SWMU 48/49 RFI Report Correspondence

5/30/14 – EPA/VDEQ Approval Letter

1/15/2014 BAE/Army Certification Letter

1/14/2014 Dec13 Draft Transmittal email

12/02/1013 email from USAIPH, concurrence with the internal draft RFI although it has comments, can wait to see if USAIPH issues another memo that concurs with the draft

9/12/2013 EPA/VDEQ acceptance of GW characterization email

9/11/2013 Transmittal of GW contours & GW contours

9/3/2013 Email to cutler regarding GW characterization

8/15/2013 Email with new GW data & new figs/table

4/2/2013 Transmittal of well install WP & WP

01/30/2013 EPA email conditional approval of the SWMU 48/49 RTCs, ARSAR RTCs, and the 01/29/2013 email

1/29/2013 Field Trip notes and Fig

01/15/2013 Email from EPA (EPA toxicologist's responses to RTCs)

11/30/2012 RTC Transmittal and RTCs

11/5/2012 Transmittal of EPA/VDEQ comments

11/5/2012 EPA/VDEQ Comments (EPA comment email is 11/05/2012)

7/12/2012 June12 Draft Certification

7/2/2012 June12 Draft Transmittal email

----2011 - Interim Measures for soil at SWMU 48 occurred ----

1/06/2011 EPA approval of Supplemental Data Report RTCs

12/09/2010 Supplemental Data Report RTCs transmittal

12/08/2010 Supplemental Data Report RTCs

12/01/2010 Transmittal of EPA/VDEQ comments on Supplemental Data Report

11/12/2010 Supplemental Data Report Transmittal

8/10/2010 Supplemental Data Report

---- March 2010 Supplemental RFI Trenching occurred ---

3/02/2010 Partnering Meeting Notes transmittal email

2/24/2010 Partnering Meeting Notes

02/19/2010 EPA email with comments

12/16/2009 McKenna transmittal of RTCs

12/16/2009 –EPA/VDEQ RTCs

7/1/2009 EPA/VDEQ Comment Transmittal

7/1/2009 EPA/VDEQ Comments

3/06/2009 USACHPPM Memo

2/12/2009 Feb09 Draft Certification Email

2/05/2009 Feb09 Draft Transmittal Email

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

May 30, 2014

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

Bob Winstead
Environmental Manager
BAE Systems Ordnance Systems, Inc.
Radford Army Ammunition Plant
P.O. Box 1
Radford, VA 24141-0100

VIA Electronic Mail

Re: Radford Army Ammunition Plant, Radford, Virginia
Solid Waste Management Units 48 and 49
RCRA Facility Investigation Report

Dear Mr. McKenna and Mr. Winstead:

The U.S. Environmental Protection Agency (EPA) and Virginia Department of Environmental Quality (VDEQ) have reviewed the U.S. Army's (Army's) SWMU 48 & 49, RCRA Facility Investigation Report (RFI). SWMUs 48 and 49 are located at the Radford Army Ammunition Plant (RFAAP) in Radford, Virginia. Based upon our review, the RFI Report is approved, and in accordance with Part II. (E)(5) of RFAAP's Corrective Action Permit, the RFI Report is considered final. If you have any questions, please call me at 410-305-2779.

Sincerely,

Erich Weissbart

Erich Weissbart, P.G.
RCRA Project Manager
Office of Remediation (3LC20)

c: James Cutler, VDEQ

BAE SYSTEMS

ORDNANCE SYSTEMS INC.
Radford Army Ammunition Plant
4050 Pepper's Ferry Road
Radford Virginia 24141

January 15, 2014

Mr. Erich Weissbart
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 23219

Subject: With Certification, SWMUs 48 and 49 RCRA Facility Investigation Report, Draft Document, January 2014 EPA ID# VA1210020730

Dear Mr. Weissbart and Mr. Cutler:

Enclosed is the certification for the subject documents that were sent to you on January 14, 2014. Also enclosed is the January 14, 2014 transmittal email.

Please coordinate with and provide any questions or comments to myself at 540 639 7785 or Mr. Jim McKenna, ACO Staff at 540 731 5782.

Sincerely,

Jay Stewart, Environmental Manager
BAE Systems, Ordnance Systems Inc.

c: E. A. Lohman
Virginia Department of Environmental Quality
Blue Ridge Regional Office
3019 Peters Creek Road
Roanoke, VA 24019

Rich Mendoza
US Army Environmental Center
2450 Connell Rd., Bldg. 2264, 1st Fl, Rm126
Attn: Richard Mendoza
San Antonio, TX 78234-7664

Tom Meyer
Corps of Engineers, Baltimore District
ATTN: CENAB-EN-HM
10 South Howard Street
Baltimore, MD 21201

bc: BAE Administrative File
J. McKenna, ACO Staff
Rob Davie-ACO Staff

Coordination: J. McKenna

14-0900-015

Concerning the following:

Radford Army Ammunition Plant
SWMUs 48 and 49
RCRA Facility Investigation Report
Draft Document, January 2014

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: Luis A. Ortiz
TITLE: Lieutenant Colonel, US Army
Commanding

SIGNATURE: _____

PRINTED NAME: William M. Barnett
TITLE: General Manager
BAE Systems

Alberts, Matt (US SSA)

From: McKenna, James J CIV (US) <james.j.mckenna16.civ@mail.mil>
Sent: Tuesday, January 14, 2014 12:04 PM
To: Alberts, Matt (US SSA); beth lohman (ealohman@deq.virginia.gov); Cutler,Jim; Bogucki, MaryAnn (US SSA); Mendoza, Richard R Jr CIV (US); Meyer, Tom NAB02; Stewart, Jay (US SSA); Timothy.Leahy@shawgrp.com; Weissbart.Erich@epamail.epa.gov
Cc: Davie, Robert N.; Ortiz, Luis (RFAAP)
Subject: Draft SWMU 48/49 RFI Report (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: FOUO

Erich, Jim C., All:

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

Jim McKenna	1Z66V7420190518467 (2 copies)
Thomas Meyer	1Z66V7420190078479
Jim Bressette	1Z66V7420190654480
Erich Weissbart	1Z66V7420192254506
JIM CUTLER	1Z66V7420194478511
E.A. LOHMAN	1Z66V7420190118523
Jay Stewart	1Z66V7420194774530
Rich Mendoza	1Z66V7420192846493 (2 copies)

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

JJM

Classification: UNCLASSIFIED
Caveats: FOUO

Leahy, Timothy

From: McKenna, James J CIV (US) [james.j.mckenna16.civ@mail.mil]
Sent: Thursday, September 12, 2013 2:39 PM
To: Weissbart, Erich
Cc: beth lohman (ealohman@deq.virginia.gov); Stewart, Jay (US SSA); Alberts, Matt (US SSA); MaryAnn Bogucki - Radford (maryann.bogucki@baesystems.com); Meyer, Tom NAB02; Mendoza, Richard R Jr CIV (US); Davie, Robert N III CIV (US); Ortiz, Luis A LTC USARMY JMC (US); Bressette, James W CIV USARMY MEDCOM PHC (US); Leahy, Timothy; Cutler,Jim
Subject: RE: SWMU 48/49 GW results (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: FOUO

Erich,

Thanks and I'm forwarding this email to the team to let them know. I'll get with them to see if they want to discuss. If you're coming to RAB meeting that could present an opportunity for a meeting during the day on Wednesday, September 25 before the meeting or Thursday, September 26 in the morning.

JJM

-----Original Message-----
From: Weissbart, Erich [mailto:Weissbart.Erich@epa.gov]
Sent: Thursday, September 12, 2013 2:29 PM
To: McKenna, James J CIV (US)
Subject: RE: SWMU 48/49 GW results (UNCLASSIFIED)

Jim,
Cutler and I are agreed that the groundwater at 48/49 is characterized. We don't quite understand the levels of contamination at 48/49 and the OB/OG; however, ultimately it doesn't matter. The point of this email is to let you know that we believe it is time to finalize the RFI/CMS for 48/49. You have our prior comments and I believe a majority have now been addressed. If we need to have a call to discuss the report we can, but I leave that up to you and your team. If your team wants to discuss the groundwater remedy (MNA vs long-term monitoring) let's have the call. From my perspective no additional fieldwork is necessary and the revised report can be resubmitted.

Erich Weissbart, P.G.
Remedial Project Manager
Land and Chemicals Division
US EPA Region III
1650 Arch Street, Philadelphia PA
215 814-3284
weissbart.erich@epa.gov

_____
From: McKenna, James J CIV (US) <james.j.mckenna16.civ@mail.mil>
Sent: Wednesday, September 11, 2013 8:08 AM
To: Weissbart, Erich

Cc: beth lohman (ealohman@deq.virginia.gov); Stewart, Jay (US SSA); Alberts, Matt (US SSA); MaryAnn Bogucki - Radford (maryann.bogucki@baesystems.com); Meyer, Tom NAB02; Mendoza, Richard R Jr CIV (US); Davie, Robert N III CIV (US); Ortiz, Luis A LTC USARMY JMC (US); Bressette, James W CIV USARMY MEDCOM PHC (US); Leahy, Timothy; Cutler,Jim
Subject: FW: SWMU 48/49 GW results (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: FOUO

Erich, All,

Additional information, preliminary gw contours in response to a question from Jim Cutler. Wanted to keep everyone in the loop.

Thanks,
JJM

-----Original Message-----
From: Leahy, Timothy [mailto:Timothy.Leahy@CBIFederalServices.com]
Sent: Tuesday, September 10, 2013 4:27 PM
To: Cutler, Jim (DEQ); McKenna, James J CIV (US)
Subject: RE: SWMU 48/49 GW results (UNCLASSIFIED)

Hi Jim,

Here are some quick and dirty contours that include the new wells. I've included the contour map from the RFI as well, for comparison to how they fall in line with previous GW contours.

Let me know if you have any questions.

Thanks,
Tim

-----Original Message-----
From: Cutler, Jim (DEQ) [mailto:James.Cutler@deq.virginia.gov]
Sent: Tuesday, September 10, 2013 10:16 AM
To: Leahy, Timothy; McKenna, James J CIV (US)
Subject: RE: SWMU 48/49 GW results (UNCLASSIFIED)

Thanks.

-----Original Message-----
From: Leahy, Timothy [mailto:Timothy.Leahy@CBIFederalServices.com]
Sent: Monday, September 09, 2013 11:44 AM
To: Cutler, Jim (DEQ); McKenna, James J CIV (US)
Subject: RE: SWMU 48/49 GW results (UNCLASSIFIED)

Hi Jim,

We haven't prepared contours yet for the latest round of data. I'll put some hand drawn ones together this afternoon and send them out.

Tim

-----Original Message-----
From: Cutler, Jim (DEQ) [mailto:James.Cutler@deq.virginia.gov]
Sent: Thursday, September 05, 2013 11:20 AM

To: McKenna, James J CIV (US)
Cc: Leahy, Timothy
Subject: RE: SWMU 48/49 GW results (UNCLASSIFIED)

Jim,

I looked at the figures provided. Are there any GW contour figures?

Thanks,

Jim

-----Original Message-----
From: McKenna, James J CIV (US) [mailto:james.j.mckenna16.civ@mail.mil]
Sent: Tuesday, September 03, 2013 3:00 PM
To: Cutler, Jim (DEQ)
Cc: Meyer, Tom NAB02; Mendoza, Richard R Jr CIV (US); Bressette, James W CIV USARMY MEDCOM PHC (US); Sherman, Jason M CIV USARMY IMCOM AEC (US); Alberts, Matt (US SSA); MaryAnn Bogucki - Radford (maryann.bogucki@baesystems.com); Stewart, Jay (US SSA); Leahy, Timothy
Subject: FW: SWMU 48/49 GW results (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: FOUO

Jim C.,

Please email below. Do you want to talk about the results or are we good to go with moving towards a remedy? If we need to talk then let's start coordinating a call for some time when Erich gets back. If not then we can start moving towards the remedy.

Thanks in advance,
JJM

-----Original Message-----
From: Weissbart, Erich [mailto:Weissbart.Erich@epa.gov]
Sent: Tuesday, August 27, 2013 7:54 AM
To: McKenna, James J CIV (US)
Subject: RE: SWMU 48/49 GW results (UNCLASSIFIED)

Jim,
I don't recall if you are back from vacation or not yet. I have looked at these results. Last I spoke with Jim he has not. Today is my last day in the office until Sept. 10. I work from home tomorrow and Thursday and then I'm on vacation. If your team wants to have a call to discuss next steps please coordinate with Cutler for when I return from vacation. From my perspective we are done characterizing at SWMU's 48/49 and ready to move towards the remedy.

Erich Weissbart, P.G.
Land and Chemicals Division (3LC20)
USEPA Region III
1650 Arch Street
Philadelphia, PA 19103
(215) 814-3284
weissbart.erich@epa.gov

-----Original Message-----
From: McKenna, James J CIV (US) [mailto:james.j.mckenna16.civ@mail.mil]

Sent: Thursday, August 15, 2013 3:41 PM
To: Weissbart, Erich; Cutler,Jim
Cc: beth lohman (ealohman@deq.virginia.gov); Stewart, Jay (US SSA); Alberts, Matt (US SSA); MaryAnn Bogucki - Radford (maryann.bogucki@baesystems.com); Meyer, Tom NAB02; Mendoza, Richard R Jr CIV (US); Davie, Robert N III CIV (US); Ortiz, Luis A LTC USARMY JMC (US); Bressette, James W CIV USARMY MEDCOM PHC (US); Leahy, Timothy
Subject: FW: SWMU 48/49 GW results (UNCLASSIFIED)

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Erich, Jim C., All,

Attached files are the draft data from the 2013 sampling effort at and around SWMU 48/49. Note this is draft and has not been reviewed by the Army.

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

JJM

-----Original Message-----
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Hi Jim,

Here are the Groundwater sampling results from the 2013 sampling at SWMU 48/49. Figure 3-8 shows the locations that were sampled based on the field trip in January. The other two figures (figure 4-5 for CT and 4-6 for TCE) show preliminary plume boundaries for the new data. The excel table includes both a summary table with ranges of concentrations, # of exceedances, # of detections, etc., as well as a sample table that shows detected constituents for each well. For those who are interested, the non-detects can be seen by going to the Excel menu "Views -> Custom Views -> Analyzed Constituents." To return to the original view, go to "Views -> Custom Views -> Detected Constituents." Let me know if you have any questions.

Thanks,

Tim

Description: Description: Description: Description: Description:
cid:_1_0AD725A00AD721CC001388C386257B11

Timothy Leahy, PMP

Project Manager

Project Management

Federal Services

Tel. +1 410 273 7228

Cell +1 410 322 6430

Fax +1 410 273 7103

timothy.leahy@CBIFederalServices.com

CB&I

4696 Millennium Drive, Suite 320

Belcamp, MD 21017

U.S.A

www.CBI.com <mailto:timothy.leahy@shawgrp.com>

Please note new email address effective May 17, 2013.

_____

Classification: UNCLASSIFIED
Caveats: FOUO

Classification: UNCLASSIFIED

Caveats: FOUO

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Subject: FW: SWMU 48/49 GW results (UNCLASSIFIED)
Attachments: GW contours_new wells.pdf; RFAAP_Fig2-7_SWMU48_49 _Potentiometric_Surface.pdf

Classification: UNCLASSIFIED
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Erich, All,

Additional information, preliminary gw contours in response to a question from Jim Cutler. Wanted to keep everyone in the loop.

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JJM

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Thanks,

Tim

Description: Description: Description: Description: Description: cid:_1_0AD725A00AD721CC001388C386257B11

Timothy Leahy, PMP

Project Manager

Project Management

Federal Services

Tel. +1 410 273 7228

Cell +1 410 322 6430

Fax +1 410 273 7103

timothy.leahy@CBIFederalServices.com

CB&I

4696 Millennium Drive, Suite 320

Belcamp, MD 21017

U.S.A

www.CBI.com <mailto:timothy.leahy@shawgrp.com>

Please note new email address effective May 17, 2013.

_____

Classification: UNCLASSIFIED
Caveats: FOUO

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Caveats: FOUO

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This e-mail and any attached files may contain CB&I Federal Services LLC (or its affiliates) confidential and privileged information. This information is protected by law and/or agreements between CB&I Federal Services LLC (or its affiliates) and either you, your employer or any contract provider with which you or your employer are associated. If you are not an intended recipient, please contact the sender by reply e-mail and delete all copies of this e-mail; further, you are notified that disclosing, copying, distributing or taking any action in reliance on the contents of this information is strictly prohibited.

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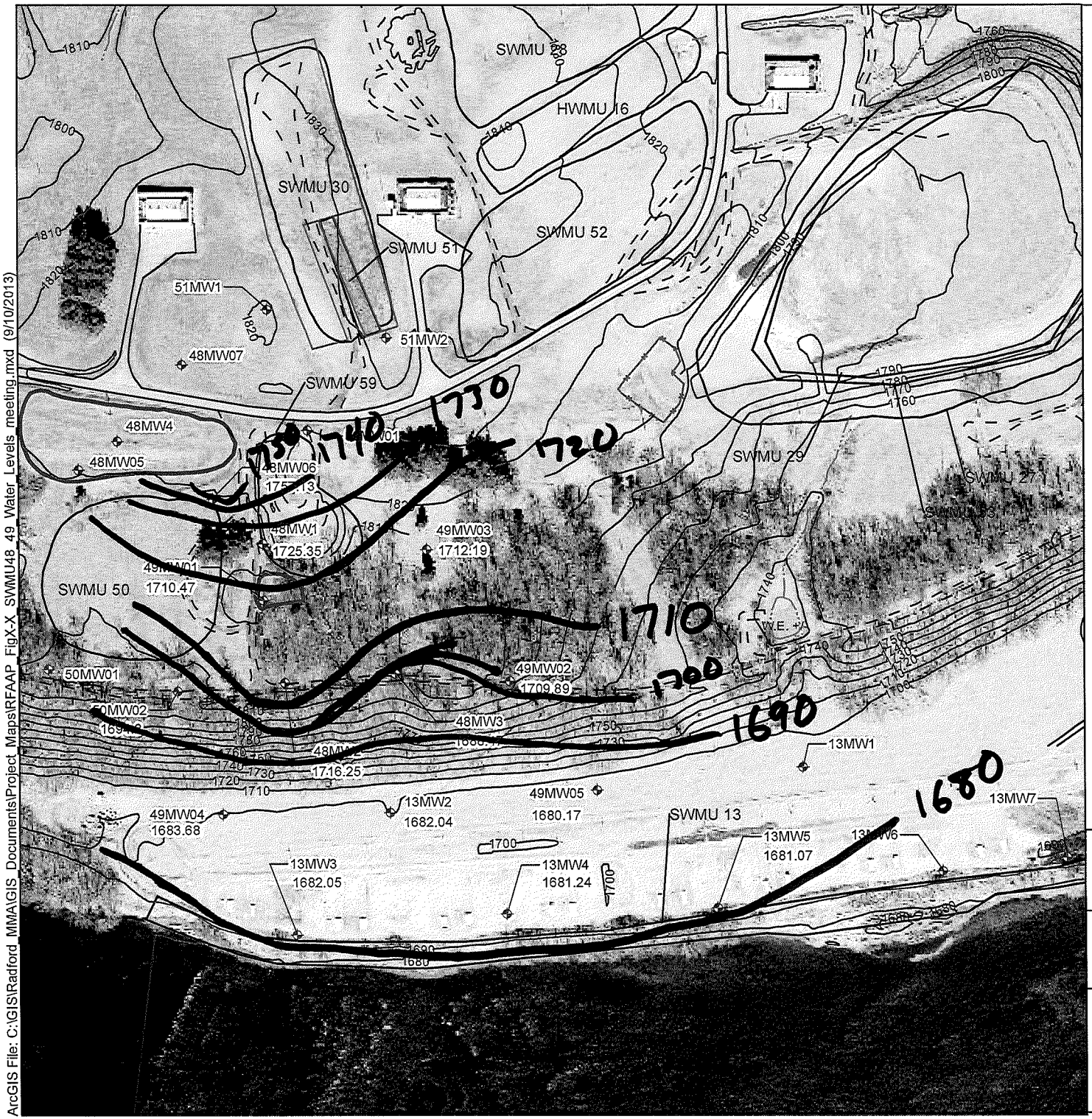


LEGEND

- Monitoring Well
- Fence
- Dirt Road
- Paved Road
- 10 ft Contour Line
- SWMU 48 and 49 Boundaries
- Other SWMU Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.
2) Groundwater elevation values are in feet.

N

Scale:

0 125 250 500 Feet

U.S. Army Corps of Engineers

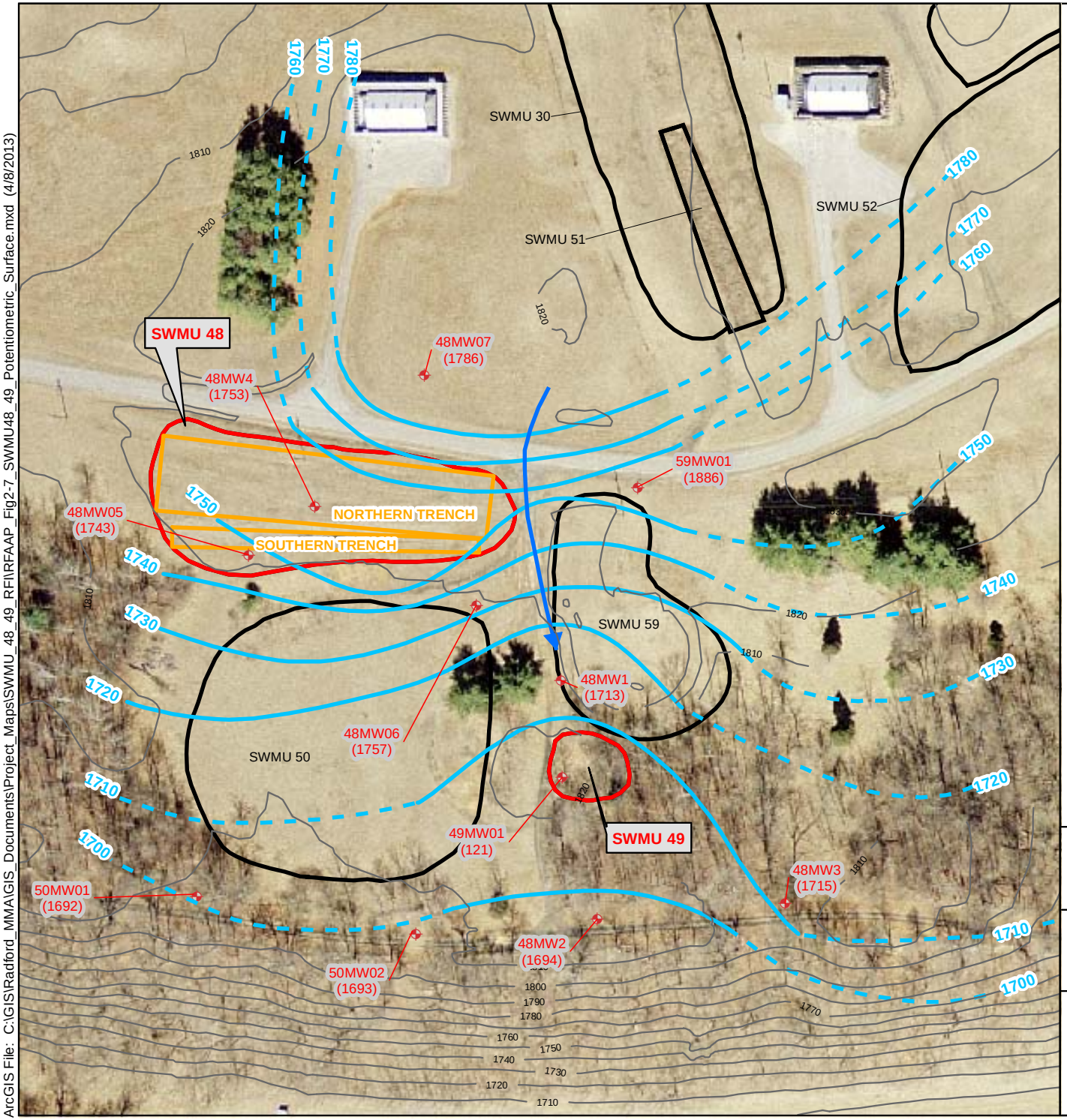
Shaw Environmental, Inc.
(A CB&I Company)
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

FIGURE X-X

May 2013 Groundwater Elevations

Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\GIS\Radford_MMA\GIS Documents\Project Maps\RFAAP FigX-X SWMU48 49 Water Levels meeting.mxd (9/10/2013)



ArcGIS File: C:\GIS\Radford_MMA\GIS_Documents\Project_Maps\SWMU_48_49_RFI\RFAAP_Fig2-7_SWMU48_49_Potentiometric_Surface.mxd (4/8/2013)

LEGEND

- Groundwater Sample Location
- Inferred Groundwater Contour
- Groundwater Contour
- Groundwater Flow Direction
- Trench Boundary (Identified in Previous Reports)
- SWMU 48 and SWMU 49 Boundaries
- Other SWMU Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.
2) Water levels are expressed in feet above mean sea level.
3) All water levels were measured in August, 2007.

N

Scale:

0 75 150 300 Feet

U.S. Army Corps of Engineers

Shaw Environmental, Inc.
(A CB&I Company)
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

FIGURE 2-7
SWMUs 48, 49, 50, and 59
Potentiometric Surface Map
Radford Army Ammunition Plant,
Radford, VA

Leahy, Timothy

From: McKenna, James J CIV (US) [james.j.mckenna16.civ@mail.mil]
Sent: Tuesday, September 03, 2013 3:00 PM
To: Cutler,Jim
Cc: Meyer, Tom NAB02; Mendoza, Richard R Jr CIV (US); Bressette, James W CIV USARMY MEDCOM PHC (US); Sherman, Jason M CIV USARMY IMCOM AEC (US); Alberts, Matt (US SSA); MaryAnn Bogucki - Radford (maryann.bogucki@baesystems.com); Stewart, Jay (US SSA); Leahy, Timothy
Subject: FW: SWMU 48/49 GW results (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: FOUO

Jim C.,

Please email below. Do you want to talk about the results or are we good to go with moving towards a remedy? If we need to talk then let's start coordinating a call for some time when Erich gets back. If not then we can start moving towards the remedy.

Thanks in advance,
JJM

-----Original Message-----
From: Weissbart, Erich [mailto:Weissbart.Erich@epa.gov]
Sent: Tuesday, August 27, 2013 7:54 AM
To: McKenna, James J CIV (US)
Subject: RE: SWMU 48/49 GW results (UNCLASSIFIED)

Jim,
I don't recall if you are back from vacation or not yet. I have looked at these results. Last I spoke with Jim he has not. Today is my last day in the office until Sept. 10. I work from home tomorrow and Thursday and then I'm on vacation. If your team wants to have a call to discuss next steps please coordinate with Cutler for when I return from vacation. From my perspective we are done characterizing at SWMU's 48/49 and ready to move towards the remedy.

Erich Weissbart, P.G.
Land and Chemicals Division (3LC20)
USEPA Region III
1650 Arch Street
Philadelphia, PA 19103
(215) 814-3284
weissbart.erich@epa.gov

-----Original Message-----
From: McKenna, James J CIV (US) [mailto:james.j.mckenna16.civ@mail.mil]
Sent: Thursday, August 15, 2013 3:41 PM
To: Weissbart, Erich; Cutler,Jim
Cc: beth lohman (ealohman@deq.virginia.gov); Stewart, Jay (US SSA); Alberts, Matt (US SSA); MaryAnn Bogucki - Radford (maryann.bogucki@baesystems.com); Meyer, Tom NAB02; Mendoza,

Richard R Jr CIV (US); Davie, Robert N III CIV (US); Ortiz, Luis A LTC USARMY JMC (US); Bressette, James W CIV USARMY MEDCOM PHC (US); Leahy, Timothy
Subject: FW: SWMU 48/49 GW results (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: FOUO

Erich, Jim C., All,

Attached files are the draft data from the 2013 sampling effort at and around SWMU 48/49. Note this is draft and has not been reviewed by the Army.

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

JJM

-----Original Message-----
From: Leahy, Timothy [mailto:Timothy.Leahy@CBIFederalServices.com]
Sent: Thursday, August 15, 2013 11:22 AM
To: McKenna, James J CIV (US)
Subject: SWMU 48/49 GW results

Hi Jim,

Here are the Groundwater sampling results from the 2013 sampling at SWMU 48/49. Figure 3-8 shows the locations that were sampled based on the field trip in January. The other two figures (figure 4-5 for CT and 4-6 for TCE) show preliminary plume boundaries for the new data. The excel table includes both a summary table with ranges of concentrations, # of exceedances, # of detections, etc., as well as a sample table that shows detected constituents for each well. For those who are interested, the non-detects can be seen by going to the Excel menu “Views -> Custom Views -> Analyzed Constituents.” To return to the original view, go to “Views -> Custom Views -> Detected Constituents.” Let me know if you have any questions.

Thanks,

Tim

Description: Description: Description: Description: Description: cid:_1_0AD725A00AD721CC001388C386257B11

Timothy Leahy, PMP

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Project Management

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Please note new email address effective May 17, 2013.

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Classification: UNCLASSIFIED
Caveats: FOUO

Classification: UNCLASSIFIED
Caveats: FOUO

Leahy, Timothy

From: McKenna, James J CIV (US) [james.j.mckenna16.civ@mail.mil]
Sent: Thursday, August 15, 2013 3:41 PM
To: Weissbart.Erich@epamail.epa.gov; Cutler,Jim
Cc: beth lohman (ealohman@deq.virginia.gov); Stewart, Jay (US SSA); Alberts, Matt (US SSA); MaryAnn Bogucki - Radford (maryann.bogucki@baesystems.com); Meyer, Tom NAB02; Mendoza, Richard R Jr CIV (US); Davie, Robert N III CIV (US); Ortiz, Luis A LTC USARMY JMC (US); Bressette, James W CIV USARMY MEDCOM PHC (US); Leahy, Timothy
Subject: FW: SWMU 48/49 GW results (UNCLASSIFIED)
Attachments: image001.gif; RFAAP_Fig4-6_SWMU48_49_2013_TCE_GW_Plume.pdf; RFAAP_Fig4-5_SWMU48_49_2013_CTC_GW_Plume.pdf; 2013 GW Results.xlsx; RFAAP_Fig3-8_SWMU48_49_2013 _Supp_RFI_Sample_Locations.pdf

Classification: UNCLASSIFIED
Caveats: FOUO

Erich, Jim C., All,

Attached files are the draft data from the 2013 sampling effort at and around SWMU 48/49. Note this is draft and has not been reviewed by the Army.

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

JJM

-----Original Message-----
From: Leahy, Timothy [mailto:Timothy.Leahy@CBIFederalServices.com]
Sent: Thursday, August 15, 2013 11:22 AM
To: McKenna, James J CIV (US)
Subject: SWMU 48/49 GW results

Hi Jim,

Here are the Groundwater sampling results from the 2013 sampling at SWMU 48/49. Figure 3-8 shows the locations that were sampled based on the field trip in January. The other two figures (figure 4-5 for CT and 4-6 for TCE) show preliminary plume boundaries for the new data. The excel table includes both a summary table with ranges of concentrations, # of exceedances, # of detections, etc., as well as a sample table that shows detected constituents for each well. For those who are interested, the non-detects can be seen by going to the Excel menu “Views -> Custom Views -> Analyzed Constituents.” To return to the

original view, go to “Views -> Custom Views -> Detected Constituents.” Let me know if you have any questions.

Thanks,

Tim

Description: Description: Description: Description: Description: cid:_1_0AD725A00AD721CC001388C386257B11

Timothy Leahy, PMP

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Please note new email address effective May 17, 2013.

_____

Classification: UNCLASSIFIED
Caveats: FOUO

LEGEND

- Monitoring Well Sampled in 2013
- Monitoring Well
- SWMU 48 and 49 Boundaries
- Other SWMU Boundary
- 10 ft Contour Line
- Dirt Road
- Paved Road
- Fence

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.

Scale:
0 125 250 500 Feet

U.S. Army Corps of Engineers

Shaw Environmental, Inc.
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4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

FIGURE 3-8

2013 Supplemental RFI Sample Locations

Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\GIS\Radford_MMA\GIS_Documents\Project_Maps\SWMU_48_49_RFI\RFAAP_Fig3-8_SWMU48_49_2013_Supp_RFI_Sample_Locations.mxd (8/7/2013)

LEGEND

- Monitoring Well
- Fence
- Dirt Road
- Paved Road
- 10 ft Contour Line
- Carbon Tetrachloride Isopleth
- Inferred Carbon Tetrachloride Isopleth
- SWMU 48 and 49 Boundaries
- Other SWMU Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.
2) Isopleth concentrations are in ug/L.
3) Sample results obtained in 2013.
4) * = Last sampled 2006. All prior concentrations were < 1 ug/L.

Scale:
0 125 250 500 Feet

U.S. Army Corps of Engineers

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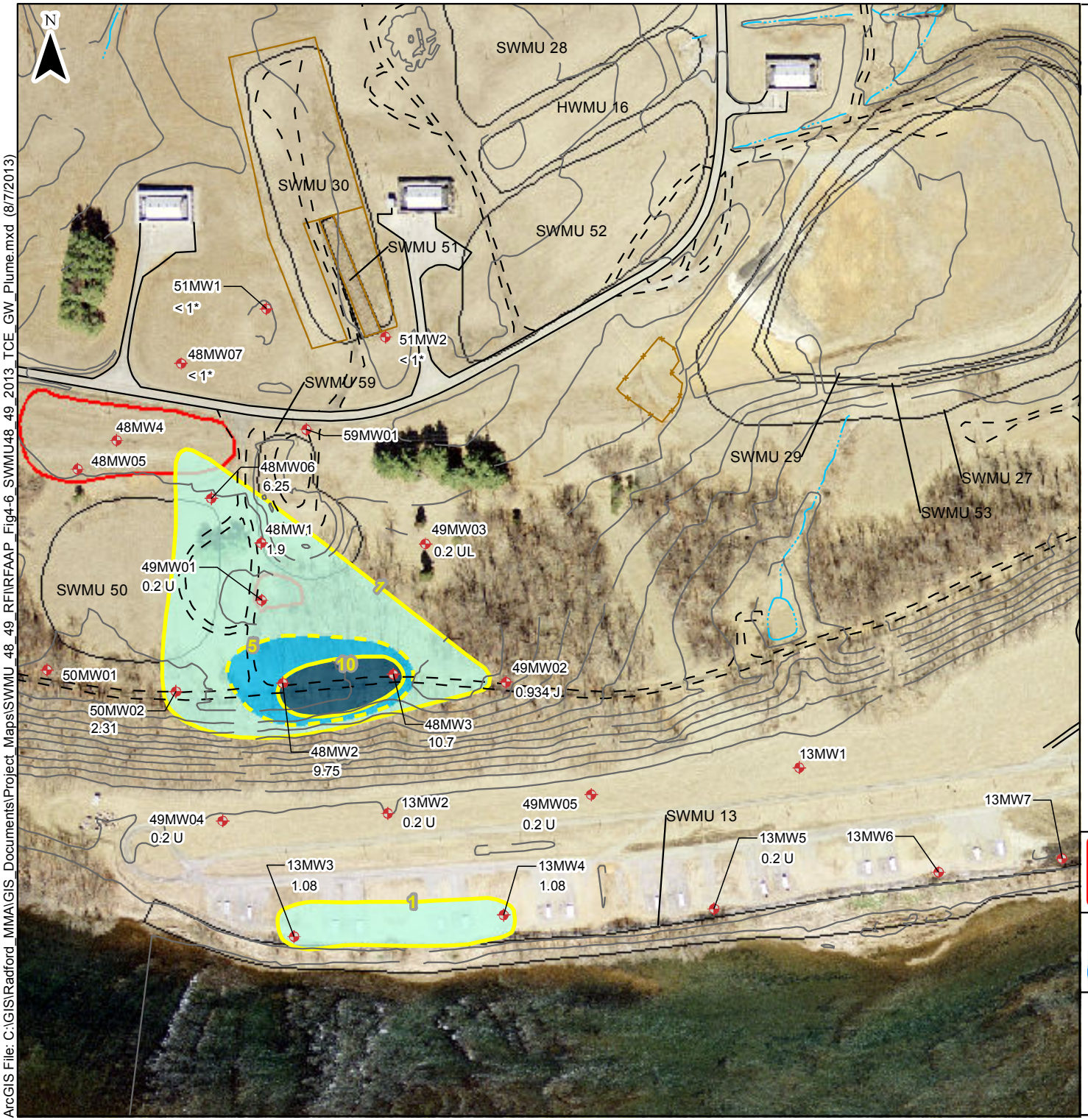
(A CB&I Company)
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

FIGURE 4-5

2013 Carbon Tetrachloride Isopleth Map

Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\GIS\Radford_MMA\GIS_Documents\Project_Maps\SWMU_48_49_RFI\RFAAP_Fig4-5_SWMU48_49_2013_CTC_GW_Plume.mxd (8/7/2013)



LEGEND

- Monitoring Well
- Fence
- Dirt Road
- Paved Road
- 10 ft Contour Line
- Trichloroethene Isopleth
- Inferred Trichloroethene Isopleth
- SWMU 48 and 49 Boundaries
- Other SWMU Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.
2) Isopleth concentrations are in ug/L.
3) Sample results obtained in 2013.
4) * = Last sampled 2006. All prior concentrations were < 1 ug/L.

