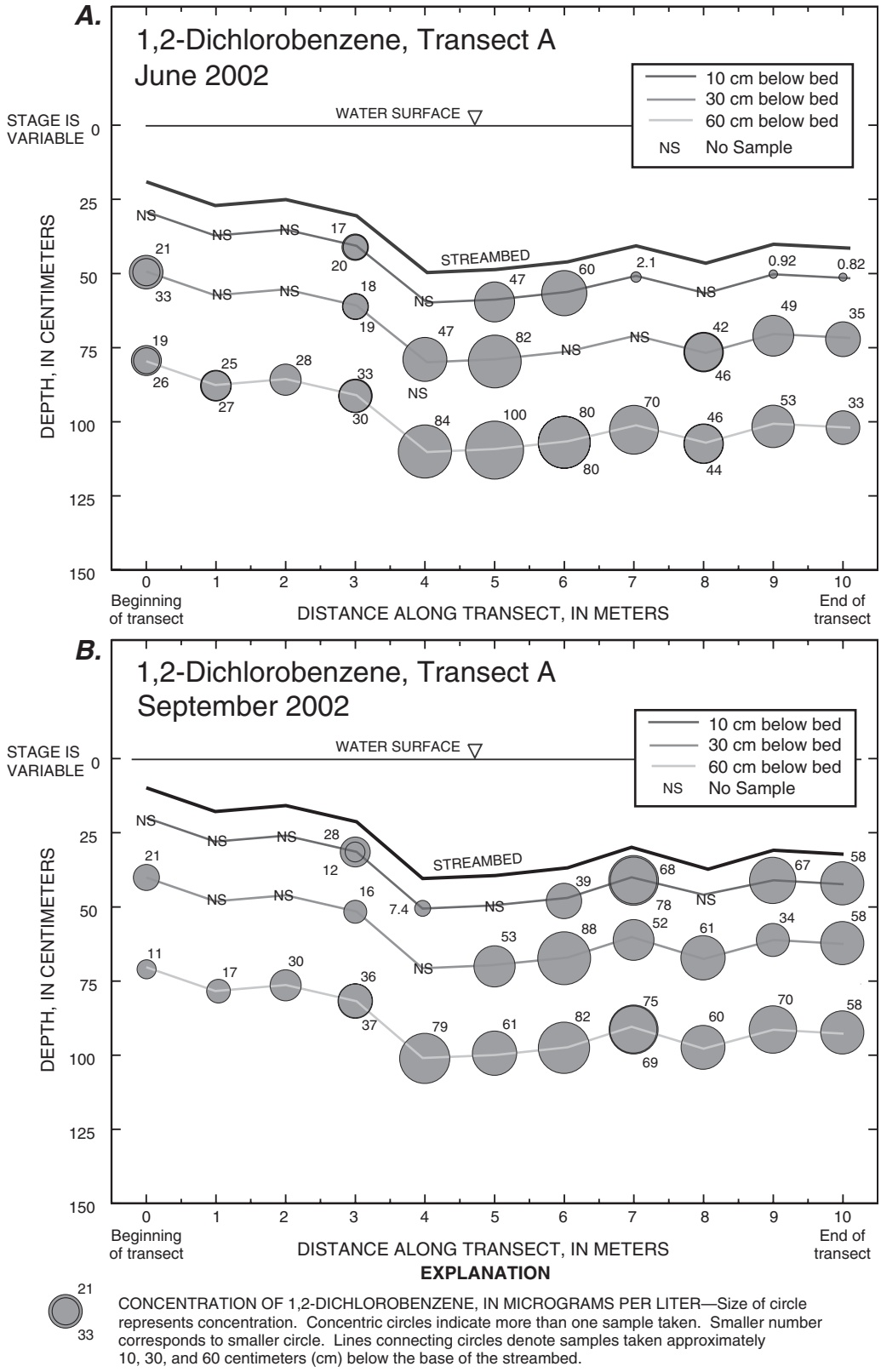


Figure 10. Concentrations of 1,2-dichlorobenzene (1,2-DCB) at three depths below the sediment surface along transect A in *A*, June 2002; *B*, September 2002; *C*, April–May 2003; and *D*, June 2003, Mill Pond, Sudbury River, Ashland, Massachusetts.

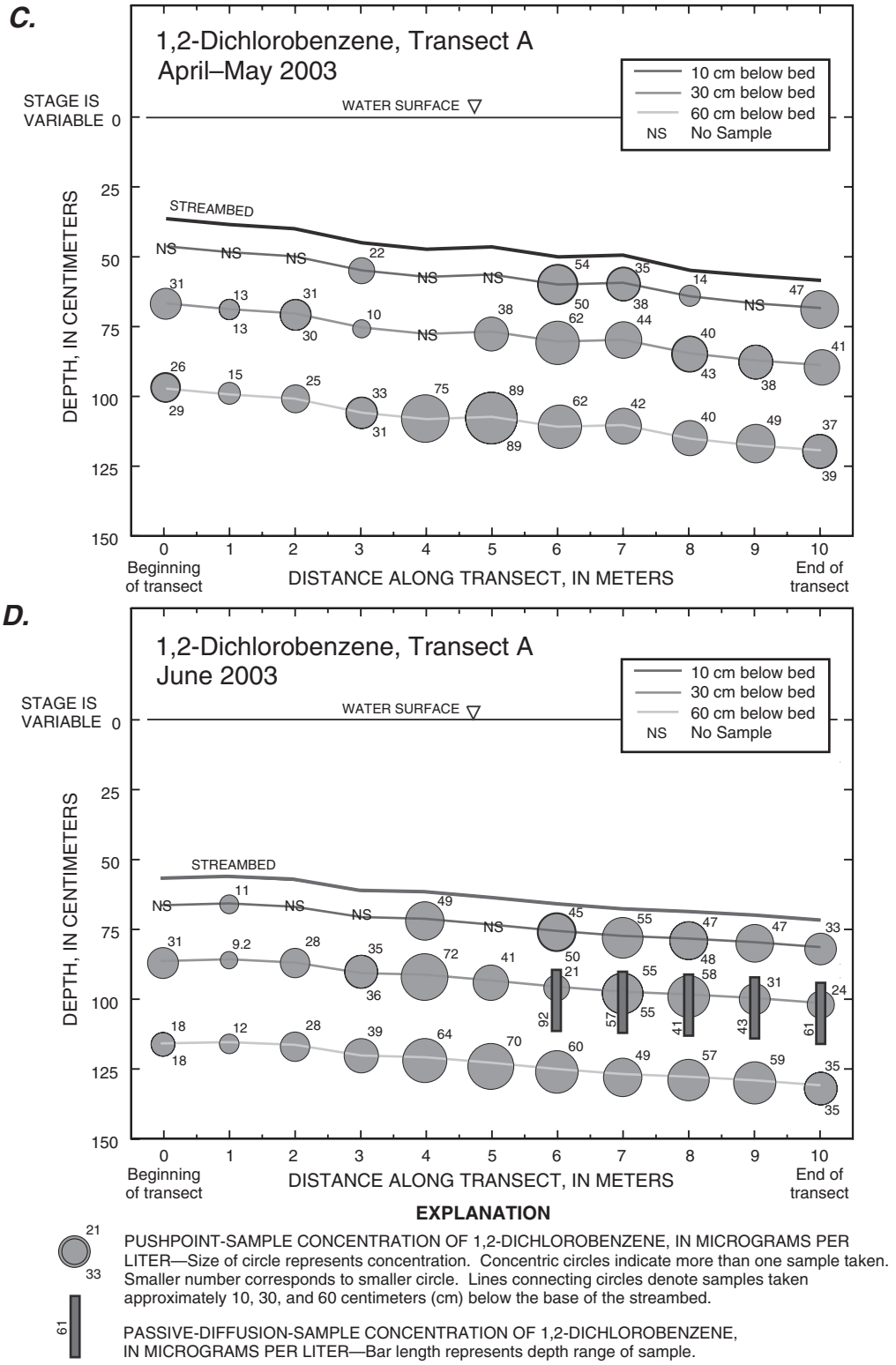


Figure 10—Continued. Concentrations of 1,2-dichlorobenzene (1,2-DCB) at three depths below the sediment surface along transect A in *A*, June 2002; *B*, September 2002; *C*, April-May 2003; and *D*, June 2003, Mill Pond, Sudbury River, Ashland, Massachusetts.

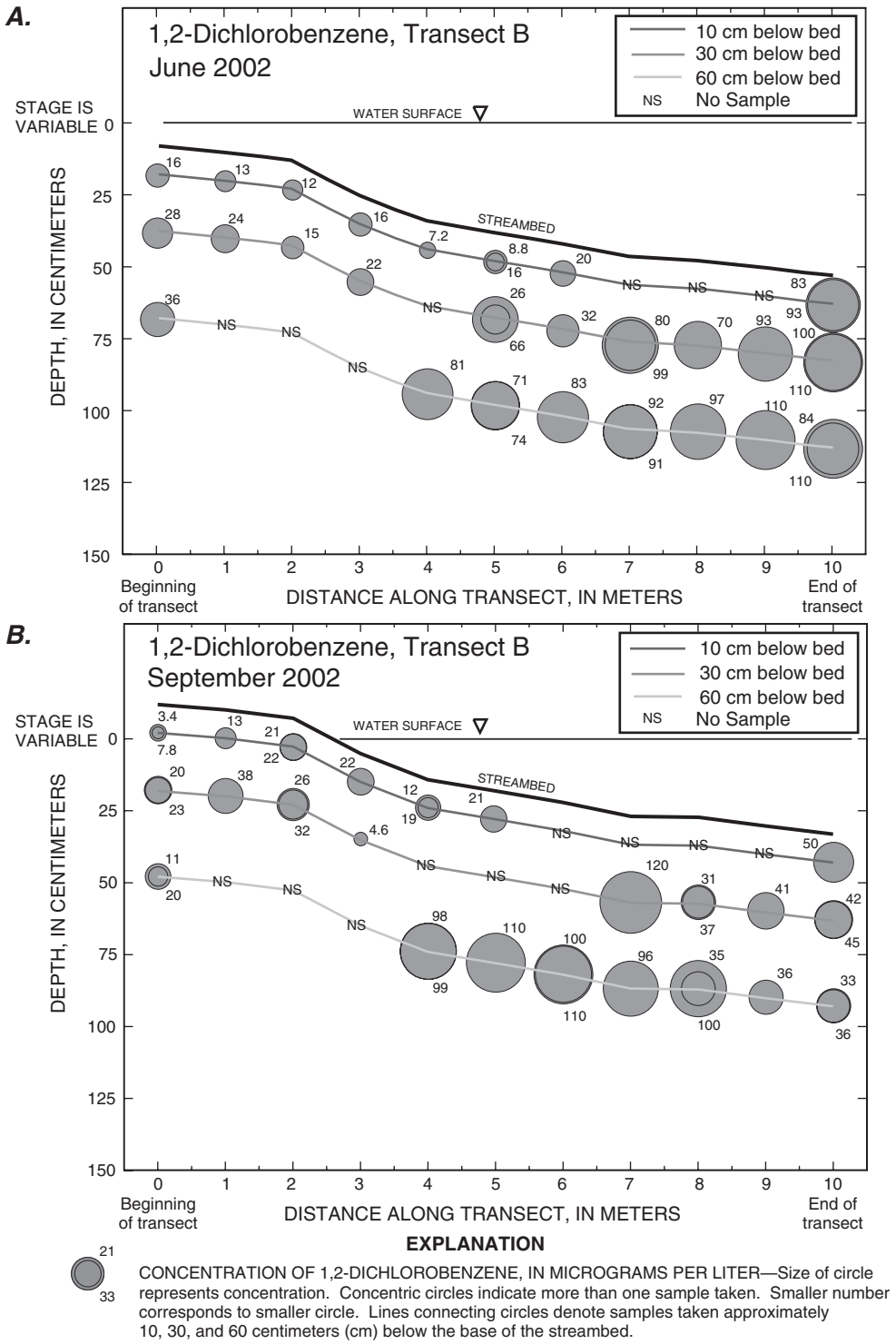


Figure 11. Concentrations of 1,2-dichlorobenzene (1,2-DCB) at three depths below the sediment surface along transect B in *A*, June 2002; *B*, September 2002; *C*, April–May 2003; and *D*, June 2003, Mill Pond, Sudbury River, Ashland, Massachusetts.

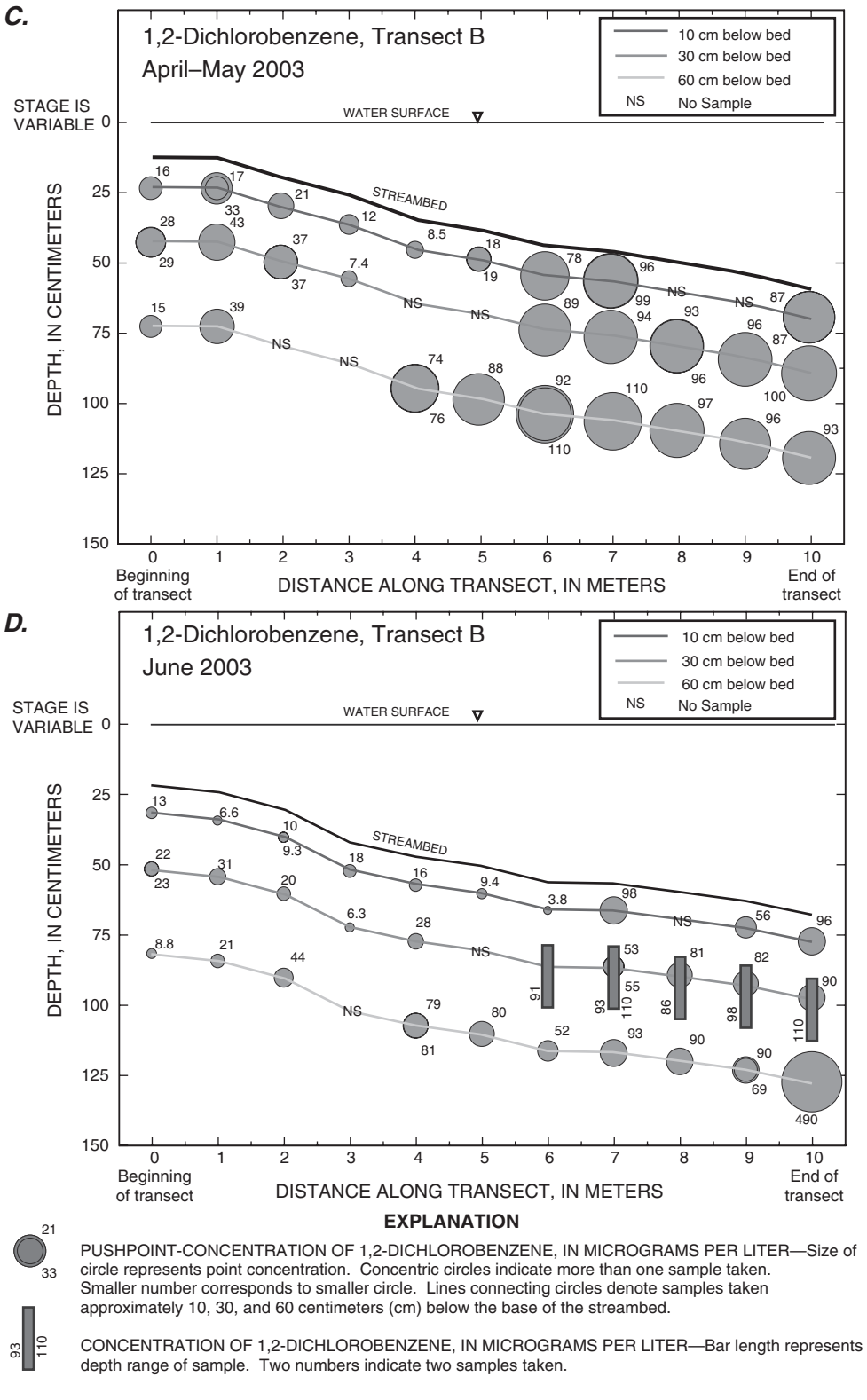


Figure 11—Continued. Concentrations of 1,2-dichlorobenzene (1,2-DCB) at three depths below the sediment surface along transect B in *A*, June 2002; *B*, September 2002; *C*, April–May 2003; and *D*, June 2003, Mill Pond, Sudbury River, Ashland, Massachusetts.

In addition to collecting samples using the PPS in June 2003, samples were collected from the 20-cm-long PDBs that were deployed for 8 weeks at 45 cm below the sediment surface 0.5 m from the five most offshore PPS sites. Almost all of the PDB samples had comparable, but higher concentrations of TCE and 1,2-DCB than those from the 30-cm PPS samples (figs. 8*D*, 9*D*, 10*D*, and 11*D*). Because the PDB method relies on diffusion through the 20-cm-long bag to produce a sample and the PPS, in theory, provides an instantaneous sample from a narrow zone near the 4-cm-long screened section, the dynamically changing nature of the contaminant plume should result in differences between the methods. Thus, whereas the PDB sample results are generally similar to the PPS sample results, the inherent differences in the two methods preclude the use of PDB samples to confirm PPS data.

The spatial and temporal precision with which PPS samples can be collected allows for the design of enhanced sampling programs to examine the details of chemical reactions at a study site. For example, TCE and *cis*-1,2-DCE are degradation products of PCE, in the series PCE→ TCE→ *cis*-1,2-DCE→ vinyl chloride→ ethene. (TCE, a common solvent, could also be the original VOC source.) The entire process is called reductive dechlorination and the transformations from PCE to TCE and from TCE to *cis*-1,2-DCE typically are faster than the others (Wiedemeir and others, 1999). The process can be coupled to ferrous iron reduction in the absence of other electron acceptors.

The data describing spatial differences in concentrations of TCE and *cis*-1,2-DCE in samples collected in the June 2003 samples (figs. 12 and 13) can be interpreted as evidence of the reductive dechlorination pathway; this interpretation is clearest along transect B. At most points along both transects, the concentrations of *cis*-1,2-DCE were higher than those of TCE, likely reflecting the rapid transformation step. Along transect A, the concentrations of *cis*-1,2-DCE and TCE generally differed less than those along transect B. Similar evidence of biodegradation in pore water was reported by Conant and others (2004) in a study of a contaminant ground-water plume discharging to a river in Ontario, Canada. The concentrations of ferrous iron along transect B occasionally exceeded the range of the analytical method; ferrous iron was rarely analyzed along transect A (tables 4 and 5) because the dissolved oxygen concentrations were generally high enough (greater than 0.2 mg/L) that the appearance of ferrous iron was not expected. Along transect B, in particular, the relatively high concentrations of ferrous iron and low concentrations of dissolved oxygen, coupled with the relatively high concentrations of *cis*-1,2-DCE (probably the degradation product) from the same sampling locations, support the inference that reductive dechlorination of TCE is occurring in this vertical interval. By designing a study to sample in this study area more frequently, it may also be possible to estimate process rates and loadings to surface water.

Unlike the PCE/TCE series of degradation products, the chlorobenzenes do not transform as readily from multichlorinated compounds to benzene as an endpoint (Dermietzel and Vieth, 2002). According to Nishino and others (1992) and Van der Meer and others (1998), microbial catabolic pathways may evolve in situ to degrade chlorobenzenes. Their biodegradation may not be as readily inferred from field data as the relation between TCE and *cis*-1,2-DCE. Nevertheless, the data from a well designed study may provide insights into the degradation processes. In this study (fig. 14), the concentration of 1,2,3-trichlorobenzene (1,2,3-TCB) is consistently the lowest along transect A and 1,2-dichlorobenzene (1,2-DCB) is the highest at all but one point. The other chlorobenzene compounds vary within the range of 1,2,3-TCB and 1,2-DCB. Combining field data, such as these, with experimental determinations of transformation rates may yield useful information about the extent of bioremediation of the chlorobenzenes at this study site on the Mill Pond on the Sudbury River in Ashland, MA.

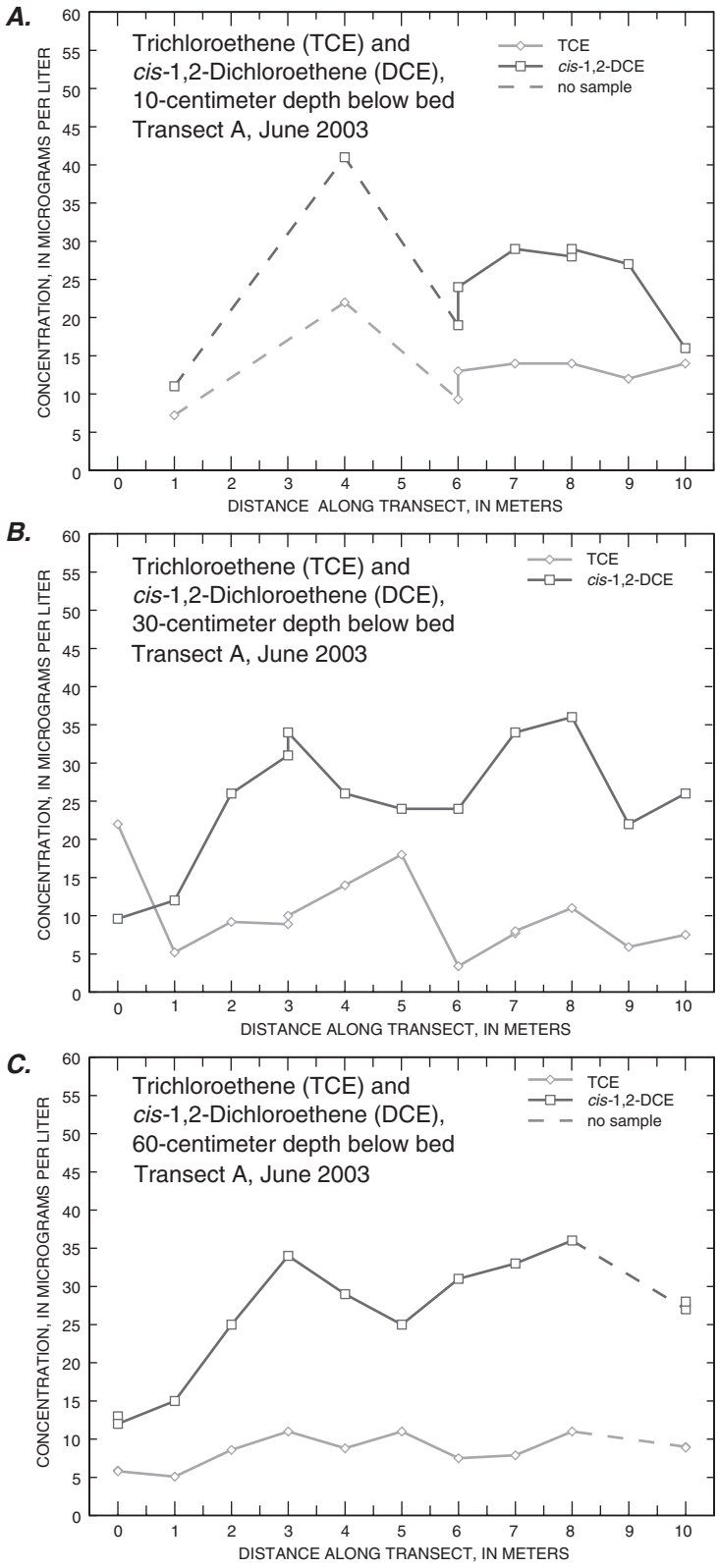


Figure 12. Concentrations of trichloroethene (TCE) and *cis*-1, 2-dichloroethene (*cis*-1,2-DCE) at sediment depths of *A*, 10 centimeters; *B*, 30 centimeters; and *C*, 60 centimeters along transect A, Mill Pond, Sudbury River, Ashland, Massachusetts, June 2003. Dashed lines indicate data missing because of failure to draw water at intermediate points. Data points connected by vertical lines indicate duplicate samples.

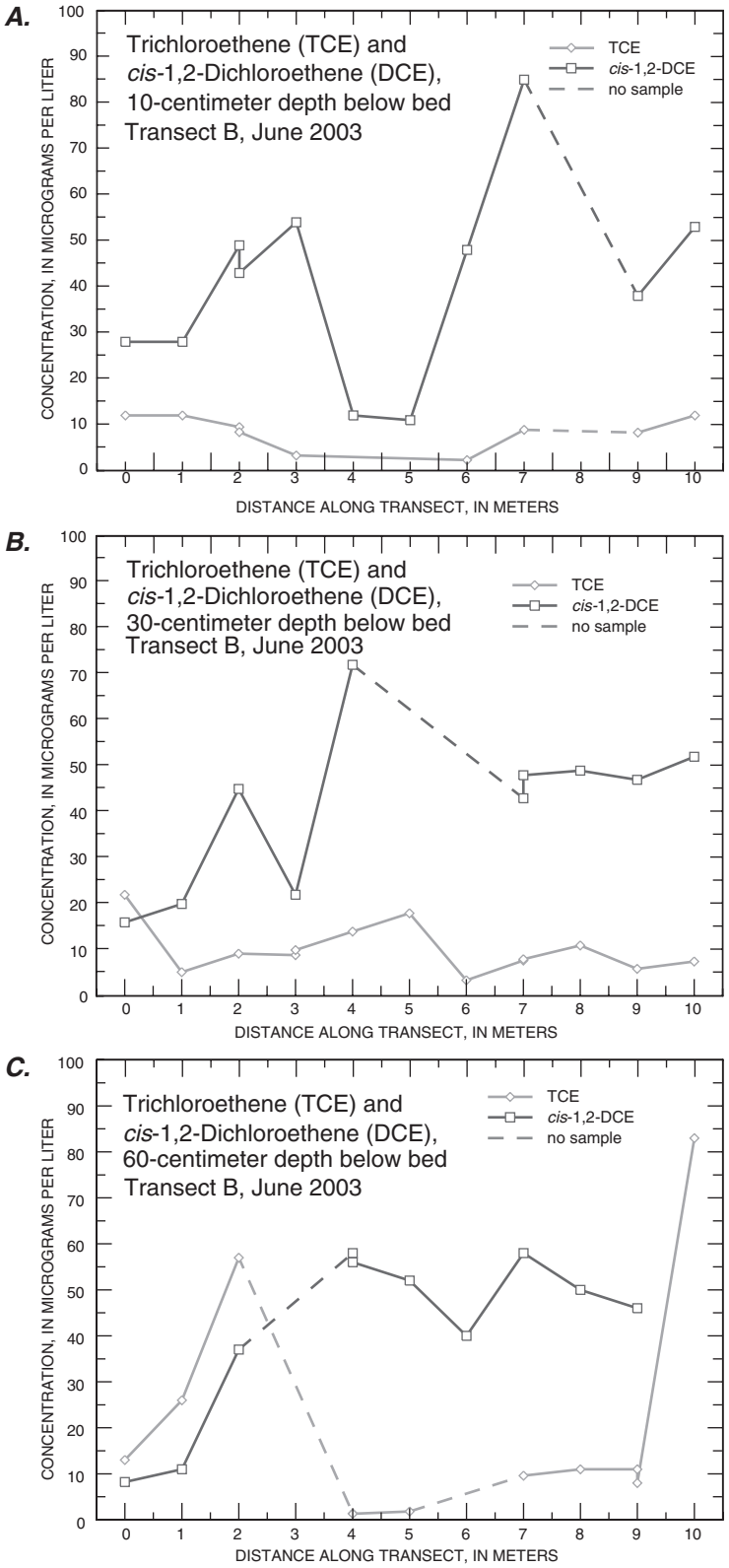


Figure 13. Concentrations of trichloroethene (TCE) and *cis*-1,2-dichloroethene (*cis* 1,2-DCE) at sediment depths of *A*, 10 centimeters; *B*, 30 centimeters; and *C*, 60 centimeters along transect B, Mill Pond, Sudbury River, Ashland, Massachusetts, June 2003. Dashed lines indicate data missing because of failure to draw water at intermediate points. Data points connected by vertical lines indicate duplicate samples.

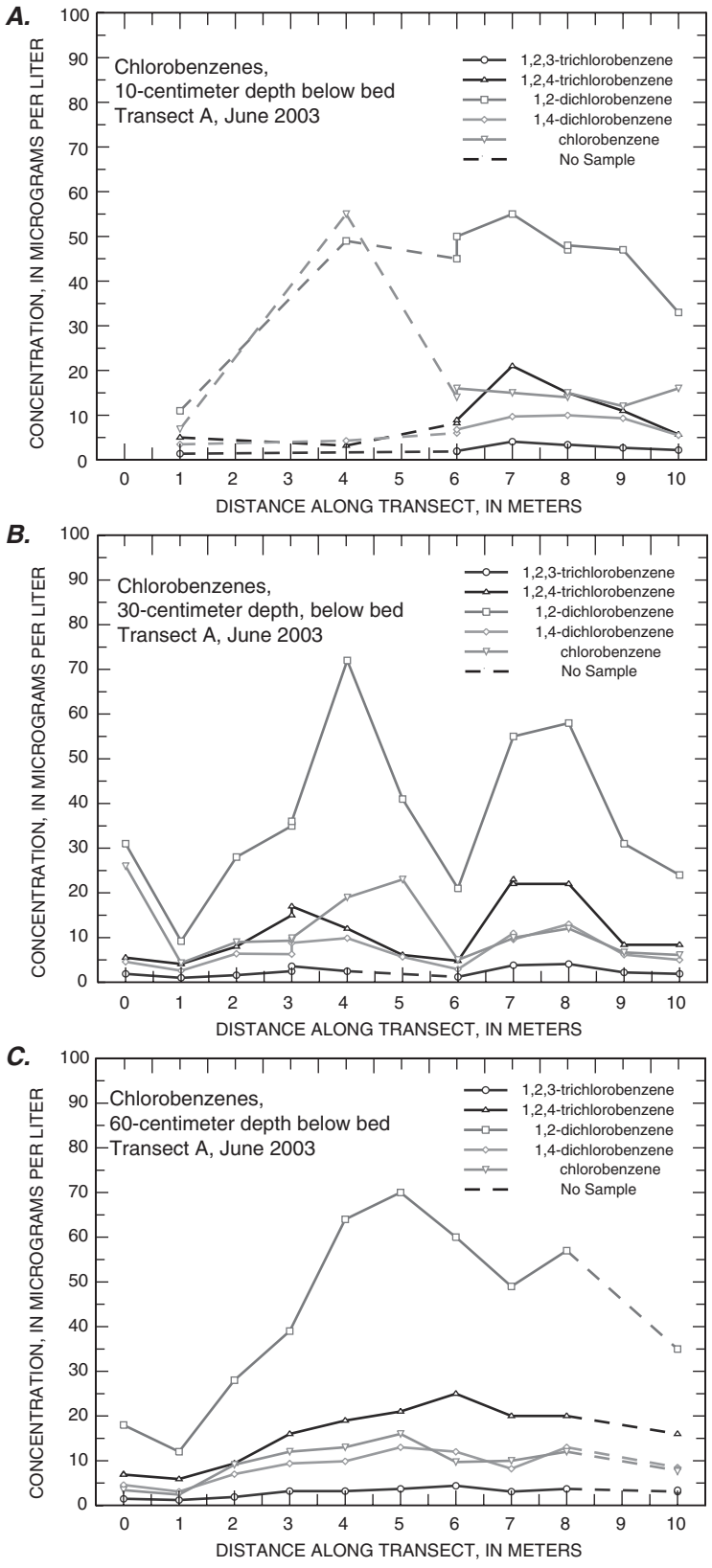


Figure 14. Concentrations of chlorobenzene and related compounds at sediment depths of *A*, 10 centimeters; *B*, 30 centimeters; and *C*, 60 centimeters along transect A, Mill Pond, Sudbury River, Ashland, Massachusetts, June 2003. Dashed lines indicate data missing because of failure to draw water at intermediate sampling points. Data points connected by vertical lines indicate duplicate samples.

Summary and Conclusions

The environmental risk posed by contaminants in streams and lake-bed sediments is affected by lateral and vertical variations in pore-water concentrations. Present technologies available to collect pore-water samples typically are unsuitable for determining lateral and vertical variations in contaminant concentrations. Also, temporal variations in contaminant concentrations are rarely evaluated. Therefore, the U.S. Geological Survey, in cooperation with the U.S. Environmental Protection Agency, began a study in 2002 to determine the effectiveness of a temporary pushpoint sampler for collecting pore-water samples from shallow sediments at Mill Pond on the Sudbury River in Ashland, MA.

During four sampling periods from April 2002 to June 2003, 307 volatile organic compound samples were collected with a pushpoint sampler at depths ranging from 10 to 60 cm below the sediment surface beneath Mill Pond, an impoundment on the Sudbury River. The concentrations obtained were consistent with the range of concentrations reported in previous studies of this Superfund site.

Results of pushpoint sampling at 1-m intervals along two 10-m transects that extended into the Sudbury River demonstrated that the sampler could provide discrete, real-time values for specific conductance to serve as a contaminant tracer in fine horizontal and vertical detail. Similarly, the capacity of the samplers to yield VOC samples with distinctly different concentrations of a variety of compounds, despite separation of sampling points by only tens of centimeters, further demonstrated the usefulness of the PPS in studies of VOC transformations in ground water.

The testing of the PushPoint Extreme Sampler showed it to be a highly cost-effective tool for mapping and sampling contaminated pore water at the study site. Specific conductance values for water samples collected at depths as small as 10 cm below the sediment surface indicated no infiltration of surface water. Occasional difficulties arose in drawing water with a peristaltic pump at a particular site and depth, but the overall ease in collecting samples from many locations and depths far outweighed the occasional inability to obtain a sample. Quality-control samples showed that the pushpoint-sampling technique did not introduce contamination into samples and consistently yielded reproducible results. Results from pushpoint samples were comparable to results from samples collected from PDBs that were deployed for 8 weeks in the sediment immediately adjacent to the pushpoint sampler transects. However, pushpoint samples represent instants in time, whereas PDB samples integrate changes over a longer periods of time (generally, days to weeks); the samples also represent different volumes. Thus, the results of the two methods (PPS and PDB) should not be considered equal or interchangeable.

The pushpoint sampler should continue to prove valuable for studies mapping the presence or extent of ground-water contaminant plumes that are suspected of entering water bodies through shallow sediments. Because of its ease of use, the pushpoint sampler can be applied in studies of microbial transformations of contaminants in ground water near the sediment-water interface of streams and impoundments, a focal point for bioremediation studies. Another area of application would be in situ measurement of the release of nutrients, such as phosphorus, from sediments, a traditional subject of limnological research.

Acknowledgments

Forest P. Lyford, Hydrologist, U.S. Geological Survey, and Richard Willey, Hydrologist, U.S. Environmental Protection Agency, proposed this study and developed its initial framework. The support and cooperation of Sharon Hayes, Remedial Program Manager, U.S. Environmental Protection Agency, is greatly appreciated.

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Tables 4 and 5

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	Temperature (°C)	Specific conductance (µS/cm)	pH (standard unit)	Dissolved oxygen (mg/L)	Ferrous iron (mg/L)	1,1,1-Trichloroethane	Tetrachloroethene	Trichloroethene
June 2002											
10	10	6-17-02	1000	14.09	410	6.04	7.49	0.1	ND	ND	ND
10	30	6-17-02	1012	13.64	524	4.72	.74	.4	ND	ND	6.0
10	60	6-17-02	1027	13.14	579	4.62	.53	3.9	ND	ND	4.3
9	10	6-17-02	1045	15.28	384	6.17	7.5	.3	ND	ND	ND
9	30	6-17-02	1053	13.76	625	4.58	.64	.0	ND	ND	7.1
9	60	6-17-02	1102	13.29	609	4.58	.94	.4	ND	ND	7.3
8	10	6-17-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
8	30	6-17-02	1134	13.91	708	4.53	.55	.2	ND	ND	7.8
8	30 REP	6-17-02	1139	13.61	689	4.56	.24	.0	ND	ND	7.2
8	60	6-17-02	1148	13.66	679	4.54	.7	.0	ND	ND	6.2
8	60 REP	6-17-02	1153	13.11	639	4.61	.92	.1	ND	ND	6.1
7	10	6-17-02	1218	15.93	391	6.06	7.45	.7	ND	ND	1.1
7	30	6-17-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
7	60	6-17-02	1236	13.45	563	4.61	.77	.2	ND	ND	6.9
6	10	6-17-02	1250	18.37	453	5.21	3.33	1.9	ND	ND	35
6	30	6-17-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
6	60	6-17-02	1315	14.16	516	4.7	.92	5.2	ND	ND	8.6
6	60 REP	6-17-02	1320	13.96	510	4.71	.71	3.1	ND	ND	8.9
5	10	6-17-02	1348	23.22	623	5.3	1.92	4.6	1.2	ND	39
5	30	6-17-02	1357	14.5	526	5.25	.38	2.1	ND	ND	19
5	60	6-17-02	1402	13.96	533	5.2	.29	3.0	ND	ND	12
4	10	6-17-02	1420	14.81	564	5.82	.97	3.4	ND	ND	20
4	30	6-17-02	1425	17.95	588	5.47	1.96	NS	NS	NS	NS
4	30	6-17-02	1431	17.95	588	5.47	1.96	OR	ND	ND	10
3	10	6-18-02	0957	19.24	505	4.93	5.42	2.6	ND	ND	12
3	10 REP	6-18-02	1005	20.16	477	5.19	4.89	3.9	ND	ND	11
3	30	6-18-02	1019	17.93	552	4.65	1.8	.7	ND	ND	6.5
3	30 REP	6-18-02	1033	16.78	555	4.87	1.97	11.2	ND	ND	5.5
3	60	6-18-02	1041	12.75	545	4.69	.28	.2	ND	ND	5.4
3	60 REP	6-18-02	1048	12.63	547	4.64	.5	1.2	ND	ND	5.2
2	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	30	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	60	6-18-02	1116	12.37	492	4.76	.93	.0	ND	ND	5.5
1	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	30	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	60	6-18-02	1131	12.5	444	4.81	.86	.0	ND	ND	5.5
1	60 REP	6-18-02	1138	12.75	442	4.79	1.29	.0	ND	ND	5.9

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	Temperature (°C)	Specific conductance (µS/cm)	pH (standard unit)	Dissolved oxygen (mg/L)	Ferrous iron (mg/L)	1,1,1-Trichloroethane	Tetrachloroethene	Trichloroethene
June 2002—Continued											
0	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
0	30	6-18-02	1150	14.51	424	4.95	0.75	0.5	ND	ND	14
0	30 REP	6-18-02	1158	13.89	421	4.91	.32	.8	ND	ND	24
0	60	6-18-02	1203	15.6	429	4.88	1.45	.3	ND	ND	5.4
0	60 REP	6-18-02	1209	13.05	429	4.69	.77	0	ND	ND	7.7
September 2002											
10	10	9-04-02	1545	20.72	727	4.59	0.3	NS	ND	ND	32
10	30	9-04-02	1550	19.86	794	4.41	.12	NS	ND	ND	10
10	60	9-04-02	1555	19.18	822	4.41	.53	NS	ND	ND	8.9
9	10	9-04-02	1515	22.09	892	4.51	.35	NS	ND	ND	40
9	30	9-04-02	1525	22.45	870	4.41	1.26	NS	ND	ND	10
9	60	9-04-02	1530	18.85	895	4.27	.11	NS	ND	ND	13
8	10	9-04-02	NA	NS	NS	NS	NS	NS	NS	ND	NS
8	30	9-04-02	1455	21.31	862	4.38	.14	NS	ND	ND	16
8	60	9-04-02	1500	18.53	955	4.22	.09	NS	ND	ND	9.0
7	10	9-04-02	1420	20.54	872	4.38	.55	NS	ND	ND	34
7	10 REP	9-04-02	1425	20.44	849	4.35	.25	NS	ND	ND	43
7	30	9-04-02	1435	23.05	901	4.32	.76	NS	ND	ND	13
7	60	9-04-02	1440	18.11	880	4.22	.11	NS	ND	ND	9.4
7	60 REP	9-04-02	1445	18.27	845	4.16	.1	NS	ND	ND	9.1
6	10	9-04-02	1255	24.2	673	4.64	1.41	NS	ND	ND	33
6	30	9-04-02	1315	18.89	669	4.5	.26	NS	ND	ND	14
6	60	9-04-02	1330	18.34	676	4.42	.17	NS	ND	ND	12
5	10	9-04-02	NA	NS	NS	NS	NS	NS	NS	ND	NS
5	30	9-04-02	1510	24.05	617	5.15	.24	NS	ND	ND	23
5	60	9-04-02	1530	20.87	636	4.61	.4	NS	ND	ND	8.6
4	10	9-04-02	1540	23.54	601	5.52	1.42	NS	ND	ND	2.3
4	30	9-04-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
4	60	9-04-02	1600	18.3	610	5.15	.19	NS	ND	ND	14
	Trip blank	9-04-02	NA	NA	NS	NS	NS	NS	ND	ND	ND
3	10	9-05-02	1100	20.8	729	4.41	.68	NS	ND	ND	22
3	10 REP	9-05-02	1115	21.73	724	4.6	.71	NS	ND	ND	13
3	30	9-05-02	1130	22.13	731	4.37	1.53	NS	ND	ND	10
3	30 REP	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
3	60	9-05-02	1150	17.44	717	4.43	.18	NS	ND	ND	6.4
3	60 REP	9-05-02	1155	17.45	713	4.27	.13	NS	ND	ND	7.6
2	10	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	30	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	60	9-05-02	1215	19.25	571	4.46	.62	NS	ND	ND	6.2