Scale:
0 125 250 500 Feet

U.S. Army Corps of Engineers

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Belcamp, Maryland 21017

FIGURE 4-6

2013 Trichloroethene Isopleth Map

Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\GIS\Radford_MMA\GIS_Documents\Project_Maps\SWMU_48_49_RFI\RFAAP_Fig4-6_SWMU48_49_2013_TCE_GW_Plume.mxd (8/7/2013)

Table X
Analytes Detected in SWMU 48/49 Groundwater Samples - April 2013

Analyte	Sample ID		13MW2					13MW3					13MW4					13MW5					48MW1					48MW2					48MW3					
	Sample Date		5/6/13					5/6/13					5/6/13					5/6/13					5/8/13					5/9/13					5/9/13					
	MCL	tw-SL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result
VOCs (ug/L)																																					
1,1,1-Trichloroethane	200	750	0.2	U		*0.123*	*0.2*	0.2	U		*0.123*	*0.2*	0.2	U		*0.123*	*0.2*	0.2	U		*0.123*	*0.2*	0.432	J	J	*0.123*	*0.2*	0.2	U		*0.123*	*0.2*	0.2	U		*0.123*	*0.2*	1.66
1,1-Dichloroethane	na	2.4	0.2	U		*0.171*	*0.2*	0.2	U		*0.171*	*0.2*	0.2	U		*0.171*	*0.2*	0.2	U		*0.171*	*0.2*	1.03			*0.171*	*0.2*	0.2	U		*0.171*	*0.2*	0.2	U		*0.171*	*0.2*	5.86
1,1-Dichloroethene	7	26	0.5	U		*0.2*	*0.5*	0.5	U		*0.2*	*0.5*	0.5	U		*0.2*	*0.5*	0.5	U		*0.2*	*0.5*	0.5	U		*0.2*	*0.5*	0.5	U		*0.2*	*0.5*	0.5	U		*0.2*	*0.5*	0.301
Acetone	na	1200	1	U		*0.193*	*1*	1	U		*0.193*	*1*	1	U		*0.193*	*1*	1	U		*0.193*	*1*	1	U		*0.193*	*1*	1	U		*0.193*	*1*	1	U		*0.193*	*1*	1
Carbon tetrachloride	5	0.39	0.5	U		*0.248*	*0.5*	5.63			*0.248*	*0.5*	0.5	U		*0.248*	*0.5*	0.5	U		*0.248*	*0.5*	0.5	U		*0.248*	*0.5*	82.7			*0.248*	*0.5*	73.1			*0.248*	*0.5*	0.5
Chloroform	80	0.19	0.2	U		*0.155*	*0.2*	0.453	J	J	*0.155*	*0.2*	0.2	U		*0.155*	*0.2*	0.2	U		*0.155*	*0.2*	0.2	U		*0.155*	*0.2*	5.97			*0.155*	*0.2*	7.89			*0.155*	*0.2*	0.2
cis-1,2-Dichloroethene	70	2.8	0.2	U		*0.103*	*0.2*	0.2	U		*0.103*	*0.2*	0.2	U		*0.103*	*0.2*	0.2	U		*0.103*	*0.2*	0.817	J	J	*0.103*	*0.2*	0.2	U		*0.103*	*0.2*	0.2	U		*0.103*	*0.2*	9.21
Methylene chloride	5	4.7	0.5	U		*0.149*	*0.5*	0.5	U		*0.149*	*0.5*	0.5	U		*0.149*	*0.5*	0.5	U		*0.149*	*0.5*	0.5	U		*0.149*	*0.5*	0.5	U		*0.149*	*0.5*	0.5	U		*0.149*	*0.5*	0.5
Tetrachloroethene	5	0.072	0.5	U		*0.193*	*0.5*	0.5	U		*0.193*	*0.5*	0.5	U		*0.193*	*0.5*	0.5	U		*0.193*	*0.5*	0.5	U		*0.193*	*0.5*	0.5	U		*0.193*	*0.5*	0.5	U		*0.193*	*0.5*	0.801
Toluene	1000	86	0.2	U		*0.122*	*0.2*	0.2	U		*0.122*	*0.2*	0.2	U		*0.122*	*0.2*	0.2	U		*0.122*	*0.2*	2.1			*0.122*	*0.2*	1.18			*0.122*	*0.2*	0.291	J	J	*0.122*	*0.2*	0.2
Trichloroethene	5	0.44	0.2	U		*0.161*	*0.2*	1.08			*0.161*	*0.2*	1.08			*0.161*	*0.2*	0.2	U		*0.161*	*0.2*	1.9			*0.161*	*0.2*	9.75			*0.161*	*0.2*	10.7			*0.161*	*0.2*	6.25
Total Metals (ug/L)																																					
Aluminum	50	16000	53.8		B	*1.66*	*6*	56.1		B	*1.66*	*6*	40.4		B	*1.66*	*6*	49.2		B	*1.66*	*6*	1730			*1.66*	*6*	726			*1.66*	*6*	86			*1.66*	*6*	14.7
Antimony	6	0.6	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1
Arsenic	10	0.045	0.28	J	B	*0.094*	*0.3*	0.1	J	B	*0.094*	*0.3*	0.16	J	B	*0.094*	*0.3*	0.11	J	B	*0.094*	*0.3*	1.12			*0.094*	*0.3*	0.39	J	J	*0.094*	*0.3*	0.25	J	J	*0.094*	*0.3*	0.14
Barium	2000	290	185			*1.54*	*6*	99.8			*0.077*	*0.3*	56.1			*0.077*	*0.3*	79.2			*0.077*	*0.3*	134			*0.77*	*3*	408			*0.77*	*3*	128			*0.77*	*3*	129
Cadmium	5	0.69	0.094	J	J	*0.026*	*0.1*	0.1	U		*0.026*	*0.1*	0.16	J	J	*0.026*	*0.1*	0.044	J	J	*0.026*	*0.1*	0.027	J	J	*0.026*	*0.1*	0.1	U		*0.026*	*0.1*	0.1	U		*0.026*	*0.1*	0.1
Calcium	na	na	91100			*868*	*2000*	83200			*434*	*1000*	46200			*434*	*1000*	88700			*434*	*1000*	53600		J	*434*	*1000*	72200			*434*	*1000*	94400		J	*434*	*1000*	102000
Chromium	100	1600	9.15			*0.03*	*0.1*	13.1			*0.03*	*0.1*	2.87			*0.03*	*0.1*	9.71			*0.03*	*0.1*	31.6			*0.03*	*0.1*	29.8			*0.03*	*0.1*	4.04			*0.03*	*0.1*	0.7
Cobalt	na	0.47	0.22	J	B	*0.053*	*0.2*	1.58			*0.053*	*0.2*	0.29	J	B	*0.053*	*0.2*	0.21	J	B	*0.053*	*0.2*	4.54			*0.053*	*0.2*	1.24			*0.053*	*0.2*	0.25	J	B	*0.053*	*0.2*	0.83
Copper	1300	62	15.9			*0.093*	*0.3*	10.5		J	*0.093*	*0.3*	15.7		J	*0.093*	*0.3*	14.6		J	*0.093*	*0.3*	8.59			*0.093*	*0.3*	2.61			*0.093*	*0.3*	0.85	J	B	*0.093*	*0.3*	0.77
Iron	300	1100	122			*3.04*	*10*	168			*3.04*	*10*	86.1	J	J	*3.04*	*10*	128			*3.04*	*10*	2870			*3.04*	*10*	988			*3.04*	*10*	160			*3.04*	*10*	56.4
Lead	15	na	0.29	J	J	*0.025*	*0.1*	0.72	J	J	*0.025*	*0.1*	0.73	J	J	*0.025*	*0.1*	0.74	J	J	*0.025*	*0.1*	1.54			*0.025*	*0.1*	0.3	J	J	*0.025*	*0.1*	0.14	J	B	*0.025*	*0.1*	0.037
Magnesium	na	na	43200			*104*	*400*	33500			*52.2*	*200*	18100			*52.2*	*200*	31800			*52.2*	*200*	40900			*52.2*	*200*	36600			*52.2*	*200*	45400			*52.2*	*200*	49900
Manganese	50	32	65			*0.27*	*1*	11.7			*0.27*	*1*	4.1	J	J	*0.27*	*1*	4.45	J	J	*0.27*	*1*	49.4			*0.27*	*1*	23.9			*0.27*	*1*	4.95	J	J	*0.27*	*1*	19.7
Nickel	na	30	2.5			*0.26*	*1*	6.65			*0.26*	*1*	2.26		J	*0.26*	*1*	4.05			*0.26*	*1*	21.3			*0.26*	*1*	19.8			*0.26*	*1*	2.88			*0.26*	*1*	5.61
Potassium	na	na	1050			*9.98*	*30*	2020			*9.98*	*30*	1000			*9.98*	*30*	1340			*9.98*	*30*	2280			*9.98*	*30*	1680			*9.98*	*30*	1410			*9.98*	*30*	6040
Selenium	50	7.8	0.42	J	J	*0.11*	*0.4*	0.41	J	J	*0.11*	*0.4*	0.55	J	J	*0.11*	*0.4*	1.56		J	*0.11*	*0.4*	0.59	J	J	*0.11*	*0.4*	0.3	J	J	*0.11*	*0.4*	1.9		J	*0.11*	*0.4*	0.56
Silver	100	7.1	0.06	U		*0.017*	*0.06*	1.43			*0.017*	*0.06*	0.06	U		*0.017*	*0.06*	0.06	U		*0.017*	*0.06*	0.69	J	J	*0.017*	*0.06*	0.06	U		*0.017*	*0.06*	0.06	U		*0.017*	*0.06*	0.06
Sodium	na	na	3970			*8*	*30*	15100			*80*	*300*	16700			*80*	*300*	11600			*80*	*300*	16100			*80*	*300*	3320			*8*	*30*	1700			*8*	*30*	79800
Thallium	2	0.016	0.2	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.12	J	J	*0.06*	*0.2*	0.11	J	J	*0.06*	*0.2*	0.2
Vanadium	na	7.8	1.18		B	*0.085*	*0.3*	0.84	J	B	*0.085*	*0.3*	0.68	J	B	*0.085*	*0.3*	0.71	J	B	*0.085*	*0.3*	3.74		J	*0.085*	*0.3*	2.53		B	*0.085*	*0.3*	1.35		B	*0.085*	*0.3*	0.22
Zinc	5000	470	48.7			*1.31*	*5*	17.5	J	J	*1.31*	*5*	34.6			*1.31*	*5*	42.3			*1.31*	*5*	30.5			*1.31*	*5*	3.6	J	J	*1.31*	*5*	5.06	J	J	*1.31*	*5*	5.61
Dissolved Metals (ug/L)																																					
Aluminum	50	16000	6.33	J	J	*1.66*	*6*	6	U		*1.66*	*6*	6	U		*1.66*	*6*	2.09	J	J	*1.66*	*6*	5.38	J	J	*1.66*	*6*	2.23	J	B	*1.66*	*6*	3.49	J	B	*1.66*	*6*	6
Antimony	6	0.6	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1
Arsenic	10	0.045	0.2	J	J	*0.094*	*0.3*	0.3	U		*0.094*	*0.3*	0.099	J	J	*0.094*	*0.3*	0.095	J	J	*0.094*	*0.3*	0.1	J	J	*0.094*	*0.3*	0.095	J	J	*0.094*	*0.3*	0.13	J	J	*0.094*	*0.3*	0.3
Barium	2000	290	171			*1.54*	*6*	91			*0.077*	*0.3*	51.2			*0.077*	*0.3*	76.3			*0.077*	*0.3*	104			*0.77*	*3*	401		K	*0.77*	*3*	110		K	*0.77*	*3*	193
Beryllium	4	1.6	0.1	U		*0.049*	*0.1*	0.1	U		*0.049*	*0.1*	0.1	U		*0.049*	*0.1*	0.1	U		*0.049*	*0.1*	0.1	U		*0.049*	*0.1*	0.1	U		*0.049*	*0.1*	0.1	U		*0.049*	*0.1*	0.1
Calcium	na	na	82700			*868*	*2000*	74100			*434*	*1000*	40900			*434*	*1000*	81100			*434*	*1000*	43900			*434*	*1000*	59900			*434*	*1000*	76000			*434*	*1000*	93000
Chromium	100	1600	6.9			*0.03*	*0.1*	1.15		B	*0.03*	*0.1*	1.73		B	*0.03*	*0.1*	3.89		B	*0.03*	*0.1*	1.27			*0.03*	*0.1*	1.05		B	*0.03*	*0.1*	1.17		B	*0.03*	*0.1*	1.06
Cobalt	na	0.47	0.1	J	J	*0.053*	*0.2*	1.16			*0.053*	*0.2*	0.18	J	J	*0.053*	*0.2*	0.092	J	J	*0.053*	*0.2*	0.75	J	J	*0.053*	*0.2*	0.23	J	J	*0.053*	*0.2*	0.077	J	J	*0.053*	*0.2*	0.36
Copper	1300	62	13			*0.093*	*0.3*	4.21			*0.093*	*0.3*	10.5			*0.093*	*0.3*	11.2			*0.093*	*0.3*	1.79			*0.093*	*0.3*	0.5	J	B	*0.093*	*0.3*	0.41	J	B	*0.093*	*0.3*	0.35
Iron	300	1100	22.1	J	B	*3.04*	*10*	19.7	J	B	*3.04*	*10*	13.1	J	B	*3.04*	*10*	23.2	J	B	*3.04*	*10*	19.3	J	B	*3.04*	*10*	20.1	J	B	*3.04*	*10*	23.4	J	B	*3.04*	*10*	24.7
Lead	15	na	0.044	J	B	*0.025*	*0.1*	0.034	J	B	*0.025*	*0.1*	0.068	J	B	*0.025*	*0.1*	0.087	J	B	*0.025*	*0.1*	0.031	J	B	*0.025*	*0.1*	0.034	J	B	*0.025*	*0.1*	0.1	U		*0.025*	*0.1*	0.1
Magnesium	na	na	39000			*104*	*400*	28900			*52.2*	*200*	16000			*52.2*	*200*	28100			*52.2*	*200*	32100			*52.2*	*200*	28300			*52.2*	*200*	35100			*52.2*	*200*	45100
Manganese	50	32	1.23	J	J	*0.27*	*1*	9.28			*0.27*	*1*	1.14	J	J	*0.27*	*1*	1.25	J	J	*0.27*	*1*	6.11			*0.27*	*1*	3.32	J	J	*0.27*	*1*	0.33	J	J	*0.27*	*1*	15.9
Nickel	na	30	1.9		B	*0.26*	*1*	4.9			*0.26*	*1*	2.69		J	*0.26*	*1*	1.77		B	*0.26*	*1*	9.57			*0.26*	*1*	8.86			*0.26*	*1*	1.79		B	*0.26*	*1*	8.59
Potassium	na	na	901			*9.98*	*30*	1800			*9.98*	*30*	892			*9.98*	*30*	1240			*9.98*	*30*	1620			*9.98*	*30*	1430			*9.98*	*30*	1130			*9.98*	*30*	5550
Selenium	50	7.8	0.42	J	J	*0.11*	*0.4*	0.39	J	J	*0.11*	*0.4*	0.54	J	J	*0.11*	*0.4*	1.8		J	*0.11*	*0.4*	0.35	J	J	*0.11*	*0.4*	0.43	J	B	*0.11*	*0.4*	2.62		J	*0.11*	*0.4*	0.53
Sodium	na	na	3760			*8*	*30*	14700			*80*	*300*	16200			*80*	*300*	11800		J	*80*	*300*	14600			*80*	*300*	3010			*8*	*30*	1410			*8*	*30*	77600
Thallium	2	0.016	0.2	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.14	J	B	*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.2
Vanadium	na	7.8	0.66	J	J	*0.085*	*0.3*	0.22	J	J	*0.085*	*0.3*	0.32	J	J	*0.085*	*0.3*	0.38	J	J	*0.085*	*0.3*	0.3	U		*0.085*	*0.3*	0.11	J	B	*0.085*	*0.3*	0.42	J	B	*0.085*	*0.3*	0.12
Zinc	5000	470	38.2			*1.31*	*5*	19.7	J	J	*1.31*	*5*	30.9			*1.31*	*5*	45.5			*1.31*	*5*	20			*1.31*	*5*	2.45	J	B	*1.31*	*5*	2.43	J	B	*1.31*	*5*	4.35
Dioxins/Furans (ug/L)	None detected																																				
Misc. (ug/L)																																					
Total Organic Carbon	na	na	1000	U		*300*	*1000*	1000	U		*300*	*1000*	1000	U		*300*	*1000*	660	J	J	*300*	*1000*	880	J	J	*300*	*1000*	310	J	J	*300*	*1000*	520	J	J	*300*	*1000*	55300
Chloride	250000	na	4380			*10*	*100*	5530			*20*	*200*	5170			*20*	*200*	5610			*20*	*200*	4140			*10*	*100*	4980			*10*	*100*	3080			*50*	*500*	12300
Nitrate (as N)	10000	5800	329	J	J	*20*	*200*	2050			*20*	*200*	1050			*20*	*200*	1540			*20*	*200*	1670			*20*	*200*	1060			*20*	*200*	6210			*100*	*1000*	4500
Sulfate	250000	na	44000			*200*	*2000*	130000			*400*	*4000*	51300			*400*	*4000*	110000			*400*	*4000*	56700			*400*	*4000*	29600			*100*	*1000*	27300			*200*	*2000*	195000
Methane	na	na	1.09	U		*0.486*	*1.09*	1.09	U		*0.486*	*1.09*	1.09	U		*0.486*	*1.09*	1.09	U		*0.486*	*1.09*	1.09	U		*0.486*	*1.09*	1.09	U		*0.486*	*1.09*	1.09	U		*0.486*	*1.09*	1.09
Ethane	na	na	0.22	U		*0.135*	*0.22*	0.22	U		*0.135*	*0.22*	0.22	U		*0.135*	*0.22*	0.22	U		*0.135*	*0.22*	0.22	U		*0.135*	*0.22*	0.22	U		*0.135*	*0.22*	0.22	U		*0.135*	*0.22*	0.22
Ethene	na	na	0.29	U		*0.157*	*0.29*	0.29	U		*0.157*	*0.29*	0.29	U		*0.157*	*0.29*	0.29	U		*0.157*	*0.29*	0.29	U		*0.157*	*0.29*	0.29	U		*0.157*	*0.29*	0.29	U		*0.157*	*0.29*	0.29

12	J	Shading and black font indicates a MCL exceedance
12	J	Bold outline indicates a tw-SL exceedance.
12	*12*	Shading in the MDL/MRL columns indicates the MDL exceeds a criterion.

Table X
Analytes Detected in SWMU 48/49 Groundwater Samples - April 2013

Analyte	Sample ID	48MW06					49MW01					49MW02					49MW03					49MW04					49MW05					50MW02				
	Sample Date	5/7/13					5/8/13					5/9/13					5/7/13					5/6/13					5/6/13					5/8/13				
	MCL	tw-SL	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/L)																																			
1,1,1-Trichloroethane	200	750			*0.123*	*0.2*	0.2	U		*0.123*	*0.2*	0.2	U		*0.123*	*0.2*	0.2	U	UL	*0.123*	*0.2*	0.2	U		*0.123*	*0.2*	0.2	U		*0.123*	*0.2*	0.251	J	J	*0.123*	*0.2*
1,1-Dichloroethane	na	2.4			*0.171*	*0.2*	0.2	U		*0.171*	*0.2*	0.2	U		*0.171*	*0.2*	0.2	U	UL	*0.171*	*0.2*	0.2	U		*0.171*	*0.2*	0.2	U		*0.171*	*0.2*	0.344	J	J	*0.171*	*0.2*
1,1-Dichloroethene	7	26	J	J	*0.2*	*0.5*	0.5	U		*0.2*	*0.5*	0.5	U		*0.2*	*0.5*	0.5	U	UL	*0.2*	*0.5*	0.5	U		*0.2*	*0.5*	0.5	U		*0.2*	*0.5*	0.5	U		*0.2*	*0.5*
Acetone	na	1200	U		*0.193*	*1*	1	U		*0.193*	*1*	2.41	J	B	*0.193*	*1*	1	U	UL	*0.193*	*1*	1	U		*0.193*	*1*	1	U		*0.193*	*1*	1	U		*0.193*	*1*
Carbon tetrachloride	5	0.39	U		*0.248*	*0.5*	4.61			*0.248*	*0.5*	5.36			*0.248*	*0.5*	0.5	U	UL	*0.248*	*0.5*	0.664	J	J	*0.248*	*0.5*	0.5	U		*0.248*	*0.5*	0.919	J	J	*0.248*	*0.5*
Chloroform	80	0.19	U		*0.155*	*0.2*	0.193	J	J	*0.155*	*0.2*	7.79			*0.155*	*0.2*	0.2	U	UL	*0.155*	*0.2*	1.25			*0.155*	*0.2*	0.2	U		*0.155*	*0.2*	0.2	U		*0.155*	*0.2*
cis-1,2-Dichloroethene	70	2.8			*0.103*	*0.2*	0.2	U		*0.103*	*0.2*	0.2	U		*0.103*	*0.2*	0.2	U	UL	*0.103*	*0.2*	0.2	U		*0.103*	*0.2*	0.2	U		*0.103*	*0.2*	0.373	J	J	*0.103*	*0.2*
Methylene chloride	5	4.7	U		*0.149*	*0.5*	0.5	U		*0.149*	*0.5*	0.5	U		*0.149*	*0.5*	2.3	J	L	*0.149*	*0.5*	0.5	U		*0.149*	*0.5*	0.5	U		*0.149*	*0.5*	0.5	U		*0.149*	*0.5*
Tetrachloroethene	5	0.072	J	J	*0.193*	*0.5*	0.5	U		*0.193*	*0.5*	0.5	U		*0.193*	*0.5*	0.5	U	UL	*0.193*	*0.5*	0.5	U		*0.193*	*0.5*	0.5	U		*0.193*	*0.5*	0.255	J	J	*0.193*	*0.5*
Toluene	1000	86	U		*0.122*	*0.2*	0.765	J	J	*0.122*	*0.2*	1.52			*0.122*	*0.2*	0.2	U	UL	*0.122*	*0.2*	0.2	U		*0.122*	*0.2*	0.2	U		*0.122*	*0.2*	0.726	J	J	*0.122*	*0.2*
Trichloroethene	5	0.44			*0.161*	*0.2*	0.2	U		*0.161*	*0.2*	0.934	J	J	*0.161*	*0.2*	0.2	U	UL	*0.161*	*0.2*	0.2	U		*0.161*	*0.2*	0.2	U		*0.161*	*0.2*	2.31			*0.161*	*0.2*
Total Metals (ug/L)																																			
Aluminum	50	16000	J	B	*1.66*	*6*	1050			*1.66*	*6*	16.4	J	B	*1.66*	*6*	39.2		B	*1.66*	*6*	34.5		B	*1.66*	*6*	1530		J	*1.66*	*6*	519		J	*1.66*	*6*
Antimony	6	0.6	U		*0.48*	*1*	1	U		*0.48*	*1*	3.53			*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*
Arsenic	10	0.045	J	B	*0.094*	*0.3*	0.53	J	J	*0.094*	*0.3*	1.56			*0.094*	*0.3*	0.3	U		*0.094*	*0.3*	0.25	J	B	*0.094*	*0.3*	0.74	J	B	*0.094*	*0.3*	0.36	J	J	*0.094*	*0.3*
Barium	2000	290		J	*1.54*	*6*	48.4			*0.077*	*0.3*	129			*0.77*	*3*	191			*0.77*	*3*	82			*0.077*	*0.3*	170			*0.77*	*3*	105			*0.77*	*3*
Cadmium	5	0.69	U		*0.026*	*0.1*	0.1	U		*0.026*	*0.1*	0.1	U		*0.026*	*0.1*	0.1	U		*0.026*	*0.1*	0.1	U		*0.026*	*0.1*	0.1	U		*0.026*	*0.1*	0.1	U		*0.026*	*0.1*
Calcium	na	na			*868*	*2000*	42600			*434*	*1000*	56100		J	*434*	*1000*	50700		J	*434*	*1000*	73000			*434*	*1000*	65600			*434*	*1000*	87300		J	*434*	*1000*
Chromium	100	1600	J	J	*0.03*	*0.1*	11.8			*0.03*	*0.1*	0.47	J	B	*0.03*	*0.1*	17.3		J	*0.03*	*0.1*	5.56			*0.03*	*0.1*	6.88			*0.03*	*0.1*	5.01		J	*0.03*	*0.1*
Cobalt	na	0.47	J	J	*0.053*	*0.2*	3.15			*0.053*	*0.2*	1.42		J	*0.053*	*0.2*	2			*0.053*	*0.2*	0.35	J	J	*0.053*	*0.2*	1.06			*0.053*	*0.2*	0.39	J	J	*0.053*	*0.2*
Copper	1300	62	J	B	*0.093*	*0.3*	8.58			*0.093*	*0.3*	0.98	J	B	*0.093*	*0.3*	2.83		J	*0.093*	*0.3*	14.8			*0.093*	*0.3*	2.3		J	*0.093*	*0.3*	2.09		J	*0.093*	*0.3*
Iron	300	1100	J	J	*3.04*	*10*	2540			*3.04*	*10*	17.9	J	J	*3.04*	*10*	142			*3.04*	*10*	66.8	J	J	*3.04*	*10*	2080			*3.04*	*10*	652		J	*3.04*	*10*
Lead	15	na	J	B	*0.025*	*0.1*	0.68	J	J	*0.025*	*0.1*	0.034	J	B	*0.025*	*0.1*	0.12	J	B	*0.025*	*0.1*	0.17	J	B	*0.025*	*0.1*	1.51			*0.025*	*0.1*	5.27		J	*0.025*	*0.1*
Magnesium	na	na			*104*	*400*	39900			*52.2*	*200*	34800			*52.2*	*200*	22700			*52.2*	*200*	40600			*52.2*	*200*	33900			*52.2*	*200*	36100			*52.2*	*200*
Manganese	50	32			*0.27*	*1*	67.8			*0.27*	*1*	36.4			*0.27*	*1*	6.58			*0.27*	*1*	4.99	J	J	*0.27*	*1*	65.1			*0.27*	*1*	12.8		J	*0.27*	*1*
Nickel	na	30		J	*0.26*	*1*	8.34			*0.26*	*1*	40.1			*0.26*	*1*	8.27		J	*0.26*	*1*	4.74			*0.26*	*1*	4.52			*0.26*	*1*	3.74		J	*0.26*	*1*
Potassium	na	na			*9.98*	*30*	1670			*9.98*	*30*	3010			*9.98*	*30*	1870			*9.98*	*30*	4860			*9.98*	*30*	2140			*9.98*	*30*	2190			*9.98*	*30*
Selenium	50	7.8	J	J	*0.11*	*0.4*	0.2	J	J	*0.11*	*0.4*	10.2		J	*0.11*	*0.4*	0.4	U		*0.11*	*0.4*	0.33	J	J	*0.11*	*0.4*	0.41	J	J	*0.11*	*0.4*	0.36	J	J	*0.11*	*0.4*
Silver	100	7.1	U		*0.017*	*0.06*	0.06	U		*0.017*	*0.06*	0.06	U		*0.017*	*0.06*	2.45			*0.017*	*0.06*	0.06	U		*0.017*	*0.06*	0.06	U		*0.017*	*0.06*	0.06	U		*0.017*	*0.06*
Sodium	na	na			*160*	*600*	673	J	J	*8*	*30*	8280			*8*	*30*	2180			*8*	*30*	2180			*8*	*30*	2060			*8*	*30*	15200			*80*	*300*
Thallium	2	0.016	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.16	J	J	*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.16	J	B	*0.06*	*0.2*	0.2	U		*0.06*	*0.2*
Vanadium	na	7.8	J	B	*0.085*	*0.3*	2.23		B	*0.085*	*0.3*	1.1		B	*0.085*	*0.3*	0.59	J	B	*0.085*	*0.3*	0.62	J	B	*0.085*	*0.3*	3.79			*0.085*	*0.3*	2.16		B	*0.085*	*0.3*
Zinc	5000	470	J	J	*1.31*	*5*	1.75	J	J	*1.31*	*5*	5	U		*1.31*	*5*	8.29	J	J	*1.31*	*5*	21.3			*1.31*	*5*	8.01	J	J	*1.31*	*5*	13.2	J	J	*1.31*	*5*
Dissolved Metals (ug/L)																																			
Aluminum	50	16000	U		*1.66*	*6*	5.02	J	B	*1.66*	*6*	11	J	B	*1.66*	*6*	4.19	J	J	*1.66*	*6*	3.52	J	J	*1.66*	*6*	5.4	J	J	*1.66*	*6*	4	J	J	*1.66*	*6*
Antimony	6	0.6	U		*0.48*	*1*	1	U		*0.48*	*1*	3.84			*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*	1	U		*0.48*	*1*
Arsenic	10	0.045	U		*0.094*	*0.3*	0.3	U		*0.094*	*0.3*	1.5			*0.094*	*0.3*	0.3	U		*0.094*	*0.3*	0.18	J	J	*0.094*	*0.3*	0.29	J	J	*0.094*	*0.3*	0.3	U		*0.094*	*0.3*
Barium	2000	290		J	*1.54*	*6*	43.6		K	*0.077*	*0.3*	134		K	*0.77*	*3*	171			*0.77*	*3*	76.2			*0.077*	*0.3*	115			*0.77*	*3*	102			*0.77*	*3*
Beryllium	4	1.6	U		*0.049*	*0.1*	0.1	U		*0.049*	*0.1*	0.1	U		*0.049*	*0.1*	0.1	U		*0.049*	*0.1*	0.1	U		*0.049*	*0.1*	0.1	U		*0.049*	*0.1*	0.1	U		*0.049*	*0.1*
Calcium	na	na			*868*	*2000*	32700			*434*	*1000*	56800			*434*	*1000*	43300			*434*	*1000*	66000			*434*	*1000*	55300			*434*	*1000*	80000			*434*	*1000*
Chromium	100	1600		B	*0.03*	*0.1*	1.22		B	*0.03*	*0.1*	0.53	J	B	*0.03*	*0.1*	1.18			*0.03*	*0.1*	0.52	J	B	*0.03*	*0.1*	0.4	J	B	*0.03*	*0.1*	1	J	J	*0.03*	*0.1*
Cobalt	na	0.47	J	J	*0.053*	*0.2*	0.12	J	J	*0.053*	*0.2*	2.02		J	*0.053*	*0.2*	0.75	J	J	*0.053*	*0.2*	0.24	J	J	*0.053*	*0.2*	0.26	J	J	*0.053*	*0.2*	0.082	J	J	*0.053*	*0.2*
Copper	1300	62	J	B	*0.093*	*0.3*	0.2	J	B	*0.093*	*0.3*	0.76	J	B	*0.093*	*0.3*	1.15			*0.093*	*0.3*	12.2			*0.093*	*0.3*	0.33	J	B	*0.093*	*0.3*	0.9	J	J	*0.093*	*0.3*
Iron	300	1100	J	B	*3.04*	*10*	12.3	J	B	*3.04*	*10*	16.9	J	B	*3.04*	*10*	13.3	J	B	*3.04*	*10*	18.7	J	B	*3.04*	*10*	16.3	J	B	*3.04*	*10*	23.1	J	B	*3.04*	*10*
Lead	15	na	U		*0.025*	*0.1*	0.029	J	B	*0.025*	*0.1*	0.035	J	B	*0.025*	*0.1*	0.1	U		*0.025*	*0.1*	0.041	J	B	*0.025*	*0.1*	0.1	U		*0.025*	*0.1*	0.2	J	J	*0.025*	*0.1*
Magnesium	na	na			*104*	*400*	32500			*52.2*	*200*	33900			*52.2*	*200*	18400			*52.2*	*200*	36300			*52.2*	*200*	27000			*52.2*	*200*	30300			*52.2*	*200*
Manganese	50	32			*0.27*	*1*	2.87	J	J	*0.27*	*1*	35.7			*0.27*	*1*	3.69	J	J	*0.27*	*1*	3.65	J	J	*0.27*	*1*	25.7			*0.27*	*1*	2.3	J	J	*0.27*	*1*
Nickel	na	30		J	*0.26*	*1*	2.69			*0.26*	*1*	35.4			*0.26*	*1*	3.88			*0.26*	*1*	3.76			*0.26*	*1*	2.06		B	*0.26*	*1*	2.28		B	*0.26*	*1*
Potassium	na	na			*9.98*	*30*	1410			*9.98*	*30*	2950			*9.98*	*30*	1630			*9.98*	*30*	4520			*9.98*	*30*	1820			*9.98*	*30*	1930			*9.98*	*30*
Selenium	50	7.8	J	J	*0.11*	*0.4*	0.4	U		*0.11*	*0.4*	11.7		J	*0.11*	*0.4*	0.4	U		*0.11*	*0.4*	0.35	J	J	*0.11*	*0.4*	0.16	J	J	*0.11*	*0.4*	0.3	J	J	*0.11*	*0.4*
Sodium	na	na			*160*	*600*	649	J	J	*8*	*30*	7760			*8*	*30*	2040			*8*	*30*	2140			*8*	*30*	2000			*8*	*30*	13600		J	*80*	*300*
Thallium	2	0.016	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.14	J	B	*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*	0.2	U		*0.06*	*0.2*
Vanadium	na	7.8	J	J	*0.085*	*0.3*	0.3	U		*0.085*	*0.3*	0.4	J	B	*0.085*	*0.3*	0.3	U		*0.085*	*0.3*	0.27	J	J	*0.085*	*0.3*	0.22	J	J	*0.085*	*0.3*	0.19	J	B	*0.085*	*0.3*
Zinc	5000	470	J	B	*1.31*	*5*	1.9	J	B	*1.31*	*5*	3.74	J	B	*1.31*	*5*	5.27	J	B	*1.31*	*5*	20.7			*1.31*	*5*	5.36	J	B	*1.31*	*5*	6.09	J	B	*1.31*	*5*
Dioxins/Furans (ug/L)	None detected																																		
Misc. (ug/L)																																			
Total Organic Carbon	na	na			*3000*	*10000*	2500			*300*	*1000*	12100			*300*	*1000*	530	J	J	*300*	*1000*	2100			*300*	*1000*	2800			*300*	*1000*	1300		J	*300*	*1000*
Chloride	250000	na			*50*	*500*	5210			*20*	*200*	12500			*100*	*1000*	5930			*20*	*200*	5770			*10*	*100*	2670			*10*	*100*	7570			*50*	*500*
Nitrate (as N)	10000	5800			*20*	*200*	242	J	J	*20*	*200*	28	J	J	*20*	*200*	1060			*20*	*200*	419	J	J	*20*	*200*	153	J	J	*20*	*200*	2300			*20*	*200*
Sulfate	250000	na			*2000*	*20000*	240			*20*	*200*	53800			*200*	*2000*	2930			*20*	*200*	46300			*400*	*4000*	35300			*200*	*2000*	69900			*1000*	*10000*
Methane	na	na	U		*0.486*	*1.09*	1.09	U		*0.486*	*1.09*	1.4	J	J	*0.486*	*1.09*	1.09	U		*0.486*	*1.09*	1.09	U		*0.486*	*1.09*	1.09	U		*0.486*	*1.09*	1.09	U		*0.486*	*1.09*
Ethane	na	na	U		*0.135*	*0.22*	0.22	U		*0.135*	*0.22*	0.22	U		*0.135*	*0.22*	0.22	U		*0.135*	*0.22*	0.22	U		*0.135*	*0.22*	0.22	U		*0.135*	*0.22*	0.22	U		*0.135*	*0.22*
Ethene	na	na	U		*0.157*	*0.29*	0.29	U		*0.157*	*0.29*	0.29	U		*0.157*	*0.29*	0.29	U		*0.157*	*0.29*	0.818	J	J	*0.157*	*0.29*	0.29	U		*0.157*	*0.29*	0.29	U		*0.157*	*0.29*

12	J
12	J
12	*12*

Leahy, Timothy

From: McKenna, James J CIV (US) [james.j.mckenna16.civ@mail.mil]
Sent: Tuesday, April 02, 2013 9:16 AM
To: Weissbart.Erich@epamail.epa.gov
Cc: Jim Cutler; Alberts, Matt (US SSA); Mendoza, Richard R Jr CIV (US); Davie, Robert N III CIV (US); Leahy, Timothy; Meyer, Tom NAB02; Maiden, Vince (DEQ); Stewart, Jay (US SSA); Davie, Robert N III CIV (US)
Subject: RE: FW: EPA/VDEQ meeting - Jan 25, 2013 (UNCLASSIFIED)
Attachments: Letter WP for well installation and sampling at SWMU 48/49; SWMU 49 Well Installation-2013 WP_rev1.pdf

Classification: UNCLASSIFIED
Caveats: FOUO

Erich, all,

This is a follow up status to this email string. We are proceeding with the approval as discussed below. I have attached an email I received from Tim Leahy, CBI (formerly Shaw) yesterday that contains their letter work plan. In case there are problems opening the attached email I've also attached the letter work plan as a separate file. It appears to match our 01/25/2013 meeting agreement. CBI plans to start the field work on Monday, April 8, 2013.

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

JJM

-----Original Message-----
From: Weissbart.Erich@epamail.epa.gov [mailto:Weissbart.Erich@epamail.epa.gov]
Sent: Wednesday, January 30, 2013 11:06 AM
To: McKenna, James J CIV (US)
Cc: Jim Cutler; Alberts, Matt (US SSA); Mendoza, Richard R Jr CIV (US); Davie, Robert N III CIV (US); Timothy.Leahy@shawgrp.com; Meyer, Tom NAB02; Maiden, Vince (DEQ)
Subject: Re: FW: EPA/VDEQ meeting - Jan 25, 2013 (UNCLASSIFIED)

To All:
Please accept this email as conditional approval of the SWMU48/49 November 30, 2012 response to comments and ARSAR December 13, 2012 response to comments. In conjunction with the January 25, 2013 site meeting and the email summary and pdf attachment submitted January 29, 2013, EPA and VADEQ have no further comment on proposed work and pending reports for either unit. Therefore this email constitutes an unconditional approval of proposed scopes of work and responses to comments for both units (ARSAR and SWMUs 48/49). It is our understanding that with this email approval, work will proceed towards additional monitoring well installation at SWMUs 48/49, a monitoring event will take place subsequent to the well installation, and a meeting proposed to discuss the results and the path forward for SWMUs 48/49. Additionally we expect that the previous draft submittals related to Interim Measures and Risk Assessment will be revised as proposed. If there are any questions please contact me.

Erich Weissbart P.G.
Land and Chemicals Division (3LC20)

US EPA Region III
1650 Arch Street
Philadelphia, PA 19103
Phone: 215-814-3284
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-----"McKenna, James J CIV (US)" <james.j.mckenna16.civ@mail.mil> wrote: -----
To: "Meyer, Tom NAB02" <Tom.Meyer@usace.army.mil>, "Mendoza, Richard R Jr CIV (US)" <richard.r.mendoza.civ@mail.mil>, "Alberts, Matt (US SSA)" <matt.alberts@baesystems.com>, Erich Weissbart/R3/USEPA/US@EPA, "Cutler,Jim" <James.Cutler@deq.virginia.gov>, "Maiden, Vince (DEQ)" <Vincent.Maiden@deq.virginia.gov>
From: "McKenna, James J CIV (US)" <james.j.mckenna16.civ@mail.mil>
Date: 01/29/2013 02:44PM
Cc: "Davie, Robert N III CIV (US)" <robert.n.davie4.civ@mail.mil>, "Timothy.Leahy@shawgrp.com" <Timothy.Leahy@shawgrp.com>
Subject: FW: EPA/VDEQ meeting - Jan 25, 2013 (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: FOUO

All,

See Tim's notes below and attached figure to document our path forward for SWMUs 48/49 and the ARSAR. Only thing I can add is that we were going to have data review meeting or conference call after we get the gw data back from SWMU 48/49 effort.

Thanks,
JJM

-----Original Message-----
From: Leahy, Timothy [mailto:Timothy.Leahy@shawgrp.com]
Sent: Tuesday, January 29, 2013 2:20 PM
To: McKenna, James J CIV (US)
Subject: EPA/VDEQ meeting - Jan 25, 2013

Here are my notes from the field trip last week. I think it was very helpful to meet face-to-face and get out to see the actual sites. Let me know if you have any changes or if you want to forward them to the rest of the group.

Thanks,

Tim

Path forward for SWMU 48&49

We will do what was in the response to comments with a few exceptions based on our meeting at RFAAP on Friday, Jan 25, 2013. The changes made to the RTCs are captured below:

-Install 4 new wells at locations shown on attached figure (rather than 2 as proposed in the RTCs).

-Collect one round of samples (instead of 2 rounds) from the newly installed wells and existing wells (circled on the attached figure) Note the wells circled on the figure are a smaller subset than what is in the RTCs:

48MW06

48MW1

49MW01

50MW02

48MW02

48MW3

13MW2

13MW3

13MW4

13MW5

Also, we will resample the existing wells where dioxins were elevated and ensure that no entrained sediment is present.

Path forward for ARSAR:

We will revise the report based on the RTCs and will also add additional geologic information that supports the elevated arsenic being the result of the "unique geologic setting" of the ARSAR at Radford. Here's the information that I presented in the van about the geology of that particular area:

The geologic map describes the unit (DO) on the hillside behind the ARSAR as:

Devonian, Silurian, and Ordovician, undivided: Includes partial sections of the

Millboro Shale, undivided Silurian units, and Martinsburg Formation. These rocks are

exposed in two windows of the Pulaski thrust sheet: one is north of the City of Radford and

the other is just to the southeast of the Radford Army Ammunition Plant. These rocks are

highly deformed allochthonous tectonic horses that are complexly folded, faulted, and internally fractured.