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	Temperature (°C)	Specific conductance (µS/cm)	pH (standard unit)	Dissolved oxygen (mg/L)	Ferrous iron (mg/L)	1,1,1-Trichloroethane	Tetrachloroethene	Trichloroethene
					September 2002—Continued						
1	10	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	30	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	60	9-05-02	1250	17.29	478	4.5	0.86	NS	ND	ND	5.3
0	10	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
0	30	9-05-02	1305	18.38	483	4.55	.39	NS	ND	ND	21
0	60	9-05-02	1310	18.7	478	4.61	.39	NS	ND	ND	5.6
					April–May 2003						
	Surface water	4-29-03	M	17.49	438	6.42	9.67	NS	NS	ND	ND
10	10	4-29-03	1329	17.7	750	4.58	.27	NS	ND	ND	21
10	30	4-29-03	1341	13.29	751	4.45	.23	NS	ND	ND	5.9
10	60	4-29-03	1358	15.18	726	4.55	.33	NS	ND	ND	5.2
10	60 REP	4-29-03	1401	NS	NS	NS	NS	NS	ND	ND	5.1
9	10	4-29-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
9	30	4-29-03	1440	17.83	849	5.55	.55	NS	NS	NS	NS
9	30 REP	4-29-03	1444	NS	NS	NS	NS	NS	ND	ND	5.8
9	60	4-29-03	1450	12.49	857	4.49	.45	NS	ND	ND	6.5
8	10	4-29-03	1517	21.95	971	4.64	.96	NS	ND	ND	5.5
8	30	4-29-03	1531	12.95	975	4.49	.35	0.0	ND	ND	6.3
8	30 REP	4-29-03	1534	NS	NS	NS	NS	NS	ND	ND	6.7
8	60	4-29-03	1540	14.11	961	4.47	.33	NS	ND	ND	5.6
7	10	4-29-03	1612	19.37	1,052	4.8	.7	NS	ND	ND	11
7	10 REP	4-29-03	1618	NS	NS	NS	NS	NS	ND	ND	11
7	30	4-29-03	1628	14.32	963	4.44	.2	.1	ND	ND	6.2
7	60	4-29-03	M	13.03	949	4.4	.66	NS	ND	ND	5.5
	Trip blank	4-29-03	NA	NS	NS	NS	NS	NS	ND	ND	ND
	Trip blank	4-30-03	NA	NS	NS	NS	NS	NS	ND	ND	ND
6	10	4-30-03	1049	13.49	1,192	4.38	.53	NS	ND	ND	8.2
6	10 REP	4-30-03	1050	NS	NS	NS	NS	NS	ND	ND	8.0
6	30	4-30-03	1057	11.82	1,250	4.33	.28	3.2	ND	ND	5.8
6	60	4-30-03	1110	12.53	1,261	4.28	.32	2.5	ND	ND	6.7
5	10	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
5	30	4-30-03	1144	17.04	955	4.87	1.45	NS	ND	ND	9.9
5	60	4-30-03	1153	11.86	956	4.91	.22	3.3	ND	ND	11
5	60 REP	4-30-03	1156	NS	NS	NS	NS	NS	ND	ND	12
	Surface water	4-30-03	1300	16.08	578	6.15	9.03	NS	NS	NS	NS
4	Field blank	4-30-03	1315	NS	NS	NS	NS	NS	ND	ND	ND
4	10	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
4	30	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
4	60	4-30-03	1353	12.56	1,004	4.92	.35	NS	ND	ND	9.1

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	Temperature (°C)	Specific conductance (µS/cm)	pH (standard unit)	Dissolved oxygen (mg/L)	Ferrous iron (mg/L)	1,1,1-Trichloroethane	Tetrachloroethene	Trichloroethene
April–May 2003—Continued											
3	10	4-30-03	1423	19.88	1,196	4.51	2.18	NS	ND	ND	10
3	30	4-30-03	1435	20.24	1,299	4.37	2.5	NS	ND	ND	3.9
3	60	4-30-03	1447	11.37	1,228	4.48	.17	0.3	ND	1.2	ND
3	60 REP	4-30-03	1450	NS	NS	NS	NS	NS	ND	1.1	6.4
2	10	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	30	4-30-03	1514	12.59	1,086	4.51	.29	NS	ND	ND	10
2	30 REP	4-30-03	1517	NS	NS	NS	NS	NS	ND	ND	10
2	60	4-30-03	1521	15.54	1,089	4.33	.28	NS	ND	1.0	5.5
1	10	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	30	4-30-03	1548	13.99	877	4.49	.29	NS	ND	ND	7.5
1	30 REP	4-30-03	1551	NS	NS	NS	NS	NS	ND	ND	7.1
1	60	4-30-03	1558	17.63	864	4.38	.55	NS	ND	ND	ND
0	Trip blank	5-01-03	NA	NS	NS	NS	NS	NS	ND	ND	ND
0	10	5-01-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
0	30	5-01-03	1131	11.22	533	4.78	.06	1.3	ND	ND	23
0	60	5-01-03	1139	11.62	552	4.85	.7	.1	ND	ND	6.8
0	60 REP	5-01-03	1142	NS	NS	NS	NS	NS	ND	ND	6.8
June 2003											
	Surface water	6-23-03	M	19.7	311	6.6	7.2	NS	NS	NS	NS
10	Trip blank	6-23-03	NA	NS	NS	NS	NS	NS	ND	ND	ND
10	10	6-23-03	1310	19.1	902	4.7	.7	NS	ND	ND	14
10	30	6-23-03	1330	22.4	924	4.7	1	NS	ND	ND	7.5
10	60	6-23-03	1345	14.5	903	4.5	.8	0.2	ND	ND	9.0
10	60 REP	6-23-03	1350	NS	NS	NS	NS	NS	ND	ND	8.9
9	10	6-23-03	1407	19.1	979	4.7	.5	NS	ND	ND	12
9	30	6-23-03	1415	21.1	977	4.7	.7	NS	ND	ND	5.9
9	Field blank	6-23-03	1425	NS	NS	NS	NS	NS	ND	ND	ND
9	60	6-23-03	1435	14.4	969	4.5	.7	NS	ND	ND	9.9
8	10	6-23-03	1455	18.5	978	4.7	.5	NS	ND	ND	14
8	10 REP	6-23-03	1458	NS	NS	NS	NS	NS	ND	ND	14
8	30	6-23-03	1507	15	992	4.6	.7	NS	ND	ND	11
8	60	6-23-03	1515	14.2	993	4.6	.7	NS	ND	ND	11
7	10	6-23-03	1527	15.9	990	4.7	.7	.3	ND	ND	14
7	30	6-23-03	1527	15.1	1,000	4.6	.7	NS	ND	ND	7.7
7	30 REP	6-23-03	1541	NS	NS	NS	NS	NS	ND	ND	8.0
7	60	6-23-03	1557	14.2	979	4.6	.9	NS	ND	ND	7.9
	Surface water	6-24-03	NA	19.8	346	6.3	7.2	NS	NS	NS	NS

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	Temperature (°C)	Specific conductance (µS/cm)	pH (standard unit)	Dissolved oxygen (mg/L)	Ferrous iron (mg/L)	1,1,1-Trichloroethane	Tetrachloroethene	Trichloroethene
June 2003—Continued											
6	10	6-24-03	1012	21.4	989	4.5	0.6	NS	ND	ND	9.3
6	10 REP	6-24-03	1015	NS	NS	NS	NS	NS	ND	ND	13
	Trip blank	6-24-03	NA	NS	NS	NS	NS	NS	ND	ND	ND
6	30	6-24-03	1032	26.8	1,021	4.6	.6	NS	ND	ND	3.4
6	60	6-24-03	1045	14.8	1,005	4.3	.7	NS	ND	ND	7.5
5	10	6-24-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
5	Field blank	6-24-03	1112	NS	NS	NS	NS	NS	ND	ND	ND
5	30	6-24-03	1120	22.9	914	4.9	.9	NS	ND	ND	18
5	60	6-24-03	1130	15.5	884	4.7	.6	NS	ND	ND	11
4	10	6-24-03	1245	19.9	862	4.9	.9	NS	ND	ND	22
4	30	6-24-03	1255	17.2	894	5.1	.6	NS	ND	ND	14
4	60	6-24-03	1308	15.7	939	5.0	.6	NS	ND	ND	8.8
3	10	6-24-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
3	30	6-24-03	1333	14.9	1,051	4.3	.6	NS	ND	ND	8.9
3	30 REP	6-24-03	1336	NS	NS	NS	NS	NS	ND	ND	10
3	60	6-24-03	1342	13.5	1,030	4.4	.7	NS	ND	ND	11
2	10	6-24-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	30	6-24-03	1400	14.2	1,045	4.3	.07	NS	ND	ND	9.2
2	60	6-24-03	1412	13.7	1,021	4.3	.7	0.0	ND	ND	8.6
1	10	6-24-03	1430	21.2	867	4.6	.5	NS	ND	ND	7.2
1	30	6-24-03	1450	21.8	858	4.6	.8	NS	ND	ND	5.2
1	Field blank	6-24-03	1500	NS	NS	NS	NS	NS	ND	ND	ND
1	60	6-24-03	1506	17.3	846	4.5	.5	.1	ND	ND	5.1
0	10	6-24-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
0	30	6-24-03	1538	15.9	694	4.6	.6	NS	ND	ND	22
0	60	6-24-03	1525	14.2	781	4.4	.7	.0	ND	ND	5.9
0	60 REP	6-24-03	1528	NS	NS	NS	NS	NS	ND	ND	5.8
10	PDB	6-26-03	NA	NS	NS	NS	NS	NS	ND	ND	6.8
9	PDB	6-26-03	NA	NS	NS	NS	NS	NS	ND	ND	6.4
8	PDB	6-26-03	NA	NS	NS	NS	NS	NS	ND	ND	13
7	PDB	6-26-03	NA	NS	NS	NS	NS	NS	ND	ND	9.2
6	PDB	6-26-03	NA	NS	NS	NS	NS	NS	ND	ND	19

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	1,1-Dichloroethene	*cis*-1,2-Dichloroethene	Vinyl chloride	Chloroethane	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene
					June 2002						
10	10	6-17-02	1000	ND	ND	ND	ND	ND	ND	[1]0.82	ND
10	30	6-17-02	1012	ND	9.3	ND	ND	2.8	13	35	1.3
10	60	6-17-02	1027	ND	11	ND	ND	2.5	14	33	1.4
9	10	6-17-02	1045	ND	ND	ND	ND	ND	ND	.92	ND
9	30	6-17-02	1053	ND	19	ND	ND	3.7	18	49	1.6
9	60	6-17-02	1102	ND	21	ND	ND	4.0	20	53	1.8
8	10	6-17-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
8	30	6-17-02	1134	ND	23	ND	ND	3.1	18	42	10
8	30 REP	6-17-02	1139	ND	22	ND	ND	3.3	19	46	1.9
8	60	6-17-02	1148	ND	22	ND	ND	2.7	18	46	1.8
8	60 REP	6-17-02	1153	ND	20	ND	ND	3.2	17	44	1.5
7	10	6-17-02	1218	ND	[1].92	ND	ND	ND	[1].59	2.1	ND
7	30	6-17-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
7	60	6-17-02	1236	ND	20	ND	ND	5.1	27	70	2.0
6	10	6-17-02	1250	ND	32	ND	ND	2.5	8.2	60	1.4
6	30	6-17-02	NS	NS	NS	NS	NS	NS	NS	NS	NS
6	60	6-17-02	1315	ND	19	ND	ND	5.7	27	80	2.7
6	60 REP	6-17-02	1320	ND	18	ND	ND	5.1	27	80	2.4
5	10	6-17-02	1348	[1]0.88	36	1.8	ND	1.0	2.4	47	ND
5	30	6-17-02	1357	1.0	24	ND	1.7	4.4	19	82	2.8
5	60	6-17-02	1402	ND	19	ND	ND	4.9	24	100	2.8
4	10	6-17-02	1420	ND	2.0	6.2	ND	ND	5.4	57	2.2
4	30	6-17-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
4	30	6-17-02	1431	ND	17	17	ND	4.1	23	84	2.6
3	10	6-18-02	0957	ND	15	ND	ND	[1].72	2.8	17	ND
3	10 REP	6-18-02	1005	ND	17	ND	ND	[1].78	2.7	20	[1].59
3	30	6-18-02	1019	ND	9.8	ND	ND	1.5	7.3	18	[1].55
3	30 REP	6-18-02	1033	ND	9.9	ND	ND	2.1	11	19	[1].66
3	60	6-18-02	1041	ND	12	ND	ND	3.0	16	33	1.2
3	60 REP	6-18-02	1048	ND	12	ND	ND	2.3	15	30	1.2
2	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	30	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	60	6-18-02	1116	ND	6.8	ND	ND	2.1	12	28	[1].93
1	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	30	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	60	6-18-02	1131	ND	4.0	ND	ND	1.9	9.3	25	[1].83
1	60 REP	6-18-02	1138	ND	4.2	ND	ND	2.0	9.2	27	[1].80

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	1,1-Dichloroethene	*cis*-1,2-Dichloroethene	Vinyl chloride	Chloroethane	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene
June 2002—Continued											
0	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
0	30	6-18-02	1150	ND	6.7	ND	ND	1.5	6.8	21	[1]0.69
0	30 REP	6-18-02	1158	ND	12	ND	ND	1.9	6.8	33	1.3
0	60	6-18-02	1203	ND	3.0	ND	ND	1.2	6.1	19	[1].72
0	60 REP	6-18-02	1209	ND	4.1	ND	ND	1.8	7.8	26	ND
September 2002											
10	10	9-04-02	1545	ND	19	0.7	ND	4.1	9.3	58	1.1
10	30	9-04-02	1550	ND	14	ND	ND	5.4	22	58	1.7
10	60	9-04-02	1555	ND	15	ND	ND	5.6	27	58	2.0
9	10	9-04-02	1515	ND	26	1.4	ND	3.6	11	67	1.2
9	30	9-04-02	1525	ND	16	ND	ND	1.8	8.3	34	ND
9	60	9-04-02	1530	ND	18	ND	ND	4.8	24	70	2.3
8	10	9-04-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
8	30	9-04-02	1455	ND	19	ND	ND	4.2	20	61	2.0
8	60	9-04-02	1500	ND	19	ND	ND	4.9	23	60	2.1
7	10	9-04-02	1420	ND	25	1.6	ND	4.8	17	68	1.8
7	10 REP	9-04-02	1425	ND	25	[1].91	ND	4.7	18	78	2.0
7	30	9-04-02	1435	ND	17	ND	ND	3.6	14	52	1.3
7	60	9-04-02	1440	ND	17	ND	ND	6.4	28	75	2.3
7	60 REP	9-04-02	1445	ND	16	ND	ND	6.2	29	69	2.3
6	10	9-04-02	1255	ND	22	ND	ND	ND	[1]4.2	39	ND
6	30	9-04-02	1315	ND	17	ND	ND	6.9	30	88	2.7
6	60	9-04-02	1330	ND	15	ND	ND	7.3	32	82	2.5
5	10	9-04-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
5	30	9-04-02	1510	ND	20	.78	ND	1.9	6.8	53	ND
5	60	9-04-02	1530	ND	11	ND	ND	4.4	20	61	1.8
4	10	9-04-02	1540	ND	8.1	1.9	ND	ND	ND	7.4	ND
4	30	9-04-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
4	60	9-04-02	1600	ND	16	ND	ND	5.1	22	79	2.2
	Trip blank	9-04-02	NA	ND	ND	ND	ND	ND	ND	ND	ND
3	10	9-05-02	1100	ND	19	ND	ND	1.8	4	28	ND
3	10 REP	9-05-02	1115	ND	16	ND	ND	ND	1.6	12	ND
3	30	9-05-02	1130	ND	11	ND	ND	1.3	5.2	16	ND
3	30 REP	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
3	60	9-05-02	1150	ND	9.9	ND	ND	3.7	19	36	1.5
3	60 REP	9-05-02	1155	ND	10	ND	ND	3.9	20	37	1.3
2	10	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	30	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	60	9-05-02	1215	ND	6.0	ND	ND	2.3	10	30	ND

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	1,1-Dichloroethene	*cis*-1,2-Dichloroethene	Vinyl chloride	Chloroethane	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene
					September 2002—Continued						
1	10	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	30	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	60	9-05-02	1250	ND	3.1	ND	ND	2.2	9.5	17	0.61
0	10	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
0	30	9-05-02	1305	ND	7.1	ND	ND	2.2	7.7	21	ND
0	60	9-05-02	1310	ND	3.2	ND	ND	[1].76	2.5	11	ND
					April–May 2003						
	Surface water	4-29-03	M	NS	ND	ND	ND	NS	NS	NS	NS
10	10	4-29-03	1329	ND	23	ND	ND	2.3	8.2	47	1.1
10	30	4-29-03	1341	ND	23	ND	ND	2.6	14	41	1.3
10	60	4-29-03	1358	ND	20	ND	ND	2.0	11	37	1.1
10	60 REP	4-29-03	1401	ND	21	ND	ND	2.0	11	39	1.1
9	10	4-29-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
9	30	4-29-03	1440	NS	NS	NS	NS	NS	NS	NS	NS
9	30 REP	4-29-03	1444	ND	28	ND	ND	1.8	9.9	38	1.1
9	60	4-29-03	1450	ND	29	ND	ND	2.4	14	49	1.5
8	10	4-29-03	1517	ND	28	ND	ND	ND	2.8	14	ND
8	30	4-29-03	1531	ND	35	ND	ND	2.1	12	40	1.4
8	30 REP	4-29-03	1534	ND	35	ND	ND	2.2	13	43	1.4
8	60	4-29-03	1540	ND	32	ND	ND	1.8	11	40	1.3
7	10	4-29-03	1612	ND	27	ND	ND	1.4	6.0	35	ND
7	10 REP	4-29-03	1618	ND	28	ND	ND	1.4	5.8	38	ND
7	30	4-29-03	1628	ND	33	ND	ND	2.2	12	44	1.4
7	60	4-29-03	M	ND	32	ND	ND	2.3	13	42	1.4
	Trip blank	4-29-03	NA	ND	ND	ND	ND	ND	ND	ND	ND
	Trip blank	4-30-03	NA	ND	ND	ND	ND	ND	ND	ND	ND
6	10	4-30-03	1049	ND	29	ND	ND	2.3	12	54	1.4
6	10 REP	4-30-03	1050	ND	30	ND	ND	2.2	11	50	1.3
6	30	4-30-03	1057	ND	33	ND	ND	3.4	19	62	1.9
6	60	4-30-03	1110	ND	25	ND	ND	5.4	26	62	2.3
5	10	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
5	30	4-30-03	1144	ND	17	ND	ND	1.3	4.2	38	6.4
5	60	4-30-03	1153	ND	21	ND	ND	4.8	24	89	2.7
5	60 REP	4-30-03	1156	ND	21	ND	ND	4.9	24	89	2.7
	Surface water	4-30-03	1300	NS	NS	NS	NS	NS	NS	NS	NS
4	Field blank	4-30-03	1315	ND	ND	ND	ND	ND	ND	ND	ND
4	10	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
4	30	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
4	60	4-30-03	1353	ND	20	ND	ND	4.8	23	75	2.3

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	1,1-Dichloroethene	*cis*-1,2-Dichloroethene	Vinyl chloride	Chloroethane	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene
April–May 2003—Continued											
3	10	4-30-03	1423	ND	16	ND	ND	1.3	4.8	22	ND
3	30	4-30-03	1435	ND	17	ND	ND	ND	3.0	10	ND
3	60	4-30-03	1447	ND	21	6.8	ND	3.2	16	33	1.3
3	60 REP	4-30-03	1450	ND	20	ND	ND	3.0	15	31	1.4
2	10	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	30	4-30-03	1514	ND	15	ND	ND	2.5	12	31	1.2
2	30 REP	4-30-03	1517	ND	16	ND	ND	2.4	11	30	1.1
2	60	4-30-03	1521	ND	15	ND	ND	2.0	10	25	1.1
1	10	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	30	4-30-03	1548	ND	9.8	ND	ND	1.4	6.8	13	ND
1	30 REP	4-30-03	1551	ND	8.9	ND	ND	1.8	6.7	13	ND
1	60	4-30-03	1558	ND	ND	ND	ND	1.4	5.9	15	ND
0	Trip blank	5-01-03	NA	ND	ND	ND	ND	ND	ND	ND	ND
0	10	5-01-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
0	30	5-01-03	1131	ND	8.2	ND	ND	2.3	6.9	31	ND
0	60	5-01-03	1139	ND	7.1	ND	ND	2.1	8.1	26	ND
0	60 REP	5-01-03	1142	ND	7.4	ND	ND	1.9	8.3	29	ND
June 2003											
	Surface water	6-23-03	M	NS	NS	NS	NS	NS	NS	NS	NS
10	Trip blank	6-23-03	NA	ND	ND	ND	ND	ND	ND	ND	ND
10	10	6-23-03	1310	ND	16	ND	ND	2.2	5.7	33	1.0
10	30	6-23-03	1330	ND	26	ND	ND	1.9	8.4	24	1.0
10	60	6-23-03	1345	ND	27	ND	ND	3.1	16	35	1.6
10	60 REP	6-23-03	1350	ND	28	ND	ND	3.4	16	35	1.5
9	10	6-23-03	1407	ND	27	ND	ND	2.7	11	47	1.4
9	30	6-23-03	1415	ND	22	ND	ND	2.2	8.4	31	1.1
9	Field blank	6-23-03	1425	ND	ND	ND	ND	ND	ND	ND	ND
9	60	6-23-03	1435	ND	34	ND	ND	3.9	21	59	2.3
8	10	6-23-03	1455	ND	28	ND	ND	3.3	15	47	1.6
8	10 REP	6-23-03	1458	ND	29	ND	ND	3.4	15	48	1.7
8	30	6-23-03	1507	ND	36	ND	ND	4.1	22	58	2.1
8	60	6-23-03	1515	ND	36	ND	ND	3.7	20	57	2.2
7	10	6-23-03	1527	ND	29	ND	ND	4.1	21	55	1.7
7	30	6-23-03	1527	ND	34	ND	ND	3.8	23	55	1.7
7	30 REP	6-23-03	1541	ND	34	ND	ND	3.8	22	55	1.8
7	60	6-23-03	1557	ND	33	ND	ND	3.1	20	49	1.6
	Surface water	6-24-03	M	NS	NS	NS	NS	NS	NS	NS	NS

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	1,1-Dichloroethene	*cis*-1,2-Dichloroethene	Vinyl chloride	Chloroethane	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene
June 2003—Continued											
6	10	6-24-03	1012	ND	19	ND	ND	1.9	8.2	45	ND
6	10 REP	6-24-03	1015	ND	24	ND	ND	2.0	8.9	50	1.1
	Trip blank	6-24-03	NA	ND	ND	ND	ND	ND	ND	ND	ND
6	30	6-24-03	1032	ND	24	ND	ND	1.2	4.8	21	ND
6	60	6-24-03	1045	ND	31	ND	ND	4.4	25	60	1.9
5	10	6-24-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
5	Field blank	6-24-03	1112	ND	ND	ND	ND	ND	ND	ND	ND
5	30	6-24-03	1120	ND	24	ND	ND	ND	6.1	41	ND
5	60	6-24-03	1130	ND	25	ND	ND	3.7	21	70	1.9
4	10	6-24-03	1245	ND	41	8.2	ND	ND	3.2	49	1.4
4	30	6-24-03	1255	ND	26	ND	ND	2.5	12	72	1.5
4	60	6-24-03	1308	ND	29	ND	ND	3.2	19	64	1.7
3	10	6-24-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
3	30	6-24-03	1333	ND	31	ND	ND	2.5	15	35	1.1
3	30 REP	6-24-03	1336	ND	34	ND	ND	3.6	17	36	1.6
3	60	6-24-03	1342	ND	34	ND	ND	3.2	16	39	1.6
2	10	6-24-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	30	6-24-03	1400	ND	26	ND	ND	1.6	8.0	28	1.0
2	60	6-24-03	1412	ND	25	ND	ND	1.9	9.4	28	1.3
1	10	6-24-03	1430	ND	11	ND	ND	1.4	5.0	11	ND
1	30	6-24-03	1450	ND	12	ND	ND	1.0	4.1	9.2	ND
1	Field blank	6-24-03	1500	ND	ND	ND	ND	ND	ND	ND	ND
1	60	6-24-03	1506	ND	15	ND	ND	1.2	5.9	12	ND
0	10	6-24-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
0	30	6-24-03	1538	ND	9.6	ND	ND	1.9	5.5	31	ND
0	60	6-24-03	1525	ND	13	ND	ND	1.5	7.0	18	ND
0	60 REP	6-24-03	1528	ND	12	ND	ND	1.5	6.9	18	ND
10	PDB	6-26-03	NA	ND	14	ND	ND	3.0	13	[2]61	1.7
9	PDB	6-26-03	NA	ND	28	ND	ND	2.2	19	43	1.3
8	PDB	6-26-03	NA	ND	33	ND	ND	2.7	15	41	1.3
7	PDB	6-26-03	NA	ND	37	ND	ND	2.9	18	57	1.9
6	PDB	6-26-03	NA	ND	24	ND	ND	4.6	19	92	1.8

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	1,4-Dichlorobenzene	Chlorobenzene	Benzene	Naphthalene	Bromomethane	Dichlorodifluoromethane	1,2,3-Trichloropropane
				June 2002						
10	10	6-17-02	1000	ND	ND	ND	ND	ND	ND	ND
10	30	6-17-02	1012	7.9	6.7	ND	ND	ND	ND	ND
10	60	6-17-02	1027	7.3	4.2	ND	ND	ND	ND	ND
9	10	6-17-02	1045	ND	ND	ND	ND	ND	ND	ND
9	30	6-17-02	1053	11	8.3	ND	ND	ND	ND	ND
9	60	6-17-02	1102	11	8.8	ND	ND	ND	ND	ND
8	10	6-17-02	NA	NS	NS	NS	NS	NS	NS	NS
8	30	6-17-02	1134	9.2	6.4	ND	ND	ND	ND	ND
8	30 REP	6-17-02	1139	10	7.2	ND	ND	ND	ND	ND
8	60	6-17-02	1148	10	7.8	ND	ND	ND	ND	ND
8	60 REP	6-17-02	1153	9.5	6.7	ND	ND	ND	ND	ND
7	10	6-17-02	1218	[1].63	ND	ND	ND	ND	ND	ND
7	30	6-17-02	NA	NS	NS	NS	NS	NS	NS	NS
7	60	6-17-02	1236	16	9.2	ND	ND	ND	ND	ND
6	10	6-17-02	1250	8.2	30	ND	ND	ND	ND	ND
6	30	6-17-02	NS	NS	NS	NS	NS	NS	NS	NS
6	60	6-17-02	1315	18	14	ND	ND	[3]5.1	ND	ND
6	60 REP	6-17-02	1320	17	12	ND	ND	7.3	ND	ND
5	10	6-17-02	1348	5.0	35	ND	ND	[3]3.4	ND	ND
5	30	6-17-02	1357	21	27	ND	ND	[3]2.4	ND	ND
5	60	6-17-02	1402	21	21	ND	ND	4.1	ND	ND
4	10	6-17-02	1420	7.8	64	ND	ND	ND	ND	ND
4	30	6-17-02	NA	NS	NS	NS	NS	NS	NS	NS
4	30	6-17-02	1431	16	15	ND	ND	ND	ND	ND
3	10	6-18-02	0957	ND	ND	ND	ND	ND	ND	ND
3	10 REP	6-18-02	1005	2.9	13	ND	ND	ND	ND	ND
3	30	6-18-02	1019	3.8	ND	ND	ND	ND	ND	ND
3	30 REP	6-18-02	1033	4.1	4.7	ND	ND	ND	ND	ND
3	60	6-18-02	1041	7.3	4.7	ND	ND	ND	ND	ND
3	60 REP	6-18-02	1048	6.7	ND	ND	ND	ND	ND	ND
2	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS
2	30	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS
2	60	6-18-02	1116	6.5	4.0	ND	ND	ND	ND	ND
1	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS
1	30	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS
1	60	6-18-02	1131	5.6	ND	ND	ND	ND	ND	ND
1	60 REP	6-18-02	1138	5.6	3.8	ND	ND	ND	ND	ND

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	1,4-Dichlorobenzene	Chlorobenzene	Benzene	Naphthalene	Bromomethane	Dichlorodifluoromethane	1,2,3-Trichloropropane
June 2002—Continued										
0	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS
0	30	6-18-02	1150	4.8	11	ND	ND	ND	ND	ND
0	30 REP	6-18-02	1158	5.9	20	ND	ND	ND	ND	ND
0	60	6-18-02	1203	4.5	4.6	ND	ND	ND	ND	ND
0	60 REP	6-18-02	1209	ND	5.0	ND	ND	ND	ND	ND
September 2002										
10	10	9-04-02	1545	8.5	47	0.63	0.68	ND	ND	ND
10	30	9-04-02	1550	12	13	ND	ND	ND	ND	ND
10	60	9-04-02	1555	13	11	ND	ND	ND	ND	ND
9	10	9-04-02	1515	10	42	.94	ND	ND	ND	19
9	30	9-04-02	1525	6.5	ND	ND	ND	ND	ND	ND
9	60	9-04-02	1530	15	14	ND	ND	ND	ND	ND
8	10	9-04-02	NA	NS	NS	NS	NS	NS	NS	NS
8	30	9-04-02	1455	13	16	ND	ND	ND	ND	ND
8	60	9-04-02	1500	12	10	ND	ND	ND	ND	18
7	10	9-04-02	1420	13	36	ND	ND	ND	ND	ND
7	10 REP	9-04-02	1425	14	41	ND	ND	ND	ND	ND
7	30	9-04-02	1435	9.9	15	ND	ND	ND	ND	ND
7	60	9-04-02	1440	15	12	ND	ND	ND	ND	ND
7	60 REP	9-04-02	1445	14	11	ND	ND	ND	ND	ND
6	10	9-04-02	1255	5.8	28	ND	ND	ND	ND	ND
6	30	9-04-02	1315	17	19	ND	ND	ND	ND	ND
6	60	9-04-02	1330	16	15	ND	ND	ND	ND	ND
5	10	9-04-02	NA	NS	NS	NS	NS	ND	ND	NS
5	30	9-04-02	1510	7.8	30	ND	ND	ND	ND	ND
5	60	9-04-02	1530	11	13	ND	ND	ND	ND	ND
4	10	9-04-02	1540	1.0	11	ND	ND	ND	ND	ND
4	30	9-04-02	NA	NS	NS	NS	NS	NS	NS	NS
4	60	9-04-02	1600	15	20	ND	ND	ND	ND	ND
	Trip blank	9-04-02	NA	ND	ND	ND	ND	ND	ND	ND
3	10	9-05-02	1100	4.3	23	ND	ND	ND	ND	ND
3	10 REP	9-05-02	1115	1.6	13	ND	ND	ND	ND	ND
3	30	9-05-02	1130	3.3	11	ND	ND	ND	ND	ND
3	30 REP	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS
3	60	9-05-02	1150	8.1	5.6	ND	ND	ND	ND	ND
3	60 REP	9-05-02	1155	8.6	6.6	ND	ND	ND	ND	ND
2	10	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS
2	30	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS
2	60	9-05-02	1215	5.7	5.2	ND	ND	ND	ND	ND

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	1,4-Dichlorobenzene	Chlorobenzene	Benzene	Naphthalene	Bromomethane	Dichlorodifluoromethane	1,2,3-Trichloropropane
				September 2002—Continued						
1	10	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS
1	30	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS
1	60	9-05-02	1250	4.3	2.9	ND	ND	ND	ND	ND
0	10	9-05-02	NA	NS	NS	NS	NS	NS	NS	NS
0	30	9-05-02	1305	5.3	17	ND	ND	ND	ND	ND
0	60	9-05-02	1310	2.2	4.7	ND	ND	ND	ND	ND
				April–May 2003						
	Surface water	4-29-03	M	NS	ND	NS	ND	ND	ND	NS
10	10	4-29-03	1329	7.3	19	ND	ND	ND	ND	ND
10	30	4-29-03	1341	8.8	6.1	ND	ND	ND	ND	ND
10	60	4-29-03	1358	7.3	5.2	ND	ND	ND	ND	ND
10	60 REP	4-29-03	1401	7.5	5.5	ND	ND	ND	ND	ND
9	10	4-29-03	NA	NS	NS	NS	NS	NS	NS	NS
9	30	4-29-03	1440	NS	NS	NS	NS	NS	NS	NS
9	30 REP	4-29-03	1444	7.6	6.0	ND	ND	ND	ND	ND
9	60	4-29-03	1450	10	7.2	ND	ND	ND	ND	ND
8	10	4-29-03	1517	2.7	5.0	ND	ND	ND	ND	ND
8	30	4-29-03	1531	8.7	6.9	ND	ND	ND	ND	ND
8	30 REP	4-29-03	1534	9.0	7.0	ND	ND	ND	ND	ND
8	60	4-29-03	1540	8.2	6.2	ND	ND	ND	ND	ND
7	10	4-29-03	1612	6.2	11	ND	ND	ND	ND	ND
7	10 REP	4-29-03	1618	6.6	11	ND	ND	ND	ND	ND
7	30	4-29-03	1628	9.2	6.8	ND	ND	ND	ND	ND
7	60	4-29-03	M	9.2	5.6	ND	ND	ND	ND	ND
	Trip blank	4-29-03	NA	ND	ND	ND	ND	ND	ND	ND
	Trip blank	4-30-03	NA	ND	ND	ND	ND	ND	ND	ND
6	10	4-30-03	1049	9.9	8.2	ND	ND	ND	ND	ND
6	10 REP	4-30-03	1050	9.1	8.1	ND	ND	ND	ND	ND
6	30	4-30-03	1057	13	7.3	ND	ND	ND	ND	ND
6	60	4-30-03	1110	13	7.3	ND	ND	ND	ND	ND
5	10	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS
5	30	4-30-03	1144	6.1	12	ND	ND	ND	ND	ND
5	60	4-30-03	1153	17	16	ND	ND	ND	ND	ND
5	60 REP	4-30-03	1156	17	16	ND	ND	ND	ND	ND
	Surface water	4-30-03	1300	NS	NS	NS	NS	NS	NS	NS
4	Field blank	4-30-03	1315	ND	ND	ND	ND	ND	ND	ND
4	10	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS
4	30	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS
4	60	4-30-03	1353	15	12	ND	ND	ND	ND	ND

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	1,4-Dichlorobenzene	Chlorobenzene	Benzene	Naphthalene	Bromomethane	Dichlorodifluoromethane	1,2,3-Trichloropropane
April–May 2003—Continued										
3	10	4-30-03	1423	4.0	7.4	ND	ND	ND	ND	ND
3	30	4-30-03	1435	2.2	2.6	ND	ND	ND	ND	ND
3	60	4-30-03	1447	7.4	4.2	ND	ND	ND	ND	ND
3	60 REP	4-30-03	1450	7.1	4.1	ND	ND	ND	ND	ND
2	10	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS
2	30	4-30-03	1514	6.9	7.8	ND	ND	ND	ND	21
2	30 REP	4-30-03	1517	6.7	7.9	ND	ND	ND	ND	ND
2	60	4-30-03	1521	5.4	3.6	ND	ND	ND	ND	ND
1	10	4-30-03	NA	NS	NS	NS	NS	NS	NS	NS
1	30	4-30-03	1548	3.7	3.6	ND	ND	ND	ND	ND
1	30 REP	4-30-03	1551	3.6	3.8	ND	ND	ND	ND	ND
1	60	4-30-03	1558	3.4	2.3	ND	ND	ND	ND	ND
0	Trip blank	5-01-03	NA	ND	ND	ND	ND	ND	ND	ND
0	10	5-01-03	NA	NS	NS	NS	NS	NS	NS	NS
0	30	5-01-03	1131	5.1	ND	ND	ND	ND	ND	ND
0	60	5-01-03	1139	5.3	ND	ND	ND	ND	ND	ND
0	60 REP	5-01-03	1142	5.8	ND	ND	ND	ND	ND	ND
June 2003										
	Surface water	6-23-03	M	NS	NS	NS	NS	NS	NS	NS
10	Trip blank	6-23-03	NA	ND	ND	ND	ND	ND	ND	ND
10	10	6-23-03	1310	5.5	16	ND	ND	ND	ND	ND
10	30	6-23-03	1330	5.0	6.1	ND	ND	ND	ND	ND
10	60	6-23-03	1345	8.5	7.8	ND	ND	ND	ND	ND
10	60 REP	6-23-03	1350	8.1	7.6	ND	ND	ND	ND	ND
9	10	6-23-03	1407	9.3	12	ND	ND	ND	ND	ND
9	30	6-23-03	1415	6.2	6.7	ND	ND	ND	ND	ND
9	Field blank	6-23-03	1425	ND	ND	ND	ND	ND	ND	ND
9	60	6-23-03	1435	13	11	ND	ND	ND	ND	ND
8	10	6-23-03	1455	10	14	ND	ND	ND	ND	ND
8	10 REP	6-23-03	1458	10	15	ND	ND	ND	ND	ND
8	30	6-23-03	1507	13	12	ND	ND	ND	ND	ND
8	60	6-23-03	1515	13	12	ND	ND	ND	ND	ND
7	10	6-23-03	1527	9.7	15	ND	ND	ND	ND	ND
7	30	6-23-03	1527	11	9.9	ND	ND	ND	ND	ND
7	30 REP	6-23-03	1541	9.6	10	ND	ND	ND	ND	ND
7	60	6-23-03	1557	8.2	10	ND	ND	ND	ND	26
	Surface water	6-24-03	M	NS	NS	NS	NS	NS	NS	NS

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	1,4-Dichlorobenzene	Chlorobenzene	Benzene	Naphthalene	Bromomethane	Dichlorodifluoromethane	1,2,3-Trichloropropane
				June 2003—Continued						
6	10	6-24-03	1012	6.0	14	ND	ND	ND	ND	ND
6	10 REP	6-24-03	1015	6.8	16	ND	ND	ND	ND	ND
	Trip blank	6-24-03	NA	ND	ND	ND	ND	ND	ND	ND
6	30	6-24-03	1032	2.9	5.0	ND	ND	ND	ND	ND
6	60	6-24-03	1045	12	9.7	ND	ND	ND	ND	ND
5	10	6-24-03	NA	NS	NS	NS	NS	NS	NS	NS
5	Field blank	6-24-03	1112	ND	ND	ND	ND	ND	ND	ND
5	30	6-24-03	1120	5.7	23	ND	ND	ND	ND	ND
5	60	6-24-03	1130	13	16	ND	ND	ND	ND	ND
4	10	6-24-03	1245	4.3	55	ND	ND	ND	ND	ND
4	30	6-24-03	1255	9.9	19	ND	ND	ND	ND	ND
4	60	6-24-03	1308	9.9	13	ND	ND	ND	ND	ND
3	10	6-24-03	NA	NS	NS	NS	NS	NS	NS	NS
3	30	6-24-03	1333	6.3	9.3	ND	ND	ND	ND	ND
3	30 REP	6-24-03	1336	8.8	9.9	ND	ND	ND	1.0	ND
3	60	6-24-03	1342	9.4	12	ND	ND	ND	ND	ND
2	10	6-24-03	NA	NS	NS	NS	NS	NS	NS	NS
2	30	6-24-03	1400	6.4	9.0	ND	ND	ND	ND	ND
2	60	6-24-03	1412	7.0	9.1	ND	ND	ND	ND	ND
1	10	6-24-03	1430	3.5	6.9	ND	ND	ND	ND	ND
1	30	6-24-03	1450	2.6	4.3	ND	ND	ND	ND	ND
1	Field blank	6-24-03	1500	ND	ND	ND	ND	ND	ND	ND
1	60	6-24-03	1506	3.1	2.4	ND	ND	ND	ND	ND
0	10	6-24-03	NA	NS	NS	NS	NS	NS	NS	NS
0	30	6-24-03	1538	4.6	26	ND	ND	ND	ND	ND
0	60	6-24-03	1525	4.3	3.4	ND	ND	ND	ND	ND
0	60 REP	6-24-03	1528	4.6	3.4	ND	ND	ND	ND	ND
10	PDB	6-26-03	NA	8.1	[3]11	ND	ND	ND	ND	ND
9	PDB	6-26-03	NA	8.3	[3]6.7	ND	ND	ND	ND	ND
8	PDB	6-26-03	NA	8.2	9.4	ND	ND	ND	ND	ND
7	PDB	6-26-03	NA	10	[3]17	ND	ND	ND	ND	ND
6	PDB	6-26-03	NA	13	[3]28	ND	ND	ND	ND	ND