The Millboro Shale is described as:

Millboro Shale: Dark-gray to black, thinly bedded, sparsely fossiliferous, fissile mudstone and black shale. Contains abundant concretions and disseminated sulfides as well as a few thin beds of carbonate. Thickness ranges from about 1,000 to 1,300 feet (305 to 400 m)

and the Martinsburg formation is described as:

Martinsburg Formation: Upper portion consists of interbedded 0.5- to 1.0-foot (15 to 30 cm) thick beds of massive, fine-grained, medium-gray sandstone with fossil debris and medium-gray well-laminated calcareous mudstone. This grades down section into dominantly medium- to dark-gray, coarse-grained, bioclastic limestone interbedded with medium-gray, well laminated calcareous mudstone. The thickness is estimated to be about 1,100 feet (335 m). The use of Martinsburg Formation in this area follows past usage by Butts (1933, 1940) and Cooper (1961).

Soils developed from the Millboro Shale have higher amounts of of arsenopyrite (a sulfide mineral), which will have its own As/Fe ratio that differs from the soils in the range floor, along with naturally higher As concentrations.

Timothy Leahy, PMP

Project Manager

Shaw's Environmental and Infrastructure Group

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www.shawgrp.com <http://www.shawgrp.com/>

Classification: UNCLASSIFIED
Caveats: FOUO

[attachment "FieldTripfigure.pdf" removed by Erich Weissbart/R3/USEPA/US]

Classification: UNCLASSIFIED
Caveats: FOUO

1.0 INTRODUCTION

CB&I, Inc (formerly Shaw Environmental, Inc.) was tasked by the U.S. Army Corps of Engineers, Baltimore District, to perform a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) and Corrective Measures Study (CMS) at Solid Waste Management Unit (SWMU) 48 (RAAP-18) - the Oily Water Burial Area and SWMU 49 (RAAP-13) - the Red Water Ash Burial No. 2. The SWMUs are located adjacent to one another in the southeastern portion of the Horseshoe Area (HSA) of Radford Army Ammunition Plant (RFAAP), east of the main bridge over the New River (**Figure 1**). The work was performed under Contract No. W912QR-04-D-0027. In order to complete the RFI at these sites, additional characterization of the extent of chlorinated solvents in groundwater is required. This supplemental RFI Work Plan describes the work that is currently scoped to meet that objective.

This Supplemental RFI Work Plan describes the proposed groundwater investigation activities for SWMU 48/49, including the installation of four additional wells to the south and east of the two sites and sampling of 10 existing wells to refine the extent of chlorinated solvents in groundwater. This Supplemental RFI Work Plan is intended to be used in conjunction with Master Work Plan (MWP) Work Plan Addendum (WPA) 019 (Shaw, 2007) and the MWP (URS, 2003) and does not duplicate information contained within those documents. Field investigative activities will be conducted in accordance with the MWP, the Master Quality Assurance Plan, Master Health and Safety Plan, and WPA 019.

2.0 SITE DESCRIPTION

2.1 Site Description

The combined study area (SWMUs 48 and 49) is located in the southeastern portion of the RFAAP HSA, east of the main bridge over the New River. As illustrated on **Figure 1**, the two SWMUs are adjacent, with SWMU 48 located approximately 200 feet (ft) northwest of SWMU 49.

The SWMU 48 study area is approximately 380 ft long by 120 ft wide; whereas the SWMU 49 study area is 75 ft long by 83 ft wide. The combined study area is situated on a bluff approximately 120 ft above and overlooking SWMU 13 and the New River. The land surface in the combined study area gently slopes from approximately 1,830 feet above mean sea level (ft msl) on the north side of SWMU 48, to approximately 1,816 ft msl on the southeast side of SWMU 49. Based on topography, surface water runoff is expected to flow approximately 700 ft south to the New River.

SWMU 48, the oily water burial area, consists of two sets of unlined trenches, one at the northern end of the site and one at the southern end. SWMU 49, the red water ash burial no. 2, during its time of active use simply looked like an area of disturbed ground.

The overall study area is grassy with wooded areas to the south, east, and west. A subsided area that coincides with southern SWMU 48 trench provides evidence of its location.

An east-west asphalt road, located at the northern edge of the study area, parallels SWMU 48 and provides access to the combined study area via a gravel and bottom ash covered dirt road that trends north-south in the middle of the study area. The dirt and gravel road connects to an east-

west trending dirt road at the southern end of the area. There are no structures in the combined study area and according to RFAAP utility maps, there are no manholes, catch basins, or storm drains located in the immediate vicinity of the area. There is also no sediment or surface water located on the sites. Site history is described more completely in the draft *SWMU 48/49 RFI Report* (Shaw, 2007) and will be further described in the report that will result from the current investigation

2.2 Previous Investigations

Several investigations (and one soil removal action) have taken place within the combined study area between 1992 and 2011. These investigations have shown that elevated levels of carbon Tetrachloride (CT) and trichloroethene (TCE) are present in groundwater at the two sites. The extent of these constituents; however, has not been fully delineated to the east and south of the sites. The previous investigations were described in draft *SWMU 48/49 RFI Report* (Shaw, 2007) and will be further described in the report that will result from the current investigation.

3.0 FIELD SAMPLING PLAN

3.1 Approach

Site-specific investigation activities will include:

- the installation of four additional groundwater monitoring wells east and south of SWMUs 48 and 49 to assess the extent of chlorinated solvents detected in groundwater at these sites;

3.1.1 Investigative Activities

The following sections describe the investigation activities. A summary of the proposed samples and analyses for each area is presented in **Table 1**.

Well Installation. Four groundwater monitoring wells will be installed to the south and east of SWMUs 48 and 49 to delineate the extent of elevated CT and TCE in groundwater. The proposed locations of the wells are shown on **Figure 1** with a yellow well symbol. Wells will be installed in accordance with MWP Standard Operating Procedure (SOP) 20.1 - *Monitoring Well Installation* and wells will be developed in accordance with MWP SOP 20.2 - *Monitoring Well Development*.

Groundwater Sampling. Groundwater samples will be collected from the four newly installed wells and from ten existing wells. The well numbers and analyses for each well are summarized in **Table 1**. The wells that will be sampled are also shown on **Figure 1** with a pink symbol. Wells will be sampled in accordance with MWP SOP 30.2 - *Groundwater Sampling.* The samples will be analyzed for TCL VOCs, which include the two constituents of concern (CT and TCE), as well as potential breakdown products. The wells will also be sampled for natural attenuation indicator parameters as shown in **Table 2**. In addition, the wells will be sampled for TAL metals (total and dissolved) and one of the wells, 50MW-2 will be re-sampled for dioxins/furans due to a past detection of dioxins/furans in this well.

3.2 Reporting

Results from this data collection event will be incorporated into a revised SWMU 48/49 RFI Report. Data, in the form of a data table and map, will initially be shared with project

stakeholders to streamline the RFI review process and provide a basis for discussion with regulators.

Table 1
Proposed Sampling and Analysis

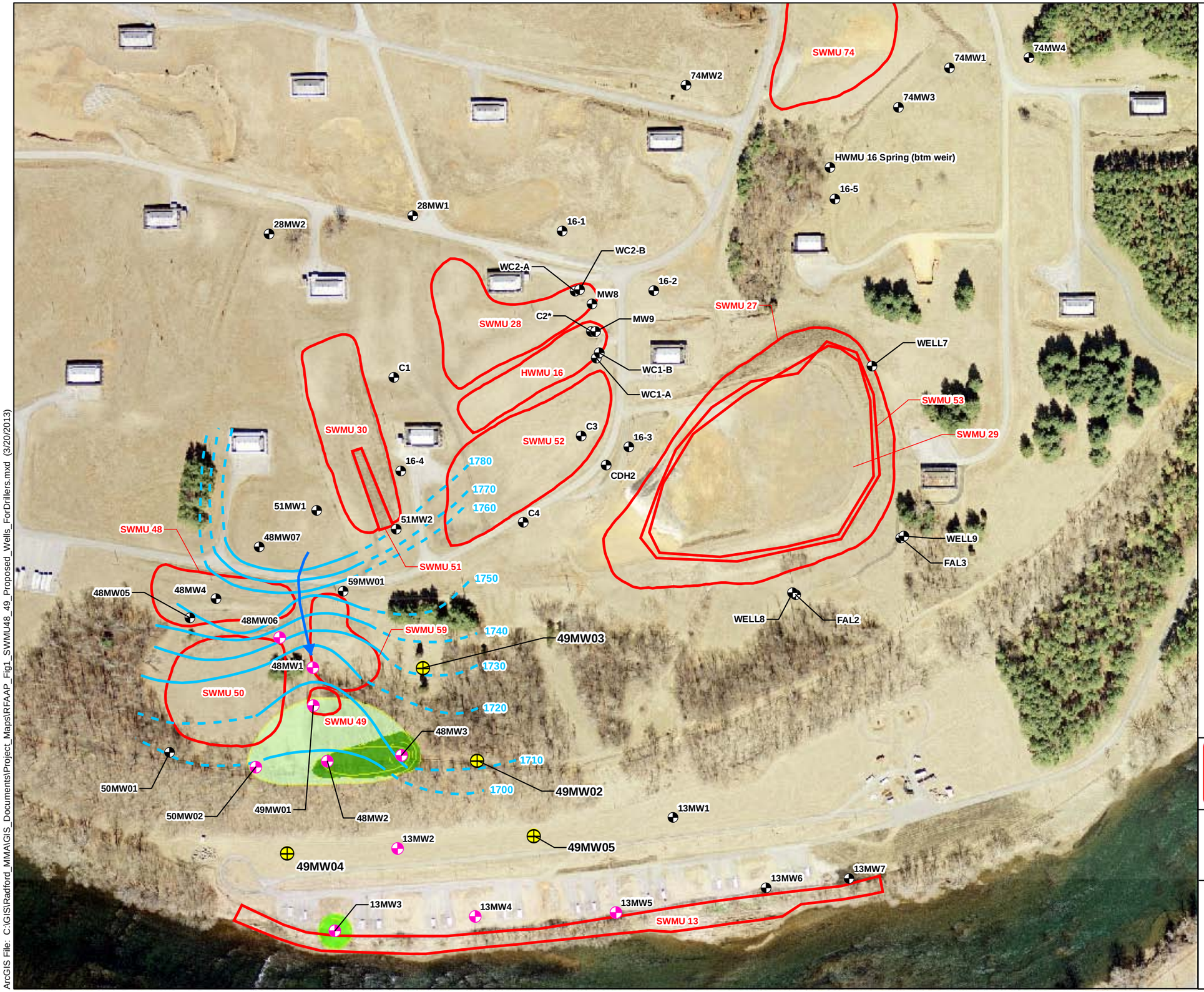
Medium	Sample ID	Location	Sample Analyses
Existing Wells			
Groundwater	48MW1		TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC
	48MW2		TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC
	48MW3		TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC
	48MW06		TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC
	49MW01		TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC
	50MW02		TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC, **dioxins/furans**
	13MW2		TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC
	13MW3		TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC
	13MW4		TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC
	13MW5		TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC
Proposed Wells			
	49MW02	Northeast of currently delineated plume	TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC
	49MW03	East of currently delineated plume	TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC
	49MW04	South of currently delineated plume (west of burning ground wells)	TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC
	49MW05	Southeast of currently delineated plume (between burning ground wells 13MW1 and 13MW2)	TCL VOCs, TAL Metals (total and dissolved), Methane, Ethane, Ethene, Chloride, Nitrate, Sulfate, TOC

Table 2
Monitored Natural Attenuation - Performance Monitoring Parameters
SWMU 49

Parameter	Data Use
TCL VOCs (including the CT and TCE)	COIs - Evaluate concentration trends and attenuation. Allows for evaluation of CT and TCE transformation processes to methane and ethene.
Total Organic Carbon	Allows for evaluation of immobilization potential of CT and TCE.
Ferrous Iron (Fe +2)	May indicate anaerobic degradation due to depletion of oxygen, nitrate, and manganese. Also allows for evaluation of immobilization potential of CT and TCE.
Nitrate (NO3)	Substrate for microbial respiration if oxygen is depleted.
Sulfate ($SO4^{2-}$)	Substrate for anaerobic microbial respiration.
Chloride (Cl)	Substrate for anaerobic microbial respiration.
Methane, Ethene, Ethane	Daughter products occurring during the degradation of TCE.
pH	Aerobic and anaerobic processes are pH sensitive. Stabilization parameter for groundwater purging and sampling.
Dissolved Oxygen (DO)	Concentrations indicate whether an aerobic or anaerobic pathway exists. Concentrations of <0.5 mg/L generally indicate an anaerobic pathway. DO 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:

DO = Dissolved Oxygen
COI = Contaminant of Interest
CT= Carbon Tetrachloride
ORP = Oxidation-Reduction Potential
mg/L = milligram per liter
mV = millivolt
TCE= Trichloroethene



ArcGIS File: C:\GIS\Radford_MMA\GIS_Documents\Project_Maps\RFAAP_Fig1_SWMU48_49_Proposed_Wells_ForDrillers.mxd (3/20/2013)

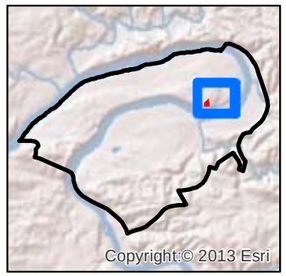
LEGEND

- Existing Monitoring Well to be Sampled
- Monitoring Well
- Proposed Monitoring Well
- Groundwater Flow Direction
- Inferred Groundwater Contour
- Groundwater Contour
- Carbon Tetrachloride Isopleth
- Inferred Carbon Tetrachloride Isopleth
- SWMU Boundary

Carbon Tetrachloride Plume (ug/L)

- 1
- 5
- 50

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.



N

Scale:

0 125 250 500 Feet

U.S. Army Corps of Engineers

Shaw Environmental, Inc.
(A CB&I Company)
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

FIGURE 1
SWMU 48/49
PROPOSED MONITORING WELLS

Radford Army Ammunition Plant,
Radford, VA

4.0 REFERENCES

IT Corporation (IT), 2002. *Radford Army Ammunition Plant, Master Work Plan Addendum 012.* Draft Final document. February 2002. Delivery Order No. 0013, Contract No. DACA31–94–D–0064.

Shaw Environmental, Inc. (Shaw), 2007. *Radford Army Ammunition Plant. Master Work Plan Addendum 019.* Final. July, 2007.

Shaw Environmental, Inc. (Shaw), 2012. *SWMUs 48 and 49 RFI/CMS Report. Radford Army Ammunition Plant. Radford VA.* Draft. June, 2012.

URS Corporation (URS), 2003. Final Master Work Plan, Quality Assurance Plan, Health and Safety Plan. Radford Army Ammunition Plant, Radford, Virginia. Prepared for the U.S. Army Corps of Engineers, Baltimore District. August 2003.

Leahy, Timothy

From: Weissbart.Erich@epamail.epa.gov
Sent: Wednesday, January 30, 2013 11:06 AM
To: McKenna, James J CIV (US)
Cc: Jim Cutler; Alberts, Matt (US SSA); Mendoza, Richard R Jr CIV (US); Davie, Robert N III CIV (US); Leahy, Timothy; Meyer, Tom NAB02; Maiden, Vince (DEQ)
Subject: Re: FW: EPA/VDEQ meeting - Jan 25, 2013 (UNCLASSIFIED)

To All:
Please accept this email as conditional approval of the SWMU48/49 November 30, 2012 response to comments and ARSAR December 13, 2012 response to comments. In conjunction with the January 25, 2013 site meeting and the email summary and pdf attachment submitted January 29, 2013, EPA and VADEQ have no further comment on proposed work and pending reports for either unit. Therefore this email constitutes an unconditional approval of proposed scopes of work and responses to comments for both units (ARSAR and SWMUs 48/49). It is our understanding that with this email approval, work will proceed towards additional monitoring well installation at SWMUs 48/49, a monitoring event will take place subsequent to the well installation, and a meeting proposed to discuss the results and the path forward for SWMUs 48/49. Additionally we expect that the previous draft submittals related to Interim Measures and Risk Assessment will be revised as proposed. If there are any questions please contact me.

Erich Weissbart P.G.
Land and Chemicals Division (3LC20)
US EPA Region III
1650 Arch Street
Philadelphia, PA 19103
Phone: 215-814-3284
e-mail: weissbart.erich@epa.gov

-----"McKenna, James J CIV (US)" <james.j.mckenna16.civ@mail.mil> wrote: -----
To: "Meyer, Tom NAB02" <Tom.Meyer@usace.army.mil>, "Mendoza, Richard R Jr CIV (US)" <richard.r.mendoza.civ@mail.mil>, "Alberts, Matt (US SSA)" <matt.alberts@baesystems.com>, Erich Weissbart/R3/USEPA/US@EPA, "Cutler,Jim" <James.Cutler@deq.virginia.gov>, "Maiden, Vince (DEQ)" <Vincent.Maiden@deq.virginia.gov>
From: "McKenna, James J CIV (US)" <james.j.mckenna16.civ@mail.mil>
Date: 01/29/2013 02:44PM
Cc: "Davie, Robert N III CIV (US)" <robert.n.davie4.civ@mail.mil>, "Timothy.Leahy@shawgrp.com" <Timothy.Leahy@shawgrp.com>
Subject: FW: EPA/VDEQ meeting - Jan 25, 2013 (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: FOUO

All,

See Tim's notes below and attached figure to document our path forward for SWMUs 48/49 and the ARSAR. Only thing I can add is that we were going to have data review meeting or conference call after we get the gw data back from SWMU 48/49 effort.

Thanks,
JJM

-----Original Message-----
From: Leahy, Timothy [mailto:Timothy.Leahy@shawgrp.com]
Sent: Tuesday, January 29, 2013 2:20 PM
To: McKenna, James J CIV (US)

Subject: EPA/VDEQ meeting - Jan 25, 2013

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Thanks,

Tim

Path forward for SWMU 48&49

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48MW1

49MW01

50MW02

48MW02

48MW3

13MW2

13MW3

13MW4

13MW5

Also, we will resample the existing wells where dioxins were elevated and ensure that no entrained sediment is present.

Path forward for ARSAR:

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The geologic map describes the unit (DO) on the hillside behind the ARSAR as:

Devonian, Silurian, and Ordovician, undivided: Includes partial sections of the Millboro Shale, undivided Silurian units, and Martinsburg Formation. These rocks are exposed in two windows of the Pulaski thrust sheet: one is north of the City of Radford and the other is just to the southeast of the Radford Army Ammunition Plant. These rocks are highly deformed allochthonous tectonic horses that are complexly folded, faulted, and internally fractured.

The Millboro Shale is described as:

Millboro Shale: Dark-gray to black, thinly bedded, sparsely fossiliferous, fissile mudstone and black shale. Contains abundant concretions and disseminated sulfides as well as a few thin beds of carbonate. Thickness ranges from about 1,000 to 1,300 feet (305 to 400 m)

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Martinsburg Formation: Upper portion consists of interbedded 0.5- to 1.0-foot (15 to 30 cm) thick beds of massive, fine-grained, medium-gray sandstone with fossil debris and medium-gray well-laminated calcareous mudstone. This grades down section into dominantly medium- to dark-gray, coarse-grained, bioclastic limestone interbedded with medium-gray, well laminated calcareous mudstone. The thickness is estimated to be about 1,100 feet (335 m). The use of Martinsburg Formation in this area follows past usage by Butts (1933, 1940) and Cooper (1961).

Soils developed from the Millboro Shale have higher amounts of of arsenopyrite (a sulfide

mineral), which will have its own As/Fe ratio that differs from the soils in the range floor, along with naturally higher As concentrations.

Timothy Leahy, PMP

Project Manager

Shaw's Environmental and Infrastructure Group

4696 Millennium Drive, Suite 320

Belcamp, MD 21017

410-273-7228 (Direct)

410-273-7103 (Fax)

410-322-6430 (Cell)

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Classification: UNCLASSIFIED
Caveats: FOUO

[attachment "FieldTripfigure.pdf" removed by Erich Weissbart/R3/USEPA/US]

Leahy, Timothy

From: McKenna, James J CIV (US) [james.j.mckenna16.civ@mail.mil]
Sent: Tuesday, January 29, 2013 2:43 PM
To: Meyer, Tom NAB02; Mendoza, Richard R Jr CIV (US); Alberts, Matt (US SSA); Weissbart.Erich@epamail.epa.gov; Cutler,Jim; Maiden, Vince (DEQ)
Cc: Davie, Robert N III CIV (US); Leahy, Timothy
Subject: FW: EPA/VDEQ meeting - Jan 25, 2013 (UNCLASSIFIED)
Attachments: FieldTripfigure.pdf

Classification: UNCLASSIFIED
Caveats: FOUO

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Project Manager

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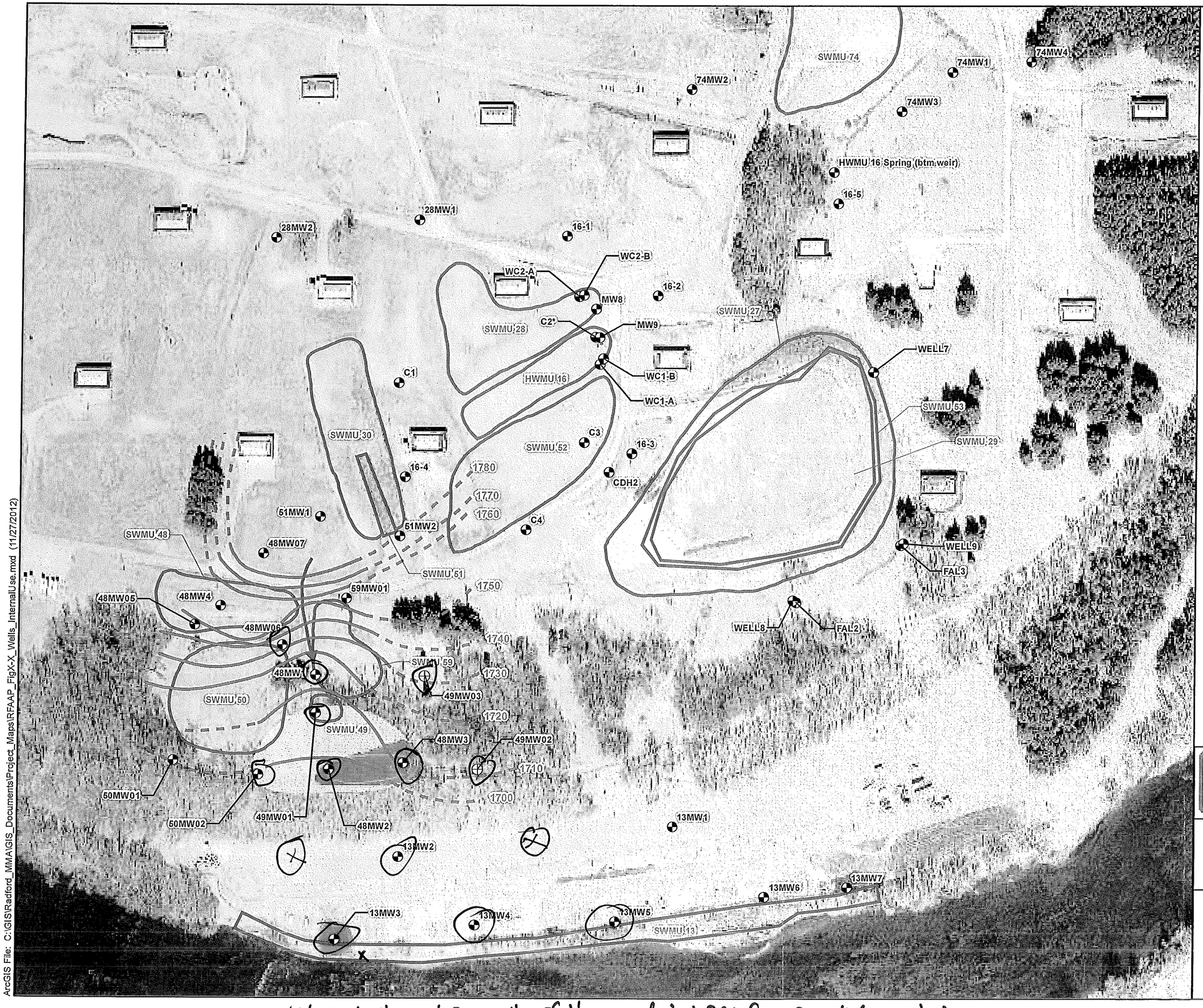
www.shawgrp.com <http://www.shawgrp.com/>

Classification: UNCLASSIFIED
Caveats: FOUO



LEGEND

- Monitoring Well
- Proposed Monitoring Well
- Groundwater Flow Direction
- Inferred Groundwater Contour
- Groundwater Contour
- Carbon Tetrachloride Isopleth
- Inferred Carbon Tetrachloride Isopleth
- SWMU Boundary

Carbon Tetrachloride Plume (ug/L)

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- 5
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Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.

N

Scale:
0 125 250 500 Feet

U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE X-X

Monitoring Wells

Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\GIS\Radford_MMA\GIS_Documents\Project_Maps\RFAAP_FigX-X_Wells_InternalUse.mxd (11/27/2012)

WLs of all - not BG wells if they are doing VOCs for Quarterly monitoring

Leahy, Timothy

From: Weissbart.Erich@epamail.epa.gov
Sent: Tuesday, January 15, 2013 9:54 AM
To: McKenna, James J CIV (US)
Cc: Cutler,Jim; Bressette, James W CIV (US); Stewart, Jay (US SSA); Parks, Jeffrey; Jeremy Flint (jeremy.flint@atk.com); MaryAnn Bogucki (maryann.bogucki@baesystems.com); Alberts, Matt (US SSA); Mendoza, Richard R Jr CIV (US); Davie, Robert N III CIV (US); Ryan, Susan M CIV USARMY IMCOM AEC (US); Leahy, Timothy; Meyer, Tom NAB02
Subject: RE: SWMU 48/49 (UNCLASSIFIED)

Jim,
Below are EPA's toxicology responses to the above submission. EPA/VADEQ will be prepared to discuss the remainder on Jan. 25.

-- There is no problem with the response to the 125 day exposure for construction workers (Comment 6). The point was that the Army cannot arbitrarily apply this exposure duration to other SWMUs, just because they used it here. Each situation requires a site-specific evaluation. We are not disupting past SWMU evaluations where this exposure duration was used.

--Several of the Army's responses require future review of changes they agree to make. For example, in comment 8, they state that risk and hazard drivers for all receptors will be checked against corresponding RAGs tables for all receptors to ensure that all drivers are listed; and that text will be added to the main body of Table 6-4 to indicate that lead is a driver. Just wanted to make you aware this to ensure that we will have the opportunity to confirm what they've committed to. Comment 11 also requires confirmation of changes that the Army agrees to make.

--Comment 7 response: The Army states that potential risk and hazards associated with vapor intrusion could be evaluated when future construction occurs. I maintain that if groundwater continues to pose a vapor intrusion risk, that an evaluation of potential vapor intrusion risks must be performed, or the Army must agree that future buildings will be constructed with vapor barriers.

--Comment 9 response: The Army agrees that the elevated concentrations of TCDD in the two new wells will be 'addressed;' however, Table 2 does not include TCDD. If Table 2 is meant to cover only natural attenuation parameters, then the Army should provide documentation of their intent to include TCDD in the upcoming sampling.

--Comment 10 response: Regardless of any ICs proposed, cleanup goals for groundwater are still drinking water standards such as MCLs or other risk-based standards for tap water (if no MCLs are available).

Erich Weissbart P.G.
Land and Chemicals Division (3LC20)
US EPA Region III
1650 Arch Street
Philadelphia, PA 19103
Phone: 215-814-3284
e-mail: weissbart.erich@epa.gov

From: "McKenna, James J CIV (US)" <james.j.mckenna16.civ@mail.mil>
To: Erich Weissbart/R3/USEPA/US@EPA
Cc: "Cutler,Jim" <James.Cutler@deq.virginia.gov>, "Davie, Robert N III CIV (US)" <robert.n.davie4.civ@mail.mil>, "Mendoza, Richard R Jr CIV (US)" <richard.r.mendoza.civ@mail.mil>, "Ryan, Susan M CIV USARMY IMCOM AEC (US)" <susan.m.ryan.civ@mail.mil>, "Meyer, Tom NAB02" <Tom.Meyer@usace.army.mil>, "Stewart, Jay (US SSA)" <jay.stewart@baesystems.com>, "Alberts, Matt (US SSA)" <matt.alberts@baesystems.com>, "MaryAnn Bogucki (maryann.bogucki@baesystems.com)" <maryann.bogucki@baesystems.com>, "Timothy.Leahy@shawgrp.com" <Timothy.Leahy@shawgrp.com>,

"Parks, Jeffrey N" <Jeffrey.Parks@shawgrp.com>, "Bressette, James W CIV (US)" <james.w.bressette@us.army.mil>, "Jeremy Flint (jeremy.flint@atk.com)" <jeremy.flint@atk.com>
Date: 11/30/2012 07:32 AM
Subject: RE: SWMU 48/49 (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: FOUO

Erich, Jim C.,

The attached files make up our responses to EPA and DEQ comments on the SWMU 48/49 RFI/CMS Report.

We are also in the process of working on the responses to EPA and DEQ comments on the ARSAR RFI/CMS Report.

Once we submit the ARSAR responses we thought it would be helpful if EPA and DEQ could come to RFAAP for a site visit as we strongly feel seeing these sites again would assist in the discussion and resolution of these comments.

We all hope that the situation with your toxicologist is improving but if not, we need to talk about how we move these remaining sites forward.

Thanks in advance,
JJM

-----Original Message-----
From: Weissbart.Erich@epamail.epa.gov [mailto:Weissbart.Erich@epamail.epa.gov]
Sent: Monday, November 05, 2012 7:56 AM
To: McKenna, James J CIV (US)
Cc: Cutler,Jim; Stewart, Jay (US SSA); Quinn.Elizabeth@epamail.epa.gov
Subject: SWMU 48/49

Jim,
Attached please find the Agencies (EPA and VADEQ) comments on the SWMUs 48 and 49 Draft RFI/CMS Report. Please note that a 30-day request for a response is included. Given the time between previous submittals and responses I believed this was necessary to keep work moving on these units.

Erich Weissbart P.G.
Land and Chemicals Division (3LC20)
US EPA Region III
1650 Arch Street
Philadelphia, PA 19103
Phone: 215-814-3284
e-mail: weissbart.erich@epa.gov

Classification: UNCLASSIFIED
Caveats: FOUO

[attachment "SWMU_48_49_EPA-VDEQ_ RTCs_fig1.pdf.pdf" deleted by Erich Weissbart/R3/USEPA/US] [attachment "SWMU_48_49_EPA-VDEQ_ RTCs_table1.pdf.pdf" deleted by Erich Weissbart/R3/USEPA/US] [attachment "SWMU_48_49_EPA-VDEQ_ RTCs_table2.pdf.pdf" deleted by Erich Weissbart/R3/USEPA/US] [attachment "SWMU_48_49_EPA-VDEQ_ RTCs_11-29-2012_rev3 29 Nov 2012.pdf" deleted by Erich Weissbart/R3/USEPA/US]

Leahy, Timothy

From: McKenna, James J CIV (US) [james.j.mckenna16.civ@mail.mil]
Sent: Friday, November 30, 2012 7:31 AM
To: Weissbart.Erich@epamail.epa.gov
Cc: Cutler,Jim; Davie, Robert N III CIV (US); Mendoza, Richard R Jr CIV (US); Ryan, Susan M CIV USARMY IMCOM AEC (US); Meyer, Tom NAB02; Stewart, Jay (US SSA); Alberts, Matt (US SSA); MaryAnn Bogucki (maryann.bogucki@baesystems.com); Leahy, Timothy; Parks, Jeffrey; Bressette, James W CIV (US); Jeremy Flint (jeremy.flint@atk.com)
Subject: RE: SWMU 48/49 (UNCLASSIFIED)
Attachments: SWMU_48_49_EPA-VDEQ_ RTCs_fig1.pdf.pdf; SWMU_48_49_EPA-VDEQ_ RTCs_table1.pdf.pdf; SWMU_48_49_EPA-VDEQ_ RTCs_table2.pdf.pdf; SWMU_48_49_EPA-VDEQ_ RTCs_11-29-2012 _rev3 29 Nov 2012.pdf

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Caveats: FOUO

Responses to EPA/VDEQ comments (Dated November 5, 2012) on the *Draft SWMU 48/49 RCRA Facility Investigation (RFI)/Corrective Measures Study (CMS) Report* June 2012

RFAAP General Response:

In general, the majority of the comments provided by EPA/VDEQ seem to focus on two major issues:

1) Whether MNA is a viable option for remediation of contaminants in groundwater, specifically carbon tetrachloride (CT) and trichloroethene (TCE).

2) Whether the extent of VOCs in groundwater has been adequately characterized/delineated to the east and northeast of the site.

While specific responses have been provided below to address each comment, we have also provided a general response framework to address these overall comments and provide a path forward for the sites.

The Army agrees with the Agency's suggestion to separate the RFI from the CMS. The interim measures action that was performed in 2011 will be incorporated into the RFI and it will recommend no further action for soil and that further investigation be conducted for groundwater to define the extent of contamination and assess the suitability of MNA as a potential groundwater remedy. We propose that two additional wells be installed east and northeast of monitoring well 48MW3 (see **Figure 1**). After installation of these wells, two rounds of groundwater sampling will be conducted to collect samples for MNA indicator parameters, TCL VOCs and TAL metals (filtered and unfiltered) and provide more recent groundwater data to assess the current concentrations of these constituents in groundwater. Additional data will also present a better picture of concentrations over time, groundwater levels and flow direction, since it has been five years since the previous sampling. The two rounds of sampling would be conducted approximately three months apart. The data will also be useful to modify the CSM, as appropriate.

Proposed well locations to better delineate the extent and source of contamination are presented on **Figure 1**. **Figure 1** also shows the wells that are proposed for sampling as part of the baseline MNA sampling described above. The wells are also listed in **Table 1**, along with the rationale for including each well. Detailed descriptions of the parameters and rationale for inclusion are presented in **Table 2**.

GENERAL COMMENTS

1. **Executive Summary** – The second paragraph states that SWMUs 48 and 49 are addressed because they are associated with further action – Monitored Natural Attenuation (MNA). This statement presumes that conclusions and proposals in this report are fact. First off Corrective Action remedies are considered proposed until completing the public participation process. Other than an Interim Measure, Corrective Action remedies must go through the public participation process. Second, the assumption that MNA is the selected remedy for groundwater prior to regulatory input is highly presumptuous. While seemingly innocuous the statement is not accurate and should be revised or removed.

   RESPONSE:

   It is understood that the Corrective Action remedies need to go through public participation however these should be remedies that the EPA, DEQ and RFAAP/Army

agree upon before that process is engaged. Historically and to clarify, the draft RFI/CMS reports submitted by RFAAP have been prepared as jointly sponsored documents with a specific recommendation for corrective action, if required. In this way the EPA, DEQ and the Army can assess and evaluate the data and reach agreement through the review process on what the site risks are and the best way to address them. Our statements with respect to the conclusions and clean up recommendations for SWMUs 48 and 49 were our best judgment at this time--absent regulatory input which was the purpose of submitting this or any draft RFI/CMS report. Note once the comments are satisfactorily addressed and the report is revised accordingly with subsequent regulatory approval, then the conclusions and clean up recommendation/s would be jointly sponsored and suitable for public participation. We would like to continue this process as it has worked well in the past.

2. **ES Groundwater** – The statement that elevated metals were the result of poorly recharging, turbid well sample is another example of opinion and not fact. The data presented in Section 8 of the report to support this statement are suggestive, but not conclusive. It is inappropriate to make marginally supported claims in the executive summary. These reports are ultimately for public consumption and a cursory analysis does not substitute for scientific fact.

   RESPONSE:

   Agree. This discussion will be removed from the ES.

3. **ES Corrective Measures Study**, Bullet 3 – It is stated that soil was excavated from SWMU 48 until residential screening levels were achieved:

   "A removal action based on the metals concentrations detected in the ash layer was completed in 2012. In compliance with the *SWMU 48 Interim Measures Work Plan* (Shaw, 2011), the source material for contamination at SWMU 48, the ash layer, has been removed to below residential use criteria. Therefore, soil at SWMU 48 is no longer a concern."

   Given that soil was previously removed as an Interim Measure the presentation of soil removal as a CMS is confusing. Equally confusing is the detailed cost estimate. Since the soil has already been excavated and disposed the costs are already known. Since the IM has been performed and completed it is confusing to present this CMS as if the IM has never happened. It is strongly suggested that the RFI be finalized as a stand-alone report. A CMS that addresses groundwater at the site should be submitted separately.

   RESPONSE:

   The IM results will be presented in the previous investigation section of the revised RFI and the CMS will be removed from the report. The Army proposes restructuring the reports so that the stand-alone RFI proposes No Further Action for soils (based on the completion of the IM) and further investigation as part of the CMS for groundwater. The two new wells would be installed and two rounds of sampling (as described in the General Response Above) would be completed as part of the CMS to better delineate the plume and assess the suitability of Monitored Natural Attenuation (MNA) as a corrective measure for groundwater.

4. **Section 2.5, Site Hydrogeology** – Statements claiming that groundwater wells downgradient of the site located at HWMU 13 are clean are completely inaccurate and

contradicted by Figures presented later in the report; therefore the statement should be removed. Cross-sections should be presented representing the primary direction of groundwater flow and perpendicular to groundwater flow. The cross-sections presented are convenient to existing well locations but ultimately do not add to interpreting site conditions. The statement that the groundwater gradient steepens beyond the units cannot be confirmed based on the potentiometric surface figure provided. In fact the isopotential contours presented on Figure 2-7 are not representive of the groundwater elevations presented on the same figure (see for example 59MW01). Also from Figure 2-7, the elevation calculated from groundwater monitoring well 49MW01 of 1705 feet appears reasonable and should be used as a data point in contouring. Conversely the Agency notes that the groundwater elevation presented from 48MW06 (1757) appears as if it were ignored; this data point should also be used in the presentation of the contours. Figures 2-6 and 2-7 should include the groundwater elevations from wells at HWMU 13. The Facility should be aware that the figures presented in this section form the basis for a conceptual site model. Based on this presentation the Agency lacks confidence that the Facility has presented an accurate conceptual model at least as it relates to groundwater flow. How does the karstic nature of the Elbrook control groundwater conditions? Finally, how does turbidity (speculated) from 49MW01 support proposed groundwater flow?

RESPONSE: The statement about wells at HWMU 13 will be revised to state that the upgradient wells at HWMU 13 (13MW2 and 13MW1) did not have detections of these constituents. All isopotential maps and cross sections will be reviewed for accuracy and revised as necessary. The conceptual site model will be revised and updated.

5. **Section 4.3.2, Groundwater**, page 4-26 – The Agency disagrees with the statement that the 2007 data best reflects current conditions. The 2007 data reflects conditions from 2007 and current conditions are unknown. Furthermore, historical groundwater data from 2006 is valuable in establishing trends in contamination and should be included with the 2007 data. No groundwater investigation work has been conducted and/or reported to EPA over the last 5 years despite previous comments from the Agencies circa 2010 requesting MNA parameters be collected. Please refrain from reiterating opinions related to elevated metals and turbidity. It is true that turbidity contributes to elevated metals reported from monitoring wells; however, unless and until the Facility confirms that turbidity is the cause of elevated metals statements claiming so are conjecture. The Agency suggests that in the future the Facility collect both dissolved and total metals and confirm the difference due to turbidity. As far as low water levels contributing to turbid samples, it is the Facility's responsibility to install quality wells and report quality data.