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	Butanone (MEK)	Chloro-methane	2-Pro-panone (acetone)	Carbon disulfide	MTBE	Tetrahy-drofuran
					June 2002				
10	10	6-17-02	1000	ND	ND	[2 3]4.1	ND	ND	ND
10	30	6-17-02	1012	ND	ND	[1 2 3]1.8	ND	ND	ND
10	60	6-17-02	1027	ND	ND	[2 3]2.5	ND	ND	ND
9	10	6-17-02	1045	ND	ND	6.0	ND	ND	ND
9	30	6-17-02	1053	ND	ND	ND	ND	ND	ND
9	60	6-17-02	1102	ND	ND	ND	ND	ND	ND
8	10	6-17-02	NA	NS	NS	NS	NS	NS	NS
8	30	6-17-02	1134	ND	ND	[1 2 3]1.9	ND	ND	ND
8	30 REP	6-17-02	1139	ND	ND	[1 2 3]2.6	ND	ND	ND
8	60	6-17-02	1148	ND	ND	[2 3]2.0	ND	ND	ND
8	60 REP	6-17-02	1153	ND	ND	[2 3]4.4	ND	ND	ND
7	10	6-17-02	1218	ND	ND	[2 3]3.1	ND	ND	ND
7	30	6-17-02	NA	NS	NS	NS	NS	NS	NS
7	60	6-17-02	1236	ND	ND	[1 2 3]1.4	ND	ND	ND
6	10	6-17-02	1250	ND	ND	ND	ND	ND	ND
6	30	6-17-02	NS	NS	NS	NS	NS	NS	NS
6	60	6-17-02	1315	ND	1.3	[2 3]23	ND	ND	ND
6	60 REP	6-17-02	1320	ND	1.5	[2 3]4.6	ND	ND	ND
5	10	6-17-02	1348	ND	ND	[2 3]6.2	ND	ND	ND
5	30	6-17-02	1357	ND	ND	[2 3]9.6	ND	ND	ND
5	60	6-17-02	1402	ND	ND	[3]130	ND	ND	ND
4	10	6-17-02	1420	ND	ND	28	ND	ND	ND
4	30	6-17-02	NA	NS	NS	NS	NS	NS	NS
4	30	6-17-02	1431	ND	ND	[3]18	ND	ND	ND
3	10	6-18-02	0957	ND	11	[2 3]6.4	ND	ND	ND
3	10 REP	6-18-02	1005	ND	ND	[2 3]5.8	ND	ND	ND
3	30	6-18-02	1019	ND	ND	[2 3]5.3	ND	ND	ND
3	30 REP	6-18-02	1033	ND	ND	[2 3]6.1	ND	ND	ND
3	60	6-18-02	1041	ND	ND	[2 3]3.8	ND	ND	ND
3	60 REP	6-18-02	1048	ND	ND	[2 3]3.0	ND	ND	ND
2	10	6-18-02	NA	NS	NS	NS	NS	NS	NS
2	30	6-18-02	NA	NS	NS	NS	NS	NS	NS
2	60	6-18-02	1116	ND	ND	[2 3]4.1	ND	ND	ND
1	10	6-18-02	NA	NS	NS	NS	NS	NS	NS
1	30	6-18-02	NA	NS	NS	NS	NS	NS	NS
1	60	6-18-02	1131	ND	ND	[2 3]2.1	ND	ND	ND
1	60 REP	6-18-02	1138	ND	ND	[2 3]2.5	ND	ND	ND

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	Butanone (MEK)	Chloro-methane	2-Pro-panone (acetone)	Carbon disulfide	MTBE	Tetrahy-drofuran
June 2002—Continued									
0	10	6-18-02	NA	NS	NS	NS	NS	NS	NS
0	30	6-18-02	1150	ND	ND	[2 3]2.5	ND	ND	ND
0	30 REP	6-18-02	1158	ND	ND	[2 3]2.3	ND	ND	ND
0	60	6-18-02	1203	ND	ND	[2 3]2.6	ND	ND	ND
0	60 REP	6-18-02	1209	ND	ND	ND	[1]1.1	ND	ND
September 2002									
10	10	9-04-02	1545	ND	ND	[1 2 3]1.7	ND	ND	ND
10	30	9-04-02	1550	ND	ND	ND	ND	ND	ND
10	60	9-04-02	1555	ND	ND	[1 2 3]1.3	ND	ND	ND
9	10	9-04-02	1515	ND	ND	[1 2 3]1.4	ND	ND	ND
9	30	9-04-02	1525	ND	ND	[1 2 3]1.2	ND	ND	ND
9	60	9-04-02	1530	ND	ND	[1 2 3]1.4	ND	ND	ND
8	10	9-04-02	NA	NS	NS	NS	NS	NS	ND
8	30	9-04-02	1455	ND	ND	[1 2 3]1.5	ND	ND	ND
8	60	9-04-02	1500	ND	ND	[1 2 3]1.3	ND	ND	ND
7	10	9-04-02	1420	ND	ND	[1 3]1.6	ND	ND	ND
7	10 REP	9-04-02	1425	ND	ND	[1 3]1.0	ND	ND	ND
7	30	9-04-02	1435	ND	ND	[1 2 3]1.1	ND	ND	ND
7	60	9-04-02	1440	ND	ND	[1 2 3]1.1	ND	ND	ND
7	60 REP	9-04-02	1445	ND	ND	[1 2 3]1.7	ND	ND	ND
6	10	9-04-02	1255	ND	ND	[1 2]7.7	ND	ND	ND
6	30	9-04-02	1315	ND	ND	[2]2.3	[1]1.4	ND	ND
6	60	9-04-02	1330	ND	ND	[2]2.1	ND	ND	ND
5	10	9-04-02	NA	ND	NS	NS	NS	ND	ND
5	30	9-04-02	1510	ND	ND	[1]1.3	ND	ND	ND
5	60	9-04-02	1530	ND	ND	[2]2.4	ND	ND	ND
4	10	9-04-02	1540	ND	ND	[1 2]1.7	ND	ND	ND
4	30	9-04-02	NA	NS	NS	NS	NS	NS	NS
4	60	9-04-02	1600	ND	ND	[1 2]1.7	ND	ND	ND
	Trip blank	9-04-02	NA	ND	ND	[1 2].99	ND	ND	ND
3	10	9-05-02	1100	ND	ND	[1 2 3]1.4	ND	ND	ND
3	10 REP	9-05-02	1115	ND	ND	[1 2 3]1.5	ND	ND	ND
3	30	9-05-02	1130	ND	ND	[1 2 3]2.5	ND	ND	ND
3	30 REP	9-05-02	NA	NS	NS	NS	NS	NS	NS
3	60	9-05-02	1150	ND	ND	[1 2 3]1.6	ND	ND	ND
3	60 REP	9-05-02	1155	ND	ND	[1 2 3]1.2	ND	ND	ND
2	10	9-05-02	NA	NS	NS	NS	NS	NS	NS
2	30	9-05-02	NA	NS	NS	NS	NS	NS	NS
2	60	9-05-02	1215	ND	ND	1.3	ND	ND	ND

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	Butanone (MEK)	Chloro-methane	2-Pro-panone (acetone)	Carbon disulfide	MTBE	Tetrahy-drofuran
				September 2002—Continued					
1	10	9-05-02	NA	NS	NS	NS	NS	NS	NS
1	30	9-05-02	NA	NS	NS	NS	NS	NS	NS
1	60	9-05-02	1250	ND	ND	[1 2 3]1.7	ND	ND	ND
0	10	9-05-02	NA	NS	NS	NS	NS	NS	NS
0	30	9-05-02	1305	ND	ND	[1 3]1.1	ND	ND	ND
0	60	9-05-02	1310	ND	ND	[1 3]1.9	ND	ND	ND
				April–May 2003					
	Surface water	4-29-03	M	NS	ND	NS	ND	ND	ND
10	10	4-29-03	1329	ND	ND	2.0	ND	ND	ND
10	30	4-29-03	1341	ND	ND	1.4	ND	ND	ND
10	60	4-29-03	1358	ND	ND	2.3	ND	ND	ND
10	60 REP	4-29-03	1401	ND	ND	2.2	ND	ND	ND
9	10	4-29-03	NA	NS	NS	NS	NS	NS	NS
9	30	4-29-03	1440	NS	NS	NS	NS	NS	NS
9	30 REP	4-29-03	1444	ND	ND	2.4	ND	ND	ND
9	60	4-29-03	1450	ND	ND	1.7	ND	ND	ND
8	10	4-29-03	1517	ND	ND	2.3	ND	ND	ND
8	30	4-29-03	1531	ND	ND	1.9	ND	ND	ND
8	30 REP	4-29-03	1534	ND	ND	ND	ND	ND	ND
8	60	4-29-03	1540	ND	ND	1.6	ND	ND	ND
7	10	4-29-03	1612	ND	ND	2.0	ND	ND	ND
7	10 REP	4-29-03	1618	ND	ND	2.5	ND	ND	ND
7	30	4-29-03	1628	ND	ND	2.1	ND	ND	ND
7	60	4-29-03	M	ND	ND	1.9	ND	ND	ND
	Trip blank	4-29-03	NA	ND	ND	2.2	ND	ND	ND
	Trip blank	4-30-03	NA	ND	ND	2.0	ND	ND	ND
6	10	4-30-03	1049	ND	ND	2.3	ND	ND	ND
6	10 REP	4-30-03	1050	ND	ND	3.0	ND	ND	ND
6	30	4-30-03	1057	ND	ND	2.1	ND	ND	ND
6	60	4-30-03	1110	ND	ND	ND	ND	ND	ND
5	10	4-30-03	NA	NS	NS	NS	NS	NS	NS
5	30	4-30-03	1144	ND	ND	2.6	ND	ND	ND
5	60	4-30-03	1153	ND	ND	1.6	ND	ND	ND
5	60 REP	4-30-03	1156	ND	ND	ND	ND	ND	ND
	Surface water	4-30-03	1300	NS	NS	NS	NS	NS	NS
4	Field blank	4-30-03	1315	ND	ND	1.9	ND	ND	ND
4	10	4-30-03	NA	NS	NS	NS	NS	NS	NS
4	30	4-30-03	NA	NS	NS	NS	NS	NS	NS
4	60	4-30-03	1353	ND	ND	2.1	ND	ND	ND

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	Butanone (MEK)	Chloro-methane	2-Pro-panone (acetone)	Carbon disulfide	MTBE	Tetrahy-drofuran
				April–May 2003—Continued					
3	10	4-30-03	1423	ND	ND	2.6	ND	ND	ND
3	30	4-30-03	1435	ND	ND	2.1	3.2	ND	ND
3	60	4-30-03	1447	ND	ND	1.4	ND	ND	ND
3	60 REP	4-30-03	1450	ND	ND	1.1	ND	ND	ND
2	10	4-30-03	NA	NS	NS	NS	NS	NS	NS
2	30	4-30-03	1514	ND	ND	ND	ND	ND	ND
2	30 REP	4-30-03	1517	ND	ND	ND	ND	ND	ND
2	60	4-30-03	1521	ND	ND	3.1	ND	ND	ND
1	10	4-30-03	NA	NS	NS	NS	NS	NS	NS
1	30	4-30-03	1548	ND	ND	1.4	1.4	ND	ND
1	30 REP	4-30-03	1551	1.0	ND	3.0	ND	ND	ND
1	60	4-30-03	1558	ND	ND	2.7	1.5	ND	ND
0	Trip blank	5-01-03	NA	ND	ND	3.0	ND	ND	ND
0	10	5-01-03	NA	NS	NS	NS	NS	NS	NS
0	30	5-01-03	1131	ND	ND	3.6	19	ND	ND
0	60	5-01-03	1139	ND	ND	1.7	4.4	ND	ND
0	60 REP	5-01-03	1142	ND	ND	3.0	4.5	ND	ND
				June 2003					
	Surface water	6-23-03	M	NS	NS	NS	NS	NS	NS
10	Trip blank	6-23-03	NA	ND	ND	ND	ND	ND	ND
10	10	6-23-03	1310	ND	ND	ND	ND	ND	ND
10	30	6-23-03	1330	ND	ND	ND	ND	ND	ND
10	60	6-23-03	1345	ND	ND	ND	ND	ND	ND
10	60 REP	6-23-03	1350	ND	ND	ND	ND	ND	ND
9	10	6-23-03	1407	ND	ND	ND	ND	ND	ND
9	30	6-23-03	1415	ND	ND	ND	ND	ND	ND
9	Field blank	6-23-03	1425	ND	ND	ND	ND	ND	ND
9	60	6-23-03	1435	ND	ND	ND	ND	ND	ND
8	10	6-23-03	1455	ND	ND	ND	ND	ND	ND
8	10 REP	6-23-03	1458	ND	ND	ND	ND	ND	ND
8	30	6-23-03	1507	ND	ND	ND	ND	1.1	ND
8	60	6-23-03	1515	ND	ND	ND	ND	1.1	ND
7	10	6-23-03	1527	ND	ND	ND	ND	1.2	ND
7	30	6-23-03	1527	ND	ND	ND	ND	1.3	ND
7	30 REP	6-23-03	1541	ND	ND	ND	ND	1.2	ND
7	60	6-23-03	1557	ND	ND	ND	ND	1.2	1.3
	Surface water	6-24-03	M	NS	NS	NS	NS	NS	NS

Table 4. Results of sampling pore water along transect A during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Reporting level was 1.0 microgram per liter for organic compounds, except for 2-propanone (2.0), butanone (4.0), and carbon disulfide (3.0). Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect A (meters)	Sample depth or description	Date	Time	Butanone (MEK)	Chloro-methane	2-Pro-panone (acetone)	Carbon disulfide	MTBE	Tetrahy-drofuran
June 2003—Continued									
6	10	6-24-03	1012	ND	ND	ND	ND	ND	ND
6	10 REP	6-24-03	1015	ND	ND	ND	ND	ND	ND
	Trip blank	6-24-03	NA	ND	ND	ND	ND	ND	ND
6	30	6-24-03	1032	ND	ND	ND	ND	ND	ND
6	60	6-24-03	1045	ND	ND	ND	ND	ND	ND
5	10	6-24-03	NA	NS	NS	NS	NS	NS	NS
5	Field blank	6-24-03	1112	ND	ND	ND	ND	ND	ND
5	30	6-24-03	1120	ND	ND	ND	ND	ND	ND
5	60	6-24-03	1130	ND	ND	ND	ND	ND	ND
4	10	6-24-03	1245	ND	ND	ND	ND	ND	ND
4	30	6-24-03	1255	ND	ND	ND	ND	ND	ND
4	60	6-24-03	1308	ND	ND	ND	ND	ND	ND
3	10	6-24-03	NA	NS	NS	NS	NS	NS	NS
3	30	6-24-03	1333	ND	ND	ND	ND	1.3	ND
3	30 REP	6-24-03	1336	ND	ND	ND	ND	1.4	ND
3	60	6-24-03	1342	ND	ND	ND	ND	1.3	ND
2	10	6-24-03	NA	NS	NS	NS	NS	NS	NS
2	30	6-24-03	1400	ND	ND	ND	ND	ND	ND
2	60	6-24-03	1412	ND	ND	ND	ND	ND	ND
1	10	6-24-03	1430	ND	ND	ND	ND	ND	ND
1	30	6-24-03	1450	ND	ND	ND	ND	ND	ND
1	Field blank	6-24-03	1500	ND	ND	ND	ND	ND	ND
1	60	6-24-03	1506	ND	ND	ND	ND	ND	ND
0	10	6-24-03	NA	NS	NS	NS	NS	NS	NS
0	30	6-24-03	1538	ND	ND	ND	ND	ND	ND
0	60	6-24-03	1525	ND	ND	ND	ND	ND	ND
0	60 REP	6-24-03	1528	ND	ND	ND	ND	ND	ND
10	PDB	6-26-03	NA	ND	ND	ND	ND	ND	ND
9	PDB	6-26-03	NA	ND	ND	ND	ND	ND	ND
8	PDB	6-26-03	NA	ND	ND	ND	ND	ND	ND
7	PDB	6-26-03	NA	ND	ND	ND	ND	ND	ND
6	PDB	6-26-03	NA	ND	ND	ND	ND	ND	ND

[1]Estimated value below calibration value.
[2]Estimated value.
[3]Analyte is associated with lab blank or trip blank contamination.

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.

[Diagram of transects is shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	Temperature (°C)	Specific conductance (µS/cm)	pH (standard unit)	Dissolved oxygen (mg/L)	Ferrous iron (mg/L)	Trichloroethene	1,1-Dichloroethene	1,1-Dichloroethane
					June 2002						
10	10	6-18-02	1305	19.7	668	4.73	1.93	1.1	12	ND	ND
10	10 REP	6-18-02	1312	20.47	662	4.77	2.22	.2	14	ND	ND
10	30	6-18-02	1321	14.11	663	4.69	.53	.3	12	ND	ND
10	30 REP	6-18-02	1326	14.52	664	4.62	.36	.9	10	ND	ND
10	60	6-18-02	1334	13.4	677	4.61	.86	.1	11	ND	ND
10	60 REP	6-18-02	1341	13.32	662	4.63	.45	.6	11	ND	ND
9	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
9	30	6-18-02	1401	13.97	652	4.68	.71	.7	11	ND	ND
9	60	6-18-02	1407	13.11	642	4.67	.74	2.3	11	ND	ND
	Trip Blank	6-19-02	NA	NS	NS	NS	NS	NS	ND	ND	ND
	Trip Blank	6-19-02	NA	NS	NS	NS	NS	NS	ND	ND	ND
8	10	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
8	30	6-19-02	1105	20.23	690	4.84	4.77	1.9	8.9	ND	ND
8	60	6-19-02	1120	13.22	651	4.84	1.32	2.3	11	ND	ND
7	10	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
7	30	6-19-02	1155	13.32	736	5.36	.8	9.1	5.2	ND	ND
7	30 REP	6-19-02	1205	13.3	722	5.38	.56	7.7	6.0	ND	ND
7	60	6-19-02	1215	12.64	723	5.39	.39	NS	7.2	ND	ND
7	60 REP	6-19-02	1225	12.52	715	5.16	.37	NS	8.2	ND	ND
6	Surface Water	6-19-02	1230	19.41	408	6.34	8.5	NS	NS	NS	NS
6	10	6-19-02	1250	21.07	670	6.06	5.11	NS	1.3	ND	ND
6	30	6-19-02	1320	21.27	737	5.79	2.08	NS	1.5	ND	ND
6	60	6-19-02	1325	12.84	735	5.6	.4	NS	3.5	ND	ND
5	10	6-19-02	1350	16.94	619	6.53	.24	NS	ND	ND	[1]0.86
5	10 REP	6-19-02	1355	17.53	589	6.61	.3	NS	ND	ND	ND
5	30	6-19-02	1405	21.12	598	6.21	2.85	NS	ND	ND	ND
5	30 REP	6-19-02	1415	19.28	603	6.27	.7	NS	1.4	ND	ND
5	60	6-19-02	1425	13.6	660	5.99	.1	NS	ND	ND	ND
5	60 REP	6-19-02	1430	13.92	670	5.97	.23	NS	ND	ND	ND
4	10	6-19-02	1450	17.02	657	6.84	.14	NS	ND	ND	ND
4	30	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
4	60	6-19-02	1500	14.29	579	6.03	.24	NS	ND	ND	ND
3	10	6-19-02	1510	15.87	564	6.55	.38	NS	ND	ND	ND
3	30	6-19-02	1520	18.76	518	6.24	1.33	NS	2.7	ND	ND
3	60	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	10	6-19-02	1550	15.78	583	6.58	.56	NS	6.7	ND	[1].45
2	30	6-19-02	1600	14.34	500	5.9	.17	NS	24	ND	ND
2	60	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	10	6-19-02	1620	14.9	532	5.64	.16	NS	16	ND	ND
1	30	6-19-02	1625	13.2	492	5.14	.12	NS	33	ND	ND
1	60	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS	NS

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03. —Continued

[Diagram of transects is shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	Temperature (°C)	Specific conductance (µS/cm)	pH (standard unit)	Dissolved oxygen (mg/L)	Ferrous iron (mg/L)	Trichloroethene	1,1-Dichloroethene	1,1-Dichloroethane
June 2002—Continued											
0	10	6-19-02	1630	15.65	647	5.58	0.2	NS	8.9	ND	ND
0	30	6-19-02	1635	13.22	528	5.18	.13	NS	40	ND	ND
0	60	6-19-02	1640	13.1	450	4.78	.27	NS	30	ND	ND
	Trip Blank	6-19-02	NA	NS	NS	NS	NS	NS	ND	ND	ND
September 2002											
10	10	9-06-02	1105	19.56	771	4.56	0.33	NS	13	ND	ND
10	30	9-06-02	1110	18.81	812	4.42	.15	NS	4.2	ND	ND
10	30 REP	9-06-02	1112	18.83	811	4.45	.2	NS	3.7	ND	ND
10	60	9-06-02	1114	18.19	813	4.41	.21	NS	3	ND	ND
10	60 REP	9-06-02	1115	18.65	804	4.45	.22	NS	3.6	ND	ND
9	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
9	30	9-06-02	1117	18.69	791	4.51	.16	NS	3.6	ND	ND
9	60	9-06-02	1125	18.65	829	4.44	.18	NS	2.8	ND	ND
8	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
8	30	9-06-02	1140	18.97	807	4.69	.59	NS	3.4	ND	ND
8	30 REP	9-06-02	1142	18.42	814	4.8	.14	NS	3.5	ND	ND
8	60	9-06-02	1145	18.07	813	4.54	.17	NS	2.5	ND	ND
8	60 REP	9-06-02	1147	17.95	836	4.69	.19	NS	12	ND	ND
7	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
7	30	9-06-02	1155	18.45	931	5.35	.16	NS	3.2	ND	ND
7	60	9-06-02	1200	17.77	932	5.02	.28	NS	7.8	ND	ND
6	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
6	30	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
6	60	9-06-02	1320	18.94	931	5.54	.24	NS	1.6	ND	ND
6	60 REP	9-06-02	1325	18.42	906	5.5	.23	NS	2.3	ND	ND
5	10	9-06-02	1330	19.13	817	6.33	.18	NS	ND	ND	1.9
5	30	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
5	60	9-06-02	1345	18.67	729	5.98	.17	NS	[1].7	ND	ND
4	10	9-06-02	1355	19.3	789	6.41	.14	NS	ND	0.55	ND
4	10 REP	9-06-02	1400	19.32	764	6.43	.11	NS	ND	[1].62	ND
4	30	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
4	60	9-06-02	1420	18.09	694	5.78	.15	NS	[1].52	ND	ND
4	60 REP	9-06-02	1430	18.15	696	5.84	.14	NS	ND	ND	ND
	Trip Blank	9-06-02	NA	NS	NS	NS	NS	NS	ND	ND	ND
3	10	9-09-02	1030	20.51	749	6.24	.38	NS	ND	1.1	ND
3	30	9-09-02	1040	25.52	643	6.09	2.91	NS	[1].55	[1].77	ND
3	60	9-09-02	NA	NS	NS	NS	NS	NS	NS	NS	NS