   The Agency disagrees with the assertion that VOCs have broken down over 11 years of groundwater monitoring. There is no data supporting this statement and laboratory data does not report the presence of daughter products: cis-1,2-dichlorethene, vinyl chloride, or chloroform. It is more likely that dissolved contaminants in groundwater continue to advect with groundwater. The Agency also disagrees with the statement that the figures presented represent monitoring wells in the "center" of the plume. Based on the figures presented the Agency has no confidence that the Facility has identified the source of the contaminants, much less the center of the plume. Figures depict dissolved contaminants in groundwater flowing to the northwest against the gradient depicted on the potentiometric drawing rather than with groundwater flow towards HWMU 13. The Agency disagrees with the assertion

that the plume is bounded in all directions by surrounding wells. The well historically reporting the most elevated carbon tetrachloride has no well located upgradient. Where does the Facility believe the source of groundwater contamination is located? Please explain how as recent as 2006, monitoring well 48MW3 reported the highest concentration of carbon tetrachloride. The facility should use the potentiometric surface map to support their interpretations of isoconcentration figures. For example, how is the lack of contaminant movement in the downgradient direction of groundwater flow possible? How realistic is the depiction in Figure 4-1 (and others) that carbon tetrachloride (CT) upgradient from HWMU 13 is not the source of CT at HWMU 13? The Agency completely disagrees with the representations of contamination in each of the Figures presented in this section (Figures 4-1 through 4-4). Please explain either how depicted source areas contain lesser concentrations than downgradient wells or how contamination advects against the groundwater gradient depicted in Section 2. In summary, groundwater hydrology is not adequately characterized and no inclusive model is proposed that correlates unit and downgradient information; additional wells may be necessary.

RESPONSE:

Groundwater data from 2006 and earlier is discussed in Sections 2.0 and 4.0 to help establish trends and repeatability of data. Sections can be revised to more clearly establish correlations between 2007 and earlier data. It is agreed that no additional groundwater data has been collected since 2007. As noted in the General Response above, the Army proposes to collect two additional rounds of groundwater to assess the viability of MNA as part of the CMS for these sites.

As to the breakdown of chlorinated solvents, cis-1,2 DCE was detected in one well at 3.8 ug/L. The highest concentration of PCE was 2.3 ug/L and the highest concentration of TCE was 11.2 ug/L. CT had the highest concentration at 94.9 ug/L but would not demonstrate the same breakdown products as TCE and PCE. Army agrees that collection of MNA parameters would help in this discussion. Discussion of elevated metals will be revised to remove opinions, and collection of both filtered and unfiltered metals for analysis would indeed be helpful for the discussion. Discussion of plume direction, flow direction, and well locations will be incorporated into a revised CSM after installation of the wells and collection of the additional data.

6. **Section 6.2.4, Quantification of Exposure, Calculation of Daily Intakes, first paragraph, and Appendix E, Human Health Risk Assessment, Tables E.1-14:** While an exposure frequency (EF) of 125 days for a construction worker may be justifiable for SWMUs 48 and 49 on a site-specific basis due to the small size and difficulty in constructing a building on these sites, EPA notes that this is a decision that applies to these SWMUs only, and not to other SWMUs throughout the Radford plant. Furthermore, language explaining and supporting the use of the EF of 125 days for a construction worker must be included in the report.

RESPONSE: It is noted that the exposure frequency for the construction worker (125 days/year) has been applied to SWMUs 48 and 49 on a site-specific basis, and not necessarily to other SWMUs at RFAAP. There is no current construction at either SWMU 48 or SWMU 49. Given the sizes of SWMUs 48 and 49 (1.009 acres and 0.11 acres, respectively), extensive construction would not be expected. Assuming five-day work weeks, the EF of 125 days/year represents a six-month construction period, which would seem reasonable for a site of this size and location.

In addition, this EF value is consistent with the EF values used for previous HHRAs of similar sites at RFAAP. Text will be added to Section 6.2.1 to clarify this assumption.

7. **Section 6.2.4, Quantification of Exposure, Calculation of Daily Intakes, fifth paragraph:** As noted in prior EPA comments, risks associated with vapor intrusion that are evaluated when 1) heterogenous geologic materials are present, and 2) no structures are currently present on the site have little relevance to actual future risks associated with vapor intrusion when buildings are present. A resolution to this issue would be an evaluation of the potential for vapor intrusion when a future building is constructed on the site, and/or installation of a vapor barrier as part of the construction of a future building.

   RESPONSE: As noted in Section 6.5.3 (Uncertainty Section), risks and hazards associated with vapor intrusion at SWMUs 48 and 49 were likely overestimated because the exposure point concentrations were based on the maximum detected concentrations. In addition, the shallowest depths to groundwater are 48.24 ft at SWMU 48 and 97.6 ft at SWMU 49. It is assumed that vapor velocities decrease rapidly with increasing distance from a structure. These assumptions contribute to a conservative estimate of hypothetical VOC concentrations in building air at SWMUs 48 and 49. Because groundwater is relatively deep in the study area, concentrations of VOCs migrating from groundwater to the ground surface over time would likely be negligible. As noted in the general response above, groundwater data will be collected at SWMUs 48 and 49 to evaluate natural attenuation. If future construction were to occur at these sites, potential risk and hazards associated with vapor intrusion could be evaluated at that time.

8. **Table 6.4, Summary of Risks and Hazards:** Risk drivers for certain timeframe/receptors are not listed in this table. For SWMU 48, thallium for the future industrial worker; arsenic, cobalt, and thallium for the future adult resident; arsenic, cobalt, and thallium for the future off-site industrial worker; and arsenic, cobalt, and thallium for the future off-site child resident must be noted as risk drivers. For SWMU 49, thallium and cobalt for the future industrial worker; TCE, thallium, cobalt, arsenic, and TCDD for the future adult resident; and thallium cobalt, arsenic barium, and vanadium for the future child resident must be noted as risk drivers. In addition, footnotes describing unacceptable risks for lead to SWMU 48/49 receptors are included; however, these risks warrant more transparent treatment such as a separate table, or at a minimum, inclusion in the main body of Table 6.4.

   RESPONSE: The risk and hazard drivers for all receptors will be checked against the corresponding RAGS tables for all receptors to ensure that all drivers are listed. Lead was originally not included as a driver in the main body of Table 6-4 because lead results are not evaluated using the hazard index approach. As requested, however, text will be added to the main body of Table 6-4 to indicate that lead is a driver at SWMU 48 because it exceeds the health protective criterion.

9. **Section 8.1, Summary of Chemicals of Interest**, page 8-1 – Please attribute the reported elevated metals concentrations resulting from well turbidity and also the concentrations in the dissolved state. The entire section, while suggestive, does not sufficiently demonstrate that the source of elevated metals is solely turbidity. These metals include thallium, lead, arsenic, cobalt, vanadium, and barium. As stated previously, it is the Facility's responsibility to

collect and report data of sufficient quality to enable decisions. Neither a solid nor hazardous waste regulatory program would accept this demonstration as evidence that MCLs are not exceeded. The Agency is open to such a demonstration; however, this analysis does not rise to that level. Therefore the Agency does not agree with the statement that only two constituents (VOCs) exceed MCLs. Additional groundwater sampling would be required to evaluate the effect of turbidity on the concentrations of metals detected. Analyzing both filtered and unfiltered samples may be necessary

Furthermore in addition to metals, groundwater revealed concentrations of TCDD (any idea where this came from?) that exceed acceptable risk levels (Table 6.4). Therefore, TCDD should also be included in this section as a chemical of interest.

RESPONSE:. The Army is proposing the installation of two additional wells and collection of additional groundwater samples and parameters to address this, and other comments on the current state of groundwater and current concentrations of contaminants.

10. **Section 8.2**, Remedial goals based on a future industrial land use require that controls be instituted which will insure that future land use remains industrial in perpetuity.

RESPONSE: Although remedial goals were selected based on an industrial land use, the actual final concentrations in soil following the IM were below residential land use standards (or within background concentrations). Institutional controls would likely be implemented to restrict groundwater usage at the site based on the results of the additional rounds of groundwater sampling proposed above in the General Response and language similar to that in other EPA/VDEQ reports where institutional controls were implemented would be added to the CMS. Example language is provided below:

*"Institutional controls are being implemented at the site within the boundaries depicted on **Figure X-X**. The objective of the ICs is to prevent groundwater usage or exposure to groundwater constituents within these boundaries. Specifically, this site has been incorporated into a plant management manual to ensure long-term protection of human health and the environment. The management manual provides for advance notice, assessment, and approval of intrusive work that may occur within the plant with a general digging prohibition at sites such as this. In the event the property is transferred or leased, equivalent ICs will be put into terms and conditions of the deed or lease, which are no less restrictive than the IC objectives described above. Furthermore, the transferee or lessee will be responsible for ensuring IC compliance by any future users. However, the Army acknowledges the responsibility for all original liability under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and its right and responsibility to enforce ICs unless otherwise transferred to the new property recipient."*

11. **Table 8.2:** Remedial goals listed in this table for noncarcinogens such as antimony, cadmium, copper, and mercury are set at a Hazard Quotient of 1, which will result in a total Hazard Index that exceeds 1 when soil concentrations at the remedial goal are present. The

Facility must segregate cleanup goals for these metals by target organ, and present revised cleanup goals based on a target organ analysis.

RESPONSE: The remedial goals will be reviewed with respect to the target organs for each chemical of concern (COC). With the exception of arsenic, however, it is noted that all COCs were detected well below these levels in the laboratory confirmation sample for soil. Arsenic was detected at half of the RG. Based on comparisons with arsenic concentrations in background soil, arsenic in total soil was found to be within background.

12. **Section 8.3, Area and Volume of Contamination,** It is the Agency's position that the Facility has not identified the upgradient source of groundwater contamination; has misrepresented the plumes of contamination as they relate to downgradient areas; and therefore any estimates of volume are complete conjecture

RESPONSE: It is unclear when the Agency is talking about" upgradient" if they are referring to upgradient to the wells under discussion but still within bounds of the 48/49 study area. RFAAP's position is that the study was to determine risk at the site and what might be migrating from the SWMU 48/49 site. As noted in the General Response above, the Army proposes to install two additional wells and collect two additional rounds of groundwater samples to resolve this, and other similar, comments.

13. **Section 9.0, Corrective Measures Development,** In the interest of maintaining progress and despite that EPA does not believe the Facility has presented an adequate conceptual model nor characterized groundwater contamination to the extent necessary to select a remedy, the following comments are presented on the proposed remedies:

Section 9 Specific Comments

1. Please detail the proposed institutional controls proposed for the case when the Facility no longer controls the site.

RESPONSE: Language similar to that in the EPA/VDEQ approved SWMU 43 RFI, where Institutional Controls were also implemented, will be added to the Conclusions and Executive Summary of the SWMU 48/49 CMS. Example text is provided above in Response to General Comment #10.

2. When quoting information from EPA guidance (EPA, 1997d) the Facility neglected to mention that EPA prefers those natural attenuation processes that degrade contaminants.

RESPONSE: Comment Noted. The text will be updated to include the information in the comment.

3. When calculating bulk degradation rates it is the decrease in contamination over time, and when calculating biodegradation rates it is the decrease in contamination over distance that is used to calculate the rate. The rate constant derived by the facility presupposes a groundwater plume that does not move with time.

RESPONSE: See General Response. Two additional sampling rounds separated by approximately three months, for TCL VOCs, TAL metals (total + filtered) and MNA parameters will be conducted to better understand the concentrations and geochemistry at the site.

4. The use of MNA is typically a component of a groundwater remedy in conjunction with source control. If the Facility has identified and remediated the source of contamination (as supported by a realistic potentiometric surface map and realistic isoconcentration maps) please document such.

RESPONSE: Two additional wells will be installed further east of existing monitoring well 48MW-03 (see **Figure 1**). Please note that the intent of this report is to characterize contamination originating from SWMUs 48/49. An interim measures action has been performed to remove soil and ash from the southern trench at SWMU 48 as the result of previous comments from EPA/VDEQ.

5. The Facility ignores the lack of obvious evidence for biodegradation, i.e. daughter products, of which there are none reported. No evidence other than decreasing concentrations has been presented to support a proposed MNA alternative and the proposed monitoring plan does not address these deficiencies.

RESPONSE: See General Response. Two additional sampling rounds, separated by approximately three months, for contaminants and MNA parameters will be conducted to better understand the contaminant concentrations, biodegradation, and geochemistry at the site.

6. Section 9.2, Page 9-4. The fact that levels have decreased for two sampling events almost ten years apart does not adequately demonstrate natural attenuation is occurring. More sampling and analysis of MNA indicator parameters is required to support any natural attenuation assumptions. The third paragraph states that conditions at the site are aerobic. If this is the case then it is extremely difficult for TCE to degrade completely to ethane. Anaerobic conditions and the presence of *Dehalococcoides* bacteria are usually required for complete breakdown. No alternative process is proposed in this section.

RESPONSE: See General Response. Two additional sampling rounds, separated by approximately three months, for contaminants and MNA parameters will be conducted to better understand the concentrations, biodegradation, and geochemistry at the site.

7. Section 9.3. Again the IM has already been performed. This report would be very confusing to the general reader in this format.

RESPONSE: As noted in previous comment responses, the Army agrees with the Agency's suggestion to split the RFI from the CMS. The IM completion report will be incorporated into the RFI as a previous investigation, along with a timeline that shows the:

- 2007 RFI Workplan and Sampling;
- 2009 RFI/CMS Report;
- 2010 EPA/VDEQ comments and partnering meeting that led to:
- 2010 Test-pit investigation to define extent of ash in the SWMU 48 Trenches:
- 2011 Interim Measures Work plan and IM field work to remove ash, soil and bags of green material with high metals concentrations; followed by the
- 2012 RFI/CMS Report

The RFI will recommend no further action for soil based on the IM and further investigation for groundwater. This approach would allow the CMS to focus exclusively on groundwater. An investigation (including the two proposed wells and sampling rounds) will be conducted as part of the CMS to evaluate the extent of the elevated constituents and the suitability of MNA as a groundwater remedy.

8. Section 9-3, Page 9-8. Please explain why the TCE decrease was statistically valid but the data for CT decrease was not. It appears that more sampling is required to understand the processes involved.

RESPONSE: See General Response. Two additional sampling rounds separated by approximately three months, for contaminants and MNA parameters, will be conducted to better understand the concentrations and geochemistry at the site.

9. There is no evidence of natural attenuation of carbon tetrachloride. Concentrations have fluctuated for 11 years.

RESPONSE: See General Response. Two additional sampling rounds, separated by approximately three months, for contaminants and MNA parameters will be conducted to better understand the concentrations and geochemistry at the site.

10. Elevated metals may correlate with turbidity, but the correlation is only suggestive. If the Facility wishes to demonstrate that metals concentrations exceeding MCLs are related to a source other than groundwater, they must propose a plan. Also, EPA is concerned with the installation and continued use of monitoring well 49MW01. If the well is not installed to the correct depth and the location is necessary as a monitoring point propose a new well. A well that only contains a few inches of groundwater cannot adequately be sampled for VOCs.

RESPONSE: When additional sampling is performed, as described in the General Response above, both total and filtered metals will be collected to evaluate the effects of turbidity on metals concentrations.

11. The use of EVO is proposed to enhance bioremediation processes as a separate alternative and as a potential backup if MNA does not achieve desired goals. This enhancement is typically used in reducing environments and may not be appropriate for site conditions.

RESPONSE: See General Response. Two additional sampling rounds, separated by approximately three months, for contaminants and MNA parameters will be conducted to better understand the concentrations and geochemistry at the site.

12. Both the monitoring network and the proposed monitoring do not satisfy Agency requirements for MNA. It would be in the Facility's interest to implement an MNA monitoring program prior to recommending MNA as the remedy because minus actual evidence for MNA the EPA cannot propose MNA as the Final Remedy. Furthermore, please clarify how the proposed monitoring well locations were determined. What was the rationale behind the proposed location(s)? The groundwater contour map which presents groundwater elevation data and contour lines combined with the analytical data does not support the recommended monitoring network. Approximately one half the wells in the proposed monitoring network will not provide data supporting the Facility's desire to implement MNA.

RESPONSE: See General Response. Two additional wells have also been proposed to be installed. One would be installed to the east of existing well 48MW03 at the top of the bluff. The second well would be installed east of SWMU 59 and northeast of existing well 48MW03. These wells would more accurately delineate the plume.

After the wells are installed, two additional sampling rounds, separated by approximately three months, for contaminants and MNA parameters will be conducted to better understand the concentrations and geochemistry at the site.

13. EPA does not understand the purpose of proposing a work plan for excavation of SWMU 48. The entire section is confusing as it is the Agency's belief that all this work has been completed already. Please clarify.

RESPONSE: At previous partnering meetings with the Army, EPA, and VDEQ discussing the draft SWMU 48/49 RFI/CMS, it was agreed that an IM for soil at SWMU 48 would be conducted with the results incorporated into the report, without re-doing the risk assessments. It is agreed that this makes a confusing timeline and the Army would like to discuss with EPA/VDEQ how best to present all the data and results. This could be done, as suggested above, by separating the RFI from the CMS.

Table 1
SWMU 48/49 Proposed Monitoring Wells
for Two Rounds of Sampling

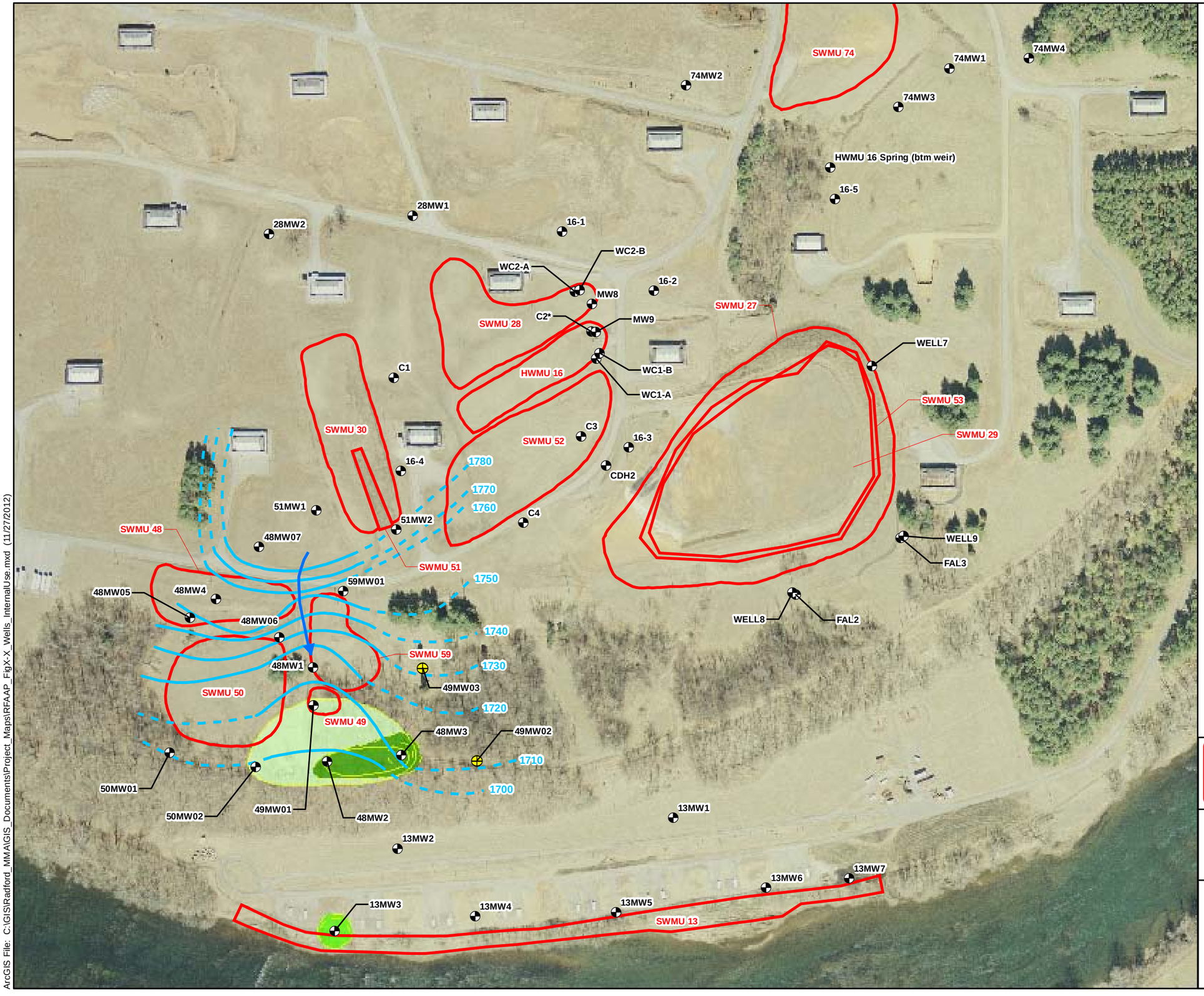
Well ID		Rationale for Inclusion
51MW1 51MW2 C4 48MW07 59MW01		Upgradient of 48/49 & downgradient of next tier of sites
48MW05 48MW4 50MW01		Bound contaminants to the west
50MW02 48MW1 48MW2 48MW06 49MW01 48MW3		Within Plume
13MW3 13MW2 13MW4		Downgradient of Plume
49MW02 49MW03		Proposed wells to the east

Table 2
Monitored Natural Attenuation - Performance Monitoring Parameters
SWMU 49 Corrective Measures Study

Parameter	Data Use
TCL VOCs (including the COIs CT and TCE)	COIs - Evaluate concentration trends and attenuation with respect to RGs. Used to document achievement of CMOs and RGs. Allows for evaluation of CT and TCE transformation processes to methane and ethene.
TAL Metals (filtered and unfiltered)	Resolve issues related to turbidity and metals concentrations.
Total Organic Carbon	Allows for evaluation of immobilization potential of CT and RDX.
Ferrous Iron (Fe +2)	May indicate anaerobic degradation due to depletion of oxygen, nitrate, and manganese. Also allows for evaluation of immobilization potential of CT and TCE.
Nitrate (NO3)	Substrate for microbial respiration if oxygen is depleted.
Sulfate ($SO4^{2-}$)	Substrate for anaerobic microbial respiration.
Chloride (Cl)	Substrate for anaerobic microbial respiration.
Methane, Ethene, Ethane	Daughter products occurring during the degradation of TCE.
pH	Aerobic and anaerobic processes are pH sensitive. Stabilization parameter for groundwater purging and sampling.
Dissolved Oxygen (DO)	Concentrations indicate whether an aerobic or anaerobic pathway exists. Concentrations of <0.5 mg/L generally indicate an anaerobic pathway. DO 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:

CMO = Corrective Measures Objective
COI = Contaminant of Interest
CT= Carbon Tetrachloride
DO = Dissolved Oxygen
mg/L = milligram per liter
mV = millivolt
ORP = Oxidation-Reduction Potential
RG = Remedial Goal
TCE= Trichloroethene



LEGEND

- Monitoring Well
- Proposed Monitoring Well
- Groundwater Flow Direction
- Inferred Groundwater Contour
- Groundwater Contour
- Carbon Tetrachloride Isopleth
- Inferred Carbon Tetrachloride Isopleth
- SWMU Boundary

Carbon Tetrachloride Plume (ug/L)

- 1
- 5
- 50

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.

N

Scale:

0 125 250 500 Feet

U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE X-X

Monitoring Wells

Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\GIS\Radford_MMA\GIS_Documents\Project_Maps\RFAAP_FigX-X_Wells_InternalUse.mxd (11/27/2012)

Leahy, Timothy

From: Weissbart.Erich@epamail.epa.gov
Sent: Monday, November 05, 2012 7:56 AM
To: McKenna, James J CIV (US)
Cc: Cutler,Jim; Stewart, Jay (US SSA); Quinn.Elizabeth@epamail.epa.gov
Subject: SWMU 48/49
Attachments: Radford SWMUs 48 and 49 RFI_CMS.pdf

Jim,
Attached please find the Agencies (EPA and VADEQ) comments on the SWMUs 48 and 49 Draft RFI/CMS Report. Please note that a 30-day request for a response is included. Given the time between previous submittals and responses I believed this was necessary to keep work moving on these units.

Erich Weissbart P.G.
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

November 5, 2012

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

Jay Stewart
Environmental Manager
BAE Systems, Ordnance Systems, Inc.
Radford Army Ammunition Plant
114 Peppers Ferry Road, P.O. Box 1
Radford, VA 24143

VIA Electronic Mail

Re: Radford Army Ammunition Plant, Radford, Virginia
Solid Waste Management Units 48 and 49
RCRA Facility Investigation/Corrective Measures Study Report

Dear Mr. McKenna and Mr. Stewart:

The U.S. Environmental Protection Agency (EPA) and Virginia Department of Environmental Quality (VDEQ) have reviewed the U.S. Army's (Army's) Solid Waste Management Units 48 and 49 (SWMU), RFI/CMS Report, for SWMUs 48 and 49 located at the Radford Army Ammunition Plant (RFAAP) in Radford, Virginia. Based on our review of this material, we identified a significant number of items that require your attention, further consideration, and revision before we can consider this document acceptable for use to complete the RFI/CMS.

In general, we found that the Draft CMI Groundwater Monitoring Plan lacks sufficient detail and supporting information to justify the statements made and proposed path forward. There is no basis or supporting data for the presentation of current conditions as stated in the document. There is no information provided that is consistent with the MNA groundwater remedy proposed. Therefore EPA cannot approve the document and requests a revised submission.

Based on our review we have prepared the following comments. Please review the comments included below and provide EPA with responses and revisions within thirty (30) calendar days of your receipt of this letter.

Executive Summary – The second paragraph states that SWMUs 48 and 49 are addressed because they are associated with further action – Monitored Natural Attenuation (MNA). This statement presumes that conclusions and proposals in this report are fact. First off Corrective Action remedies are considered proposed until completing the public participation process. Other than an Interim Measure,

Corrective Action remedies must go through the public participation process. Second, the assumption that MNA is the selected remedy for groundwater prior to regulatory input is highly presumptuous. While seemingly innocuous the statement is not accurate and should be revised or removed.

ES Groundwater – The statement that elevated metals were the result of poorly recharging, turbid well sample is another example of opinion and not fact. The data presented in Section 8 of the report to support this statement are suggestive, but not conclusive. It is inappropriate to make marginally supported claims in the executive summary. These reports are ultimately for public consumption and a cursory analysis does not substitute for scientific fact.

ES Corrective Measures Study, Bullet 3 – It is stated that soil was excavated from SWMU 48 until residential screening levels were achieved:

> A removal action based on the metals concentrations detected in the ash layer was completed in 2012. In compliance with the *SWMU 48 Interim Measures Work Plan* (Shaw, 2011), the source material for contamination at SWMU 48, the ash layer, has been removed to below residential use criteria. Therefore, soil at SWMU 48 is no longer a concern.

Given that soil was previously removed as an Interim Measure the presentation of soil removal as a CMS is confusing. Equally confusing is the detailed cost estimate. Since the soil has already been excavated and disposed the costs are already known. Since the IM has been performed and completed it is confusing to present this CMS as if the IM has never happened. It is strongly suggested that the RFI be finalized as a stand-alone report. A CMS that addresses groundwater at the site should be submitted separately.

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Section 4.3.2, Groundwater, page 4-26 – The Agency disagrees with the statement that the 2007 data best reflects current conditions. The 2007 data reflects conditions from 2007 and current conditions are unknown. Furthermore, historical groundwater data from 2006 is valuable in establishing trends in contamination and should be included with the 2007 data. No groundwater investigation work has been conducted and/or reported to EPA over the last 5 years despite previous comments from the Agencies circa 2010 requesting MNA parameters be collected. Please refrain from reiterating opinions related to

elevated metals and turbidity. It is true that turbidity contributes to elevated metals reported from monitoring wells; however, unless and until the Facility confirms that turbidity is the cause of elevated metals statements claiming so are conjecture. The Agency suggests that in the future the Facility collect both dissolved and total metals and confirm the difference due to turbidity. As far as low water levels contributing to turbid samples, it is the Facility's responsibility to install quality wells and report quality data.

The Agency disagrees with the assertion that VOCs have broken down over 11 years of groundwater monitoring. There is no data supporting this statement and laboratory data does not report the presence of daughter products: cis-1,2-dichlorethene, vinyl chloride, or chloroform. It is more likely that dissolved contaminants in groundwater continue to advect with groundwater. The Agency also disagrees with the statement that the figures presented represent monitoring wells in the "center" of the plume. Based on the figures presented the Agency has no confidence that the Facility has identified the source of the contaminants, much less the center of the plume. Figures depict dissolved contaminants in groundwater flowing to the northwest against the gradient depicted on the potentiometric drawing rather than with groundwater flow towards HWMU 13. The Agency disagrees with the assertion that the plume is bounded in all directions by surrounding wells. The well historically reporting the most elevated carbon tetrachloride has no well located upgradient. Where does the Facility believe the source of groundwater contamination is located? Please explain how as recent as 2006, monitoring well 48MW3 reported the highest concentration of carbon tetrachloride. The facility should use the potentiometric surface map to support their interpretations of isoconcentration figures. For example, how is the lack of contaminant movement in the downgradient direction of groundwater flow possible? How realistic is the depiction in Figure 4-1 (and others) that carbon tetrachloride (CT) upgradient from HWMU 13 is not the source of CT at HWMU 13? The Agency completely disagrees with the representations of contamination in each of the Figures presented in this section (Figures 4-1 through 4-4). Please explain either how depicted source areas contain lesser concentrations than downgradient wells or how contamination advects against the groundwater gradient depicted in Section 2. In summary, groundwater hydrology is not adequately characterized and no inclusive model is proposed that correlates unit and downgradient information; additional wells may be necessary.

Section 6.2.4, Quantification of Exposure, Calculation of Daily Intakes, first paragraph, and Appendix E, Human Health Risk Assessment, Tables E.1-14: While an exposure frequency (EF) of 125 days for a construction worker may be justifiable for SWMUs 48 and 49 on a site-specific basis due to the small size and difficulty in constructing a building on these sites, EPA notes that this is a decision that applies to these SWMUs only, and not to other SWMUs throughout the Radford plant. Furthermore, language explaining and supporting the use of the EF of 125 days for a construction worker must be included in the report.

Section 6.2.4, Quantification of Exposure, Calculation of Daily Intakes, fifth paragraph: As noted in prior EPA comments, risks associated with vapor intrusion that are evaluated when 1) heterogenous geologic materials are present, and 2) no structures are currently present on the site have little relevance to actual future risks associated with vapor intrusion when buildings are present. A resolution to this issue would be an evaluation of the potential for vapor intrusion when a future building is constructed on the site, and/or installation of a vapor barrier as part of the construction of a future building.

Table 6.4, Summary of Risks and Hazards: Risk drivers for certain timeframe/receptors are not listed in this table. For SWMU 48, thallium for the future industrial worker; arsenic, cobalt, and thallium for the future adult resident; arsenic, cobalt, and thallium for the future off-site industrial worker; and arsenic, cobalt, and thallium for the future off-site child resident must be noted as risk drivers. For SWMU 49, thallium and cobalt for the future industrial worker; TCE, thallium, cobalt, arsenic, and

TCDD for the future adult resident; and thallium cobalt, arsenic barium, and vanadium for the future child resident must be noted as risk drivers. In addition, footnotes describing unacceptable risks for lead to SWMU 48/49 receptors are included; however, these risks warrant more transparent treatment such as a separate table, or at a minimum, inclusion in the main body of Table 6.4.

Section 8.1, Summary of Chemicals of Interest, page 8-1 – Please attribute the reported elevated metals concentrations resulting from well turbidity and also the concentrations in the dissolved state. The entire section, while suggestive, does not sufficiently demonstrate that the source of elevated metals is solely turbidity. These metals include thallium, lead, arsenic, cobalt, vanadium, and barium. As stated previously, it is the Facility's responsibility to collect and report data of sufficient quality to enable decisions. Neither a solid nor hazardous waste regulatory program would accept this demonstration as evidence that MCLs are not exceeded. The Agency is open to such a demonstration; however, this analysis does not rise to that level. Therefore the Agency does not agree with the statement that only two constituents (VOCs) exceed MCLs. Additional groundwater sampling would be required to evaluate the effect of turbidity on the concentrations of metals detected. Analyzing both filtered and unfiltered samples may be necessary.

Furthermore in addition to metals, groundwater revealed concentrations of TCDD that exceed acceptable risk levels (Table 6.4). Therefore, TCDD should also be included in this section as a chemical of interest.

Section 8.2, Remedial goals based on a future industrial land use require that controls be instituted which will insure that future land use remains industrial in perpetuity.

Table 8.2: Remedial goals listed in this table for noncarcinogens such as antimony, cadmium, copper, and mercury are set at a Hazard Quotient of 1, which will result in a total Hazard Index that exceeds 1 when soil concentrations at the remedial goal are present. The Facility must segregate cleanup goals for these metals by target organ, and present revised cleanup goals based on a target organ analysis.

Section 8.3, Area and Volume of Contamination, It is the Agency's position that the Facility has not identified the upgradient source of groundwater contamination; has misrepresented the plumes of contamination as they relate to downgradient areas; and therefore any estimates of volume are complete conjecture.

Section 9.0, Corrective Measures Development, In the interest of maintaining progress and despite that EPA does not believe the Facility has presented an adequate conceptual model nor characterized groundwater contamination to the extent necessary to select a remedy, the following comments are presented on the proposed remedies:

1. Please detail the proposed institutional controls proposed for the case when the Facility no longer controls the site.
2. When quoting information from EPA guidance (EPA, 1997d) the Facility neglected to mention that EPA prefers those natural attenuation processes that degrade contaminants.
3. When calculating bulk degradation rates it is the decrease in contamination over time, and when calculating biodegradation rates it is the decrease in contamination over distance that is used to calculate the rate. The rate constant derived by the facility presupposes a groundwater plume that does not move with time.
4. The use of MNA is typically a component of a groundwater remedy in conjunction with source control. If the Facility has identified and remediated the source of contamination (as supported

by a realistic potentiometric surface map and realistic isoconcentration maps) please document such.

5. The Facility ignores the lack of obvious evidence for biodegradation, i.e. daughter products, of which there are none reported. No evidence other than decreasing concentrations has been presented to support a proposed MNA alternative and the proposed monitoring plan does not address these deficiencies.
6. Section 9.2, Page 9-4. The fact that levels have decreased for two sampling events almost ten years apart does not adequately demonstrate natural attenuation is occurring. More sampling and analysis of MNA indicator parameters is required to support any natural attenuation assumptions. The third paragraph states that conditions at the site are aerobic. If this is the case then it is extremely difficult for TCE to degrade completely to ethane. Anaerobic conditions and the presence of *Dehalococcoides* bacteria are usually required for complete breakdown. No alternative process is proposed in this section.
7. Section 9.3. Again the IM has already been performed. This report would be very confusing to the general reader in this format.
8. Section 9-3, Page 9-8. Please explain why the TCE decrease was statistically valid but the data for CT decrease was not. It appears that more sampling is required to understand the processes involved.
9. There is no evidence of natural attenuation of carbon tetrachloride. Concentrations have fluctuated for 11 years.
10. Elevated metals may correlate with turbidity, but the correlation is only suggestive. If the Facility wishes to demonstrate that metals concentrations exceeding MCLs are related to a source other than groundwater, they must propose a plan. Also, EPA is concerned with the installation and continued use of monitoring well 49MW01. If the well is not installed to the correct depth and the location is necessary as a monitoring point propose a new well. A well that only contains a few inches of groundwater cannot adequately be sampled for VOCs.
11. The use of EVO is proposed to enhance bioremediation processes as a separate alternative and as a potential backup if MNA does not achieve desired goals. This enhancement is typically used in reducing environments and may not be appropriate for site conditions.
12. Both the monitoring network and the proposed monitoring do not satisfy Agency requirements for MNA. It would be in the Facility's interest to implement an MNA monitoring program prior to recommending MNA as the remedy because minus actual evidence for MNA the EPA cannot propose MNA as the Final Remedy. Furthermore, please clarify how the proposed monitoring well locations were determined. What was the rationale behind the proposed location(s)? The groundwater contour map which presents groundwater elevation data and contour lines combined with the analytical data does not support the recommended monitoring network. Approximately one half the wells in the proposed monitoring network will not provide data supporting the Facility's desire to implement MNA.
13. EPA does not understand the purpose of proposing a work plan for excavation of SWMU 48. The entire section is confusing as it is the Agency's belief that all this work has been completed already. Please clarify.

While EPA has provided a review of the CMS section we cannot adequately review this material until adequate information is provided to describe the path forward for updating the conceptual site model for groundwater flow patterns and contaminant migration.

Although it is possible that active remedial options may not be effective, it is premature to preclude this without adequate supporting information. It is also premature to determine that active remedial options may not provide measurable advantages compared to natural attenuation mechanisms. Until information

has been presented to indicate that natural attenuation is occurring at the site, all options should be considered open.

This concludes our review comments for the July 2012 Draft SWMU 48 and 49 RFI/CMS submitted for the RFAAP Facility. Please review the comments included herein and provide EPA with responses and revisions within thirty (30) calendar days of your receipt of this letter. Please contact me if you have any questions.

Sincerely,

Erich Weissbart

Erich Weissbart, P.G.
RCRA Project Manager
Office of Remediation (3LC20)

c: James Cutler, VDEQ
Elizabeth Quinn, EPA

BAE SYSTEMS

ORDNANCE SYSTEMS INC.
6580 Valley Center Drive, Suite 333
Radford, VA 24141
Telephone: 540-267-3449

July 6, 2012

Mr. Erich Weissbart
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 23219

Subject: With Certification, SWMU 48 Interim Measures Completion Report, Draft June 2012 and SWMUs 48 and 49 RCRA Facility Investigation/Corrective Measures Study Report, Draft June 2012
EPA ID# VA1 210020730

Dear Mr. Weissbart and Mr. Cutler:

Enclosed is the certification for the subject documents that were sent to you on July 2, 2012. Also enclosed is the July 2, 2012 transmittal email.

Please coordinate with and provide any questions or comments to myself at (423) 578 6253 or Jim McKenna, ACO Staff (540) 731-5782.

Sincerely,

Bob Winstead, Environmental Manager
BAE Systems

c: Karen Sismour
Virginia Department of Environmental Quality
P. O. Box 1105
Richmond, VA 23218

E. A. Lohman
Virginia Department of Environmental Quality
Blue Ridge Regional Office
3019 Peters Creek Road
Roanoke, VA 24019

Rich Mendoza
US Army Environmental Center
2450 Connell Rd., Bldg 2264, 1st Fl, Rm126
Attn: Richard Mendoza
San Antonio, TX 78234-7664

Tom Meyer
Corps of Engineers, Baltimore District
ATTN: CENAB-EN-HM
10 South Howard Street
Baltimore, MD 21201

bc: BAE Administrative File
J. McKenna, ACO Staff
Rob Davie-ACO Staff

Coordination: J. McKenna

Concerning the following:

Radford Army Ammunition Plant
SWMU 48 Interim Measures Completion Report, Draft June 2012
and
SWMUs 48 and 49 RCRA Facility Investigation/Corrective Measures Study Report,
Draft June 2012

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: Wm Byron Penland
TITLE: Lieutenant Colonel, US Army

Commanding

SIGNATURE: 6 July 2012
PRINTED NAME: Todd D. Hayes
TITLE: Director, Facility Support Services
BAE Systems

Winstead, Bob (US SSA)

From: McKenna, James J CIV (US) <james.j.mckenna16.civ@mail.mil>
Sent: Monday, July 02, 2012 1:45 PM
To: beth lohman (ealohman@deq.virginia.gov); Winstead, Bob (US SSA); Cutler,Jim; Jeremy Flint (jeremy.flint@atk.com); Mendoza, Richard R Jr CIV (US); Meyer, Tom NAB02; Parks, Jeffrey N; Timothy.Leahy@shawgrp.com; Weissbart.Erich@epamail.epa.gov; Hillebrand, Jeffrey
Cc: Davie, Robert N III CIV (US)
Subject: Draft SWMU 48 and 49 RFI/CMS Report & Draft SWMU 48 IM Completion Report Transmittal email (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: FOUO

All:

Note the contractor will ship the subject documents with a copy of this email to the POCs and tracking numbers below. Certification will follow by separate letter.