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03. —Continued

[Diagram of transects is shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	Temperature (°C)	Specific conductance (µS/cm)	pH (standard unit)	Dissolved oxygen (mg/L)	Ferrous iron (mg/L)	Trichloroethene	1,1-Dichloroethene	1,1-Dichloroethane
September 2002—Continued											
2	10	9-09-02	1050	19.33	628	5.89	0.44	NS	13	ND	ND
2	10 REP	9-09-02	1055	19.03	662	5.79	.55	NS	20	ND	ND
2	30	9-09-02	1100	18.35	556	5.49	.19	NS	26	ND	ND
2	30 REP	9-09-02	1102	18.16	551	5.41	.21	NS	28	ND	ND
2	60	9-09-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	10	9-09-02	1125	20.83	778	5.13	2.89	NS	8.7	ND	ND
1	30	9-09-02	1130	17.86	538	4.79	.26	NS	26	ND	ND
1	60	9-09-02	NA	NS	NS	NS	NS	NS	NS	NS	NS
0	10	9-09-02	1140	21.07	820	5.92	3.22	NS	1.3	ND	ND
0	10 REP	9-09-02	1143	19.5	633	5.57	.31	NS	7.1	ND	ND
0	30	9-09-02	1147	17.21	550	4.82	.18	NS	22	ND	ND
0	30 REP	9-09-02	1150	17.35	556	4.91	.13	NS	23	ND	ND
0	60	9-09-02	1200	19.82	545	4.6	1.23	NS	11	ND	ND
0	60 REP	9-09-02	1205	20.34	533	4.6	.54	NS	5.1	ND	ND
	Trip Blank	9-09-02	NA	NS	NS	NS	NS	NS	ND	ND	ND
April–May 2003											
10	10	5-01-03	1301	13.61	889	4.8	0.05	0.6	21	ND	ND
10	10 REP	5-01-03	1304	NS	NS	NS	NS	NS	21	ND	ND
10	30	5-01-03	1313	12.22	885	4.61	.01	.2	14	ND	ND
10	60	5-01-03	1320	11.81	896	4.6	.05	.3	14	ND	ND
9	10	5-01-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
9	30	5-01-03	1340	12.56	858	4.63	.12	1.3	14	ND	ND
9	Field Blank	5-01-03	1353	NS	NS	NS	NS	NS	ND	ND	ND
9	60	5-01-03	1358	12.27	869	4.67	.09	1.6	12	ND	ND
8	10	5-01-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
8	30	5-01-03	1419	11.98	871	4.93	.27	.27	13	ND	ND
8	30 REP	5-01-03	1422	NS	NS	NS	NS	NS	12	ND	ND
8	60	5-01-03	1432	11.41	875	4.88	.02	3	11	ND	ND
7	10	5-01-03	1457	13.46	858	5.63	.11	11.2	15	ND	ND
7	10 REP	5-01-03	1500	NS	NS	NS	NS	NS	13	ND	ND
7	30	5-01-03	1509	13.25	927	5.65	.12	12.1	5.9	ND	ND
7	60	5-01-03	1515	11.33	901	5.37	.02	NS	9.4	ND	ND
6	10	5-01-03	1536	13.8	919	5.97	.08	OR	2	ND	ND
6	30	5-01-03	1551	13.38	906	5.78	.08	11.5	3.4	ND	ND
6	60	5-01-03	1554	11.2	926	5.73	.0	13.9	6.2	ND	ND
6	60 REP	5-01-03	1557	NS	NS	NS	NS	NS	6.6	ND	ND
	Trip Blank	5-02-03	NA	NS	NS	NS	NS	NS	ND	NS	ND
5	10	5-02-03	1103	14.29	816	6.19	.01	OR	ND	ND	ND
5	10 REP	5-02-03	1104	NS	NS	NS	NS	NS	[1].52	ND	[1]0.73
5	30	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
5	60	5-02-03	1120	14.42	878	5.91	.08	OR	1.9	ND	ND

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03. —Continued

[Diagram of transects is shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	Temperature (°C)	Specific conductance (µS/cm)	pH (standard unit)	Dissolved oxygen (mg/L)	Ferrous iron (mg/L)	Trichloroethene	1,1-Dichloroethene	1,1-Dichloroethane
April–May 2003—Continued											
4	10	5-02-03	1134	14.26	818	6.52	0.03	OR	ND	ND	ND
4	30	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
4	60	5-02-03	1157	13.2	820	5.8	.08	12.1	1.9	ND	ND
4	60 REP	5-02-03	1200	NS	NS	NS	NS	NS	1.8	ND	ND
3	10	5-02-03	1258	19.45	803	6.38	.95	OR	1.4	ND	0.58
3	30	5-02-03	1309	19.25	684	6.18	.23	OR	1.2	ND	.51
3	60	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
2	10	5-02-03	1330	13.67	636	6.14	.06	NS	19	ND	.82
2	30	5-02-03	1340	12.08	630	5.48	.08	4.0	51	ND	.73
2	30 REP	5-02-03	1343	NS	NS	NS	NS	NS	52	ND	[1].72
2	60	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
1	10	5-02-03	1354	14.85	610	5.9	.09	13.5	8.3	ND	[1].59
1	30	5-02-03	1401	11.53	634	5.06	.08	2.4	36	ND	ND
1	Field Blank	5-02-03	1420	NS	NS	NS	NS	NS	ND	ND	ND
1	60	5-02-03	1429	15.07	645	4.7	.14	.3	26	ND	ND
0	10	5-02-03	1444	17.55	691	5.73	.13	4.9	18	ND	ND
0	30	5-02-03	1451	11.13	631	4.92	.08	2.3	46	ND	ND
0	30 REP	5-02-03	1453	NS	NS	NS	NS	NS	45	ND	ND
0	60	5-02-03	1512	17.48	591	4.97	.59	1.3	32	ND	ND
	Trip Blank	5-05-03	NA	NS	NS	NS	NS	NS	ND	ND	ND
June 2003											
	Surface Water	6-25-03	M	21	328	6.5	7.4	NS	NS	NS	NS
0	10	6-25-03	1015	18.4	784	5.7	.7	NS	12	ND	ND
0	30	6-25-03	1025	16.7	884	5.0	1.1	NS	42	ND	ND
0	30 REP	6-25-03	1028	NS	NS	NS	NS	NS	41	ND	ND
	Trip Blank	6-25-03	NA	NS	NS	NS	NS	NS	ND	ND	ND
0	60	6-25-03	1045	24.5	840	4.8	1.0	NS	13	ND	ND
1	10	6-25-03	1105	23.9	858	5.5	.9	NS	12	ND	ND
1	30	6-25-03	1115	16.2	849	5.6	.6	NS	22	ND	ND
1	60	6-25-03	1123	20.5	811	4.8	.6	NS	26	ND	ND
2	10	6-25-03	1240	21.9	886	6.4	.5	NS	9.5	ND	ND
2	10 REP	6-25-03	1243	NS	NS	NS	NS	NS	8.4	ND	ND
2	30	6-25-03	1255	16	828	5.6	.5	9.3	30	ND	ND
2	Field Blank	6-25-03	1303	NS	NS	NS	NS	NS	ND	ND	ND
2	60	6-25-03	1312	15.3	841	5.4	.6	5.0	57	ND	ND
3	10	6-25-03	1325	17.5	917	6.4	.5	OR	3.3	ND	ND
3	30	6-25-03	1335	25.4	853	6.2	.5	OR	6.1	ND	ND
3	60	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS	NS

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03. —Continued

[Diagram of transects is shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	Temperature (°C)	Specific conductance (µS/cm)	pH (standard unit)	Dissolved oxygen (mg/L)	Ferrous iron (mg/L)	Trichloroethene	1,1-Dichloroethene	1,1-Dichloroethane
June 2003—Continued											
4	10	6-25-03	1400	19.2	918	6.5	0.5	OR	ND	ND	ND
4	30	6-25-03	1420	25.3	871	6.1	.3	OR	3.1	ND	ND
4	60	6-25-03	1439	14.3	898	5.7	.7	OR	1.4	ND	ND
4	60 REP	6-25-03	1442	NS	NS	NS	NS	NS	1.3	ND	ND
5	10	6-25-03	1452	20.5	814	6.5	.4	OR	ND	ND	1.4
5	30	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
5	60	6-25-03	1523	15.5	982	5.8	.8	NS	1.8	ND	ND
6	10	6-25-03	1540	20.8	1008	6.0	.5	OR	2.3	ND	ND
6	30	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
6	Field Blank	6-25-03	1550	NS	NS	NS	NS	NS	ND	ND	ND
6	60	6-25-03	1557	23.6	971	6.0	.8	OR	ND	ND	ND
7	10	6-26-03	1035	21.1	1,006	5.6	.7	11.2	8.9	ND	ND
7	30	6-26-03	1045	20.9	1,037	5.7	.9	14	5.1	ND	ND
7	30 REP	6-26-03	1048	NS	NS	NS	NS	NS	ND	ND	ND
7	Field Blank	6-26-03	1055	NS	NS	NS	NS	NS	ND	ND	ND
7	60	6-26-03	1100	15.2	1,014	5.3	.6	6.8	9.6	ND	ND
	Trip Blank	6-26-03	1108	NS	NS	NS	NS	NS	ND	ND	ND
8	10	6-26-03	NA	NS	NS	NS	NS	NS	NS	NS	NS
8	30	6-26-03	1120	16	1,042	5.2	.8	4.7	11	ND	ND
8	60	6-26-03	1130	14	1,038	4.7	.7	2.8	11	ND	ND
9	10	6-26-03	1140	24.4	1,077	4.7	.5	2.7	8.3	ND	ND
9	30	6-26-03	1150	20	1,073	4.7	.5	2.2	9.3	ND	ND
9	60	6-26-03	1155	14.5	1,036	4.5	.8	2.9	11	ND	ND
9	60 REP	6-26-03	1205	NS	NS	NS	NS	NS	8.0	ND	ND
10	10	6-26-03	1315	18.8	1,046	4.5	.6	.5	12	ND	ND
10	30	6-26-03	1320	16.8	1,049	4.4	.7	NS	13	ND	ND
10	60	6-26-03	1330	14.4	1,035	4.5	.7	NS	83	ND	ND
10	Field Blank	6-26-03	1340	NS	NS	NS	NS	NS	ND	ND	ND
10	PDB	6-26-03	NA	NS	NS	NS	NS	NS	12	ND	ND
9	PDB	6-26-03	NA	NS	NS	NS	NS	NS	12	ND	ND
8	PDB	6-26-03	NA	NS	NS	NS	NS	NS	16	ND	ND
7	PDB	6-26-03	NA	NS	NS	NS	NS	NS	15	ND	ND
7	PDB	6-26-03	NA	NS	NS	NS	NS	NS	10	ND	ND
6	PDB	6-26-03	NA	NS	NS	NS	NS	NS	2.3	ND	ND

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	*cis*-1,2-Di-chloro-ethene	*trans*-1,2-Di-chloro-ethene	Vinyl chloride	Chloro-ethane	1,2,3-Tri-chloro-benzene	1,2,4-Tri-chloro-benzene	1,2 Di-chloro-benzene
					June 2002					
10	10	6-18-02	1305	22	ND	ND	ND	3.5	22	83
10	10 REP	6-18-02	1312	25	ND	ND	ND	4.5	24	93
10	30	6-18-02	1321	24	ND	ND	ND	5.8	35	110
10	30 REP	6-18-02	1326	23	ND	ND	ND	5.7	38	100
10	60	6-18-02	1334	20	ND	ND	ND	4.7	29	84
10	60 REP	6-18-02	1341	21	ND	ND	ND	5.6	35	110
9	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS
9	30	6-18-02	1401	25	ND	ND	ND	5.7	41	93
9	60	6-18-02	1407	24	ND	ND	ND	4.7	37	110
	Trip Blank	6-19-02	NA	ND	ND	ND	ND	ND	ND	ND
	Trip Blank	6-19-02	NA	ND	ND	ND	ND	ND	ND	ND
8	10	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
8	30	6-19-02	1105	20	ND	ND	ND	3.5	25	70
8	60	6-19-02	1120	21	ND	ND	ND	5.0	34	97
7	10	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
7	30	6-19-02	1155	36	ND	ND	ND	5.3	37	80
7	30 REP	6-19-02	1205	33	ND	ND	ND	5.7	38	99
7	60	6-19-02	1215	31	ND	ND	ND	5.2	33	92
7	60 REP	6-19-02	1225	29	ND	ND	ND	4.6	32	91
6	Surface Water	6-19-02	1230	NS	NS	NS	NS	NS	NS	NS
6	10	6-19-02	1250	23	ND	12	ND	ND	2.2	20
6	30	6-19-02	1320	32	ND	ND	ND	[1].93	6.7	32
6	60	6-19-02	1325	36	ND	[1].57	ND	3.8	29	83
5	10	6-19-02	1350	14	ND	40	ND	ND	[1].87	16
5	10 REP	6-19-02	1355	9.4	ND	28	ND	ND	ND	8.8
5	30	6-19-02	1405	65	ND	4.4	ND	ND	2.6	26
5	30 REP	6-19-02	1415	89	ND	ND	ND	1.4	5.6	66
5	60	6-19-02	1425	33	ND	ND	ND	[1]1.6	13	71
5	60 REP	6-19-02	1430	33	ND	ND	ND	[1]1.7	12	74
4	10	6-19-02	1450	[1]1.9	ND	3.7	ND	ND	ND	7.2
4	30	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
4	60	6-19-02	1500	41	ND	ND	ND	2.2	20	81
3	10	6-19-02	1510	31	ND	24	ND	ND	ND	16
3	30	6-19-02	1520	42	ND	19	ND	1.4	ND	22
3	60	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
2	10	6-19-02	1550	67	1.6	9.8	ND	ND	ND	12
2	30	6-19-02	1600	46	ND	3.1	ND	ND	ND	15
2	60	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
1	10	6-19-02	1620	33	ND	2.1	ND	ND	ND	13
1	30	6-19-02	1625	18	ND	ND	ND	ND	ND	24
1	60	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	*cis*-1,2-Di-chloro-ethene	*trans*-1,2-Di-chloro-ethene	Vinyl chloride	Chloro-ethane	1,2,3-Tri-chloro-benzene	1,2,4-Tri-chloro-benzene	1,2 Di-chloro-benzene
June 2002—Continued										
0	10	6-19-02	1630	39	ND	7.4	ND	ND	ND	16
0	30	6-19-02	1635	22	ND	ND	ND	1.3	1.4	28
0	60	6-19-02	1640	18	ND	ND	ND	1.6	5.0	36
	Trip Blank	6-19-02	NA	ND	ND	ND	ND	ND	ND	ND
September 2002										
10	10	9-06-02	1105	13	ND	ND	ND	2.3	12	50
10	30	9-06-02	1110	7.7	ND	ND	ND	2.4	15	45
10	30 REP	9-06-02	1112	7.2	ND	ND	ND	2.3	14	42
10	60	9-06-02	1114	5.7	ND	ND	ND	1.8	11	33
10	60 REP	9-06-02	1115	6.7	ND	ND	ND	1.9	12	36
9	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
9	30	9-06-02	1117	7.6	ND	ND	ND	2.1	13	41
9	60	9-06-02	1125	6.2	ND	ND	ND	1.8	10	36
8	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
8	30	9-06-02	1140	8.7	ND	ND	ND	1.6	9.4	31
8	30 REP	9-06-02	1142	10	ND	ND	ND	2.0	13	37
8	60	9-06-02	1145	7.1	ND	ND	ND	1.9	11	35
8	60 REP	9-06-02	1147	35	ND	[1 3]0.88	ND	5.6	44	100
7	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
7	30	9-06-02	1155	71	ND	[1 3]1	ND	6.1	42	120
7	60	9-06-02	1200	32	ND	ND	ND	6.4	39	96
6	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
6	30	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
6	60	9-06-02	1320	41	ND	ND	ND	5.1	32	100
6	60 REP	9-06-02	1325	41	ND	ND	ND	5.5	35	110
5	10	9-06-02	1330	13	ND	52	ND	ND	1.0	21
5	30	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
5	60	9-06-02	1345	48	[1]0.72	1.6	ND	3.6	20	110
4	10	9-06-02	1355	2.7	ND	5.5	ND	.64	ND	12
4	10 REP	9-06-02	1400	5.4	ND	10	ND	ND	[1].62	19
4	30	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
4	60	9-06-02	1420	55	[1].58	[3]1.1	ND	2.4	23	99
4	60 REP	9-06-02	1430	58	[1].56	[3]1.2	ND	2.2	22	98
	Trip Blank	9-06-02	NA	ND	ND	ND	ND	ND	ND	ND
3	10	9-09-02	1030	41	1.1	[3]80	ND	ND	[1].62	22
3	30	9-09-02	1040	22	ND	[3]47	ND	ND	ND	4.6
3	60	9-09-02	NA	NS	NS	NS	NS	NS	NS	NS

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	*cis*-1,2-Di-chloro-ethene	*trans*-1,2-Di-chloro-ethene	Vinyl chloride	Chloro-ethane	1,2,3-Tri-chloro-benzene	1,2,4-Tri-chloro-benzene	1,2 Di-chloro-benzene
September 2002—Continued										
2	10	9-09-02	1050	150	ND	[3]24	ND	ND	ND	22
2	10 REP	9-09-02	1055	72	ND	[3]7.8	ND	ND	[1]1.7	21
2	30	9-09-02	1100	31	ND	ND	ND	ND	ND	26
2	30 REP	9-09-02	1102	28	ND	ND	ND	ND	ND	32
2	60	9-09-02	NA	NS	NS	NS	NS	NS	NS	NS
1	10	9-09-02	1125	23	ND	ND	ND	ND	ND	13
1	30	9-09-02	1130	14	ND	ND	ND	ND	2.1	38
1	60	9-09-02	NA	NS	NS	NS	NS	NS	NS	NS
0	10	9-09-02	1140	2.7	ND	2.0	ND	ND	ND	3.4
0	10 REP	9-09-02	1143	22	ND	2.6	ND	ND	[1].67	7.8
0	30	9-09-02	1147	13	ND	ND	ND	ND	ND	23
0	30 REP	9-09-02	1150	14	ND	ND	ND	ND	ND	20
0	60	9-09-02	1200	8.4	ND	ND	ND	[1]1.8	5.4	20
0	60 REP	9-09-02	1205	5.1	ND	ND	ND	ND	4.5	11
	Trip Blank	9-09-02	NA	ND	ND	ND	ND	ND	ND	ND
April–May 2003										
10	10	5-01-03	1301	60	ND	[3]1.2	ND	3.3	20	87
10	10 REP	5-01-03	1304	59	ND	[3]1.2	ND	3.3	20	87
10	30	5-01-03	1313	70	ND	1.2	ND	3.7	27	100
10	60	5-01-03	1320	68	ND	1.2	ND	3.1	24	93
9	10	5-01-03	NA	NS	NS	NS	NS	NS	NS	NS
9	30	5-01-03	1340	74	ND	1.5	ND	3.9	30	96
9	Field Blank	5-01-03	1353	ND	ND	ND	ND	ND	ND	ND
9	60	5-01-03	1358	91	ND	1.9	ND	3.4	26	86
8	10	5-01-03	NA	NS	NS	NS	NS	NS	NS	NS
8	30	5-01-03	1419	71	ND	1.4	ND	3.3	23	96
8	30 REP	5-01-03	1422	92	ND	2.0	ND	3.4	27	93
8	60	5-01-03	1432	87	ND	1.7	1.4	3.4	27	97
7	10	5-01-03	1457	100	ND	13	ND	ND	11	96
7	10 REP	5-01-03	1500	84	ND	9.3	ND	ND	13	99
7	30	5-01-03	1509	72	ND	1.3	ND	3.6	30	94
7	60	5-01-03	1515	84	ND	1.6	ND	4.1	37	110
6	10	5-01-03	1536	48	ND	19	ND	ND	20	78
6	30	5-01-03	1551	73	ND	2.2	ND	3.6	33	89
6	60	5-01-03	1554	76	ND	1.3	ND	3.2	29	92
6	60 REP	5-01-03	1557	81	ND	1.5	ND	3.1	29	110
	Trip Blank	5-02-03	NA	ND	ND	ND	ND	ND	ND	ND
5	10	5-02-03	1103	14	ND	30	ND	ND	1.3	18
5	10 REP	5-02-03	1104	12	ND	25	ND	[1].52	1.8	19
5	30	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS
5	60	5-02-03	1120	48	ND	.97	ND	2.0	20	88