Erich Weissbart 3 Paper copy/3 CD 1Z63V8840198032357

Jim Cutler 1 Paper copy/1 CD 1Z63V8840198210762

Tom Meyer 1 Paper copy/1 CD 1Z63V8840199610720

Richard Mendoza 1 Paper copy/1 CD 1Z63V8840199863547

E.A. Lohman 1 CD 1Z63V8840196934770

Bob Winstead 1 Paper Copy/1 CD 1Z63V8840196500381

Jeffrey Leach 1 CD 1Z63V8840197328334

Thank you for your support of the Radford Army Ammunition Plant Installation Restoration Program.

Jim McKenna

Classification: UNCLASSIFIED
Caveats: FOUO

Leahy, Timothy

From: Geiger.William@epamail.epa.gov
Sent: Thursday, January 06, 2011 3:27 PM
To: McKenna, James J CIV (US)
Cc: Andy Kassoff; Druck, Dennis E Mr CIV USA MEDCOM PHC; Cutler,Jim; Parks, Jeffrey; jeremy.flint@atk.com; jerome.redder@atk.com; Jason Steele; Mendoza, Richard R Jr CIV (US); Leahy, Timothy; Meyer, Tom NAB02
Subject: RE: Draft SWMU 48 Supplemental RFI data report (UNCLASSIFIED)

EPA/VDEQ approve of these responses to our comments on the SWMU 48 RFI supplemental data report. While explosives will not be driving the removal effort, we recommend including them in the confirmation sampling. Please call or email Jim Cutler or me with any questions. Thanks.

William A. Geiger
Remedial Project Manager
Office of Remediation (3LC20)
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029
Phone: 215.814.3413
Geiger.William@epa.gov

Leahy, Timothy

From: McKenna, James J CIV (US) [james.j.mckenna16.civ@mail.mil]
Sent: Thursday, December 09, 2010 2:00 PM
To: Geiger.William@epamail.epa.gov
Cc: Andy Kassoff; Druck, Dennis E Mr CIV USA MEDCOM PHC; Cutler,Jim; Parks, Jeffrey; jeremy.flint@atk.com; jerome.redder@atk.com; Jason Steele; Mendoza, Richard R Jr CIV (US); Leahy, Timothy; Meyer, Tom NAB02
Subject: RE: Draft SWMU 48 Supplemental RFI data report (UNCLASSIFIED)
Attachments: TrenchReportRTCs.docx

Importance: High

Classification: UNCLASSIFIED
Caveats: FOUO

Will Geiger and Jim Cutler,

Attached are our responses to EPA/VDEQ comments.

I'll call later. Thanks,
JJM

-----Original Message-----
From: Geiger.William@epamail.epa.gov [mailto:Geiger.William@epamail.epa.gov]
Sent: Wednesday, December 01, 2010 9:23 AM
To: McKenna, Jim J Mr CIV USA AMC
Cc: Andy Kassoff; Druck, Dennis E Mr CIV USA MEDCOM PHC; Cutler,Jim; Parks, Jeffrey; jeremy.flint@atk.com; jerome.redder@atk.com; Jason Steele; Mendoza, Richard R Mr CIV USA IMCOM; Leahy, Timothy; Meyer, Tom NAB02
Subject: RE: Draft SWMU 48 Supplemental RFI data report

Jim, here are EPA/VDEQ comments on the SWMU 48 Supplemental RFI data report. Please call or email me with any questions.

1) Results from the 3/2010 sampling of the ash layer at SWMU 48 revealed significant concentrations of several metals. A lead concentration of 114,000 mg/kg (> 10%) was measured in sample 48TP02; other notable concentrations of lead were reported in samples 48TP04 (665 mg/kg) and 48TP05 (450 mg/kg). Mean lead concentrations in test pit samples considered collectively were 5839 mg/kg, well in excess of both residential and industrial screening concentrations for lead. Mercury was also measured at significant concentrations in several samples; notable concentrations included 25.5 mg/kg reported in sample 48TP04, 12.5 mg/kg reported in sample 48TP07, and 5.9 mg/kg reported in sample 48TP05. The upper confidence limit on the arithmetic mean concentration of mercury in test pit samples was 8.5 mg/kg which exceeds both residential and industrial screening concentrations for this metal. A copper concentration of 81,800 mg/kg in sample 48TP02 far exceeded copper concentrations reported in the remainder of test pit samples. An upper confidence limit concentration for copper of 29,700 mg/kg results when all test pit results are combined. The upper confidence limit calculation is significant because it is the concentration term utilized in the risk algorithm of a baseline risk assessment (BLRA). For lead, the arithmetic mean is the risk concentration term used in both the children's (IEUBK) and adult lead models. For all metals discussed, a BLRA would likely predict an unacceptable risk associated with either

residential or industrial exposure. In addition to unacceptable risks, the ash layer may serve as a source of contamination for other environmental media.

2) The 3/2010 sampling of the ash layer did not reveal notable concentrations of explosive material. Notable concentrations of the explosive, 2,4,6-trinitrotoluene (2,4,6-TNT; up to 935 mg/kg), were measured in 1998 samples of soil below the fill material at SWMU 48. As with the metals, an upper confidence limit on the mean 2,4,6-TNT concentrations was 788.6 mg/kg, exceeding both industrial and residential screening concentrations. Thus both the ash layer and soil below the ash layer reveal significant concentrations of one or more contaminants which may pose unacceptable risks to human receptors.

3) Several undefined qualifiers in the "Lab" column appear on Table 8, including terms such as "B," "RLA," "V," and "PG." Provide definitions for these qualifiers and evaluate impacts on results; in addition, laboratory data (Form I's) should be provided to EPA for review.

4) The legend of Table 8 includes a statement that inorganic results below background UTLs are not indicated as exceedances. Note that all exceedances of screening concentrations must be identified and evaluated for potential risks. Following the appropriate risk characterization, a comparison to background concentrations is discussed.

5) The pH measurement for sample 48TP06 of 12.4 exceeded the threshold pH of 12. This may indicate that some of the ash layer material qualifies as a hazardous waste (characteristic).

William A. Geiger
Remedial Project Manager
Office of Remediation (3LC20)
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029
Phone: 215.814.3413
Geiger.William@epa.gov

From: "McKenna, Jim J Mr CIV USA AMC" <jim.mckenna@us.army.mil>
To: William Geiger/R3/USEPA/US@EPA
Cc: "Meyer, Tom NAB02" <Tom.Meyer@usace.army.mil>, "Mendoza, Richard R Mr CIV USA IMCOM" <richard.r.mendoza@us.army.mil>, "Druck, Dennis E Mr CIV USA MEDCOM PHC" <dennis.druck@us.army.mil>, "Parks, Jeffrey" <Jeffrey.Parks@shawgrp.com>, "Leahy, Timothy" <Timothy.Leahy@shawgrp.com>, "Cutler,Jim" <James.Cutler@deq.virginia.gov>, <jeremy.flint@atk.com>, <jerome.redder@atk.com>, "Andy Kassoff" <akassoff@eee-consulting.com>, "Jason Steele" <jsteele@eee-consulting.com>
Date: 11/12/2010 11:36 AM
Subject: RE: Draft SWMU 48 Supplemental RFI data report (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: FOUO

Will Geiger and all,

Sending a revised report. The 1st page of Table 8 was missing and the blank page before Appendix A was also removed. This version is complete now. Conclusions didn't change.

Apologize for any confusion.

Thanks,
JJM

-----Original Message-----
From: McKenna, Jim J Mr CIV USA AMC
Sent: Wednesday, August 11, 2010 2:13 PM
To: 'Geiger.William@epamail.epa.gov'
Cc: Meyer, Tom NAB02; Mendoza, Richard R Mr CIV USA IMCOM; Druck, Dennis E Mr CIV USA MEDCOM PHC; Parks, Jeffrey; 'Leahy, Timothy'; Cutler,Jim; Jeremy Flint (jeremy.flint@atk.com); jerome.redder@atk.com
Subject: Draft SWMU 48 Supplemental RFI data report (UNCLASSIFIED)
Importance: High

Classification: UNCLASSIFIED
Caveats: FOUO

Will & Jim,

This is the SWMU 48 data report from our March 2010 sampling event. This was performed as a follow up to our Feb 2010 partnering meeting. Please take a look at it. We'd like to get your feedback on proceeding with the SWMU 48/49 RFI/CMS report.

Thanks,
Jim

Classification: UNCLASSIFIED
Caveats: FOUO

Classification: UNCLASSIFIED
Caveats: FOUO

[attachment "SWMU 48 Supplemental Data report_revJimscomments.pdf" deleted by William Geiger/R3/USEPA/US]

Classification: UNCLASSIFIED
Caveats: FOUO

Presented below are EPA/VDEQ comments on the *Draft SWMU 48 Supplemental RFI Data Report,* Radford Army Ammunition Plant (RFAAP), Virginia, dated August 2010 (RFI/CMS Report).

EPA/VDEQ COMMENTS

1. Results from the 3/2010 sampling of the ash layer at SWMU 48 revealed significant concentrations of several metals. A lead concentration of 114,000 mg/kg (> 10%) was measured in sample 48TP02; other notable concentrations of lead were reported in samples 48TP04 (665 mg/kg) and 48TP05 (450 mg/kg). Mean lead concentrations in test pit samples considered collectively were 5839 mg/kg, well in excess of both residential and industrial screening concentrations for lead. Mercury was also measured at significant concentrations in several samples; notable concentrations included 25.5 mg/kg reported in sample 48TP04, 12.5 mg/kg reported in sample 48TP07, and 5.9 mg/kg reported in sample 48TP05. The upper confidence limit on the arithmetic mean concentration of mercury in test pit samples was 8.5 mg/kg which exceeds both residential and industrial screening concentrations for this metal. A copper concentration of 81,800 mg/kg in sample 48TP02 far exceeded copper concentrations reported in the remainder of test pit samples. An upper confidence limit concentration for copper of 29,700 mg/kg results when all test pit results are combined. The upper confidence limit calculation is significant because it is the concentration term utilized in the risk algorithm of a baseline risk assessment (BLRA). For lead, the arithmetic mean is the risk concentration term used in both the children's (IEUBK) and adult lead models. For all metals discussed, a BLRA would likely predict an unacceptable risk associated with either residential or industrial exposure. In addition to unacceptable risks, the ash layer may serve as a source of contamination for other environmental media.

   RESPONSE: It should be noted that one of the samples (48TP02-RFI) was collected from a green grout material that was encountered at one test pit location. The material was inside a 5 gallon fiber-board drum wrapped in a plastic bag. Four of these drums were uncovered, segregated and drummed for disposal. A sample was collected of this material for characterization and waste disposal purposes, but the concentrations are no longer present in soil at SWMU 48. The extremely high concentrations of lead and copper in the material result in biased UCLs that are calculated based on concentrations no longer present. However, based on the uncertainty of whether additional bags of grout are present, the Army agrees that a limited removal action should be performed within the boundaries of the southern trench at the site. An Interim Measures Work Plan will be prepared that describes the excavation activities. Based on the lack of reproducibility of the elevated TNT concentration from the 1998 sample (see Response to Comment #2, below), the Army proposes that the removal action be based on metals concentrations in the soil rather than explosives concentrations.

2. The 3/2010 sampling of the ash layer did not reveal notable concentrations of explosive material. Notable concentrations of the explosive, 2,4,6-trinitrotoluene (2,4,6-TNT; up to 935 mg/kg), were measured in 1998 samples of soil below the fill material at SWMU 48. As with the metals, an upper confidence limit on the mean 2,4,6-TNT concentrations

was 788.6 mg/kg, exceeding both industrial and residential screening concentrations. Thus both the ash layer and soil below the ash layer reveal significant concentrations of one or more contaminants which may pose unacceptable risks to human receptors.

RESPONSE: The purpose of the supplemental investigation described in this report was to demonstrate whether the 935 mg/kg of TNT was representative of the ash material. Nineteen samples, including a sample from the same location as the elevated 1998 sample, were collected from the ash layer or the soil immediately below the ash layer. 2,4,6-TNT was only detected in four of the samples, and the highest concentration of TNT was 1.6 mg/kg. Since the 1998 result has been irreproducible, it is appropriate to replace that anomalous result with the new 2010 data based on the lack of reproducibility of the 1998 result. The elevated UCL is entirely due to the single, irreproducible concentration.

3. Several undefined qualifiers in the "Lab" column appear on Table 8, including terms such as "B," "RLA," "V," and "PG." Provide definitions for these qualifiers and evaluate impacts on results; in addition, laboratory data (Form I's) should be provided to EPA for review.

   RESPONSE: The table legend will be updated to include the missing laboratory qualifiers.

4. The legend of Table 8 includes a statement that inorganic results below background UTLs are not indicated as exceedances. Note that all exceedances of screening concentrations must be identified and evaluated for potential risks. Following the appropriate risk characterization, a comparison to background concentrations is discussed.

   RESPONSE: All exceedances are identified and evaluated for potential risks per EPA risk assessment guidance. Table 8 is intended to help define the nature and extent of contamination due to past activities at the site. Excluding exceedances that are below background UTLs makes it easier for the reader to visually identify potential constituents of concern without referring back to the text.

5. The pH measurement for sample 48TP06 of 12.4 exceeded the threshold pH of 12. This may indicate that some of the ash layer material qualifies as a hazardous waste (characteristic).

   RESPONSE: Agreed. The TCLP (including corrosivity as pH) results were measured for planning purposes to assess the ultimate disposal requirements for soil and/or ash from the site. Additional waste characterization sampling will be conducted and results sent to the disposal facility for approval prior to excavation and offsite disposal if a removal action is approved at this site.

RE: Draft SWMU 48 Supplemental RFI data report

Geiger.William@epamail.epa.gov

Sent: Wednesday, December 01, 2010 9:23 AM
To: McKenna, James J CIV (US) [james.j.mckenna16.civ@mail.mil]
Cc: Andy Kassoff [akassoff@eee-consulting.com]; Druck, Dennis E Mr CIV USA MEDCOM PHC [IMCEAEX-_O=CONUS_OU=BRAGG+20ADMINISTRATIVE+20GROUP_CN=RECIPIENTS_CN=DENNIS+2EDRUCK+40US+2EARMY+2EMIL@easf.csd.disa.mil] ; Cutler,Jim [James.Cutler@deq.virginia.gov]; Parks, Jeffrey [Jeffrey.Parks@shawgrp.com]; jeremy.flint@atk.com; jerome.redder@atk.com; Jason Steele [jsteele@eee-consulting.com]; Mendoza, Richard R Jr CIV (US) [richard.r.mendoza.civ@mail.mil]; Leahy, Timothy; Meyer, Tom NAB02 [Tom.Meyer@usace.army.mil]

Jim, here are EPA/VDEQ comments on the SWMU 48 Supplemental RFI data report. Please call or email me with any questions.

1) Results from the 3/2010 sampling of the ash layer at SWMU 48 revealed significant concentrations of several metals. A lead concentration of 114,000 mg/kg (> 10%) was measured in sample 48TP02; other notable concentrations of lead were reported in samples 48TP04 (665 mg/kg) and 48TP05 (450 mg/kg). Mean lead concentrations in test pit samples considered collectively were 5839 mg/kg, well in excess of both residential and industrial screening concentrations for lead. Mercury was also measured at significant concentrations in several samples; notable concentrations included 25.5 mg/kg reported in sample 48TP04, 12.5 mg/kg reported in sample 48TP07, and 5.9 mg/kg reported in sample 48TP05. The upper confidence limit on the arithmetic mean concentration of mercury in test pit samples was 8.5 mg/kg which exceeds both residential and industrial screening concentrations for this metal. A copper concentration of 81,800 mg/kg in sample 48TP02 far exceeded copper concentrations reported in the remainder of test pit samples. An upper confidence limit concentration for copper of 29,700 mg/kg results when all test pit results are combined. The upper confidence limit calculation is significant because it is the concentration term utilized in the risk algorithm of a baseline risk assessment (BLRA). For lead, the arithmetic mean is the risk concentration term used in both the children's (IEUBK) and adult lead models. For all metals discussed, a BLRA would likely predict an unacceptable risk associated with either residential or industrial exposure. In addition to unacceptable risks, the ash layer may serve as a source of contamination for other environmental media.

2) The 3/2010 sampling of the ash layer did not reveal notable concentrations of explosive material. Notable concentrations of the explosive, 2,4,6-trinitrotoluene (2,4,6-TNT; up to 935 mg/kg), were measured in 1998 samples of soil below the fill material at SWMU 48. As with the metals, an upper confidence limit on the mean 2,4,6-TNT concentrations was 788.6 mg/kg, exceeding both industrial and residential screening concentrations. Thus both the ash layer and soil below the ash layer reveal significant concentrations of one or more contaminants which may pose unacceptable risks to human receptors.

3) Several undefined qualifiers in the "Lab" column appear on Table 8, including terms such as "B," "RLA," "V," and "PG." Provide definitions for these qualifiers and evaluate impacts on results; in addition, laboratory data (Form I's) should be provided to EPA for review.

4) The legend of Table 8 includes a statement that inorganic results below background UTLs are not indicated as exceedances. Note that all exceedances of screening concentrations must be identified and evaluated for potential risks. Following the appropriate risk characterization, a comparison to background concentrations is discussed.

5) The pH measurement for sample 48TP06 of 12.4 exceeded the threshold pH of 12. This may indicate that some of the ash layer material qualifies as a hazardous waste (characteristic).

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

To: William Geiger/R3/USEPA/US@EPA

Cc: "Meyer, Tom NAB02" <Tom.Meyer@usace.army.mil>, "Mendoza, Richard R Mr CIV USA IMCOM" <richard.r.mendoza@us.army.mil>, "Druck, Dennis E Mr CIV USA MEDCOM PHC" <dennis.druck@us.army.mil>, "Parks, Jeffrey" <Jeffrey.Parks@shawgrp.com>, "Leahy, Timothy" <Timothy.Leahy@shawgrp.com>, "Cutler,Jim" <James.Cutler@deq.virginia.gov>, <jeremy.flint@atk.com>, <jerome.redder@atk.com>, "Andy Kassoff" <akassoff@eee-consulting.com>, "Jason

Steele" <jsteele@eee-consulting.com>

Date: 11/12/2010 11:36 AM

Subject: RE: Draft SWMU 48 Supplemental RFI data report (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: FOUO

Will Geiger and all,

Sending a revised report. The 1st page of Table 8 was missing and the blank page before Appendix A was also removed. This version is complete now. Conclusions didn't change.

Apologize for any confusion.

Thanks,
JJM

-----Original Message-----
From: McKenna, Jim J Mr CIV USA AMC
Sent: Wednesday, August 11, 2010 2:13 PM
To: 'Geiger.William@epamail.epa.gov'
Cc: Meyer, Tom NAB02; Mendoza, Richard R Mr CIV USA IMCOM; Druck, Dennis E Mr CIV USA MEDCOM PHC; Parks, Jeffrey; 'Leahy, Timothy'; Cutler,Jim; Jeremy Flint (jeremy.flint@atk.com); jerome.redder@atk.com
Subject: Draft SWMU 48 Supplemental RFI data report (UNCLASSIFIED)
Importance: High

Classification: UNCLASSIFIED
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Will & Jim,

This is the SWMU 48 data report from our March 2010 sampling event. This was performed as a follow up to our Feb 2010 partnering meeting. Please take a look at it. We'd like to get your feedback on proceeding with the SWMU 48/49 RFI/CMS report.

Thanks,
Jim

Classification: UNCLASSIFIED
Caveats: FOUO

Classification: UNCLASSIFIED
Caveats: FOUO

[attachment "SWMU 48 Supplemental Data report_revJimscomments.pdf" deleted by William Geiger/R3/USEPA/US]

Leahy, Timothy

From: McKenna, James J CIV (US) [james.j.mckenna16.civ@mail.mil]
Sent: Friday, November 12, 2010 11:29 AM
To: 'Geiger.William@epamail.epa.gov'
Cc: Meyer, Tom NAB02; 'Mendoza, Richard R Mr CIV USA IMCOM'; Druck, Dennis E Mr CIV USA MEDCOM PHC; Parks, Jeffrey; Leahy, Timothy; Cutler,Jim; Jeremy Flint (jeremy.flint@atk.com); jerome.redder@atk.com; Andy Kassoff; Jason Steele
Subject: RE: Draft SWMU 48 Supplemental RFI data report (UNCLASSIFIED)
Attachments: SWMU 48 Supplemental Data report_revJimscomments.pdf

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RADFORD ARMY AMMUNITION PLANT, VIRGINIA

SWMU 48 (RAAP – 018)
Supplemental RCRA Facility Investigation (RFI) Data Report

Prepared for:

USACE Baltimore District
10 S. Howard St.
Baltimore, MD 21201

Prepared by:

Shaw Environmental, Inc.
2113 Emmorton Park Rd.
Edgewood, MD 21040

Draft Document

August 2010

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LIST OF ACRONYMS AND ABBREVIATIONS

AHA.....Activity Hazard Analysis
CFR.....Code of Federal Regulations
CMS.....Corrective Measures Study
DNB.....Dinitrobenzene
DNT.....Dinitrotoluene
Ft.....feet
ft bgs.....feet below ground surface
ft msl.....feet above mean sea level
HSA.....Horseshoe Area
i-SL.....Industrial Screening Level
IDM.....Investigation-Derived Material
IMWP.....Interim Measures Work Plan
MHSP.....Master Health and Safety Plan
MMA.....Main Manufacturing Area
MQAP.....Master Quality Assurance Plan
MWP.....Master Work Plan
PPE.....Personal Protective Equipment
QA/QC.....Quality Assurance/Quality Control
r-SL.....Residential Screening Level
RCRA.....Resource Conservation and Recovery Act
RFA.....RCRA Facility Assessment
RFAAP.....Radford Army Ammunition Plant
RFI.....RCRA Facility Investigation
SWMU.....Solid Waste Management Unit
TAL.....Target Analyte List
TCL.....Target Compound List
TCLP RL.....Toxicity Characteristic Leachate Procedure Regulatory Limit
TNT.....Trinitrotoluene
USACE.....U.S. Army Corps of Engineers
USEPA.....U.S. Environmental Protection Agency
WPA.....Work Plan Addendum
VI.....Verification Investigation
yd^3.....cubic yard

1.0 INTRODUCTION

Shaw Environmental, Inc. (Shaw) was tasked by the U.S. Army Corps of Engineers (USACE), Baltimore District, to perform characterization activities at Solid Waste Management Unit (SWMU) 48 (RAAP-18) - the Oily Water Burial Area of Radford Army Ammunition Plant (RFAAP), in accordance with Contract No. W912QR-04-D-0027, Delivery Order DA0101. This document is intended to describe the completed investigation activities performed and report the results of supplemental data at the SWMU 48 site. The purpose of the data collection effort was to collect supplemental data in order to complete the Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI)/Corrective Measures Study (CMS) for the site.

The proposed work was performed in accordance with RFAAP's *Master Work Plan (MWP)* (URS, 2003), *MWP Addendum 019* (Shaw, 2007), and elements of the SWMU 51 Interim Measures Work Plan (IMWP) (Shaw, 2008). **Table 1** provides cross references between the applicable sections in the MWP, Work Plan Addendum (WPA) 019, and the SWMU 51 IMWP that were used to complete the supplemental data collection effort.

Table 1
Work Elements Referenced in the Master Work Plan and Addendum 019

Task Description	MWP Section	WPA 019 Section	MWP SOP #	SWMU 51 IMWP
Introduction	2.0	1.1	NA	NA
Installation Setting and Site Description	2.0	2.1.1	NA	NA
Summary of Previous Investigations	NA	2.3	NA	NA
Soil Sampling/Test Pitting				
Field Logbooks	NA		10.1	
Sample Logbooks	NA		10.2	
Chain-of Custody	NA		10.4	
Subsurface Soil Sampling	5.2		30.1, 30.7	2.2.3
Sample Labels	5.1		50.1	
Sample Packaging	5.1		50.2	
Investigative Derived Material	5.13		70.1	
Decontamination	5.12		80.1	

Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC) procedures followed those specified in the Master Quality Assurance Plan (MQAP) (URS, 2003). Section 2.0 of the MWP establishes requirements for documentation, data collection and reporting, management and tracking of electronic and hard copy data, and presentation format. The MQAP provides assurance that data of known and documented quality is generated to allow the Army to make accurate risk management decisions.

Health and Safety

Health and Safety procedures, including monitoring and personal protection levels, followed those specified in the Master Health and Safety Plan (MHSP) (URS, 2003). Site-specific training, personal protective equipment and clothing (PPE), and applicable monitoring requirements are presented in Section 3.0 of the MWP. These procedures were developed to provide the requirements for protection of site personnel including government employees, Shaw, regulators, subcontractors, and visitors, who are expected to be involved with site activities.

In addition to the Master Health and Safety Plan (URS, 2003), *Section 8.0 – Health and Safety* from the SWMU 51 Interim Measures Work Plan (Shaw, 2008) was incorporated by reference to this document. Subsections related to excavation and heavy equipment, including an Excavation Activity Hazard Analysis (AHA), have been included in **Appendix A** of this plan. AHAs define the activities being performed and identify the sequences of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level. All investigation activities will be performed in accordance with the safety provisions of 29 Code of Federal Regulations (CFR) Parts 1910 and 1926, and USACE EM 385-1-1.

2.0 BACKGROUND

2.1 Site Description

SWMU 48 is located in the southeastern portion of the RFAAP Horseshoe Area (HSA), east of the main bridge over the New River (**Figure 1**). The SWMU is situated in the northwestern corner of a group of SWMUs consisting of SWMU 48, SWMU 49, SWMU 50, and SWMU 59. SWMU 48 is located approximately 30 feet (ft) north of SWMU 50, 75 ft west of SWMU 59, and 200 ft northwest of SWMU 49.

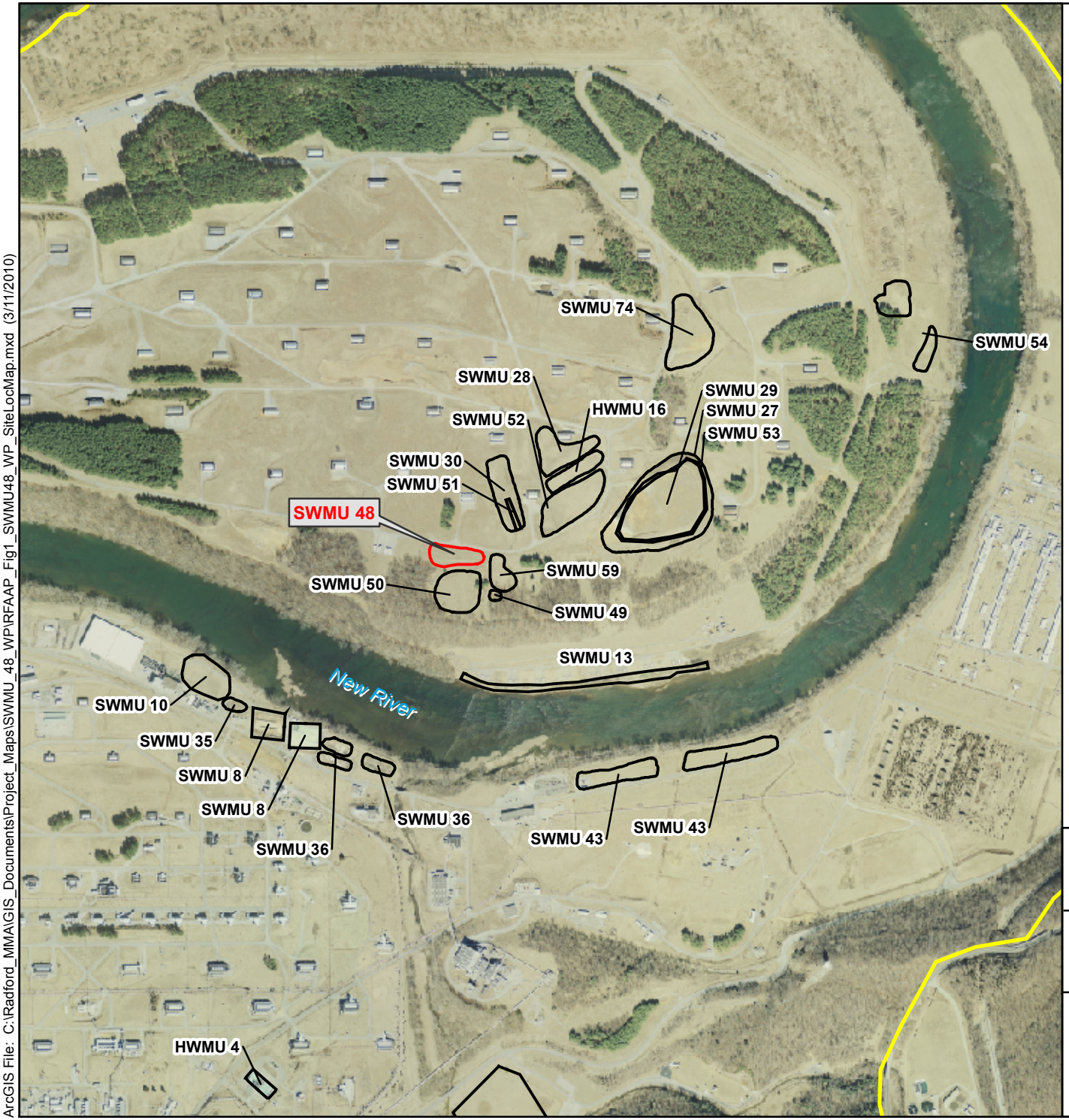
The SWMU 48 study area is approximately 380 ft long by 120 ft wide. The site is situated on a bluff approximately 120 ft above and overlooking SWMU 13 and the New River. The land surface in the combined study area gently slopes from approximately 1,830 feet above mean sea level (ft msl) on the north side of SWMUs 48 and 59, to approximately 1,814 ft msl on the south of SWMU 50. Based on topography, surface water runoff is expected to infiltrate into the soil.

The overall study area is grassy with wooded areas to the south, east, and west. The site map shown on **Figure 2** indicates ground scarring and disturbed soil; however, the site has re-vegetated in the years since they were active. A subsided area that coincides with the southern trench in SWMU 48 provides evidence of its location.

An east-west asphalt road, located at the northern edge of the study area, parallels SWMU 48 and provides access to the combined study area via a gravel and bottom ash covered dirt road that trends north-south between SWMUs 48 and 59. The dirt and gravel road connects to an east-west trending dirt road south of SWMU 50. There are no structures in the combined study area; and, according to RFAAP utility maps, there are no manholes, catch basins, or storm drains located in the immediate vicinity of the area.

2.2 Site History

Aerial photographs taken in 1971 and 1986 indicate that SWMU 48 consists of two sets of unlined trenches, identified as the northern and southern trenches (**Figure 2**). Prior to off-post waste oil reclamation, approximately 200,000 gallons of oily wastewater removed from oil/water separators throughout RFAAP was reportedly disposed of in SWMU 48 (Dames and Moore, 1992). However, the results of environmental sampling to date indicate that the oily wastewater was likely disposed of in the area associated with SWMU 49. Conversely, sampling indicates that the red water ash associated with SWMU 49 was disposed in the SWMU 48 disposal trenches. Interpretations of aerial photographs indicate that activity first occurred at SWMU 48 in 1970 (USEPA, 1992). The northern trench is visible in the 1971 aerial photograph as light colored east to west trending scars of disturbed soil that parallel the asphalt road. Revegetation had occurred by the time of the 1981 aerial photograph. The filled and revegetated southern trench is prominent in the 1986 aerial photograph, positioned at a slight angle below the northern trench. This trench is marked by the growth of grass visibly different from the surrounding vegetation (e.g., greener and thicker) and by extensive ground subsidence. There is no documentation for disposal activities, but observations during soil boring and test pit activities during the 1998 RFI indicate a layer of fine black material (ash) occurring at approximately 6-9 ft below ground surface (bgs). Explosives compounds were detected in samples of this material.



ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\SWMU_48_WP\RFAAP_Fig1_SWMU48_WP_SiteLocMap.mxd (3/11/2010)

LEGEND

- SWMU 48 Boundary
- Other SWMU Boundary
- Installation Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County Planning, VA Planning & GIS Services.

N

Scale:
0 500 1,000 2,000 Feet

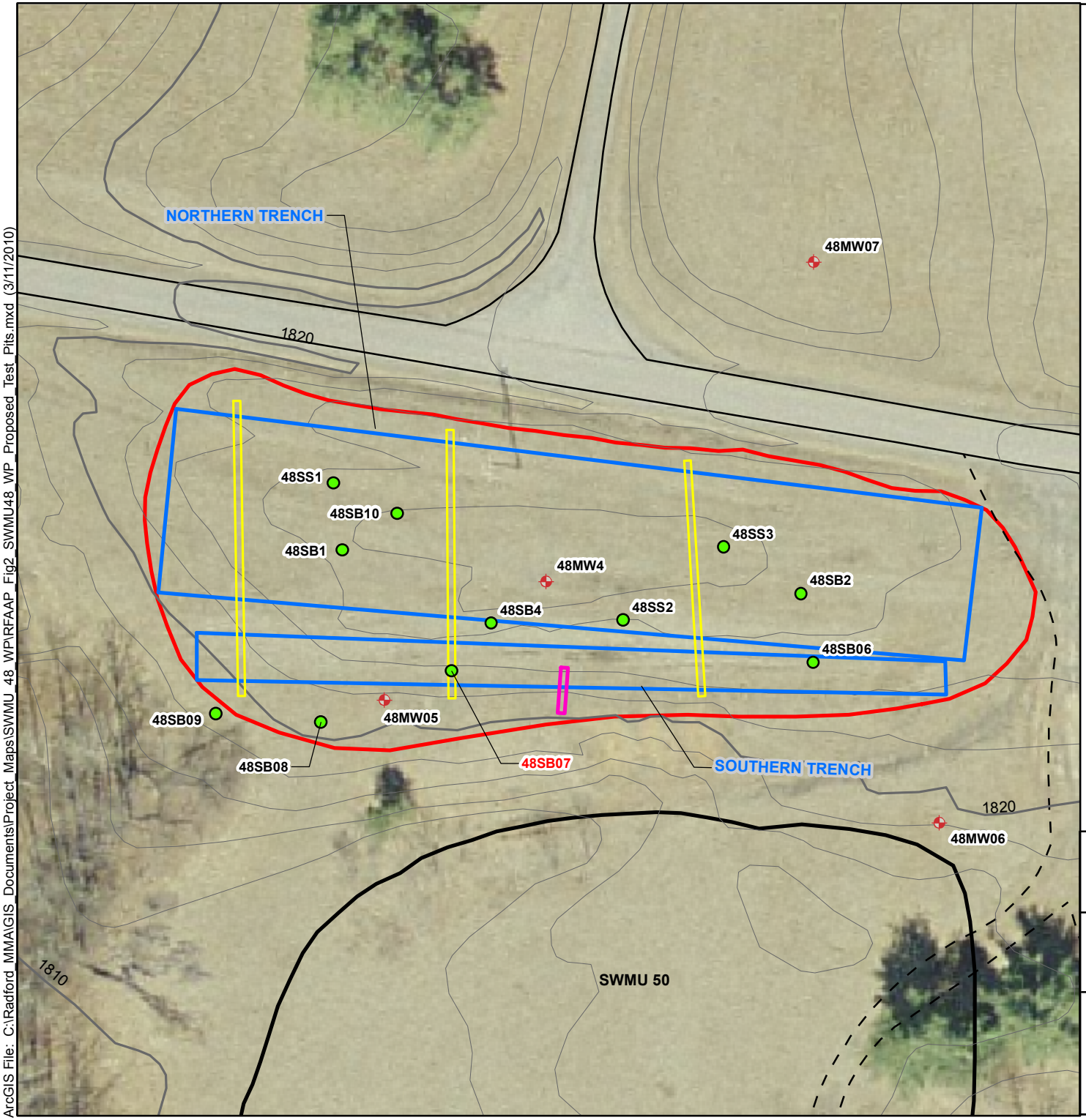
U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE 1

SWMU 48 Site Location Map

Radford Army Ammunition Plant,
Radford, VA



ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\SWMU_48_WP\RFAAP_Fig2_SWMU48_WP_Proposed_Test_Pits.mxd (3/11/2010)

LEGEND

- Monitoring Well Location
- Soil Sample Location
- Dirt Road
- Paved Road
- 2 ft Contour Line
- 10 ft Contour Line
- Proposed Test Pit Boundary
- Trench Boundary
- 1998 RFI Trench Boundary
- SWMU 48 Boundary
- Other SWMU Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.

N

Scale:

0 30 60 120 Feet

U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE 2

SWMU 48 Proposed Test Pit Locations

Radford Army Ammunition Plant,
Radford, VA

2.3 Summary of Previous Investigations

Six previous investigations have been conducted at SWMU 48. In 1987, the U.S. Environmental Protection Agency (USEPA) conducted an RCRA Facility Assessment (RFA) to evaluate potential hazardous waste or hazardous constituent releases and implement corrective actions, as necessary. In 1992, Dames and Moore performed a Verification Investigation (VI), which included surface and subsurface soil sampling to characterize the nature and extent of contamination. In 1996, Parsons Engineering Science conducted an RFI to further delineate the extent of contamination identified during the 1992 VI sampling. ICF Kaiser Engineers also performed an RFI in 1998 to further refine the understanding of the nature and extent of contamination identified during the previous investigations. Additional sampling was conducted by IT Corporation/Shaw in 2002 and 2006 to collect sufficient data to complete human health and ecological risk assessments.

Sample locations from these investigations are illustrated on **Figure 2**. A summary of the previous investigation samples collected is presented in **Table 2**. Detected results from soil samples collected in the fill material (0-6 ft bgs) overlying the ash layer discovered in the southern trench at SWMU 48 are presented in **Table 3** and summarized in **Table 4**. Detected results from soil samples collected below the fill material (> 6 ft bgs) at SWMU 48 are presented in **Table 5** and summarized in **Table 6**.