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	*cis*-1,2-Di-chloro-ethene	*trans*-1,2-Di-chloro-ethene	Vinyl chloride	Chloro-ethane	1,2,3-Tri-chloro-benzene	1,2,4-Tri-chloro-benzene	1,2 Di-chloro-benzene
April–May 2003—Continued										
4	10	5-02-03	1134	7.4	ND	10	0.55	ND	0.7	8.5
4	30	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS
4	60	5-02-03	1157	47	ND	1.1	.84	2.6	20	74
4	60 REP	5-02-03	1200	45	ND	[1].98	.85	2.5	19	76
3	10	5-02-03	1258	28	[1]0.65	13	ND	ND	1.2	12
3	30	5-02-03	1309	16	ND	20	ND	ND	.94	7.4
3	60	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS
2	10	5-02-03	1330	51	[1].64	5.3	ND	ND	ND	21
2	30	5-02-03	1340	31	ND	1.6	ND	.95	1.2	37
2	30 REP	5-02-03	1343	32	ND	1.5	ND	[1].87	1.2	37
2	60	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS
1	10	5-02-03	1354	32	[1].5	3.9	ND	ND	ND	17
1	30	5-02-03	1401	21	ND	.74	ND	1.0	2.0	43
1	Field Blank	5-02-03	1420	ND	ND	ND	ND	ND	ND	[1].52
1	60	5-02-03	1429	13	ND	ND	ND	1.8	6.0	39
0	10	5-02-03	1444	24	ND	4.5	ND	ND	1.0	16
0	30	5-02-03	1451	15	ND	ND	ND	.71	[1].98	28
0	30 REP	5-02-03	1453	15	ND	ND	ND	[1].81	1.0	29
0	60	5-02-03	1512	13	ND	ND	ND	[1].57	1.1	15
	Trip Blank	5-05-03	1120	ND	ND	ND	ND	ND	ND	ND
June 2003										
	Surface Water	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS
0	10	6-25-03	1015	28	ND	2.7	ND	ND	ND	13
0	30	6-25-03	1025	16	ND	ND	ND	ND	ND	22
0	30 REP	6-25-03	1028	16	ND	ND	ND	ND	ND	23
	Trip Blank	6-25-03	1040	ND	ND	ND	ND	ND	ND	ND
0	60	6-25-03	1045	8.2	ND	ND	ND	ND	ND	8.8
1	10	6-25-03	1105	28	ND	1.3	ND	ND	ND	6.6
1	30	6-25-03	1115	20	ND	4.4	ND	ND	ND	31
1	60	6-25-03	1123	11	ND	ND	ND	ND	1.1	21
2	10	6-25-03	1240	49	ND	6.6	ND	ND	ND	10
2	10 REP	6-25-03	1433	43	ND	5.8	ND	ND	ND	9.3
2	30	6-25-03	1255	45	ND	3.0	ND	ND	ND	20
2	Field Blank	6-25-03	1303	ND	ND	ND	ND	ND	ND	ND
2	60	6-25-03	1312	37	ND	1.4	ND	ND	1.0	44
3	10	6-25-03	1325	54	ND	25	ND	ND	ND	18
3	30	6-25-03	1335	22	ND	14	ND	ND	ND	6.3
3	60	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	*cis*-1,2-Di-chloro-ethene	*trans*-1,2-Di-chloro-ethene	Vinyl chloride	Chloro-ethane	1,2,3-Tri-chloro-benzene	1,2,4-Tri-chloro-benzene	1,2 Di-chloro-benzene
June 2003—Continued										
4	10	6-25-03	1400	12	ND	18	ND	ND	ND	16
4	30	6-25-03	1420	72	ND	2.8	ND	ND	1.6	28
4	60	6-25-03	1439	58	ND	2.0	ND	2.8	23	79
4	60 REP	6-25-03	1442	56	ND	1.7	ND	2.8	23	81
5	10	6-25-03	1452	11	ND	39	ND	ND	ND	9.4
5	30	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS
5	60	6-25-03	1523	52	ND	2.0	ND	1.8	21	80
6	10	6-25-03	1540	48	ND	23	ND	ND	4.2	3.8
6	30	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS
6	Field Blank	6-25-03	1550	ND	ND	ND	ND	ND	ND	ND
6	60	6-25-03	1557	40	ND	ND	ND	ND	10	52
7	10	6-26-03	1035	85	ND	12	ND	ND	12	98
7	30	6-26-03	1045	43	ND	ND	ND	ND	16	53
7	30 REP	6-26-03	1048	48	ND	ND	ND	ND	16	55
7	Field Blank	6-26-03	1055	ND	ND	ND	ND	ND	ND	ND
7	60	6-26-03	1100	58	ND	ND	ND	ND	27	93
	Trip Blank	6-26-03	1108	ND	ND	ND	ND	ND	ND	ND
8	10	6-26-03	NA	NS	NS	NS	NS	NS	NS	NS
8	30	6-26-03	1120	49	ND	ND	ND	ND	27	81
8	60	6-26-03	1130	50	ND	ND	ND	ND	28	90
9	10	6-26-03	1140	38	ND	ND	ND	ND	13	56
9	30	6-26-03	1150	47	ND	ND	ND	ND	26	82
9	60	6-26-03	1155	46	ND	ND	ND	ND	24	90
9	60 REP	6-26-03	1205	ND	ND	34	ND	ND	19	69
10	10	6-26-03	1315	53	ND	ND	ND	ND	29	96
10	30	6-26-03	1320	52	ND	ND	ND	ND	25	90
10	60	6-26-03	1330	290	ND	ND	ND	18	150	490
10	Field Blank	6-26-03	1340	ND	ND	ND	ND	ND	ND	1.2
10	PDB	6-26-03	NA	55	ND	ND	ND	4.6	38	110
9	PDB	6-26-03	NA	60	ND	ND	ND	4.6	47	98
8	PDB	6-26-03	NA	61	ND	ND	ND	3.8	42	86
7	PDB	6-26-03	NA	85	ND	ND	ND	4.4	31	93
7	PDB	6-26-03	NA	37	ND	ND	ND	4.2	34	110
6	PDB	6-26-03	NA	43	ND	ND	ND	3.3	40	91

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Diagram of transects shown in figure 5. Transect location is shown on figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	1,3-Di-chloro-benzene	1,4-Di-chloro-benzene	Chloro-benzene	Benzene	Toluene	Naphthalene	Bromo-methane
					June 2002					
10	10	6-18-02	1305	2.2	15	14	ND	ND	ND	ND
10	10 REP	6-18-02	1312	2.4	20	17	ND	ND	ND	ND
10	30	6-18-02	1321	2.9	24	14	ND	ND	ND	ND
10	30 REP	6-18-02	1326	3.4	25	16	ND	ND	ND	ND
10	60	6-18-02	1334	2.9	18	13	ND	ND	ND	ND
10	60 REP	6-18-02	1341	3.4	23	15	ND	ND	ND	ND
9	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS
9	30	6-18-02	1401	4.2	24	17	ND	ND	ND	ND
9	60	6-18-02	1407	3.8	26	15	ND	ND	ND	ND
	Trip Blank	6-19-02	NA	ND	ND	ND	ND	ND	ND	ND
	Trip Blank	6-19-02	NA	ND	ND	ND	ND	ND	ND	ND
8	10	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
8	30	6-19-02	1105	2.3	14	11	ND	ND	ND	ND
8	60	6-19-02	1120	3.2	20	14	ND	ND	ND	ND
7	10	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
7	30	6-19-02	1155	3.8	22	17	ND	ND	ND	ND
7	30 REP	6-19-02	1205	3.7	22	17	ND	ND	ND	ND
7	60	6-19-02	1215	3.5	20	15	ND	ND	ND	ND
7	60 REP	6-19-02	1225	3.3	19	14	ND	ND	ND	ND
6	Surface Water	6-19-02	1230	NS	NS	NS	NS	NS	NS	NS
6	10	6-19-02	1250	.92	4.2	14	ND	ND	ND	ND
6	30	6-19-02	1320	1.0	5.9	8.8	ND	ND	ND	ND
6	60	6-19-02	1325	3.5	18	ND	ND	ND	ND	ND
5	10	6-19-02	1350	[1].43	1.6	18	ND	ND	ND	ND
5	10 REP	6-19-02	1355	ND	ND	13	ND	ND	ND	ND
5	30	6-19-02	1405	1.0	4.2	18	ND	ND	ND	ND
5	30 REP	6-19-02	1415	1.9	8.4	42	ND	ND	ND	ND
5	60	6-19-02	1425	3.0	13	ND	ND	ND	ND	[1 2]1.9
5	60 REP	6-19-02	1430	2.8	13	ND	ND	ND	ND	[1 2]1.8
4	10	6-19-02	1450	ND	ND	ND	ND	ND	ND	[2]2.1
4	30	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
4	60	6-19-02	1500	4.9	16	19	ND	ND	ND	ND
3	10	6-19-02	1510	ND	[1]1.0	ND	ND	ND	ND	[1 2]1.9
3	30	6-19-02	1520	ND	2.2	38	1.0	ND	ND	ND
3	60	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
2	10	6-19-02	1550	ND	ND	29	1.4	ND	ND	ND
2	30	6-19-02	1600	ND	ND	ND	ND	ND	ND	[1 2]1.3
2	60	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
1	10	6-19-02	1620	ND	ND	ND	ND	ND	ND	[1 2]1.2
1	30	6-19-02	1625	ND	[1 2]1.3	ND	ND	ND	ND	[1 2]1.6
1	60	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Diagram of transects shown in figure 5. Transect location is shown on figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	1,3-Di-chloro-benzene	1,4-Di-chloro-benzene	Chloro-benzene	Benzene	Toluene	Naphthalene	Bromo-methane
					June 2002—Continued					
0	10	6-19-02	1630	ND	1.0	38	ND	ND	ND	ND
0	30	6-19-02	1635	ND	1.9	34	ND	ND	ND	ND
0	60	6-19-02	1640	ND	3.9	26	ND	ND	ND	ND
	Trip Blank	6-19-02	NA	ND	ND	ND	ND	ND	ND	[1,2]0.57
					September 2002					
10	10	9-06-02	1105	1.3	9.9	21	ND	ND	ND	1.1
10	30	9-06-02	1110	1.2	9.3	7.7	ND	ND	ND	[2]2.6
10	30 REP	9-06-02	1112	1.2	8.3	7.1	ND	ND	ND	[2]2.6
10	60	9-06-02	1114	[1].92	6.5	5.3	ND	ND	ND	[2]3.4
10	60 REP	9-06-02	1115	[1].97	7.4	7.1	ND	ND	ND	3.6
9	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
9	30	9-06-02	1117	1.1	8.3	7.8	ND	ND	ND	[2]3.6
9	60	9-06-02	1125	[1].95	7.2	6.1	ND	ND	ND	[2]4.5
8	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
8	30	9-06-02	1140	[1].83	6.1	7.6	ND	ND	ND	[2]4.1
8	30 REP	9-06-02	1142	1	7.7	8.5	ND	ND	ND	3.8
8	60	9-06-02	1145	[1].94	6.8	6.2	ND	ND	ND	[2]4.0
8	60 REP	9-06-02	1147	4.2	28	ND	ND	ND	ND	ND
7	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
7	30	9-06-02	1155	5.1	30	ND	ND	ND	ND	ND
7	60	9-06-02	1200	3.8	23	18	ND	ND	ND	ND
6	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
6	30	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
6	60	9-06-02	1320	4.1	22	20	ND	ND	ND	ND
6	60 REP	9-06-02	1325	4.1	22	20.4	ND	ND	ND	ND
5	10	9-06-02	1330	ND	2.3	37	ND	ND	ND	ND
5	30	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
5	60	9-06-02	1345	4.3	22	30	ND	ND	ND	ND
4	10	9-06-02	1355	[1].84	3.2	120	1.6	0.74	ND	ND
4	10 REP	9-06-02	1400	1.1	3.2	96	1.8	[1].85	ND	ND
4	30	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
4	60	9-06-02	1420	5.5	20	30	ND	ND	ND	ND
4	60 REP	9-06-02	1430	5.7	20	31	ND	ND	ND	ND
	Trip Blank	9-06-02	NA	ND	ND	ND	ND	ND	ND	ND
3	10	9-09-02	1030	[1].64	1.5	64	1.9	[1].67	ND	ND
3	30	9-09-02	1040	ND	ND	35	1.2	ND	ND	ND
3	60	9-09-02	NA	NS	NS	NS	NS	NS	NS	NS

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Diagram of transects shown in figure 5. Transect location is shown on figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	1,3-Di-chloro-benzene	1,4-Di-chloro-benzene	Chloro-benzene	Benzene	Toluene	Naphthalene	Bromo-methane
					September 2002—Continued					
2	10	9-09-02	1050	ND	ND	82	2.1	ND	ND	ND
2	10 REP	9-09-02	1055	ND	ND	49	[1]1.6	ND	ND	ND
2	30	9-09-02	1100	ND	ND	39	ND	ND	ND	ND
2	30 REP	9-09-02	1102	ND	ND	41	ND	ND	ND	ND
2	60	9-09-02	NA	NS	NS	NS	NS	NS	NS	NS
1	10	9-09-02	1125	ND	ND	17	ND	ND	ND	ND
1	30	9-09-02	1130	ND	3.1	34	ND	ND	ND	ND
1	60	9-09-02	NA	NS	NS	NS	NS	NS	NS	NS
0	10	9-09-02	1140	ND	ND	21	ND	ND	ND	ND
0	10 REP	9-09-02	1143	ND	[1].95	33	ND	ND	ND	ND
0	30	9-09-02	1147	ND	ND	28	ND	ND	ND	ND
0	30 REP	9-09-02	1150	ND	ND	28	ND	ND	ND	ND
0	60	9-09-02	1200	ND	3.7	13	ND	ND	ND	ND
0	60 REP	9-09-02	1205	ND	2.4	9.1	ND	ND	ND	ND
	Trip Blank	9-09-02	NA	ND	ND	ND	ND	ND	ND	[1 2 3]1.0
					April–May 2003					
10	10	5-01-03	1301	2.2	18	19	ND	ND	ND	ND
10	10 REP	5-01-03	1304	2.2	17	20	ND	ND	ND	ND
10	30	5-01-03	1313	2.7	23	15	ND	ND	ND	ND
10	60	5-01-03	1320	2.5	19	15	ND	ND	ND	ND
9	10	5-01-03	NA	NS	NS	NS	NS	NS	NS	NS
9	30	5-01-03	1340	3.0	23	17	ND	ND	ND	ND
9	Field Blank	5-01-03	1353	ND	ND	ND	ND	ND	ND	ND
9	60	5-01-03	1358	2.9	22	20	ND	ND	ND	ND
8	10	5-01-03	NA	NS	NS	NS	NS	NS	NS	NS
8	30	5-01-03	1419	2.7	20	16	ND	ND	ND	ND
8	30 REP	5-01-03	1422	2.9	22	20	ND	ND	ND	ND
8	60	5-01-03	1432	3.2		20	2.5	ND	ND	ND
7	10	5-01-03	1457	3.3	11	26	ND	ND	ND	ND
7	10 REP	5-01-03	1500	3.6	12	28	ND	ND	ND	ND
7	30	5-01-03	1509	3.2	21	20	ND	ND	ND	ND
7	60	5-01-03	1515	4.0	27	27	ND	ND	ND	ND
6	10	5-01-03	1536	8.0	28	49	ND	ND	ND	ND
6	30	5-01-03	1551	4.2	23	27	ND	ND	ND	ND
6	60	5-01-03	1554	3.9	24	26	ND	ND	ND	ND
6	60 REP	5-01-03	1557	3.8	24	25	ND	ND	ND	ND
	Trip Blank	5-02-03	NA	ND	ND	ND	ND	ND	ND	ND
5	10	5-02-03	1103	ND	2.4	50	ND	ND	ND	ND
5	10 REP	5-02-03	1104	ND	[1].84	48	ND	ND	ND	ND
5	30	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS
5	60	5-02-03	1120	4.7	17	21	ND	ND	ND	ND

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Diagram of transects shown in figure 5. Transect location is shown on figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	1,3-Di-chloro-benzene	1,4-Di-chloro-benzene	Chloro-benzene	Benzene	Toluene	Naphthalene	Bromo-methane
April–May 2003—Continued										
4	10	5-02-03	1134	0.77	1.9	86	1.1	0.57	ND	ND
4	30	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS
4	60	5-02-03	1157	3.9	15	17	ND	ND	ND	ND
4	60 REP	5-02-03	1200	3.9	15	16	ND	ND	ND	ND
3	10	5-02-03	1258	ND	1.5	22	.68	ND	ND	ND
3	30	5-02-03	1309	ND	1.1	22	1.1	[1].53	ND	ND
3	60	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS
2	10	5-02-03	1330	ND	.58	42	1.1	ND	[1]0.51	ND
2	30	5-02-03	1340	ND	1.4	47	.74	ND	ND	ND
2	30 REP	5-02-03	1343	ND	1.5	49	[1].75	ND	ND	ND
2	60	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS
1	10	5-02-03	1354	ND	[1].85	24	[1].55	ND	ND	ND
1	30	5-02-03	1401	[1].53	[1 3].52	37	ND	ND	ND	ND
1	Field Blank	5-02-03	1420	ND	ND	[1].53	ND	ND	ND	ND
1	60	5-02-03	1429	[1].89	6.0	20	ND	ND	ND	ND
0	10	5-02-03	1444	ND	1.4	30	[1].56	ND	ND	ND
0	30	5-02-03	1451	ND	1.6	36	[1].52	ND	ND	ND
0	30 REP	5-02-03	1453	ND	1.7	36	ND	ND	ND	ND
0	60	5-02-03	1512	ND	1.2	27	ND	ND	ND	ND
	Trip Blank	5-05-03	1120	ND	ND	ND	ND	ND	ND	ND
June 2003										
	Surface Water	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS
0	10	6-25-03	1015	ND	ND	28	ND	ND	ND	ND
0	30	6-25-03	1025	ND	ND	34	ND	ND	ND	ND
0	30 REP	6-25-03	1028	ND	1.0	35	ND	ND	ND	ND
	Trip Blank	6-25-03	1040	ND	ND	ND	ND	ND	ND	ND
0	60	6-25-03	1045	ND	ND	11	ND	ND	ND	ND
1	10	6-25-03	1105	ND	ND	15	ND	ND	ND	ND
1	30	6-25-03	1115	ND	1.6	41	ND	ND	ND	ND
1	60	6-25-03	1123	ND	1.5	22	ND	ND	ND	ND
2	10	6-25-03	1240	ND	ND	31	ND	ND	ND	ND
2	10 REP	6-25-03	1433	ND	ND	27	ND	ND	ND	ND
2	30	6-25-03	1255	ND	ND	44	ND	ND	ND	ND
2	Field Blank	6-25-03	1303	ND	ND	ND	ND	ND	ND	ND
2	60	6-25-03	1312	ND	1.9	53	ND	ND	ND	ND
3	10	6-25-03	1325	ND	ND	49	1.5	ND	ND	ND
3	30	6-25-03	1335	ND	ND	19	1.1	ND	ND	ND
3	60	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03.—Continued