Table 2
Previous Investigations Samples and Analyses

Media	Sample ID	Depth (ft bgs)	Analyses
1992 Verification Investigation, Dames & Moore			
Subsurface Soil	48SB1	7.5-9.5	TAL metals, VOCs, SVOCs, TCLP metals
	48SB1	13-15	TAL metals, VOCs, SVOCs, TCLP metals
	48SB2	10-12	TAL metals, VOCs, SVOCs, TCLP metals
	48SB2	20-22	TAL metals, VOCs, SVOCs, TCLP metals
1996 RCRA Facility Investigation, Parsons Engineering Science, Inc.			
Surface Soil	48SS1	0-1	TAL metals, VOCs, SVOCs, explosives, TPH
	48SS2	0-1	TAL metals, VOCs, SVOCs, explosives, TPH
	48SS3	0-1	TAL metals, VOCs, SVOCs, explosives, TPH
Subsurface Soil	48SB4A11	10-11	VOCs, SVOCs, explosives, TPH
	48SB4B21	20-21	VOCs, SVOCs, explosives, TPH, TOC
1998 RCRA Facility Investigation, ICF Kaiser Engineers, Inc.			
Surface Soil	48SB6C	1-3	TAL metals, VOCs, SVOCs, PAHs, explosives
	48SB6C2	1-3	VOCs (methanol preservation)
Subsurface Soil	48SB6A	6-7	TAL metals, VOCs, SVOCs, PAHs, explosives
	48SB6A2	6-7	VOCs (methanol preservation)
	48SB6B	14-16	TAL metals, VOCs, SVOCs, PAHs, explosives
	48SB6B2	14-16	VOCs (methanol preservation)
	48SB7A	8-9	TAL metals, VOCs, SVOCs, PAHs, explosives
	48SB7A2	8-9	VOCs (methanol preservation)
	48SB7B	10-11	TAL metals, VOCs, SVOCs, PAHs, explosives
	48TP1	6-6.5	TAL metals, VOCs, SVOCs, PAHs, explosives
	48TP2	6-6.5	TAL metals, VOCs, SVOCs, PAHs, explosives
	48TP3	6-6.5	TAL metals, VOCs, SVOCs, PAHs, explosives
	48TP4	6-6.5	TAL metals, VOCs, SVOCs, PAHs, explosives

Table 2
Previous Investigations Samples and Analyses (Continued)

Media	Sample ID	Depth (ft bgs)	Analyses
2002 Site Characterization, IT Corporation			
Surface Soil	48SB08A	0-0.5	TCL VOCs, SVOCs, pesticides/PCBs, herbicides, PAHs, explosives, TAL metals, dioxins/furans, TOC, grain size, pH
	48SB09A	0-0.5	Explosives, dioxins/furans
	48SB10A	0-0.5	TCL VOCs, SVOCs, pesticides/PCBs, herbicides, PAHs, explosives, TAL metals, dioxins/furans
Subsurface Soil	48SB08B	4-6	TCL VOCs, SVOCs, PCBs, PAHs, explosives, TAL metals, dioxins/furans
	48SB08C	8-10	TCL VOCs, SVOCs, PCBs, PAHs, explosives, TAL metals, dioxins/furans, TOC, grain size, pH
	48SB09B	4-6	Explosives, dioxins/furans
	48SB09C	8-10	Explosives, dioxins/furans
	48SB10B	4-6	TCL VOCs, SVOCs, PCBs, PAHs, explosives, TAL metals, dioxins/furans
	48SB10C	8-10	TCL VOCs, SVOCs, PCBs, PAHs, explosives, TAL metals, dioxins/furans

Fill Material

As shown in **Tables 3 and 4**, concentrations of constituents detected in the fill material overlying the ash layer at SWMU 48 were below residential screening levels (r-SLs) with the exception of Aroclor-1254, iron, mercury, and 2,4- and 2,6-Dinitrotoluene (DNT). Aroclor-1254 was detected above the r-SL, but below the industrial screening level (i-SL), in one sample (48SB10A) collected from 0-0.5 ft bgs. Iron was detected above the r-SL and i-SL in one sample (48SB10B) collected from 4-6 ft bgs. The concentration of mercury was above the r-SL only in surface soil sample 48SS1. Concentrations of 2,4-DNT were detected above the "DNT mixture" r-SL and i-SL and the 2,6-DNT concentration was above the DNT mixture" r-SL both in sample 48SB6C from 1-3 ft bgs.

Although 2,4- and 2,6-DNT concentrations are present in one sample above r- and i-SLs for DNT mixture, a comparison of Shaw's recent sample results from waste characterization sampling at SWMU 54 to 2,4- and 2,6-DNT concentrations in SWMU 48 fill samples indicates that the fill material contains theoretical explosive concentrations below the Toxicity Characteristic Leachate Procedure Regulatory Limit (TCLP RL). In addition, concentrations of Aroclor-1254 and mercury were isolated in single samples at concentrations below the i-SL and iron was only detected above the i-SL in one sample. Based on these results, fill material from 0-6 ft bgs is suitable for re-use during test pitting activities proposed at the site.

Soil Below the Fill Material

As shown in **Tables 4 and 5**, three metals (aluminum, iron, and mercury) and four explosives [1,3-Dinitrobenzene (DNB), 2,4,6-Trinitrotoluene (TNT), 2,4- and 2,6-DNT] were detected at concentrations above r-SLs in soil samples collected below the fill material. Two of the explosives (2,4,6-TNT and 2,4-DNT) were present at concentrations above i-SLs below the fill material. Concentrations of explosives above SLs were limited to three samples collected in the southern trench. Subsurface soil samples 48SB07A (8-9 ft bgs) and 48TP1 (6-6.5 ft bgs) were both collected from soil containing ash. Sample 48SB7B (10-11 ft bgs) was collected directly

below sample 48SB7A and indicates a marked decrease in the concentration of 2,4,6-TNT. Based on sample results from the previous investigations samples collected below the fill material at SWMU 48, it appears as though the ash layer is a discontinuous layer that has been identified at depths from 6-9 ft bgs. Although explosive concentrations were present in samples collected directly from the ash layer, sample results from samples collected directly below the samples containing ash indicate that the explosives are not mobile in soil.

Table 3
Analytes Detected in Fill Samples at SWMU 48

Analyte	Sample ID			48SS1					48SS2					48SS3					48SB6C					48SB6C2					48SB08A				
	Sample Date			12/16/94					12/16/94					12/16/94					3/26/98					4/8/98					6/24/02				
	Sample Depth			0-0.5					0-0.5					0-0.5					1-3					1-3					0-0.5				
	i-SL	r-SL	Background	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)																																	
1,2,4-Trichlorobenzene	99000	22000	na	NT					NT					NT					0.06			*0.005*		1.2	U		*1.2*		NT				
Acetone	63000000	6100000	na	3300	U			*3300*	3300	U			*3300*	3300	U			*3300*	0.14		B	*0.005*		1.4	B	B	*0.005*		26		B	*2.2*	*4.9*
Ethylbenzene	27000	5400	na	190	U			*190*	190	U			*190*	190	U			*190*	0.49		K	*0.005*		1.2	U		*1.2*		4.9	U		*0.33*	*4.9*
Methylene chloride	53000	11000	na	4400	U			*4400*	4400	U			*4400*	4400	U			*4400*	0.048		B	*0.005*		1.2	U		*1.2*		4.9	U		*0.31*	*4.9*
o-Xylene	1900000	380000	na	NT					NT					NT					0.77		K	*0.005*		1.2	U		*1.2*		4.9	U		*1*	*4.9*
Toluene	4500000	500000	na	100	U			*100*	100	U			*100*	100	U			*100*	0.047	U		*0.047*		1.2	U		*1.2*		0.84	J	B	*0.32*	*4.9*
PAHs (ug/kg)																																	
2-Methylnaphthalene	410000	31000	na	NT					NT					NT					NT					NT					2.5		B	*0.63*	*1.9*
Anthracene	17000000	1700000	na	NT					NT					NT					0.002	J	J	*0.0032*		NT					1.9	U		*0.2*	*1.9*
Benz(a)anthracene	2100	150	na	NT					NT					NT					0.0051			*0.0032*		NT					4.4			*0.25*	*1.9*
Benzo(a)pyrene	210	15	na	NT					NT					NT					0.0056			*0.0032*		NT					3.6			*0.21*	*1.9*
Benzo(b)fluoranthene	2100	150	na	NT					NT					NT					0.0064	U		*0.0064*		NT					7.9			*0.35*	*1.9*
Benzo(g,h,i)perylene	1700000	170000	na	NT					NT					NT					0.0064	U		*0.0064*		NT					2.4			*0.66*	*1.9*
Benzo(k)fluoranthene	21000	1500	na	NT					NT					NT					0.0054			*0.0032*		NT					2			*0.33*	*1.9*
Chrysene	210000	15000	na	NT					NT					NT					0.0032	U		*0.0032*		NT					4.7			*0.3*	*1.9*
Dibenz(a,h)anthracene	210	15	na	NT					NT					NT					0.0064	U		*0.0064*		NT					1.9	U		*0.64*	*1.9*
Fluoranthene	2200000	230000	na	NT					NT					NT					0.0082			*0.0064*		NT					9.8			*0.32*	*1.9*
Fluorene	2200000	230000	na	NT					NT					NT					0.0064	U		*0.0064*		NT					1.9	U		*0.5*	*1.9*
Indeno(1,2,3-cd)pyrene	2100	150	na	NT					NT					NT					0.007			*0.0032*		NT					2.9			*0.6*	*1.9*
Naphthalene	18000	3600	na	NT					NT					NT					0.032	U	UL	*0.032*		NT					1.8	JB	B	*0.72*	*1.9*
Phenanthrene	1700000	170000	na	NT					NT					NT					0.0081			*0.0032*		NT					7.6			*0.29*	*1.9*
Pyrene	1700000	170000	na	NT					NT					NT					0.0046		J	*0.0032*		NT					9.5			*0.42*	*1.9*
SVOCs (ug/kg)																																	
bis(2-Ethylhexyl)phthalate	120000	35000	na	1500					1300					480	U			*480*	0.35	J	J	*0.62*		NT					190	U		*12*	*190*
Chrysene	210000	15000	na	86					32	U			*32*	32	U			*32*	NT					NT					190	U		*4.3*	*190*
Di-n-butylphthalate	6200000	610000	na	1300	U			*1300*	10000					1300	U			*1300*	33			*6.2*		NT					190	U		*54*	*190*
Fluoranthene	2200000	230000	na	32	U			*32*	32	U			*32*	32	U			*32*	NT					NT					11	J	J	*6.1*	*190*
N-nitrosodiphenylamine	350000	99000	na	290	U			*290*	290	U			*290*	290	U			*290*	0.56	J	J	*0.62*		NT					190	U		*8.8*	*190*
Phenanthrene	1700000	170000	na	270					32	U			*32*	32	U			*32*	NT					NT					10	J	J	*5.8*	*190*
Pyrene	1700000	170000	na	83	U			*83*	83	U			*83*	83	U			*83*	NT					NT					7.9	J	J	*5.7*	*190*
Pesticides (ug/kg)																																	
4,4'-DDD	7200	2000	na	NT					NT					NT					NT					NT					0.389	J	J	*0.155*	*0.733*
4,4'-DDE	5100	1400	na	NT					NT					NT					NT					NT					0.462	BJ	B	*0.154*	*0.733*
4,4'-DDT	7000	1700	na	NT					NT					NT					NT					NT					0.733	U		*0.259*	*0.733*
Endosulfan II	na	na	na	NT					NT					NT					NT					NT					0.733	U		*0.262*	*0.733*
Endrin aldehyde	na	na	na	NT					NT					NT					NT					NT					0.733	U		*0.37*	*0.733*
Methoxychlor	310000	31000	na	NT					NT					NT					NT					NT					0.567	J	J	*0.559*	*0.733*
PCBs (mg/kg)																																	
PCB-1254	0.74	0.022	na	NT					NT					NT					NT					NT					0.0366	U	UJ	*0.0108*	*0.0366*
Explosives (mg/kg)																																	
2,4-Dinitrotoluene	2.5	0.71	na	NT					NT					NT					3.8		L	*0.25*		NT					0.2	U		*0.0163*	*0.2*
2,6-Dinitrotoluene	2.5	0.71	na	NT					NT					NT					1.1		J	*0.25*		NT					0.2	U		*0.0246*	*0.2*
Nitroglycerin	6.2	0.61	na	NT					NT					NT					1.3	U	UL	*1.3*		NT					0.12	J	J	*0.11*	*0.33*
Herbicides (ug/kg)																																	
Metals (mg/kg)																																	
Aluminum	99000	7700	40041	NT					NT					NT					11800			*1.1*		NT					12600			*6.1*	*22*
Antimony	41	3.1	na	19.6	U				19.6	U				19.6	U				0.94	U		*0.94*		NT					0.549	U	UL	*0.19*	*0.549*
Arsenic	1.6	0.39	15.8	3.42					7.97					2.5	U				5			*1.1*		NT					1.46		L	*0.38*	*0.549*
Barium	19000	1500	209	**572**					82.3					108					47		L	*0.19*		NT					102			*0.37*	*2.2*
Beryllium	200	16	1.02	**1.62**					0.739					0.872					0.56	B	B	*0.19*		NT					0.73			*0.0379*	*0.549*
Calcium	na	na	na	NT					NT					NT					120000			*4.3*		NT					415		J	*3.1*	*11*
Chromium	150000	12000	65.3	5.34					47.8					24.3					**65.4**			*0.19*		NT					27.5			*0.41*	*1.1*
Cobalt	30	2.3	72.3	NT					NT					NT					4.2	B	L	*0.19*		NT					10.3		J	*0.89*	*5.49*
Copper	4100	310	53.5	NT					NT					NT					**149**		**K**	*0.19*		NT					5.39			*0.68*	*2.2*
Iron	72000	5500	50962	NT					NT					NT					11700			*3.4*		NT					15500		J	*3.7*	*5.49*
Lead	800	400	26.8	4.4					**160**					18					**286**			*0.38*		NT					18.7			*0.033*	*0.33*
Magnesium	na	na	na	NT					NT					NT					4730			*5.8*		NT					587		J	*2.6*	*11*
Manganese	2300	180	2543	NT					NT					NT					123			*0.19*		NT					998		J	*0.061*	*1.1*
Mercury	3.4	0.56	0.13	**1.11**					**0.441**					0.05	U				0.18	U		*0.18*		NT					0.03	B	J	*0.0218*	*0.0549*
Nickel	2000	160	62.8	8.93					25.4					6.13					39.2		K	*0.19*		NT					7.16		J	*1*	*4.4*
Potassium	na	na	na	NT					NT					NT					805	B	K	*8.3*		NT					673			*37*	*330*
Selenium	510	39	na	0.449	U				1.07					0.449	U				0.75	U		*0.75*		NT					1.1	U	UL	*0.36*	*1.1*
Silver	510	39	na	0.0124	U				0.0285					0.0245					0.38	U		*0.38*		NT					1.1	U		*0.54*	*1.1*
Sodium	na	na	na	NT					NT					NT					339	B	K	*5.6*		NT					22.1		B	*4.1*	*22*
Thallium	na	na	2.11	34.3	U				34.3	U				34.3	U				1.1	U		*1.1*		NT					0.14	B	J	*0.033*	*0.33*
Vanadium	7.2	0.55	108	NT					NT					NT					16.2		K	*0.19*		NT					32.6		J	*0.64*	*5.49*
Zinc	31000	2300	202	NT					NT					NT					73.6		K	*0.38*		NT					23.8		J	*0.39*	*2.2*

Table 3
Analytes Detected in Fill Samples at SWMU 48

Analyte	Sample ID			48SB08B					48SB09A					48SB09B					48SB10A					48SB10B				
	Sample Date			6/24/02					6/24/02					6/24/02					6/24/02					6/24/02				
	Sample Depth			4-6					0-0.5					4-6					0-0.5					4-6				
	i-SL	r-SL	Background	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)																												
1,2,4-Trichlorobenzene	99000	22000	na	NT					NT					NT					NT					NT				
Acetone	63000000	6100000	na	5.6	U	UJ	*2.5*	*5.6*	NT					NT					4.8	U	UJ	*2.1*	*4.8*	5.4	U	UJ	*2.4*	*5.4*
Ethylbenzene	27000	5400	na	5.6	U		*0.37*	*5.6*	NT					NT					4.8	U		*0.32*	*4.8*	5.4	U		*0.36*	*5.4*
Methylene chloride	53000	11000	na	5.6	U		*0.35*	*5.6*	NT					NT					4.8	U		*0.3*	*4.8*	5.4	U		*0.34*	*5.4*
o-Xylene	1900000	380000	na	5.6	U		*1.2*	*5.6*	NT					NT					4.8	U		*1*	*4.8*	5.4	U		*1.1*	*5.4*
Toluene	4500000	500000	na	5.6	U		*0.36*	*5.6*	NT					NT					4.8	U		*0.31*	*4.8*	5.4	U		*0.35*	*5.4*
PAHs (ug/kg)																												
2-Methylnaphthalene	410000	31000	na	1.2	J	B	*0.71*	*2.1*	NT					NT					9.6			*0.61*	*1.8*	2	U		*0.69*	*2*
Anthracene	17000000	1700000	na	2.1	U		*0.23*	*2.1*	NT					NT					0.71	J	J	*0.2*	*1.8*	2	U		*0.22*	*2*
Benz(a)anthracene	2100	150	na	2.1	U		*0.28*	*2.1*	NT					NT					2.9			*0.24*	*1.8*	2	U		*0.27*	*2*
Benzo(a)pyrene	210	15	na	2.1	U		*0.24*	*2.1*	NT					NT					2.4			*0.2*	*1.8*	2	U		*0.23*	*2*
Benzo(b)fluoranthene	2100	150	na	2.1	U		*0.4*	*2.1*	NT					NT					4.7			*0.34*	*1.8*	2	U		*0.39*	*2*
Benzo(g,h,i)perylene	1700000	170000	na	2.1	U		*0.74*	*2.1*	NT					NT					1.4	J	J	*0.63*	*1.8*	2	U		*0.72*	*2*
Benzo(k)fluoranthene	21000	1500	na	2.1	U		*0.37*	*2.1*	NT					NT					1.5	J	J	*0.31*	*1.8*	2	U		*0.36*	*2*
Chrysene	210000	15000	na	2.1	U		*0.34*	*2.1*	NT					NT					4.6			*0.29*	*1.8*	2	U		*0.33*	*2*
Dibenz(a,h)anthracene	210	15	na	2.1	U		*0.72*	*2.1*	NT					NT					0.74	J	J	*0.61*	*1.8*	2	U		*0.69*	*2*
Fluoranthene	2200000	230000	na	2.1	U		*0.36*	*2.1*	NT					NT					6.3			*0.31*	*1.8*	2	U		*0.35*	*2*
Fluorene	2200000	230000	na	2.1	U		*0.56*	*2.1*	NT					NT					1.1	J	J	*0.48*	*1.8*	2	U		*0.54*	*2*
Indeno(1,2,3-cd)pyrene	2100	150	na	2.1	U		*0.68*	*2.1*	NT					NT					1.6	J	J	*0.58*	*1.8*	2	U		*0.65*	*2*
Naphthalene	18000	3600	na	1.5	JB	B	*0.82*	*2.1*	NT					NT					6.7	B		*0.7*	*1.8*	1.2	JB	B	*0.79*	*2*
Phenanthrene	1700000	170000	na	2.1	U		*0.32*	*2.1*	NT					NT					18			*0.28*	*1.8*	2	U		*0.31*	*2*
Pyrene	1700000	170000	na	2.1	U		*0.48*	*2.1*	NT					NT					8.2			*0.41*	*1.8*	2	U		*0.46*	*2*
SVOCs (ug/kg)																												
bis(2-Ethylhexyl)phthalate	120000	35000	na	210	U		*14*	*210*	NT					NT					130	J	B	*12*	*180*	200	U		*14*	*200*
Chrysene	210000	15000	na	210	U		*4.8*	*210*	NT					NT					180	U		*4.1*	*180*	200	U		*4.7*	*200*
Di-n-butylphthalate	6200000	610000	na	210	U		*61*	*210*	NT					NT					180	U		*52*	*180*	200	U		*58*	*200*
Fluoranthene	2200000	230000	na	210	U		*6.9*	*210*	NT					NT					7.9	J	J	*5.9*	*180*	200	U		*6.6*	*200*
N-nitrosodiphenylamine	350000	99000	na	210	U		*10*	*210*	NT					NT					180	U		*8.5*	*180*	200	U		*9.6*	*200*
Phenanthrene	1700000	170000	na	210	U		*6.5*	*210*	NT					NT					13	J	J	*5.6*	*180*	200	U		*6.3*	*200*
Pyrene	1700000	170000	na	210	U		*6.4*	*210*	NT					NT					8.1	J	J	*5.5*	*180*	200	U		*6.2*	*200*
Pesticides (ug/kg)																												
4,4'-DDD	7200	2000	na	NT					NT					NT					0.347	J	J	*0.15*	*0.708*	NT				
4,4'-DDE	5100	1400	na	NT					NT					NT					0.525	BJ	B	*0.149*	*0.708*	NT				
4,4'-DDT	7000	1700	na	NT					NT					NT					2.31			*0.251*	*0.708*	NT				
Endosulfan II	na	na	na	NT					NT					NT					0.418	J	J	*0.253*	*0.708*	NT				
Endrin aldehyde	na	na	na	NT					NT					NT					0.55	J	J	*0.358*	*0.708*	NT				
Methoxychlor	310000	31000	na	NT					NT					NT					0.708	U		*0.54*	*0.708*	NT				
PCBs (mg/kg)																												
PCB-1254	0.74	0.022	na	0.0415	U	UJ	*0.0122*	*0.0415*	NT					NT					0.0769		J	*0.0104*	*0.0354*	0.04	U	UJ	*0.0118*	*0.04*
Explosives (mg/kg)																												
2,4-Dinitrotoluene	2.5	0.71	na	0.2	U		*0.0163*	*0.2*	0.2	U		*0.0163*	*0.2*	0.2	U		*0.0163*	*0.2*	0.2	U		*0.0163*	*0.2*	0.2	U		*0.0163*	*0.2*
2,6-Dinitrotoluene	2.5	0.71	na	0.2	U		*0.0246*	*0.2*	0.2	U		*0.0246*	*0.2*	0.2	U		*0.0246*	*0.2*	0.2	U		*0.0246*	*0.2*	0.2	U		*0.0246*	*0.2*
Nitroglycerin	6.2	0.61	na	0.374	U		*0.124*	*0.374*	0.324	U		*0.108*	*0.324*	0.382	U		*0.127*	*0.382*	0.15	J	J	*0.106*	*0.318*	0.36	U		*0.12*	*0.36*
Herbicides (ug/kg)																												
Metals (mg/kg)																												
Aluminum	99000	7700	40041	32900			*6.9*	*24.9*	NT					NT					10900			*5.9*	*21.2*	24200			*6.6*	*24*
Antimony	41	3.1	na	0.36	B	B	*0.21*	*0.623*	NT					NT					0.531	U	UL	*0.18*	*0.531*	0.6	U	UL	*0.2*	*0.6*
Arsenic	1.6	0.39	15.8	0.6	B	L	*0.44*	*0.623*	NT					NT					2.62		L	*0.37*	*0.531*	0.6	U	UL	*0.42*	*0.6*
Barium	19000	1500	209	56.3			*0.42*	*2.49*	NT					NT					73.3			*0.36*	*2.12*	164			*0.4*	*2.4*
Beryllium	200	16	1.02	0.765			*0.043*	*0.623*	NT					NT					0.44	B	J	*0.0366*	*0.531*	0.745			*0.0414*	*0.6*
Calcium	na	na	na	141		J	*3.5*	*12.5*	NT					NT					15900		J	*3*	*10.6*	26.8		B	*3.4*	*12*
Chromium	150000	12000	65.3	36.1			*0.47*	*1.25*	NT					NT					30.7			*0.4*	*1.06*	17.6			*0.45*	*1.2*
Cobalt	30	2.3	72.3	6.1	B	J	*1*	*6.23*	NT					NT					5.98		J	*0.86*	*5.31*	58.2		J	*0.97*	*6*
Copper	4100	310	53.5	15.9			*0.77*	*2.49*	NT					NT					6.59			*0.66*	*2.12*	13.7			*0.74*	*2.4*
Iron	72000	5500	50962	41600		J	*4.2*	*6.23*	NT					NT					12100		J	*3.6*	*5.31*	**81800**		**J**	*4*	*6*
Lead	800	400	26.8	13.6			*0.038*	*0.374*	NT					NT					17			*0.032*	*0.318*	19.9			*0.036*	*0.36*
Magnesium	na	na	na	1100		J	*2.9*	*12.5*	NT					NT					1640		J	*2.5*	*10.6*	1040		J	*2.8*	*12*
Manganese	2300	180	2543	129		J	*0.07*	*1.25*	NT					NT					248		J	*0.059*	*1.06*	2070		J	*0.067*	*1.2*
Mercury	3.4	0.56	0.13	0.0674			*0.0247*	*0.0623*	NT					NT					0.037	B	J	*0.021*	*0.0531*	0.047	B	J	*0.0238*	*0.06*
Nickel	2000	160	62.8	12.3		J	*1.1*	*4.98*	NT					NT					5.54		J	*0.97*	*4.25*	11.3		J	*1.1*	*4.8*
Potassium	na	na	na	1340			*42*	*374*	NT					NT					642			*36*	*318*	1280			*40*	*360*
Selenium	510	39	na	1.25	U	UL	*0.41*	*1.25*	NT					NT					1.06	U	UL	*0.35*	*1.06*	1.2	U	UL	*0.39*	*1.2*
Silver	510	39	na	0.71	B	B	*0.61*	*1.25*	NT					NT					1.06	U		*0.52*	*1.06*	1.2	B	B	*0.59*	*1.2*
Sodium	na	na	na	21	B	B	*4.7*	*24.9*	NT					NT					19	B	B	*4*	*21.2*	19	B	B	*4.5*	*24*
Thallium	na	na	2.11	0.17	B	J	*0.038*	*0.374*	NT					NT					0.14	B	J	*0.032*	*0.318*	0.27	B	J	*0.036*	*0.36*
Vanadium	7.2	0.55	108	73.3		J	*0.72*	*6.23*	NT					NT					30.8		J	*0.61*	*5.31*	55.9		J	*0.69*	*6*
Zinc	31000	2300	202	42.9		J	*0.45*	*2.49*	NT					NT					24.4		J	*0.38*	*2.12*	42.2		J	*0.43*	*2.4*

Table 4
Summary of Analytes Detected in Fill Samples at SWMU 48
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Analyte	i-SL	r-SL	Background	# of i-SL Exceedances	# of r-SL Exceedances	# of Background Exceedances	# of Detections	# of Samples	Minimum Concentration	Maximum Concentration	Location of Maximum
VOCs (ug/kg)											
1,2,4-Trichlorobenzene	99000	22000	na	0	0	na	1	2	0.06	0.06	48SB6C
Acetone	63000000	6100000	na	0	0	na	3	9	0.14	26	48SB08A
Ethylbenzene	27000	5400	na	0	0	na	1	9	0.49	0.49	48SB6C
Methylene chloride	53000	11000	na	0	0	na	1	9	0.048	0.048	48SB6C
o-Xylene	1900000	380000	na	0	0	na	1	6	0.77	0.77	48SB6C
Toluene	4500000	500000	na	0	0	na	1	9	0.84	0.84	48SB08A
PAHs (ug/kg)											
2-Methylnaphthalene	410000	31000	na	0	0	na	3	4	1.2	9.6	48SB10A
Anthracene	17000000	1700000	na	0	0	na	2	5	0.002	0.71	48SB10A
Benz(a)anthracene	2100	150	na	0	0	na	3	5	0.0051	4.4	48SB08A
Benzo(a)pyrene	210	15	na	0	0	na	3	5	0.0056	3.6	48SB08A
Benzo(b)fluoranthene	2100	150	na	0	0	na	2	5	4.7	7.9	48SB08A
Benzo(g,h,i)perylene	1700000	170000	na	0	0	na	2	5	1.4	2.4	48SB08A
Benzo(k)fluoranthene	21000	1500	na	0	0	na	3	5	0.0054	2	48SB08A
Chrysene	210000	15000	na	0	0	na	2	5	4.6	4.7	48SB08A
Dibenz(a,h)anthracene	210	15	na	0	0	na	1	5	0.74	0.74	48SB10A
Fluoranthene	2200000	230000	na	0	0	na	3	5	0.0082	9.8	48SB08A
Fluorene	2200000	230000	na	0	0	na	1	5	1.1	1.1	48SB10A
Indeno(1,2,3-cd)pyrene	2100	150	na	0	0	na	3	5	0.007	2.9	48SB08A
Naphthalene	18000	3600	na	0	0	na	4	5	1.2	6.7	48SB10A
Phenanthrene	1700000	170000	na	0	0	na	3	5	0.0081	18	48SB10A
Pyrene	1700000	170000	na	0	0	na	3	5	0.0046	9.5	48SB08A
SVOCs (ug/kg)											
bis(2-Ethylhexyl)phthalate	120000	35000	na	0	0	na	4	8	0.35	1500	48SS1
Chrysene	210000	15000	na	0	0	na	1	7	86	86	48SS1
Di-n-butylphthalate	6200000	610000	na	0	0	na	2	8	33	10000	48SS2
Fluoranthene	2200000	230000	na	0	0	na	2	7	7.9	11	48SB08A
N-nitrosodiphenylamine	350000	99000	na	0	0	na	1	8	0.56	0.56	48SB6C
Phenanthrene	1700000	170000	na	0	0	na	3	7	10	270	48SS1
Pyrene	1700000	170000	na	0	0	na	2	7	7.9	8.1	48SB10A
Pesticides (ug/kg)											
4,4'-DDD	7200	2000	na	0	0	na	2	2	0.347	0.389	48SB08A
4,4'-DDE	5100	1400	na	0	0	na	2	2	0.462	0.525	48SB10A
4,4'-DDT	7000	1700	na	0	0	na	1	2	2.31	2.31	48SB10A
Endosulfan II	na	na	na	na	na	na	1	2	0.418	0.418	48SB10A
Endrin aldehyde	na	na	na	na	na	na	1	2	0.55	0.55	48SB10A
Methoxychlor	310000	31000	na	0	0	na	1	2	0.567	0.567	48SB08A
PCBs (mg/kg)											
PCB-1254	0.74	0.022	na	0	1	na	1	4	0.0769	0.0769	48SB10A
Explosives (mg/kg)											
2,4-Dinitrotoluene	2.5	0.71	na	1	1	na	1	7	3.8	3.8	48SB6C
2,6-Dinitrotoluene	2.5	0.71	na	0	1	na	1	7	1.1	1.1	48SB6C
Nitroglycerin	6.2	0.61	na	0	0	na	2	7	0.12	0.15	48SB10A
Herbicides (ug/kg)											
Metals (mg/kg)											
Aluminum	99000	7700	40041	0	0	0	5	5	10900	32900	48SB08B
Antimony	41	3.1	na	0	0	na	1	8	0.36	0.36	48SB08B
Arsenic	1.6	0.39	15.8	0	0	0	6	8	0.6	7.97	48SS2
Barium	19000	1500	209	0	0	1	8	8	47	572	48SS1
Beryllium	200	16	1.02	0	0	1	8	8	0.44	1.62	48SS1

Table 4
Summary of Analytes Detected in Fill Samples at SWMU 48
Page 2 of 2

Analyte	i-SL	r-SL	Background	# of i-SL Exceedances	# of r-SL Exceedances	# of Background Exceedances	# of Detections	# of Samples	Minimum Concentration	Maximum Concentration	Location of Maximum
Calcium	na	na	na	na	na	na	5	5	26.8	120000	48SB6C
Chromium	150000	12000	65.3	0	0	1	8	8	5.34	65.4	48SB6C
Cobalt	30	2.3	72.3	0	0	0	5	5	4.2	58.2	48SB10B
Copper	4100	310	53.5	0	0	1	5	5	5.39	149	48SB6C
Iron	72000	5500	50962	1	1	1	5	5	11700	81800	48SB10B
Lead	800	400	26.8	0	0	2	8	8	4.4	286	48SB6C
Magnesium	na	na	na	na	na	na	5	5	587	4730	48SB6C
Manganese	2300	180	2543	0	0	0	5	5	123	2070	48SB10B
Mercury	3.4	0.56	0.13	0	1	2	6	8	0.03	1.11	48SS1
Nickel	2000	160	62.8	0	0	0	8	8	5.54	39.2	48SB6C
Potassium	na	na	na	na	na	na	5	5	642	1340	48SB08B
Selenium	510	39	na	0	0	na	1	8	1.07	1.07	48SS2
Silver	510	39	na	0	0	na	4	8	0.0245	1.2	48SB10B
Sodium	na	na	na	na	na	na	5	5	19	339	48SB6C
Thallium	na	na	2.11	na	na	0	4	8	0.14	0.27	48SB10B
Vanadium	7.2	0.55	108	0	0	0	5	5	16.2	73.3	48SB08B
Zinc	31000	2300	202	0	0	0	5	5	23.8	73.6	48SB6C

Table 5
Analytes Detected in Soil Below Fill Material at SWMU 48

Analyte	Sample ID			48SB1 (RVFS*1)					48SB1 (RVFS*2)					48SB2 (RVFS*3)					48SB2 (RVFS*4)					48SB4A11					48SB4B21					48SB6A				
	Sample Date			8/19/91					8/19/91					8/16/91					8/16/91					12/17/94					12/17/94					3/26/98				
	Sample Depth			7.5-9.5					13-15					10-12					20-22					10-11					20-21					6-7				
	i-SL	r-SL	Background	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)																																						
Acetone	63000000	6100000	na	17	U			*17*	17	U			*17*	17	U			*17*	17	U			*17*	3300	U			*3300*	3300	U			*3300*	NT				
Benzene	5600	1100	na	1.5	U			*1.5*	1.5	U			*1.5*	1.5	U			*1.5*	1.5	U			*1.5*	100	U			*100*	100	U			*100*	0.017		J	*0.005*	
Dichlorodifluoromethane	78000	18000	na	NT					NT					NT					NT					NT					NT					0.008	U	R	*0.008*	
m- & p-Xylene	na	na	na	NT					NT					NT					NT					NT					NT					0.008	U	R	*0.008*	
Methylene chloride	53000	11000	na	12	U			*12*	12	U			*12*	12	U			*12*	12	U			*12*	4400	U			*4400*	4400	U			*4400*	0.049		B	*0.005*	
o-Xylene	1900000	380000	na	NT					NT					NT					NT					NT					NT					0.008	U	R	*0.008*	
Toluene	4500000	500000	na	0.78	U			*0.78*	0.78	U			*0.78*	1					0.78	U			*0.78*	100	U			*100*	100	U			*100*	0.023		J	*0.005*	
Trichlorofluoromethane	340000	79000	na	5.9	U			*5.9*	5.9	U			*5.9*	5.9	U			*5.9*	5.9	U			*5.9*	230	U			*230*	230	U			*230*	0.008	U	R	*0.008*	
Vinyl chloride	1700	60	na	6.2	U			*6.2*	6.2	U			*6.2*	6.2	U			*6.2*	6.2	U			*6.2*	1800	U			*1800*	1800	U			*1800*	0.008	U	R	*0.008*	
PAHs (ug/kg)																																						
2-Methylnaphthalene	410000	31000	na	NT					NT					NT					NT					NT					NT					NT				
Chrysene	210000	15000	na	NT					NT					NT					NT					NT					NT					0.0029	U	UL	*0.0029*	
Fluoranthene	2200000	230000	na	NT					NT					NT					NT					NT					NT					0.048		L	*0.0058*	
Naphthalene	18000	3600	na	NT					NT					NT					NT					NT					NT					0.029	U	UL	*0.029*	
Phenanthrene	1700000	170000	na	NT					NT					NT					NT					NT					NT					0.0029	U	UL	*0.0029*	
Pyrene	1700000	170000	na	NT					NT					NT					NT					NT					NT					0.025		J	*0.0029*	
SVOCs (ug/kg)																																						
2,4-Dinitrotoluene	120000	12000	na	700	U			*700*	140	U			*140*	3200					140	U			*140*	2500	U			*2500*	2500	U			*2500*	NT				
2,6-Dinitrotoluene	62000	6100	na	400	U			*400*	85	U			*85*	1200					85	U			*85*	2000	U			*2000*	2000	U			*2000*	NT				
bis(2-Ethylhexyl)phthalate	120000	35000	na	3000	U			*3000*	620	U			*620*	1000					620	U			*620*	2800					3600					0.13	J	J	*0.52*	
Di-n-butylphthalate	6200000	610000	na	300	U			*300*	61	U			*61*	2900					190					1300	U			*1300*	6000					0.36	J	J	*0.52*	
Naphthalene	18000	3600	na	200	U			*200*	37	U			*37*	270					37	U			*37*	740	U			*740*	740	U			*740*	NT				
N-nitrosodiphenylamine	350000	99000	na	10000	U			*10000*	190	U			*190*	190	U			*190*	190	U			*190*	1400					1700					0.65			*0.52*	
Phenanthrene	1700000	170000	na	200					33	U			*33*	130					33	U			*33*	32	U			*32*	32	U			*32*	NT				
Pyrene	1700000	170000	na	300					33	U			*33*	33	U			*33*	33	U			*33*	83	U			*83*	83	U			*83*	NT				
Pesticides (ug/kg)		None detected																																				
PCBs (mg/kg)		None detected																																				
Explosives (mg/kg)																																						
1,3,5-Trinitrobenzene	2700	220	na	NT					NT					NT					NT					NT					NT					0.25	U	UL	*0.25*	
1,3-Dinitrobenzene	6.2	0.61	na	NT					NT					NT					NT					NT					NT					0.25	U	UL	*0.25*	
2,4,6-Trinitrotoluene	7.9	1.9	na	NT					NT					NT					NT					2	U			*2*	2	U			*2*	0.25	U	UL	*0.25*	
2,4-Dinitrotoluene	2.5	0.71	na	NT					NT					NT					NT					NT					NT					0.25	U	UL	*0.25*	
2,6-Dinitrotoluene	2.5	0.71	na	NT					NT					NT					NT					NT					NT					0.25	U		*0.25*	
4-amino-2,6-Dinitrotoluene	190	15	na	NT					NT					NT					NT					NT					NT					0.25	U	UL	*0.25*	
HMX	4900	380	na	NT					NT					NT					NT					2	U			*2*	2	U			*2*	0.25	U	UL	*0.25*	
Nitrobenzene	28	3.1	na	NT					NT					NT					NT					NT					NT					0.25	U	UL	*0.25*	
RDX	24	5.5	na	NT					NT					NT					NT					1.28	U			*1.28*	1.28	U			*1.28*	0.25	U	UL	*0.25*	
Herbicides (ug/kg)		Samples were not tested for this group.																																				
Metals (mg/kg)																																						
Aluminum	99000	7700	40041	2940					12200					15700					14600					NT					NT					15700			*0.95*	
Antimony	41	3.1	na	7.14	U				7.14	U				7.14	U				7.14	U				NT					NT					1.6	B	J	*0.79*	
Arsenic	1.6	0.39	15.8	8.19					3.1					4.7					2.75					NT					NT					2.8			*0.95*	
Barium	19000	1500	209	42.5					36.7					52.4					70.8					NT					NT					83.4		L	*0.16*	
Beryllium	200	16	1.02	0.767					**1.73**					**2.15**					**4.98**					NT					NT					0.16	U		*0.16*	
Calcium	na	na	na	240000					662					9740					198					NT					NT					35800			*3.6*	
Chromium	150000	12000	65.3	7.78					27.3					29.5					31.9					NT					NT					35.5			*0.16*	
Cobalt	30	2.3	72.3	3.01					6.34					11.3					17.9					NT					NT					7.6	B	L	*0.16*	
Copper	4100	310	53.5	10.8					6.87					**135**					14.6					NT					NT					33.3		K	*0.16*	
Iron	72000	5500	50962	8550					21200					25800					41600					NT					NT					18100			*2.9*	
Lead	800	400	26.8	**36.9**					10.5	U				**154**					10.5	U				NT					NT					**59.6**			*0.32*	
Magnesium	na	na	na	130000					784					3390					763					NT					NT					4660			*4.9*	
Manganese	2300	180	2543	222					195					278					547					NT					NT					148			*0.16*	
Mercury	3.4	0.56	0.13	**2.6**					0.05	U				**0.23**					0.05	U				NT					NT					0.16	U		*0.16*	
Nickel	2000	160	62.8	4.91					6.57					25.6					24.5					NT					NT					18.8		K	*0.16*	
Potassium	na	na	na	327					551					758					934					NT					NT					2200		K	*7*	
Silver	510	39	na	1.03					0.589	U				0.855					0.589	U				NT					NT					0.16	U		*0.32*	
Sodium	na	na	na	551					372					391					2880					NT					NT					537	B	K	*4.8*	
Thallium	na	na	2.11	6.62	U				6.62	U				6.62	U				6.62	U				NT					NT					0.79	U	UL	*0.95*	
Vanadium	7.2	0.55	108	8.97					30					34.3					32.8					NT					NT					33		K	*0.16*	
Zinc	31000	2300	202	38.2					23					71.3					29.8					NT					NT					54.5		K	*0.32*	

Table 5
Analytes Detected in Soil Below Fill Material at SWMU 48
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Analyte	Sample ID			48SB6A2					48SB6B					48SB6B2					48SB7A					48SB7A2					48SB7B					48SB08C				
	Sample Date			4/8/98					3/26/98					4/8/98					3/30/98					4/9/98					3/30/98					6/24/02				
	Sample Depth			6-7					14-16					14-16					8-9					8-9					10-11					8-10				
	i-SL	r-SL	Background	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)																																						
Acetone	63000000	6100000	na	1.3	B	B	*0.005*		NT					1	B	B	*0.005*		0.008		B	*0.005*		1.1	B	B	*0.005*		0.008		B	*0.005*		5.4	U	UJ	*2.4*	*5.4*
Benzene	5600	1100	na	0.99	U		*0.99*		0.007	U		*0.007*		0.85	U		*0.85*		0.008	U		*0.008*		0.94	U		*0.94*		0.006	U		*0.006*		5.4	U		*0.3*	*5.4*
Dichlorodifluoromethane	78000	18000	na	0.99	U		*0.99*		0.007	U		*0.007*		0.85	U		*0.85*		0.008	U		*0.008*		0.94	U		*0.94*		0.006	U		*0.006*		NT				
m- & p-Xylene	na	na	na	1.1			*0.005*		0.007	U		*0.007*		0.85	U		*0.85*		0.008	U		*0.008*		0.94	U		*0.94*		0.006	U		*0.006*		11	U		*1.1*	*11*
Methylene chloride	53000	11000	na	0.99	U		*0.99*		0.002	J	B	*0.005*		0.85	U		*0.85*		0.003	J	B	*0.005*		0.94	U		*0.94*		0.006		B	*0.005*		5.4	U		*0.34*	*5.4*
o-Xylene	1900000	380000	na	0.64	J	J	*0.005*		0.007	U		*0.007*		0.85	U		*0.85*		0.008	U		*0.008*		0.94	U		*0.94*		0.006	U		*0.006*		5.4	U		*1.1*	*5.4*
Toluene	4500000	500000	na	0.99	U		*0.99*		0.007	U		*0.007*		0.85	U		*0.85*		0.008	U		*0.008*		0.94	U		*0.94*		0.006	U		*0.006*		5.4	U		*0.35*	*5.4*
Trichlorofluoromethane	340000	79000	na	0.99	U		*0.99*		0.007	U		*0.007*		0.85	U		*0.85*		0.002	J	J	*0.005*		0.7	J	J	*0.005*		0.006	U		*0.006*		NT				
Vinyl chloride	1700	60	na	0.99	U		*0.99*		0.007	U		*0.007*		0.85	U		*0.85*		0.008	U		*0.008*		0.94	U		*0.94*		0.006	U		*0.006*		5.4	U		*0.41*	*5.4*
PAHs (ug/kg)																																						
2-Methylnaphthalene	410000	31000	na	NT					NT					NT					NT					NT					NT					0.89	J	B	*0.69*	*2.1*
Chrysene	210000	15000	na	NT					0.002	U	UL	*0.002*		NT					0.021	U		*0.021*		NT					0.0019	U		*0.0019*		2.1	U		*0.33*	*2.1*
Fluoranthene	2200000	230000	na	NT					0.0039	U	UL	*0.0039*		NT					0.042	U		*0.042*		NT					0.0038	U		*0.0038*		2.1	U		*0.35*	*2.1*
Naphthalene	18000	3600	na	NT					0.02	U	UL	*0.02*		NT					0.21	U	UL	*0.21*		NT					0.019	U	UL	*0.019*		1.5	JB	B	*0.79*	*2.1*
Phenanthrene	1700000	170000	na	NT					0.002	U	UL	*0.002*		NT					0.021	U		*0.021*		NT					0.0019	U		*0.0019*		2.1	U		*0.31*	*2.1*
Pyrene	1700000	170000	na	NT					0.002	U	UL	*0.002*		NT					0.021	U		*0.021*		NT					0.0019	U		*0.0019*		2.1	U		*0.46*	*2.1*
SVOCs (ug/kg)																																						
2,4-Dinitrotoluene	120000	12000	na	NT					NT					NT					NT					NT					NT					210	U		*6.9*	*210*
2,6-Dinitrotoluene	62000	6100	na	NT					NT					NT					NT					NT					NT					210	U		*5.1*	*210*
bis(2-Ethylhexyl)phthalate	120000	35000	na	NT					0.45	U		*0.45*		NT					0.49	U		*0.49*		NT					0.38	U		*0.38*		210	U		*14*	*210*
Di-n-butylphthalate	6200000	610000	na	NT					0.45	U		*0.45*		NT					0.49	U	UJ	*0.49*		NT					0.081	J	J	*0.38*		210	U		*59*	*210*
Naphthalene	18000	3600	na	NT					NT					NT					NT					NT					NT					210	U		*7.5*	*210*
N-nitrosodiphenylamine	350000	99000	na	NT					0.45	U		*0.45*		NT					0.49	U	UJ	*0.49*		NT					0.38	U		*0.38*		210	U		*9.7*	*210*
Phenanthrene	1700000	170000	na	NT					NT					NT					NT					NT					NT					210	U		*6.4*	*210*
Pyrene	1700000	170000	na	NT					NT					NT					NT					NT					NT					210	U		*6.2*	*210*
Pesticides (ug/kg)		None detected																																				
PCBs (mg/kg)		None detected																																				
Explosives (mg/kg)																																						
1,3,5-Trinitrobenzene	2700	220	na	NT					0.24	U	UL	*0.24*		NT					102		L	*25*		NT					0.53		L	*0.25*		0.1	U		*0.0246*	*0.1*
1,3-Dinitrobenzene	6.2	0.61	na	NT					0.24	U	UL	*0.24*		NT					3.6		L	*0.25*		NT					0.25	U	UL	*0.25*		0.1	U		*0.0216*	*0.1*
2,4,6-Trinitrotoluene	7.9	1.9	na	NT					0.24	U	UL	*0.24*		NT					935		L	*25*		NT					35.68		L	*1*		0.2	U		*0.0187*	*0.2*
2,4-Dinitrotoluene	2.5	0.71	na	NT					0.24	U	UL	*0.24*		NT					0.25	U	UL	*0.25*		NT					0.25	U	UL	*0.25*		0.2	U		*0.0163*	*0.2*
2,6-Dinitrotoluene	2.5	0.71	na	NT					0.24	U		*0.24*		NT					0.25	U	UL	*0.25*		NT					0.25	U	UL	*0.25*		0.2	U		*0.0246*	*0.2*
4-amino-2,6-Dinitrotoluene	190	15	na	NT					0.24	U		*0.24*		NT					0.25	U	UL	*0.25*		NT					0.25	U	UL	*0.25*		0.2	U		*0.0444*	*0.2*
HMX	4900	380	na	NT					0.24	U	UL	*0.24*		NT					0.25	U	UL	*0.25*		NT					0.25	U	UL	*0.25*		0.2	U		*0.0602*	*0.2*
Nitrobenzene	28	3.1	na	NT					0.24	U	UL	*0.24*		NT					0.25	U	UL	*0.25*		NT					0.25	U	UL	*0.25*		0.2	U		*0.0583*	*0.2*
RDX	24	5.5	na	NT					0.24	U	UL	*0.24*		NT					0.25	U	UL	*0.25*		NT					0.25	U	UL	*0.25*		0.2	U		*0.035*	*0.2*
Herbicides (ug/kg)		Samples were not tested fo																																				
Metals (mg/kg)																																						
Aluminum	99000	7700	40041	NT					34200			*0.81*		NT					24600			*0.88*		NT					16500			*0.69*		22500			*6.7*	*24.2*
Antimony	41	3.1	na	NT					1.1	B	J	*0.67*		NT					0.9	B	J	*0.73*		NT					0.57	U		*0.57*		0.605	U	UL	*0.2*	*0.605*
Arsenic	1.6	0.39	15.8	NT					5.4			*0.81*		NT					8			*0.88*		NT					3.5			*0.69*		0.846		L	*0.42*	*0.605*
Barium	19000	1500	209	NT					72.9		L	*0.13*		NT					111		L	*0.15*		NT					49.8		L	*0.11*		29.4			*0.4*	*2.42*
Beryllium	200	16	1.02	NT					0.93		K	*0.13*		NT					0.69	B	B	*0.15*		NT					0.76		B	*0.11*		0.701			*0.0418*	*0.605*
Calcium	na	na	na	NT					860			*3.1*		NT					2640			*3.4*		NT					984			*2.6*		81.7		J	*3.4*	*12.1*
Chromium	150000	12000	65.3	NT					42.2			*0.13*		NT					33.3			*0.15*		NT					37.4			*0.11*		27.2			*0.45*	*1.21*
Cobalt	30	2.3	72.3	NT					11.5		L	*0.13*		NT					12.5		L	*0.15*		NT					15		L	*0.11*		4.6	B	J	*0.98*	*6.05*
Copper	4100	310	53.5	NT					15.1		K	*0.13*		NT					36.9		K	*0.15*		NT					9.6		B	*0.11*		8.03			*0.75*	*2.42*
Iron	72000	5500	50962	NT					39700			*2.4*		NT					45600			*2.6*		NT					25300			*2.1*		27500		J	*4.1*	*6.05*
Lead	800	400	26.8	NT					8			*0.27*		NT					25.6			*0.29*		NT					9			*0.23*		4.89			*0.037*	*0.363*
Magnesium	na	na	na	NT					1440			*4.2*		NT					1810			*4.5*		NT					950			*3.6*		832		J	*2.9*	*12.1*
Manganese	2300	180	2543	NT					342			*0.13*		NT					176			*0.15*		NT					613			*0.11*		122		J	*0.068*	*1.21*
Mercury	3.4	0.56	0.13	NT					0.14	U		*0.14*		NT					0.15	U		*0.15*		NT					0.12	U		*0.12*		0.033	B	J	*0.024*	*0.0605*
Nickel	2000	160	62.8	NT					17.6		K	*0.13*		NT					24.4		K	*0.15*		NT					10.6		K	*0.11*		7.85		J	*1.1*	*4.84*
Potassium	na	na	na	NT					1430		K	*5.9*		NT					2220		K	*6.5*		NT					909		K	*5.1*		1490			*40*	*363*
Silver	510	39	na	NT					0.13	U		*0.27*		NT					0.39	B	J	*0.29*		NT					0.23	U		*0.23*		1.21	U		*0.6*	*1.21*
Sodium	na	na	na	NT					180	B	K	*4*		NT					211	B	B	*4.4*		NT					100	B	B	*3.4*		14	B	B	*4.5*	*24.2*
Thallium	na	na	2.11	NT					0.67	U	UL	*0.81*		NT					0.88	U		*0.88*		NT					0.69	U		*0.69*		0.097	B	J	*0.036*	*0.363*
Vanadium	7.2	0.55	108	NT					41.2		K	*0.13*		NT					73.2		K	*0.15*		NT					23.1		K	*0.11*		23.8		J	*0.7*	*6.05*
Zinc	31000	2300	202	NT					46.6		K	*0.27*		NT					67.1		K	*0.29*		NT					29		K	*0.23*		29		J	*0.43*	*2.42*

Table 5
Analytes Detected in Soil Below Fill Material at SWMU 48

Analyte	Sample ID			48SB09C					48SB10C					48TP1					48TP2					48TP3					48TP4				
	Sample Date			6/24/02					6/24/02					3/24/98					3/24/98					3/24/98					3/24/98				
	Sample Depth			8-10					8-10					6-6.5					6-6.5					6-6.5					6-6.5				
	i-SL	r-SL	Background	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)																																	
Acetone	63000000	6100000	na	NT					5.6	U	UJ	*2.5*	*5.6*	NT					NT					NT					NT				
Benzene	5600	1100	na	NT					5.6	U		*0.31*	*5.6*	0.011	U	UJ	*0.011*		0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
Dichlorodifluoromethane	78000	18000	na	NT					NT					0.006	J	J	*0.005*		0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
m- & p-Xylene	na	na	na	NT					11	U		*1.2*	*11*	0.011	U	UJ	*0.011*		0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
Methylene chloride	53000	11000	na	NT					5.6	U		*0.35*	*5.6*	0.007	JB	B	*0.005*		0.002	J	B	*0.005*		0.002	J	B	*0.005*		0.002	J	B	*0.005*	
o-Xylene	1900000	380000	na	NT					5.6	U		*1.2*	*5.6*	0.011	U	UJ	*0.011*		0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
Toluene	4500000	500000	na	NT					5.6	U		*0.36*	*5.6*	0.011	U	UJ	*0.011*		0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
Trichlorofluoromethane	340000	79000	na	NT					NT					0.007	J	J	*0.005*		0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
Vinyl chloride	1700	60	na	NT					5.6	U		*0.42*	*5.6*	0.011	J	J	*0.011*		0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
PAHs (ug/kg)																																	
2-Methylnaphthalene	410000	31000	na	NT					0.95	J	B	*0.71*	*2.1*	NT					NT					NT					NT				
Chrysene	210000	15000	na	NT					2.1	U		*0.34*	*2.1*	0.017		J	*0.003*		0.0021	U		*0.0021*		0.0022	U		*0.0022*		0.0021	U		*0.0021*	
Fluoranthene	2200000	230000	na	NT					2.1	U		*0.36*	*2.1*	0.006	U		*0.006*		0.0042	U		*0.0042*		0.0044	U		*0.0044*		0.0042	U		*0.0042*	
Naphthalene	18000	3600	na	NT					1.6	JB	B	*0.82*	*2.1*	0.03	U		*0.03*		0.021	U		*0.021*		0.022	U		*0.022*		0.021	U		*0.021*	
Phenanthrene	1700000	170000	na	NT					2.1	U		*0.32*	*2.1*	0.094		J	*0.003*		0.0021	U		*0.0021*		0.0022	U		*0.0022*		0.0021	U		*0.0021*	
Pyrene	1700000	170000	na	NT					2.1	U		*0.48*	*2.1*	0.003	U		*0.003*		0.0021	U		*0.0021*		0.0022	U		*0.0022*		0.0021	U		*0.0021*	
SVOCs (ug/kg)																																	
2,4-Dinitrotoluene	120000	12000	na	NT					210	U		*7.1*	*210*	NT					NT					NT					NT				
2,6-Dinitrotoluene	62000	6100	na	NT					210	U		*5.2*	*210*	NT					NT					NT					NT				
bis(2-Ethylhexyl)phthalate	120000	35000	na	NT					210	U		*14*	*210*	0.72	U		*0.72*		0.43	U		*0.43*		0.44	U		*0.44*		0.43	U		*0.43*	
Di-n-butylphthalate	6200000	610000	na	NT					210	U		*61*	*210*	0.72	U		*0.72*		0.43	U		*0.43*		0.44	U		*0.44*		0.43	U		*0.43*	
Naphthalene	18000	3600	na	NT					210	U		*7.7*	*210*	NT					NT					NT					NT				
N-nitrosodiphenylamine	350000	99000	na	NT					210	U		*10*	*210*	0.72	U		*0.72*		0.43	U		*0.43*		0.44	U		*0.44*		0.43	U		*0.43*	
Phenanthrene	1700000	170000	na	NT					210	U		*6.5*	*210*	NT					NT					NT					NT				
Pyrene	1700000	170000	na	NT					210	U		*6.4*	*210*	NT					NT					NT					NT				
Pesticides (ug/kg)	None detected																																
PCBs (mg/kg)	None detected																																
Explosives (mg/kg)																																	
1,3,5-Trinitrobenzene	2700	220	na	0.1	U		*0.0246*	*0.1*	0.1	U		*0.0246*	*0.1*	1.4		J	*0.25*		0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
1,3-Dinitrobenzene	6.2	0.61	na	0.1	U		*0.0216*	*0.1*	0.1	U		*0.0216*	*0.1*	2.7		J	*0.25*		0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
2,4,6-Trinitrotoluene	7.9	1.9	na	0.2	U		*0.0187*	*0.2*	0.2	U		*0.0187*	*0.2*	0.25	U				0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
2,4-Dinitrotoluene	2.5	0.71	na	0.2	U		*0.0163*	*0.2*	0.2	U		*0.0163*	*0.2*	6.7		J	*0.25*		0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
2,6-Dinitrotoluene	2.5	0.71	na	0.2	U		*0.0246*	*0.2*	0.2	U		*0.0246*	*0.2*	1.3			*0.25*		0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
4-amino-2,6-Dinitrotoluene	190	15	na	0.2	U		*0.0444*	*0.2*	0.2	U		*0.0444*	*0.2*	5.5		J	*0.25*		0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
HMX	4900	380	na	0.2	U		*0.0602*	*0.2*	0.2	U		*0.0602*	*0.2*	5.2		J	*0.25*		0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
Nitrobenzene	28	3.1	na	0.2	U		*0.0583*	*0.2*	0.2	U		*0.0583*	*0.2*	1		J	*0.25*		0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
RDX	24	5.5	na	0.2	U		*0.035*	*0.2*	0.2	U		*0.035*	*0.2*	0.85		J	*0.25*		0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
Herbicides (ug/kg)	Samples were not tested fo																																
Metals (mg/kg)																																	
Aluminum	99000	7700	40041	NT					24100			*6.9*	*24.9*	9230			*1.3*		**47400**			*0.75*		**50700**			*0.79*		**47900**			*0.78*	
Antimony	41	3.1	na	NT					0.623	U	UL	*0.21*	*0.623*	0.66	U		*1.1*		1.3	B	J	*0.62*		1.5	B	J	*0.66*		1.5	B	J	*0.65*	
Arsenic	1.6	0.39	15.8	NT					0.623	U	UL	*0.44*	*0.623*	8.1			*1.3*		4.3			*0.75*		4.8			*0.79*		4.8			*0.78*	
Barium	19000	1500	209	NT					63.4			*0.42*	*2.49*	34.6	B	L	*0.22*		71.8		L	*0.12*		70.6		L	*0.13*		80.4		L	*0.13*	
Beryllium	200	16	1.02	NT					1			*0.043*	*0.623*	**1.5**		**K**	*0.22*		0.48	B	K	*0.12*		0.51	B	K	*0.13*		0.55	B	K	*0.13*	
Calcium	na	na	na	NT					16.8		B	*3.5*	*12.5*	4650			*5*		697			*2.9*		266	B	J	*3*		246	B	J	*3*	
Chromium	150000	12000	65.3	NT					27.6			*0.47*	*1.25*	23.2			*0.22*		28.4			*0.12*		33			*0.13*		31.2			*0.13*	
Cobalt	30	2.3	72.3	NT					18.6		J	*1*	*6.23*	13.8		L	*0.22*		6.7		L	*0.12*		7.5		L	*0.13*		6.2	B	L	*0.13*	
Copper	4100	310	53.5	NT					15.7			*0.77*	*2.49*	15.4		K	*0.22*		18.6		K	*0.12*		19.7		K	*0.13*		20.1		K	*0.13*	
Iron	72000	5500	50962	NT					**61400**		**J**	*4.2*	*6.23*	16700			*3.9*		**51100**			*2.2*		**55000**			*2.4*		**54800**			*2.3*	
Lead	800	400	26.8	NT					10.5			*0.038*	*0.374*	17.8			*0.44*		17			*0.25*		14.7			*0.26*		15.8			*0.26*	
Magnesium	na	na	na	NT					1480		J	*2.9*	*12.5*	442	B	J	*6.8*		2310			*3.9*		1980			*4.1*		2160			*4*	
Manganese	2300	180	2543	NT					508		J	*0.07*	*1.25*	314			*0.22*		188			*0.12*		218			*0.13*		163			*0.13*	
Mercury	3.4	0.56	0.13	NT					0.0623	U		*0.0247*	*0.0623*	0.22	U		*0.22*		0.13	U		*0.13*		0.13	U		*0.13*		0.13	U		*0.13*	
Nickel	2000	160	62.8	NT					13		J	*1.1*	*4.98*	8.6	B	K	*0.22*		20.9		K	*0.12*		21.2		K	*0.13*		22		K	*0.13*	
Potassium	na	na	na	NT					1720			*42*	*374*	176	B	K	*9.6*		2910		K	*5.5*		2670		K	*5.8*		2920		K	*5.7*	
Silver	510	39	na	NT					0.87	B	B	*0.61*	*1.25*	0.22	U		*0.44*		0.12	U		*0.25*		0.13	U		*0.26*		0.13	U		*0.26*	
Sodium	na	na	na	NT					16	B	B	*4.7*	*24.9*	5740		K	*6.6*		323	B	K	*3.7*		288	B	K	*4*		224	B	K	*3.9*	
Thallium	na	na	2.11	NT					0.21	B	J	*0.038*	*0.374*	1.1	U	UL	*1.3*		1.9		L	*0.75*		0.66	U	UL	*0.79*		0.65	U	UL	*0.78*	
Vanadium	7.2	0.55	108	NT					63.7		J	*0.72*	*6.23*	12.1		K	*0.22*		94.6		K	*0.12*		100		K	*0.13*		96.4		K	*0.13*	
Zinc	31000	2300	202	NT					53.9		J	*0.45*	*2.49*	58.7		K	*0.44*		65.6		K	*0.25*		70.2		K	*0.26*		67.8		K	*0.26*	

Table 6
Summary of Analytes Detected in Soil Below Fill Material at SWMU 48

Analyte	i-SL	r-SL	Background	# of i-SL Exceedances	# of r-SL Exceedances	# of Background Exceedances	# of Detections	# of Samples	Minimum Concentration	Maximum Concentration	Location of Maximum
VOCs (ug/kg)											
Acetone	63000000	6100000	na	0	0	na	5	13	0.008	1.3	48SB6A2
Benzene	5600	1100	na	0	0	na	1	19	0.017	0.017	48SB6A
Dichlorodifluoromethane	78000	18000	na	0	0	na	1	11	0.006	0.006	48TP1
m- & p-Xylene	na	na	na	na	na	na	1	13	1.1	1.1	48SB6A2
Methylene chloride	53000	11000	na	0	0	na	8	19	0.002	0.049	48SB6A
o-Xylene	1900000	380000	na	0	0	na	1	13	0.64	0.64	48SB6A2
Toluene	4500000	500000	na	0	0	na	2	19	0.023	1	48SB2 (RVFS*3)
Trichlorofluoromethane	340000	79000	na	0	0	na	3	17	0.002	0.7	48SB7A2
Vinyl chloride	1700	60	na	0	0	na	1	19	0.011	0.011	48TP1
PAHs (ug/kg)											
2-Methylnaphthalene	410000	31000	na	0	0	na	2	2	0.89	0.95	48SB10C
Chrysene	210000	15000	na	0	0	na	1	10	0.017	0.017	48TP1
Fluoranthene	2200000	230000	na	0	0	na	1	10	0.048	0.048	48SB6A
Naphthalene	18000	3600	na	0	0	na	2	10	1.5	1.6	48SB10C
Phenanthrene	1700000	170000	na	0	0	na	1	10	0.094	0.094	48TP1
Pyrene	1700000	170000	na	0	0	na	1	10	0.025	0.025	48SB6A
SVOCs (ug/kg)											
2,4-Dinitrotoluene	120000	12000	na	0	0	na	1	8	3200	3200	48SB2 (RVFS*3)
2,6-Dinitrotoluene	62000	6100	na	0	0	na	1	8	1200	1200	48SB2 (RVFS*3)
bis(2-Ethylhexyl)phthalate	120000	35000	na	0	0	na	4	16	0.13	3600	48SB4B21
Di-n-butylphthalate	6200000	610000	na	0	0	na	5	16	0.081	6000	48SB4B21
Naphthalene	18000	3600	na	0	0	na	1	8	270	270	48SB2 (RVFS*3)
N-nitrosodiphenylamine	350000	99000	na	0	0	na	3	16	0.65	1700	48SB4B21
Phenanthrene	1700000	170000	na	0	0	na	2	8	130	200	48SB1 (RVFS*1)
Pyrene	1700000	170000	na	0	0	na	1	8	300	300	48SB1 (RVFS*1)
Pesticides (ug/kg)		***None detected***									
PCBs (mg/kg)		***None detected***									
Explosives (mg/kg)											
1,3,5-Trinitrobenzene	2700	220	na	0	0	na	3	11	0.53	102	48SB7A
1,3-Dinitrobenzene	6.2	0.61	na	0	2	na	2	11	2.7	3.6	48SB7A
2,4,6-Trinitrotoluene	7.9	1.9	na	2	2	na	2	13	35.68	935	48SB7A
2,4-Dinitrotoluene	2.5	0.71	na	1	1	na	1	11	6.7	6.7	48TP1
2,6-Dinitrotoluene	2.5	0.71	na	0	1	na	1	11	1.3	1.3	48TP1
4-amino-2,6-Dinitrotoluene	190	15	na	0	0	na	1	11	5.5	5.5	48TP1
HMX	4900	380	na	0	0	na	1	13	5.2	5.2	48TP1
Nitrobenzene	28	3.1	na	0	0	na	1	11	1	1	48TP1
RDX	24	5.5	na	0	0	na	1	13	0.85	0.85	48TP1
Herbicides (ug/kg)		***Samples were not tested for this group.***									
Metals (mg/kg)											
Aluminum	99000	7700	40041	0	3	3	14	14	2940	50700	48TP3
Antimony	41	3.1	na	0	0	na	6	14	0.9	1.6	48SB6A
Arsenic	1.6	0.39	15.8	0	0	0	13	14	0.846	8.19	48SB1 (RVFS*1)
Barium	19000	1500	209	0	0	0	14	14	29.4	111	48SB7A
Beryllium	200	16	1.02	0	0	4	13	14	0.48	4.98	48SB2 (RVFS*4)
Calcium	na	na	na	na	na	na	14	14	16.8	240000	48SB1 (RVFS*1)
Chromium	150000	12000	65.3	0	0	0	14	14	7.78	42.2	48SB6B
Cobalt	30	2.3	72.3	0	0	0	14	14	3.01	18.6	48SB10C
Copper	4100	310	53.5	0	0	1	14	14	6.87	135	48SB2 (RVFS*3)
Iron	72000	5500	50962	0	4	4	14	14	8550	61400	48SB10C
Lead	800	400	26.8	0	0	3	12	14	4.89	154	48SB2 (RVFS*3)
Magnesium	na	na	na	na	na	na	14	14	442	130000	48SB1 (RVFS*1)
Manganese	2300	180	2543	0	0	0	14	14	122	613	48SB7B
Mercury	3.4	0.56	0.13	0	1	2	3	14	0.033	2.6	48SB1 (RVFS*1)
Nickel	2000	160	62.8	0	0	0	14	14	4.91	25.6	48SB2 (RVFS*3)
Potassium	na	na	na	na	na	na	14	14	176	2920	48TP4
Silver	510	39	na	0	0	na	4	14	0.39	1.03	48SB1 (RVFS*1)
Sodium	na	na	na	na	na	na	14	14	14	5740	48TP1
Thallium	na	na	2.11	na	na	0	3	14	0.097	1.9	48TP2
Vanadium	7.2	0.55	108	0	0	0	14	14	8.97	100	48TP3
Zinc	31000	2300	202	0	0	0	14	14	23	71.3	48SB2 (RVFS*3)

3.0 COMPLETED ACTIVITIES

The activities conducted at SWMU 48 are intended to provide supplemental data in order to complete the RFI/CMS for the site. High concentrations of 2,4,6-TNT were detected in soil samples collected within and immediately below an ash layer that was discovered during test pit and soil boring advancement during the 1998 RFI at SWMU 48.

The objective of the supplemental data collection was to attempt to visibly locate the ash layer within the SWMU 48 trenches via test pitting and characterize the concentrations of explosives in soil above, within, and below the ash layer. A summary of the proposed sampling is presented in **Table 7**.

Table 7
Proposed Sampling and Analysis

Media	Number of Samples*	Analysis	Objective
Subsurface Soil	18	TAL metals, explosives	Characterize the concentrations of metals and explosives associated with the ash layer, if present.
Subsurface Soil Composite	3	TCLP SVOCs, TCLP metals, explosives, corrosivity as pH, reactivity, and ignitability	Determine if excavated soil contains explosive or waste characteristic concentrations above TCLP RLs.

*Sample numbers do not include QA/QC samples
- Blind field duplicate samples were collected at a frequency of 10% of the total number of env. samples
- MS/MSD samples and rinse blanks were collected at a frequency of 5% of the total number of env. samples

3.1 Test Pitting

Three test pits were proposed for advancement perpendicularly across the northern and southern trenches at SWMU 48 (**Figure 2**). The test pits were to be advanced downward and through the ash layer, if present. The initial excavation at test pit 48TP1 encountered the ash layer. As a result, the test pit excavation plan was altered to focus on determining the extent and boundaries of the ash layer. Actual test pit locations are depicted on **Figure** 3. Several test pits, approximately 5 to 10 feet in length, within the southern and northern trenches were advanced and logged until the ash layer visually terminated within or was no longer present in the outlying test pits. As shown on **Figure 2**, the initially excavated test pit, 48TP1, was advanced to intersect 1998 RFI subsurface soil sample 48SB07A, where 2,4,6-TNT was detected at a concentration of 935 mg/kg.

Test pit advancement was performed using a 20-ton excavator (trackhoe). Fill soil above the ash layer (0-6 ft bgs) was staged on the outside of the test pits for re-use as backfill following the completion of test pit advancement. Soil below 6 ft in depth and any soil containing ash was excavated and directly loaded into drums that were transported to the RFAAP 90-day accumulation storage area. Less than 1 cubic yard investigation derived material (IDM) was generated.

The sides of all excavations in which employees were exposed to danger from moving ground were guarded by benching the ground. The benching was in accordance with EM 385-1-1 and Shaw procedure HS307, Excavation and Trenching. Excavations less than 5 ft in depth and which a "competent person" examines and determines there to be no potential for cave-in did not require protective systems. EM 385-1-1 defines a "competent person" as "one who can identify

existing and predictable hazards in the working environment or working conditions that are dangerous to personnel and who has the authority to take prompt corrective measures to eliminate them." Shaw Health and Safety provides Excavation Competent Person Training, and Shaw will ensure that the Site Superintendent for the project has completed this training. Excavation work will comply with EM 385-1-1 and 29CFR1926 Subpart P – *Excavations* and will follow the health and safety requirements specified the AHA adopted from the SWMU 51 IMWP (**Appendix A**). Excavations greater than 4 ft may constitute a confined space, as such, no Personnel was allowed to enter the excavation. Soil sampling was performed from the bucket of the excavator and is described in more detail in the following section.

3.2 Visual Inspection

Test Pits were visually inspected and logged by a staff geologist, as soil was unearthed. Test Pits typically consisted of light brown, Silty SAND (SM) fill overlying a reddish brown native Lean CLAY (CL). A dark gray to black layer of very moist black ash was encountered in several test pits including; 48TP1 through 48TP5, 48TP8, 48TP10, and 48TP13, typically around 0.5 to 3.5 ft bgs. The thickness of the ash layer generally ranged from approximately 0.3 to 2.0 feet thick. Lenses of plastics, roofing materials, and asphalt debris were encountered in Test Pits 48TP6, 48TP9, 48TP11, and 48TP12. An unknown green clayey substance was encountered at approximately 6.5 ft bgs in Test Pit 48TP6. This substance was found in approximately 12 inch by 12 inch blocks, contained by weathered cardboard and wrapped in plastic. Based on further excavations, this material was confined to 48TP6.

3.3 Soil Sampling

As shown in **Table 7**, eighteen soil grab samples and three composite samples were collected from the test pits advanced at SWMU 48 to further characterize metals and explosives concentrations associated with the ash layer. Sample locations are presented on **Figure 3**. Three soil samples were collected from each test pit, with the exception of 48TP2, 48TP4 48TP5, and 48TP13, within the southern trench. These test pits were used to visually define the boundaries of the ash layer. Test pits were typically sampled on an "every other" test pit basis. Additionally, test pits 48TP10, 48TP14, and 48TP12 in the northern trench were also not sampled, as there was no ash layer encountered, and fill material was sparse. A soil sample was typically collected from above, within, and below the ash layer, if present. As indicated in *Section 3.1*, personnel were not allowed to enter a test pit greater than 4 ft in depth for sampling. Soil sampling was performed from the bucket of the excavator in all test pits.

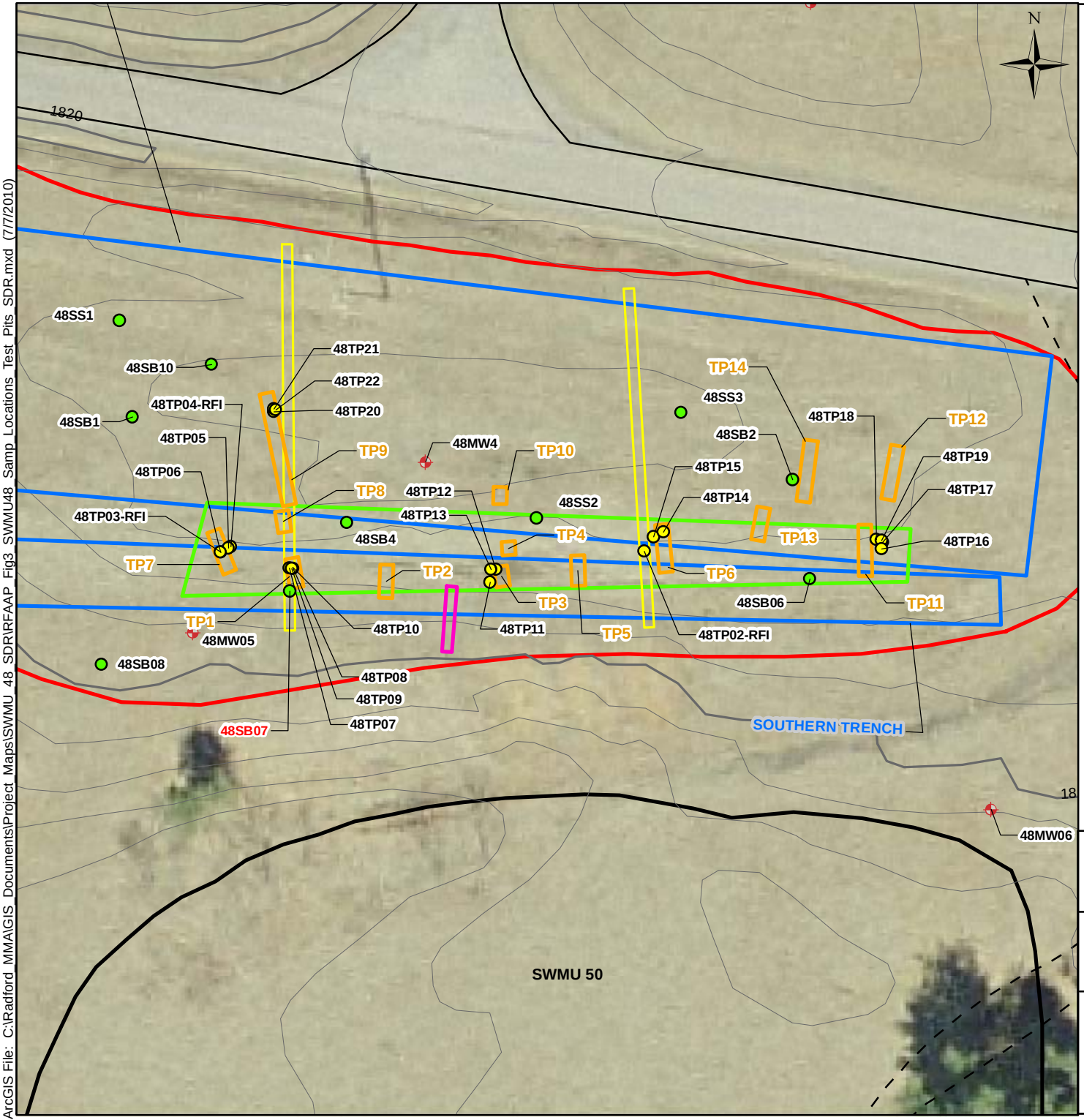
As indicated in **Table 7**, soil samples were collected to further characterize metals and explosives concentrations associated with the ash were analyzed at an offsite laboratory for Target Analyte List (TAL) metals and explosives. Three composite soil samples were also collected; one sample from test pits 48TP7, 48TP8, and 48TP11. Each composite sample consisted of three aliquots of soil; above, below, and within the encountered ash layer, that were subsequently homogenized. The composite samples were collected and tested to determine if excavated soil contains explosive or waste characteristic concentrations above TCLP RLs. Results from the sampling event are tabulated in **Tables 8 and 9**. The TCLP results are presented in **Table 10**.

TAL Metals. Twenty-three metals were detected in the soil samples. Arsenic exceeded the industrial screening level in one sample. Antimony and cadmium exceeded the residential

screening level in single samples. Lead exceeded its industrial screening level in one sample and its residential screening level in three samples. The single industrial level exceedances was from a sample of the green material that appears to be a grout mix likely used in the conductive flooring that is present in many of the explosive loading and handling buildings at Radford. Copper also exceeded its industrial screening level in this sample. Mercury exceeded the industrial screening level in three samples and the residential screening level in six samples.

Explosives. Nine explosives were detected in the subsurface soil samples. All results were below residential screening levels, with the exception of a single detection of nitroglycerin that exceeded the residential criteria.

TCLP. No TCLP SVOCs were detected. Lead, barium and mercury were detected in the TCLP metals analysis at concentrations below the TCLP Regulatory Limits (RLs), indicating that this soil would be disposed of as non-hazardous waste.



LEGEND

- Test Pit Delineation Soil Sample Location
- Monitoring Well Location
- Soil Sample Location
- Test Pit
- Dirt Road
- Paved Road
- 1998 RFI Trench Boundary
- Proposed Test Pit Boundary
- Southern Trench (GPS)
- Trench Boundary
- 10 ft Contour Line
- 2 ft Contour Line
- SWMU 48 Boundary
- Other SWMU Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.