[Diagram of transects shown in figure 5. Transect location is shown on figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	1,3-Di-chloro-benzene	1,4-Di-chloro-benzene	Chloro-benzene	Benzene	Toluene	Naphthalene	Bromo-methane
June 2003—Continued										
4	10	6-25-03	1400	ND	2.8	110	1.1	ND	ND	ND
4	30	6-25-03	1420	ND	2.2	37	ND	ND	ND	ND
4	60	6-25-03	1439	4.4	16	20	ND	ND	ND	ND
4	60 REP	6-25-03	1442	4.7	17	20	ND	ND	ND	ND
5	10	6-25-03	1452	ND	ND	14	ND	ND	ND	ND
5	30	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS
5	60	6-25-03	1523	5.4	17	19	ND	ND	ND	ND
6	10	6-25-03	1540	2.9	9.0	34	ND	ND	ND	ND
6	30	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS
6	Field Blank	6-25-03	1550	ND	ND	ND	ND	ND	ND	ND
6	60	6-25-03	1557	ND	11	15	ND	ND	ND	ND
7	10	6-26-03	1035	ND	14	33	ND	ND	ND	ND
7	30	6-26-03	1045	ND	ND	16	ND	ND	ND	ND
7	30 REP	6-26-03	1048	ND	12	16	ND	ND	ND	ND
7	Field Blank	6-26-03	1055	ND	ND	ND	ND	ND	ND	ND
7	60	6-26-03	1100	ND	20	24	ND	ND	ND	ND
	Trip Blank	6-26-03	1108	ND	ND	ND	ND	ND	ND	ND
8	10	6-26-03	NA	NS	NS	NS	NS	NS	NS	NS
8	30	6-26-03	1120	ND	18	18	ND	ND	ND	ND
8	60	6-26-03	1130	ND	19	18	ND	ND	ND	ND
9	10	6-26-03	1140	ND	10	15	ND	ND	ND	ND
9	30	6-26-03	1150	ND	14	16	ND	ND	ND	ND
9	60	6-26-03	1155	ND	15	17	ND	ND	ND	ND
9	60 REP	6-26-03	1205	ND	12	13	ND	ND	ND	ND
10	10	6-26-03	1315	ND	19	18	ND	ND	ND	ND
10	30	6-26-03	1320	ND	18	19	ND	ND	ND	ND
10	60	6-26-03	1330	15	100	92	ND	ND	ND	ND
10	Field Blank	6-26-03	1340	ND	ND	ND	ND	ND	ND	ND
10	PDB	6-26-03	NA	4.2	23	[3]17	ND	ND	ND	ND
9	PDB	6-26-03	NA	4	27	[3]18	ND	ND	ND	ND
8	PDB	6-26-03	NA	2.4	19	[3]36	ND	ND	ND	ND
7	PDB	6-26-03	NA	2.8	20	[3]37	ND	ND	ND	ND
7	PDB	6-26-03	NA	3.6	26	[3]27	ND	ND	ND	ND
6	PDB	6-26-03	NA	4.5	19	[3]23	ND	ND	ND	ND

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03. —Continued

[Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	Dichloro-difluoro-methane	1,2,3-Tri-chloro-propane	Butanone (MEK)	Chloro-methane	2-Pro-panone (acetone)	Carbon disulfide	MTBE
					June 2002					
10	10	6-18-02	1305	ND	ND	ND	ND	[1 2 3]1.8	4.6	ND
10	10 REP	6-18-02	1312	ND	ND	ND	ND	[2 3]7.7	ND	ND
10	30	6-18-02	1321	ND	ND	ND	ND	[2 3]3.0	ND	ND
10	30 REP	6-18-02	1326	ND	ND	ND	ND	[2 3]6.9	[1]2.0	ND
10	60	6-18-02	1334	ND	ND	ND	ND	[3]21	ND	ND
10	60 REP	6-18-02	1341	ND	ND	ND	ND	[2 3]2.5	ND	ND
9	10	6-18-02	NA	NS	NS	NS	NS	NS	NS	NS
9	30	6-18-02	1401	ND	ND	ND	ND	[2 3]2.5	ND	ND
9	60	6-18-02	1407	ND	ND	ND	ND	ND	ND	ND
	Trip Blank	6-19-02	NA	ND	ND	ND	ND	[2 3]3.9	ND	ND
	Trip Blank	6-19-02	NA	ND	ND	ND	ND	[1 2 3]1.1	ND	ND
8	10	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
8	30	6-19-02	1105	ND	ND	ND	ND	[2 3]3.4	ND	ND
8	60	6-19-02	1120	ND	ND	ND	ND	[2 3]2.8	ND	ND
7	10	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
7	30	6-19-02	1155	ND	ND	ND	ND	[2 3]2.2	ND	ND
7	30 REP	6-19-02	1205	ND	ND	ND	ND	[2 3]3.7	ND	ND
7	60	6-19-02	1215	ND	ND	ND	ND	[2 3]2.9	ND	ND
7	60 REP	6-19-02	1225	ND	ND	ND	ND	[2 3]2.4	ND	ND
6	Surface Water	6-19-02	1230	NS	NS	NS	NS	NS	NS	NS
6	10	6-19-02	1250	ND	ND	ND	ND	[2 3]2.1	ND	ND
6	30	6-19-02	1320	ND	ND	ND	ND	[2 3]2.5	ND	ND
6	60	6-19-02	1325	ND	ND	ND	ND	[1 2 3]2.0	ND	ND
5	10	6-19-02	1350	ND	ND	ND	ND	[2 3]4.5	ND	ND
5	10 REP	6-19-02	1355	ND	ND	ND	ND	2.4	ND	ND
5	30	6-19-02	1405	ND	ND	ND	ND	ND	ND	ND
5	30 REP	6-19-02	1415	ND	ND	ND	ND	ND	ND	ND
5	60	6-19-02	1425	ND	ND	ND	ND	[1 2]1.5	ND	ND
5	60 REP	6-19-02	1430	ND	ND	ND	ND	[1 2]1.4	ND	ND
4	10	6-19-02	1450	ND	ND	ND	ND	[1 2]1.4	ND	ND
4	30	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
4	60	6-19-02	1500	ND	ND	ND	ND	ND	ND	ND
3	10	6-19-02	1510	ND	ND	ND	ND	ND	ND	ND
3	30	6-19-02	1520	ND	21	ND	ND	[2 3]2.2	ND	ND
3	60	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
2	10	6-19-02	1550	ND	ND	ND	ND	[2 3]2.4	ND	ND
2	30	6-19-02	1600	ND	ND	ND	ND	[1 2]1.4	ND	ND
2	60	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS
1	10	6-19-02	1620	ND	ND	ND	ND	[1 2]1.2	ND	ND
1	30	6-19-02	1625	ND	ND	ND	ND	[1 2]1.3	ND	ND
1	60	6-19-02	NA	NS	NS	NS	NS	NS	NS	NS

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03. —Continued

[Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	Dichloro-difluoro-methane	1,2,3-Tri-chloro-propane	Butanone (MEK)	Chloro-methane	2-Pro-panone (acetone)	Carbon disulfide	MTBE
				June 2002—Continued						
0	10	6-19-02	1630	ND	ND	ND	ND	[2 3]3.3	ND	ND
0	30	6-19-02	1635	ND	ND	ND	ND	[2 3]2.3	ND	ND
0	60	6-19-02	1640	ND	ND	ND	ND	[2 3]5.0	ND	ND
	Trip Blank	6-19-02	NA	ND	ND	ND	ND	ND	ND	ND
				September 2002						
10	10	9-06-02	1105	ND	ND	ND	ND	[1 2 3]1.4	ND	ND
10	30	9-06-02	1110	ND	ND	ND	ND	[1 2 3]1.2	ND	ND
10	30 REP	9-06-02	1112	ND	ND	ND	ND	ND	ND	ND
10	60	9-06-02	1114	ND	ND	ND	ND	[1 2 3]1.1	ND	ND
10	60 REP	9-06-02	1115	ND	ND	ND	ND	[1 2 3]1.3	ND	ND
9	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
9	30	9-06-02	1117	ND	ND	ND	ND	ND	ND	ND
9	60	9-06-02	1125	ND	ND	ND	ND	[1 2 3]1.3	ND	ND
8	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
8	30	9-06-02	1140	ND	ND	ND	ND	[1 2 3]1.1	ND	ND
8	30 REP	9-06-02	1142	ND	ND	ND	ND	[1 2 3]1.2	ND	ND
8	60	9-06-02	1145	ND	ND	ND	ND	[1 2 3]1.3	ND	ND
8	60 REP	9-06-02	1147	ND	ND	ND	ND	ND	ND	ND
7	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
7	30	9-06-02	1155	ND	ND	ND	ND	ND	ND	ND
7	60	9-06-02	1200	ND	ND	ND	ND	1.5	ND	ND
6	10	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
6	30	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
6	60	9-06-02	1320	ND	ND	ND	ND	[1 2 3]1.5	ND	ND
6	60 REP	9-06-02	1325	ND	ND	ND	ND	[1 2 3]1.5	ND	ND
5	10	9-06-02	1330	ND	ND	ND	ND	[1 2 3]1.3	ND	ND
5	30	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
5	60	9-06-02	1345	ND	ND	ND	ND	2.1	ND	ND
4	10	9-06-02	1355	ND	ND	ND	ND	[3]2.2	ND	ND
4	10 REP	9-06-02	1400	ND	ND	ND	ND	[1 2 3]1.3	ND	ND
4	30	9-06-02	NA	NS	NS	NS	NS	NS	NS	NS
4	60	9-06-02	1420	ND	ND	ND	ND	ND	ND	ND
4	60 REP	9-06-02	1430	ND	ND	ND	ND	[1 2 3]1.0	ND	ND
	Trip Blank	9-06-02	NA	ND	ND	ND	ND	ND	ND	ND
3	10	9-09-02	1030	ND	ND	ND	1.3	[1 2 3]1.6	ND	ND
3	30	9-09-02	1040	ND	ND	ND	1.5	3.1	ND	ND
3	60	9-09-02	NA	NS	NS	NS	NS	NS	NS	NS

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03. —Continued

[Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	Dichloro-difluoro-methane	1,2,3-Tri-chloro-propane	Butanone (MEK)	Chloro-methane	2-Pro-panone (acetone)	Carbon disulfide	MTBE
					September 2002—Continued					
2	10	9-09-02	1050	ND	ND	ND	ND	ND	ND	ND
2	10 REP	9-09-02	1055	ND	ND	ND	ND	[2 3]4.2	ND	ND
2	30	9-09-02	1100	ND	ND	ND	ND	[2 3]5.9	ND	ND
2	30 REP	9-09-02	1102	ND	ND	ND	ND	[1 2 3]9.2	ND	ND
2	60	9-09-02	NA	NS	NS	NS	NS	NS	NS	NS
1	10	9-09-02	1125	ND	ND	ND	ND	[2 3]4.9	ND	ND
1	30	9-09-02	1130	ND	ND	ND	ND	[1 2 3]2.5	ND	ND
1	60	9-09-02	NA	NS	NS	NS	NS	NS	NS	NS
0	10	9-09-02	1140	ND	ND	ND	ND	[2 3]2.7	ND	ND
0	10 REP	9-09-02	1143	ND	ND	ND	ND	[2 3]2.1	ND	ND
0	30	9-09-02	1147	ND	ND	ND	ND	[1 2 3]5.9	ND	ND
0	30 REP	9-09-02	1150	ND	ND	ND	ND	[1 2 3]7.7	ND	ND
0	60	9-09-02	1200	ND	ND	ND	ND	[1 2 3]3.2	ND	ND
0	60 REP	9-09-02	1205	ND	ND	ND	ND	[1 2 3]3.0	ND	ND
	Trip Blank	9-09-02	NA	ND	ND	ND	1.3	[1 2 3]1.0	ND	ND
					April–May 2003					
10	10	5-01-03	1301	ND	ND	ND	ND	3.8	ND	ND
10	10 REP	5-01-03	1304	ND	ND	ND	ND	3.1	ND	ND
10	30	5-01-03	1313	ND	ND	ND	ND	2.2	ND	ND
10	60	5-01-03	1320	ND	ND	ND	ND	2.8	ND	ND
9	10	5-01-03	NA	NS	NS	NS	NS	NS	NS	NS
9	30	5-01-03	1340	ND	ND	ND	ND	2.4	ND	ND
9	Field Blank	5-01-03	1353	ND	ND	ND	ND	ND	ND	ND
9	60	5-01-03	1358	ND	ND	ND	ND	3.2	ND	ND
8	10	5-01-03	NA	NS	NS	NS	NS	NS	NS	NS
8	30	5-01-03	1419	ND	ND	ND	ND	2.8	ND	ND
8	30 REP	5-01-03	1422	ND	ND	ND	ND	3.0	ND	ND
8	60	5-01-03	1432	ND	21	ND	ND	24	ND	ND
7	10	5-01-03	1457	ND	ND	ND	ND	4.6	ND	ND
7	10 REP	5-01-03	1500	ND	ND	ND	ND	3.3	ND	ND
7	30	5-01-03	1509	ND	ND	ND	ND	ND	ND	ND
7	60	5-01-03	1515	ND	ND	ND	ND	2.2	ND	ND
6	10	5-01-03	1536	ND	ND	ND	1.3	2.4	ND	ND
6	30	5-01-03	1551	ND	ND	ND	ND	1.4	ND	ND
6	60	5-01-03	1554	ND	ND	ND	ND	2.3	ND	ND
6	60 REP	5-01-03	1557	ND	ND	ND	ND	2.7	ND	ND
	Trip Blank	5-02-03	NA	ND	ND	ND	ND	ND	ND	ND
5	10	5-02-03	1103	ND	ND	ND	ND	2.8	ND	ND
5	10 REP	5-02-03	1104	ND	ND	1.0	ND	3.1	ND	ND
5	30	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS
5	60	5-02-03	1120	ND	ND	[1 3].51	1.7	[3]2.1	[1]0.78	ND

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03. —Continued

[Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	Dichloro-difluoro-methane	1,2,3-Tri-chloro-propane	Butanone (MEK)	Chloro-methane	2-Pro-panone (acetone)	Carbon disulfide	MTBE
					April–May 2003—Continued					
4	10	5-02-03	1134	ND	ND	2.1	1.7	0.81	ND	ND
4	30	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS
4	60	5-02-03	1157	ND	ND	ND	2.0	1.6	ND	0.52
4	60 REP	5-02-03	1200	ND	ND	.92	1.6	1.6	ND	ND
3	10	5-02-03	1258	ND	ND	.72	1.9	2.7	ND	ND
3	30	5-02-03	1309	ND	ND	ND	1.4	3.5	ND	ND
3	60	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS
2	10	5-02-03	1330	ND	ND	.69	2.1	.58	ND	ND
2	30	5-02-03	1340	ND	ND	.57	1.5	2.4	ND	ND
2	30 REP	5-02-03	1343	ND	ND	[1 3].64	1.7	[3]1.9	ND	ND
2	60	5-02-03	NA	NS	NS	NS	NS	NS	NS	NS
1	10	5-02-03	1354	ND	ND	[1]1.3	2.0	3.2	ND	ND
1	30	5-02-03	1401	ND	ND	ND	1.6	[1 3].78	ND	ND
1	Field Blank	5-02-03	1420	ND	ND	ND	ND	[3]1.9	ND	ND
1	60	5-02-03	1429	ND	ND	ND	1.7	[3]2.4	ND	ND
0	10	5-02-03	1444	ND	ND	[1 3].7	1.7	1.9	ND	ND
0	30	5-02-03	1451	ND	ND	[1 3].57	1.7	2.4	ND	ND
0	30 REP	5-02-03	1453	ND	ND	ND	1.8	[1 3].65	[1]0.67	ND
0	60	5-02-03	1512	ND	ND	[1 3].64	1.9	1.4	ND	ND
	Trip Blank	5-05-03	1120	ND	ND	ND	ND	ND	ND	ND
					June 2003					
	Surface Water	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS
0	10	6-25-03	1015	ND	ND	ND	ND	ND	ND	2.2
0	30	6-25-03	1025	ND	ND	ND	ND	ND	ND	ND
0	30 REP	6-25-03	1028	ND	ND	ND	ND	ND	ND	ND
	Trip Blank	6-25-03	1040	ND	ND	ND	ND	ND	ND	ND
0	60	6-25-03	1045	ND	ND	ND	ND	ND	ND	ND
1	10	6-25-03	1105	ND	ND	ND	ND	ND	ND	ND
1	30	6-25-03	1115	ND	ND	ND	ND	ND	ND	ND
1	60	6-25-03	1123	ND	ND	ND	ND	ND	ND	ND
2	10	6-25-03	1240	ND	ND	ND	ND	ND	ND	ND
2	10 REP	6-25-03	1433	ND	ND	ND	ND	ND	ND	ND
2	30	6-25-03	1255	ND	ND	ND	ND	ND	ND	ND
2	Field Blank	6-25-03	1303	ND	ND	ND	ND	ND	ND	ND
2	60	6-25-03	1312	ND	ND	ND	ND	ND	ND	ND
3	10	6-25-03	1325	ND	ND	ND	ND	ND	ND	ND
3	30	6-25-03	1335	ND	ND	ND	1.0	ND	ND	ND
3	60	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS

Table 5. Results of sampling pore water along transect B during field studies, Mill Pond, Sudbury River, Ashland, Massachusetts, 2002–03. —Continued

[Diagram of transects shown in figure 5. Transect location is shown in figure 2. **Sample depth or description:** Depth is in centimeters below sediment surface. Unless otherwise indicated, all concentration units are micrograms per liter. M, missing; MTBE, methyl *tert*-butyl ether; NA, not applicable; ND, not detected; NS, not sampled; OR, out of calibration range; PDB, passive-diffusion-bag sampler; REP, replicate sample; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter]

Distance along transect B (meters)	Sample depth or description	Date	Time	Dichloro-difluoro-methane	1,2,3-Tri-chloro-propane	Butanone (MEK)	Chloro-methane	2-Pro-panone (acetone)	Carbon disulfide	MTBE
June 2003—Continued										
4	10	6-25-03	1400	ND	ND	ND	ND	ND	ND	ND
4	30	6-25-03	1420	ND	ND	ND	ND	ND	ND	ND
4	60	6-25-03	1439	ND	ND	ND	ND	ND	ND	ND
4	60 REP	6-25-03	1442	ND	ND	ND	ND	ND	ND	ND
5	10	6-25-03	1452	ND	ND	ND	ND	ND	ND	ND
5	30	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS
5	60	6-25-03	1523	ND	ND	ND	ND	ND	ND	[3]1.1
6	10	6-25-03	1540	ND	ND	ND	ND	ND	ND	ND
6	30	6-25-03	NA	NS	NS	NS	NS	NS	NS	NS
6	Field Blank	6-25-03	1550	ND	ND	ND	ND	ND	ND	ND
6	60	6-25-03	1557	ND	ND	ND	ND	ND	ND	ND
7	10	6-26-03	1035	ND	ND	ND	ND	ND	ND	ND
7	30	6-26-03	1045	ND	ND	ND	ND	ND	ND	ND
7	30 REP	6-26-03	1048	ND	ND	ND	ND	ND	ND	ND
7	Field Blank	6-26-03	1055	ND	ND	ND	ND	ND	ND	ND
7	60	6-26-03	1100	ND	ND	ND	ND	ND	ND	ND
	Trip Blank	6-26-03	1108	ND	ND	ND	ND	ND	ND	ND
8	10	6-26-03	NA	NS	NS	NS	NS	NS	NS	NS
8	30	6-26-03	1120	ND	ND	ND	ND	ND	ND	ND
8	60	6-26-03	1130	ND	ND	ND	ND	ND	ND	ND
9	10	6-26-03	1140	ND	ND	ND	ND	ND	ND	ND
9	30	6-26-03	1150	ND	ND	ND	ND	ND	ND	ND
9	60	6-26-03	1155	ND	ND	ND	ND	ND	ND	ND
9	60 REP	6-26-03	1205	ND	ND	ND	ND	ND	ND	ND
10	10	6-26-03	1315	ND	ND	ND	ND	ND	ND	ND
10	30	6-26-03	1320	ND	ND	ND	ND	ND	ND	ND
10	60	6-26-03	1330	ND	ND	ND	ND	ND	ND	ND
10	Field Blank	6-26-03	1340	ND	ND	ND	ND	ND	ND	ND
10	PDB	6-26-03	NA	ND	ND	ND	ND	ND	ND	ND
9	PDB	6-26-03	NA	ND	ND	ND	ND	ND	ND	ND
8	PDB	6-26-03	NA	ND	ND	ND	ND	ND	ND	ND
7	PDB	6-26-03	NA	ND	ND	ND	ND	ND	ND	ND
7	PDB	6-26-03	NA	ND	ND	ND	ND	ND	ND	ND
6	PDB	6-26-03	NA	ND	ND	ND	ND	ND	ND	ND

[1]Estimated value below calibration value.
[2]Estimated value.
[3]Analyte is associated with lab blank or trip blank contamination.

SOLID WASTE MANAGEMENT UNIT 54 RCRA FACILITY INVESTIGATION/ CORRECTIVE MEASURES STUDY REPORT

VOLUME I

RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

FINAL
SEPTEMBER 2008

URS

CONTRACT NO.
DACA31-00-D-0011
DELIVERY ORDER NO. 0027