Scale:
0 20 40 80 Feet

U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE 3
SWMU 48 Test Pits and Sample Locations
Radford Army Ammunition Plant, Radford, VA

ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\SWMU_48_SDR\RFAAP_Fig3_SWMU48_Samp_Locations_Test_Pits_SDR.mxd (7/7/2010)

Table 8
Analytes Detected in Trenching Investigation Soil Samples
SWMU 48, Radford Army Ammunition Plant, Radford VA

Analyte	Sample ID			48TP02-RFI					48TP03-RFI					48TP04-RFI					48TP05				
	Sample Date			3/18/10					3/18/10					3/18/10					3/18/10				
	Sample Depth			6-7					1-2					3-4					5-6				
	i-SL	**r-SL**	**Background**	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																							
1,3,5-Trinitrobenzene	2700	220	na	0.13	J PG		*0.01*	*0.25*	0.25	U		*0.01*	*0.25*	0.25	U		*0.01*	*0.25*	0.25	U		*0.009*	*0.25*
1,3-Dinitrobenzene	6.2	0.61	na	0.25	U		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*
2,4,6-Trinitrotoluene	7.9	1.9	na	0.25	U		*0.019*	*0.25*	0.056	J		*0.019*	*0.25*	0.18	J		*0.019*	*0.25*	0.25	U		*0.019*	*0.25*
2,4-Dinitrotoluene	120	12	na	0.022	J		*0.005*	*0.25*	0.079	J		*0.005*	*0.25*	1.6			*0.005*	*0.25*	0.13	J		*0.005*	*0.25*
2,6-Dinitrotoluene	62	6.1	na	0.25	U		*0.007*	*0.25*	0.074	J		*0.007*	*0.25*	0.19	J		*0.007*	*0.25*	0.054	J		*0.007*	*0.25*
2-amino-4,6-Dinitrotoluene	200	15	na	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*
4-amino-2,6-Dinitrotoluene	190	15	na	0.25	U		*0.01*	*0.25*	0.038	J		*0.01*	*0.25*	0.01	J PG		*0.01*	*0.25*	0.022	J		*0.009*	*0.25*
HMX	4900	380	na	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.025	J		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*
Nitroglycerin	6.2	0.61	na	0.5	U		*0.015*	*0.5*	0.051	J PG		*0.015*	*0.5*	1.2	PG		*0.015*	*0.5*	0.17	J		*0.015*	*0.5*
Metals (mg/kg)																							
Aluminum	99000	7700	40041	96.9			*9.2*	*32.9*	18000			*8.6*	*30.8*	9910			*8.1*	*28.9*	16200			*8.7*	*30.9*
Antimony	41	3.1	na	0.99	U		*0.33*	*0.99*	1.2		NOT	*0.31*	*0.92*	3.2			*0.29*	*0.87*	1.5			*0.31*	*0.93*
Arsenic	1.6	0.39	15.8	0.82	U		*0.25*	*0.82*	4		VALIDAT	*0.23*	*0.77*	3.5			*0.22*	*0.72*	4.1			*0.23*	*0.77*
Barium	19000	1500	209	0.96			*0.16*	*0.49*	114			*0.15*	*0.46*	199			*0.14*	*0.43*	142			*0.15*	*0.46*
Beryllium	200	16	1.02	0.16	U		*0.016*	*0.16*	0.79			*0.015*	*0.15*	0.69			*0.014*	*0.14*	0.91			*0.015*	*0.15*
Cadmium	81	7	0.69	**9.2**			*0.082*	*0.25*	**1.1**			*0.077*	*0.23*	**6.3**			*0.072*	*0.22*	**1.8**			*0.077*	*0.23*
Calcium	na	na	na	737			*41.1*	*164*	221000	RLA		*193*	*770*	16900			*36.1*	*144*	174000	RLA		*193*	*773*
Chromium	150000	12000	65.3	2.7			*0.33*	*0.99*	31.2			*0.31*	*0.92*	48.5			*0.29*	*0.87*	34.5			*0.31*	*0.93*
Cobalt	30	2.3	72.3	9			*0.16*	*0.49*	4.6			*0.15*	*0.46*	6.8			*0.14*	*0.43*	6			*0.15*	*0.46*
Copper	4100	310	53.5	**81800**	**B RLA**		*247*	*822*	31.7	B		*0.23*	*0.77*	**239**	**B**		*0.22*	*0.72*	**87.5**	**B**		*0.23*	*0.77*
Iron	72000	5500	50962	118			*5.1*	*16.4*	13900			*4.8*	*15.4*	15500			*4.5*	*14.4*	15100			*4.8*	*15.5*
Lead	800	400	26.8	**114000**	**B RLA**		*98.7*	*329*	**294**	**B**	**O DAT**	*0.092*	*0.31*	**665**	**B**		*0.087*	*0.29*	**450**	**B**		*0.093*	*0.31*
Magnesium	na	na	na	382			*12.3*	*82.2*	17400			*11.6*	*77*	3320			*10.8*	*72.2*	14000			*11.6*	*77.3*
Manganese	2300	180	2543	11.3			*0.41*	*1.3*	145			*0.39*	*1.2*	162			*0.36*	*1.2*	180			*0.39*	*1.2*
Mercury	3.4	0.56	0.13	0.024	J		*0.014*	*0.066*	**1.5**	**RLA**		*0.026*	*0.12*	**25.5**	**RLA**		*0.31*	*1.4*	**5.9**	**RLA**		*0.11*	*0.49*
Nickel	2000	160	62.8	10.7			*0.16*	*0.49*	25			*0.15*	*0.46*	22.7			*0.14*	*0.43*	23.3			*0.15*	*0.46*
Potassium	na	na	na	73.3	J		*41.1*	*164*	2370			*38.5*	*154*	627			*36.1*	*144*	2340			*38.7*	*155*
Selenium	510	39	na	0.7			*0.16*	*0.49*	0.77			*0.15*	*0.46*	1.1			*0.14*	*0.43*	0.85			*0.15*	*0.46*
Silver	510	39	na	0.95			*0.049*	*0.16*	1.1			*0.046*	*0.15*	30	RLA		*0.22*	*0.72*	13.5			*0.046*	*0.15*
Sodium	na	na	na	779	J		*41.1*	*822*	210	J		*38.5*	*770*	77.4	J		*36.1*	*722*	153	J		*38.7*	*773*
Thallium	na	na	2.11	0.25	U		*0.082*	*0.25*	0.23	U		*0.077*	*0.23*	0.22	U		*0.072*	*0.22*	0.23	U		*0.077*	*0.23*
Vanadium	7.2	0.55	108	3.3	U		*0.99*	*3.3*	24.4			*0.92*	*3.1*	15.2			*0.87*	*2.9*	24.9			*0.93*	*3.1*
Zinc	31000	2300	202	32.9	U G		*9.9*	*32.9*	40.4			*0.92*	*3.1*	**499**			*0.87*	*2.9*	143			*0.93*	*3.1*

12	J	Shading and black font indicates a i-SL exceedance.
12	J	Bold outline indicates a r-SL exceedance.
12	**J**	Bold, underlined font indicates a Background exceedance.
12	*12*	Shading in the MDL/MRL columns indicates the MDL exceeds a criterion.

SLs for non-Carcinogenic compounds have been recalculated to an HI of 0.1.
The pyrene SL and SSL was used for acenaphthylene, benzo(g,h,i)perylene and phenanthrene.
Inorganic results below background UTLs are not indicated as exceedances on the table.
SL/SSL source: ORNL Regional Screening Table. April 2009.
BTAG sediment source: USEPA Region III BTAG Sediment Screening Benchmarks. December 2005.
BTAG soil source: USEPA Region III BTAG Soil Screening Values. 1995.

Table 8
Analytes Detected in Trenching Investigation Soil Samples
SWMU 48, Radford Army Ammunition Plant, Radford VA

Analyte	Sample ID			48TP07					48TP08					48TP08D					48TP09				
	Sample Date			3/18/10					3/18/10					3/18/10					3/18/10				
	Sample Depth			2.35-2.5					3.5-4					3.5-4					5-6				
	i-SL	**r-SL**	**Background**	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																							
1,3,5-Trinitrobenzene	2700	220	na	0.25	U		*0.01*	*0.25*	0.62			*0.009*	*0.25*	0.14	J PG		*0.01*	*0.25*	0.25	U		*0.01*	*0.25*
1,3-Dinitrobenzene	6.2	0.61	na	0.25	U		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*
2,4,6-Trinitrotoluene	7.9	1.9	na	0.25	U		*0.019*	*0.25*	1.6			*0.019*	*0.25*	0.42			*0.019*	*0.25*	0.25	U		*0.019*	*0.25*
2,4-Dinitrotoluene	120	12	na	0.25	U		*0.005*	*0.25*	0.75			*0.005*	*0.25*	0.32			*0.005*	*0.25*	0.25	U		*0.005*	*0.25*
2,6-Dinitrotoluene	62	6.1	na	0.11	J		*0.007*	*0.25*	0.9			*0.007*	*0.25*	0.27			*0.007*	*0.25*	0.013	J		*0.007*	*0.25*
2-amino-4,6-Dinitrotoluene	200	15	na	0.25	U		*0.012*	*0.25*	1.7			*0.012*	*0.25*	2.6			*0.012*	*0.25*	0.032	J		*0.012*	*0.25*
4-amino-2,6-Dinitrotoluene	190	15	na	0.25	U		*0.01*	*0.25*	0.43			*0.009*	*0.25*	0.45			*0.01*	*0.25*	0.25	U		*0.01*	*0.25*
HMX	4900	380	na	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*
Nitroglycerin	6.2	0.61	na	0.5	U		*0.015*	*0.5*	0.5	U		*0.015*	*0.5*	0.5	U		*0.015*	*0.5*	0.5	U		*0.015*	*0.5*
Metals (mg/kg)																							
Aluminum	99000	7700	40041	11300			*7.6*	*27.1*	18100			*7.1*	*25.2*	12200			*6.5*	*23.3*	31200			*7.2*	*25.7*
Antimony	41	3.1	na	1.9			*0.27*	*0.81*	1			*0.25*	*0.76*	0.36	J		*0.23*	*0.7*	0.77	U		*0.26*	*0.77*
Arsenic	1.6	0.39	15.8	6.4			*0.2*	*0.68*	**112**			*0.19*	*0.63*	7.4			*0.17*	*0.58*	2.8			*0.19*	*0.64*
Barium	19000	1500	209	144			*0.14*	*0.41*	96.1			*0.13*	*0.38*	95.8			*0.12*	*0.35*	55.4			*0.13*	*0.39*
Beryllium	200	16	1.02	0.69			*0.014*	*0.14*	0.89			*0.013*	*0.13*	0.83			*0.012*	*0.12*	0.69			*0.013*	*0.13*
Cadmium	81	7	0.69	**2.2**			*0.068*	*0.2*	**1.1**			*0.063*	*0.19*	**0.71**			*0.058*	*0.17*	0.31			*0.064*	*0.19*
Calcium	na	na	na	31300			*33.9*	*136*	18300			*31.6*	*126*	49400			*29.1*	*116*	2370			*32.1*	*128*
Chromium	150000	12000	65.3	32.7			*0.27*	*0.81*	52			*0.25*	*0.76*	23.5			*0.23*	*0.7*	26.7			*0.26*	*0.77*
Cobalt	30	2.3	72.3	4.9			*0.14*	*0.41*	8.5			*0.13*	*0.38*	7.1			*0.12*	*0.35*	4.6			*0.13*	*0.39*
Copper	4100	310	53.5	**98**	**B**		*0.2*	*0.68*	27.5	B		*0.19*	*0.63*	23.4	B		*0.17*	*0.58*	17.1	B		*0.19*	*0.64*
Iron	72000	5500	50962	15600			*4.2*	*13.6*	24600			*3.9*	*12.6*	17100			*3.6*	*11.6*	40400			*4*	*12.8*
Lead	800	400	26.8	**349**	**B**		*0.081*	*0.27*	**105**	**B**		*0.076*	*0.25*	**106**	**B**		*0.07*	*0.23*	26.3	B		*0.077*	*0.26*
Magnesium	na	na	na	5840			*10.2*	*67.8*	5470			*9.5*	*63.1*	14600			*8.7*	*58.2*	1530			*9.6*	*64.2*
Manganese	2300	180	2543	171			*0.34*	*1.1*	456			*0.32*	*1*	356			*0.29*	*0.93*	130			*0.32*	*1*
Mercury	3.4	0.56	0.13	**12.5**	**RLA**		*0.29*	*1.4*	**2.1**	**RLA**		*0.032*	*0.15*	**0.71**			*0.01*	*0.047*	**0.31**			*0.011*	*0.051*
Nickel	2000	160	62.8	16.9			*0.14*	*0.41*	13.4			*0.13*	*0.38*	15.6			*0.12*	*0.35*	15.3			*0.13*	*0.39*
Potassium	na	na	na	962			*33.9*	*136*	973			*31.6*	*126*	1130			*29.1*	*116*	1530			*32.1*	*128*
Selenium	510	39	na	1.2			*0.14*	*0.41*	1.1			*0.13*	*0.38*	0.73			*0.12*	*0.35*	0.72			*0.13*	*0.39*
Silver	510	39	na	16.1	RLA		*0.2*	*0.68*	3.1			*0.038*	*0.13*	1.8			*0.035*	*0.12*	0.49			*0.039*	*0.13*
Sodium	na	na	na	94.4	J		*33.9*	*678*	46.8	J		*31.6*	*631*	80.2	J		*29.1*	*582*	642	U		*32.1*	*642*
Thallium	na	na	2.11	0.12	J		*0.068*	*0.2*	1.3			*0.063*	*0.19*	0.11	J		*0.058*	*0.17*	0.21			*0.064*	*0.19*
Vanadium	7.2	0.55	108	24.4			*0.81*	*2.7*	37.2			*0.76*	*2.5*	33.5			*0.7*	*2.3*	77.6			*0.77*	*2.6*
Zinc	31000	2300	202	**209**			*0.81*	*2.7*	158			*0.76*	*2.5*	170			*0.7*	*2.3*	45.1			*0.77*	*2.6*

Table 8
Analytes Detected in Trenching Investigation Soil Samples
SWMU 48, Radford Army Ammunition Plant, Radford VA

Analyte	Sample ID / Sample Date / Sample Depth			48TP11 3/18/10 1-2					48TP12 3/18/10 1-2					48TP13 3/18/10 3-4					48TP14 3/18/10 2-3				
	i-SL	**r-SL**	**Background**	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																							
1,3,5-Trinitrobenzene	2700	220	na	0.25	U		*0.009*	*0.25*	0.25	U		*0.009*	*0.25*	0.25	U		*0.009*	*0.25*	1.3	U		*0.05*	*1.3*
1,3-Dinitrobenzene	6.2	0.61	na	0.25	U		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*	1.3	U		*0.021*	*1.3*
2,4,6-Trinitrotoluene	7.9	1.9	na	0.25	U		*0.019*	*0.25*	0.25	U		*0.019*	*0.25*	0.25	U		*0.019*	*0.25*	1.3	U		*0.097*	*1.3*
2,4-Dinitrotoluene	120	12	na	0.25	U		*0.005*	*0.25*	0.25	U		*0.005*	*0.25*	0.25	U		*0.005*	*0.25*	6.9	V		*0.027*	*1.3*
2,6-Dinitrotoluene	62	6.1	na	0.25	U		*0.007*	*0.25*	0.3	PG		*0.007*	*0.25*	0.25	U		*0.007*	*0.25*	2.7			*0.037*	*1.3*
2-amino-4,6-Dinitrotoluene	200	15	na	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	1.3	U		*0.063*	*1.3*
4-amino-2,6-Dinitrotoluene	190	15	na	0.25	U		*0.009*	*0.25*	0.13	J		*0.009*	*0.25*	0.25	U		*0.009*	*0.25*	1.3	U		*0.05*	*1.3*
HMX	4900	380	na	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	1.3	U		*0.061*	*1.3*
Nitroglycerin	6.2	0.61	na	0.5	U		*0.015*	*0.5*	0.5	U		*0.015*	*0.5*	0.5	U		*0.015*	*0.5*	2.5	U		*0.075*	*2.5*
Metals (mg/kg)																							
Aluminum	99000	7700	40041	35000			*7.3*	*26.1*	8620			*7.3*	*25.9*	29900			*6.5*	*23.1*	11000			*10.1*	*36*
Antimony	41	3.1	na	0.78	U		*0.26*	*0.78*	0.78	U		*0.26*	*0.78*	0.69	U		*0.23*	*0.69*	0.81	J		*0.36*	*1.1*
Arsenic	1.6	0.39	15.8	4			*0.2*	*0.65*	3.7			*0.19*	*0.65*	3			*0.17*	*0.58*	3.4			*0.27*	*0.9*
Barium	19000	1500	209	67.3			*0.13*	*0.39*	41.1			*0.13*	*0.39*	62.5			*0.12*	*0.35*	78.7			*0.18*	*0.54*
Beryllium	200	16	1.02	0.71			*0.013*	*0.13*	0.43			*0.013*	*0.13*	0.68			*0.012*	*0.12*	0.74			*0.018*	*0.18*
Cadmium	81	7	0.69	0.37			*0.065*	*0.2*	0.19			*0.065*	*0.19*	0.3			*0.058*	*0.17*	0.57			*0.09*	*0.27*
Calcium	na	na	na	169			*32.6*	*130*	3570			*32.4*	*130*	165			*28.9*	*116*	78300			*45.1*	*180*
Chromium	150000	12000	65.3	26.7			*0.26*	*0.78*	22.9			*0.26*	*0.78*	21.5			*0.23*	*0.69*	**68.3**			*0.36*	*1.1*
Cobalt	30	2.3	72.3	14.8			*0.13*	*0.39*	6			*0.13*	*0.39*	21			*0.12*	*0.35*	5.4			*0.18*	*0.54*
Copper	4100	310	53.5	15.6	B		*0.2*	*0.65*	5.1			*0.19*	*0.65*	14	B		*0.17*	*0.58*	**83.5**	**B**		*0.27*	*0.9*
Iron	72000	5500	50962	46100			*4*	*13*	17400			*4*	*13*	38900			*3.6*	*11.6*	14300			*5.6*	*18*
Lead	800	400	26.8	15.5	B		*0.078*	*0.26*	17.6	B		*0.078*	*0.26*	18.2	B		*0.069*	*0.23*	**257**	**B**		*0.11*	*0.36*
Magnesium	na	na	na	1350			*9.8*	*65.1*	807			*9.7*	*64.8*	1360			*8.7*	*57.8*	3980			*13.5*	*90.1*
Manganese	2300	180	2543	429			*0.33*	*1*	327			*0.32*	*1*	944			*0.29*	*0.92*	237			*0.45*	*1.4*
Mercury	3.4	0.56	0.13	**0.15**			*0.011*	*0.052*	0.078			*0.011*	*0.052*	**0.16**			*0.009*	*0.046*	**0.21**			*0.015*	*0.072*
Nickel	2000	160	62.8	16.7			*0.13*	*0.39*	5.3			*0.13*	*0.39*	15.4			*0.12*	*0.35*	55.4			*0.18*	*0.54*
Potassium	na	na	na	1310			*32.6*	*130*	532			*32.4*	*130*	1290			*28.9*	*116*	675			*45.1*	*180*
Selenium	510	39	na	0.51			*0.13*	*0.39*	0.64			*0.13*	*0.39*	0.49			*0.12*	*0.35*	0.74			*0.18*	*0.54*
Silver	510	39	na	0.097	J		*0.039*	*0.13*	0.049	J		*0.039*	*0.13*	0.093	J		*0.035*	*0.12*	0.27			*0.054*	*0.18*
Sodium	na	na	na	163	J		*32.6*	*651*	203	J		*32.4*	*648*	109	J		*28.9*	*578*	99.6	J		*45.1*	*901*
Thallium	na	na	2.11	0.32			*0.065*	*0.2*	0.12	J		*0.065*	*0.19*	0.26			*0.058*	*0.17*	0.27	U		*0.09*	*0.27*
Vanadium	7.2	0.55	108	82.3			*0.78*	*2.6*	34.7			*0.78*	*2.6*	74.4			*0.69*	*2.3*	19.2			*1.1*	*3.6*
Zinc	31000	2300	202	45.9			*0.78*	*2.6*	20.1			*0.78*	*2.6*	40.9			*0.69*	*2.3*	66.7			*1.1*	*3.6*

Table 8
Analytes Detected in Trenching Investigation Soil Samples
SWMU 48, Radford Army Ammunition Plant, Radford VA

Analyte	Sample ID / Sample Date / Sample Depth			48TP14D 3/18/10 2-3					48TP15 3/18/10 8-9					48TP16 3/18/10 1-2					48TP17 3/18/10 4-5				
	i-SL	**r-SL**	**Background**	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																							
1,3,5-Trinitrobenzene	2700	220	na	1.2	U		*0.049*	*1.2*	0.25	U		*0.01*	*0.25*	0.25	U		*0.01*	*0.25*	0.25	U		*0.009*	*0.25*
1,3-Dinitrobenzene	6.2	0.61	na	1.2	U		*0.02*	*1.2*	0.073	J PG		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*
2,4,6-Trinitrotoluene	7.9	1.9	na	1.2	U		*0.094*	*1.2*	0.25	U		*0.019*	*0.25*	0.25	U		*0.019*	*0.25*	0.25	U		*0.019*	*0.25*
2,4-Dinitrotoluene	120	12	na	5.3	V		*0.026*	*1.2*	0.25	U		*0.005*	*0.25*	0.25	U		*0.005*	*0.25*	0.078	J		*0.005*	*0.25*
2,6-Dinitrotoluene	62	6.1	na	2.8			*0.036*	*1.2*	0.25	U		*0.007*	*0.25*	0.25	U		*0.007*	*0.25*	0.04	J		*0.007*	*0.25*
2-amino-4,6-Dinitrotoluene	200	15	na	1.2	U		*0.061*	*1.2*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*
4-amino-2,6-Dinitrotoluene	190	15	na	1.2	U		*0.049*	*1.2*	0.25	U		*0.01*	*0.25*	0.25	U		*0.01*	*0.25*	0.25	U		*0.009*	*0.25*
HMX	4900	380	na	1.2	U		*0.059*	*1.2*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*
Nitroglycerin	6.2	0.61	na	2.4	U		*0.073*	*2.4*	0.5	U		*0.015*	*0.5*	0.5	U		*0.015*	*0.5*	0.5	U		*0.015*	*0.5*
Metals (mg/kg)																							
Aluminum	99000	7700	40041	13000			*9.5*	*33.9*	7590			*11.8*	*42.2*	16000			*6.6*	*23.5*	13300			*6.6*	*23.6*
Antimony	41	3.1	na	0.92	J		*0.34*	*1*	1.3	U		*0.42*	*1.3*	0.71	U		*0.24*	*0.71*	0.71	U		*0.24*	*0.71*
Arsenic	1.6	0.39	15.8	3.7			*0.25*	*0.85*	14			*0.32*	*1.1*	2.8			*0.18*	*0.59*	2.8			*0.18*	*0.59*
Barium	19000	1500	209	57			*0.17*	*0.51*	76.8			*0.21*	*0.63*	70.2			*0.12*	*0.35*	110			*0.12*	*0.35*
Beryllium	200	16	1.02	0.64			*0.017*	*0.17*	0.48			*0.021*	*0.21*	0.51			*0.012*	*0.12*	0.61			*0.012*	*0.12*
Cadmium	81	7	0.69	0.59			*0.085*	*0.25*	0.56			*0.11*	*0.32*	0.18			*0.059*	*0.18*	0.16	J		*0.059*	*0.18*
Calcium	na	na	na	95300			*42.4*	*169*	14400			*52.8*	*211*	502			*29.4*	*118*	590			*29.5*	*118*
Chromium	150000	12000	65.3	**75.7**			*0.34*	*1*	19.4			*0.42*	*1.3*	23.7			*0.24*	*0.71*	18.9			*0.24*	*0.71*
Cobalt	30	2.3	72.3	4.7			*0.17*	*0.51*	6.6			*0.21*	*0.63*	5.7			*0.12*	*0.35*	6.4			*0.12*	*0.35*
Copper	4100	310	53.5	**100**	**B**		*0.25*	*0.85*	18			*0.32*	*1.1*	7.6			*0.18*	*0.59*	8.8			*0.18*	*0.59*
Iron	72000	5500	50962	19300			*5.3*	*16.9*	18500			*6.5*	*21.1*	18400			*3.6*	*11.8*	14800			*3.7*	*11.8*
Lead	800	400	26.8	**305**	**B**		*0.1*	*0.34*	**51.3**	**B**		*0.13*	*0.42*	16.7	B		*0.071*	*0.24*	22.8	B		*0.071*	*0.24*
Magnesium	na	na	na	3860			*12.7*	*84.7*	2220			*15.8*	*106*	636			*8.8*	*58.9*	560			*8.8*	*59*
Manganese	2300	180	2543	202			*0.42*	*1.4*	510			*0.53*	*1.7*	504			*0.29*	*0.94*	1250	RLA		*2.9*	*9.4*
Mercury	3.4	0.56	0.13	**0.24**			*0.015*	*0.068*	**0.43**			*0.018*	*0.084*	0.086			*0.01*	*0.047*	0.071			*0.01*	*0.047*
Nickel	2000	160	62.8	59.6			*0.17*	*0.51*	13.2			*0.21*	*0.63*	9.9			*0.12*	*0.35*	8.4			*0.12*	*0.35*
Potassium	na	na	na	1120			*42.4*	*169*	431			*52.8*	*211*	834			*29.4*	*118*	751			*29.5*	*118*
Selenium	510	39	na	0.73			*0.17*	*0.51*	1.2			*0.21*	*0.63*	0.66			*0.12*	*0.35*	0.89			*0.12*	*0.35*
Silver	510	39	na	0.19			*0.051*	*0.17*	0.073	J		*0.063*	*0.21*	0.043	J		*0.035*	*0.12*	0.037	J		*0.035*	*0.12*
Sodium	na	na	na	85.9	J		*42.4*	*847*	332	J		*52.8*	*1060*	589	U		*29.4*	*589*	590	U		*29.5*	*590*
Thallium	na	na	2.11	0.25	U		*0.085*	*0.25*	0.55			*0.11*	*0.32*	0.15	J		*0.059*	*0.18*	0.13	J		*0.059*	*0.18*
Vanadium	7.2	0.55	108	15.9			*1*	*3.4*	33.9			*1.3*	*4.2*	47.8			*0.71*	*2.4*	28.8			*0.71*	*2.4*
Zinc	31000	2300	202	60.6			*1*	*3.4*	21.7			*1.3*	*4.2*	33.1			*0.71*	*2.4*	26.8			*0.71*	*2.4*

Table 8
Analytes Detected in Trenching Investigation Soil Samples
SWMU 48, Radford Army Ammunition Plant, Radford VA

Analyte	Sample ID			48TP18					48TP20					48TP21					48TP22				
	Sample Date			3/18/10					3/18/10					3/18/10					3/18/10				
	Sample Depth			6-7					1-2					3-4					5-6				
	i-SL	**r-SL**	**Background**	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																							
1,3,5-Trinitrobenzene	2700	220	na	0.25	U		*0.009*	*0.25*	0.25	U		*0.009*	*0.25*	0.25	U		*0.009*	*0.25*	0.25	U		*0.009*	*0.25*
1,3-Dinitrobenzene	6.2	0.61	na	0.25	U		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*	0.25	U		*0.004*	*0.25*
2,4,6-Trinitrotoluene	7.9	1.9	na	0.25	U		*0.019*	*0.25*	0.25	U		*0.019*	*0.25*	0.25	U		*0.019*	*0.25*	0.25	U		*0.019*	*0.25*
2,4-Dinitrotoluene	120	12	na	0.15	J		*0.005*	*0.25*	0.25	U		*0.005*	*0.25*	0.25	U		*0.005*	*0.25*	0.25	U		*0.005*	*0.25*
2,6-Dinitrotoluene	62	6.1	na	0.16	J PG		*0.007*	*0.25*	0.25	U		*0.007*	*0.25*	0.25	U		*0.007*	*0.25*	0.25	U		*0.007*	*0.25*
2-amino-4,6-Dinitrotoluene	200	15	na	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*
4-amino-2,6-Dinitrotoluene	190	15	na	0.25	U		*0.009*	*0.25*	0.25	U		*0.009*	*0.25*	0.25	U		*0.009*	*0.25*	0.25	U		*0.009*	*0.25*
HMX	4900	380	na	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*	0.25	U		*0.012*	*0.25*
Nitroglycerin	6.2	0.61	na	0.5	U		*0.015*	*0.5*	0.5	U		*0.015*	*0.5*	0.5	U		*0.015*	*0.5*	0.5	U		*0.015*	*0.5*
Metals (mg/kg)																							
Aluminum	99000	7700	40041	26600			*7*	*25*	27500			*6.9*	*24.8*	36500			*7.4*	*26.4*	28000			*7.1*	*25.3*
Antimony	41	3.1	na	0.75	U		*0.25*	*0.75*	0.74	U		*0.25*	*0.74*	0.79	U		*0.26*	*0.79*	0.76	U		*0.25*	*0.76*
Arsenic	1.6	0.39	15.8	1.8			*0.19*	*0.62*	4.1			*0.19*	*0.62*	4.1			*0.2*	*0.66*	2.3			*0.19*	*0.63*
Barium	19000	1500	209	47.1			*0.12*	*0.37*	63.9			*0.12*	*0.37*	53.8			*0.13*	*0.4*	46.2			*0.13*	*0.38*
Beryllium	200	16	1.02	0.54			*0.012*	*0.12*	0.41			*0.012*	*0.12*	0.5			*0.013*	*0.13*	0.55			*0.013*	*0.13*
Cadmium	81	7	0.69	0.21			*0.062*	*0.19*	0.3			*0.062*	*0.19*	0.26			*0.066*	*0.2*	0.24			*0.063*	*0.19*
Calcium	na	na	na	1480			*31.2*	*125*	361			*31*	*124*	307			*33*	*132*	124	J		*31.6*	*126*
Chromium	150000	12000	65.3	17.9			*0.25*	*0.75*	28.6			*0.25*	*0.74*	35			*0.26*	*0.79*	20.4			*0.25*	*0.76*
Cobalt	30	2.3	72.3	4.4			*0.12*	*0.37*	18.9			*0.12*	*0.37*	4.5			*0.13*	*0.4*	9.6			*0.13*	*0.38*
Copper	4100	310	53.5	12.9			*0.19*	*0.62*	11.4			*0.19*	*0.62*	13.8	B		*0.2*	*0.66*	15.3	B		*0.19*	*0.63*
Iron	72000	5500	50962	32000			*3.9*	*12.5*	32800			*3.8*	*12.4*	44700			*4.1*	*13.2*	35300			*3.9*	*12.6*
Lead	800	400	26.8	14.1	B		*0.075*	*0.25*	**34.5**	**B**		*0.074*	*0.25*	14.7	B		*0.079*	*0.26*	20	B		*0.076*	*0.25*
Magnesium	na	na	na	1210			*9.4*	*62.5*	909			*9.3*	*62*	928			*9.9*	*66.1*	1190			*9.5*	*63.2*
Manganese	2300	180	2543	167			*0.31*	*1*	689			*0.31*	*0.99*	124			*0.33*	*1.1*	280			*0.32*	*1*
Mercury	3.4	0.56	0.13	0.052			*0.011*	*0.05*	**0.36**			*0.011*	*0.05*	**0.24**			*0.011*	*0.053*	0.096			*0.011*	*0.051*
Nickel	2000	160	62.8	11.6			*0.12*	*0.37*	10.3			*0.12*	*0.37*	13.3			*0.13*	*0.4*	12.6			*0.13*	*0.38*
Potassium	na	na	na	1440			*31.2*	*125*	766			*31*	*124*	1070			*33*	*132*	1300			*31.6*	*126*
Selenium	510	39	na	0.47			*0.12*	*0.37*	0.7			*0.12*	*0.37*	0.79			*0.13*	*0.4*	0.52			*0.13*	*0.38*
Silver	510	39	na	0.068	J		*0.037*	*0.12*	0.09	J		*0.037*	*0.12*	0.07	J		*0.04*	*0.13*	0.063	J		*0.038*	*0.13*
Sodium	na	na	na	625	U		*31.2*	*625*	620	U		*31*	*620*	37.5	J		*33*	*661*	632	U		*31.6*	*632*
Thallium	na	na	2.11	0.14	J		*0.062*	*0.19*	0.57			*0.062*	*0.19*	0.3			*0.066*	*0.2*	0.2			*0.063*	*0.19*
Vanadium	7.2	0.55	108	62			*0.75*	*2.5*	65.9			*0.74*	*2.5*	85.9			*0.79*	*2.6*	67			*0.76*	*2.5*
Zinc	31000	2300	202	33			*0.75*	*2.5*	38.8			*0.74*	*2.5*	41.4			*0.79*	*2.6*	35.8			*0.76*	*2.5*

Table 9
Summary of Detected Analytes - Trenching Investigation Soil Samples
SWMU 48, Radford Army Ammunition Plant, Radford VA

	i-SL	r-SL	Background	# of i-SL Exceedances	# of r-SL Exceedances	# of Background Exceedances	# of Detections	# of Samples	Minimum Concentration	Maximum Concentration	Location of Maximum
Explosives (mg/kg)											
1,3,5-Trinitrobenzene	2700	220	na	0	0	na	3	20	0.13	0.62	48TP08
1,3-Dinitrobenzene	6.2	0.61	na	0	0	na	1	20	0.073	0.073	48TP15
2,4,6-Trinitrotoluene	7.9	1.9	na	0	0	na	4	20	0.056	1.6	48TP08
2,4-Dinitrotoluene	120	12	na	0	0	na	10	20	0.022	6.9	48TP14
2,6-Dinitrotoluene	62	6.1	na	0	0	na	12	20	0.013	2.8	48TP14D
2-amino-4,6-Dinitrotoluene	200	15	na	0	0	na	3	20	0.032	2.6	48TP08D
4-amino-2,6-Dinitrotoluene	190	15	na	0	0	na	6	20	0.01	0.45	48TP08D
HMX	4900	380	na	0	0	na	1	20	0.025	0.025	48TP04-RFI
Nitroglycerin	6.2	0.61	na	0	1	na	3	20	0.051	1.2	48TP04-RFI
Metals (mg/kg)											
Aluminum	99000	7700	40041	0	0	0	20	20	96.9	36500	48TP21
Antimony	41	3.1	na	0	1	na	8	20	0.36	3.2	48TP04-RFI
Arsenic	1.6	0.39	15.8	1	1	1	19	20	1.8	112	48TP08
Barium	19000	1500	209	0	0	0	20	20	0.96	199	48TP04-RFI
Beryllium	200	16	1.02	0	0	0	19	20	0.41	0.91	48TP05
Cadmium	81	7	0.69	0	1	7	20	20	0.16	9.2	48TP02-RFI
Calcium	na	na	na	na	na	na	20	20	124	221000	48TP03-RFI
Chromium	150000	12000	65.3	0	0	2	20	20	2.7	75.7	48TP14D
Cobalt	30	2.3	72.3	0	0	0	20	20	4.4	21	48TP13
Copper	4100	310	53.5	1	1	6	20	20	5.1	81800	48TP02-RFI
Iron	72000	5500	50962	0	0	0	20	20	118	46100	48TP11
Lead	800	400	26.8	1	3	11	20	20	14.1	114000	48TP02-RFI
Magnesium	na	na	na	na	na	na	20	20	382	17400	48TP03-RFI
Manganese	2300	180	2543	0	0	0	20	20	11.3	1250	48TP17
Mercury	3.4	0.56	0.13	3	6	14	20	20	0.024	25.5	48TP04-RFI
Nickel	2000	160	62.8	0	0	0	20	20	5.3	59.6	48TP14D
Potassium	na	na	na	na	na	na	20	20	73.3	2370	48TP03-RFI
Selenium	510	39	na	0	0	na	20	20	0.47	1.2	48TP07
Silver	510	39	na	0	0	na	20	20	0.037	30	48TP04-RFI
Sodium	na	na	na	na	na	na	14	20	37.5	779	48TP02-RFI
Thallium	na	na	2.11	na	na	0	14	20	0.11	1.3	48TP08
Vanadium	7.2	0.55	108	0	0	0	19	20	15.2	85.9	48TP21
Zinc	31000	2300	202	0	0	2	19	20	20.1	499	48TP04-RFI

Table 10
SWMU 48 TCLP Results

Analyte	TCLP RL	Sample ID		
		48TP06	48TP10	48TP19
TCLP SVOCs (ug/L)				
TCLP 2,4-Dinitrotoluene	130	< 0.05	< 0.05	< 0.05
TCLP Hexachlorobenzene	130	< 0.05	< 0.05	< 0.05
TCLP Hexachlorobutadiene	500	< 0.05	< 0.05	< 0.05
TCLP Hexachloroethane	3000	< 0.05	< 0.05	< 0.05
TCLP 2-Methylphenol	200000	< 0.05	< 0.05	< 0.05
TCLP Nitrobenzene	2000	< 0.05	< 0.05	< 0.05
TCLP Pentachlorophenol	100000	< 0.25	< 0.25	< 0.25
TCLP Pyridine	5000	< 0.1	< 0.1	< 0.1
TCLP 2,4,5-Trichlorophenol	400000	< 0.05	< 0.05	< 0.05
TCLP 2,4,6-Trichlorophenol	2000	< 0.05	< 0.05	< 0.05
TCLP 3-Methylphenol & 4-Methylphenol	200000	< 0.05	< 0.05	< 0.05
TCLP 1,4-Dichlorobenzene	7500000	< 0.05	< 0.05	< 0.05
TCLP Metals (mg/L)				
TCLP Arsenic	5	< 1.0	< 1.0	< 1.0
TCLP Lead	5	< 0.5	**0.018**	< 0.5
TCLP Barium	100	**0.35**	**0.70**	**1.1**
TCLP Mercury	0.2	**0.0020**	**0.0015**	**0.0020**
TCLP Selenium	1	< 0.20	< 0.20	< 0.20
TCLP Silver	5	< 0.10	< 0.10	< 0.10
TCLP Chromium	5	< 0.10	< 0.10	< 0.10
TCLP Cadmium	1	< 0.050	< 0.050	< 0.050
Misc				
pH (pH units)	<2 or >12	**12.4**	**10.3**	**8.7**
Cyanide, Total (mg/kg)	na	**0.70**	**0.69**	**0.63**

Notes: Detections are shown in bold.
Highlighted cells indicate a value greater than the TCLP Regulatory Limit (RL)

3.4 IDM Disposal

During excavation of the test pits, shallow soil (less than 6 ft) was placed to the side of the excavation in an enclosure constructed from silt fencing. Soil below 6 ft in depth, and any soil containing ash, was excavated and directly loaded into drums that were transported to the RFAAP 90-day accumulation storage area. The green, clayey substance found in paper drums wrapped in plastic bags was also drummed. A composite sample was collected from the drummed material and sent to an offsite laboratory for TCLP analysis. Based on those results, the material was disposed of as hazardous waste due to the leachable lead levels from the green material. Drums were clearly labeled with the project information, drum contents, and date of generation prior to storage at the 90 day accumulation area. As discussed in *Section 3.1*, less than 1 yd^3 of IDM was generated. The drums were disposed of at EQ's Belleville, Michigan Disposal Facility.

3.5 Conclusions

Shaw conducted test pits and additional sampling at SWMU 48 to re-characterize the trenches and ash layer based on regulatory concerns about the extent of the ash layer and an elevated TNT result (970 mg/kg) from the 1998 investigation. The results of the test pitting demonstrated that the ash layer is present for much of the length of the trench. However, the elevated TNT level found in 1998 was an anomalous result that could not be replicated. Twenty additional samples were analyzed for explosives, and the highest concentration of TNT was 1.6 mg/kg (**Table 9**). Based on these results, a removal action based on the explosives concentrations in the ash layer does not appear warranted.

4.0 REFERENCES

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Shaw Environmental and Infrastructure, (Shaw), 2008. *SWMU 51 Interim Measures Work Plan. Radford Army Ammunition Plant, Radford VA.* Final document. October 2008. Contract No. W912QR-04-D-0027, Delivery Order DA0101.

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Appendix A
Activity Hazard Analysis

Table 8-1. Activity Hazard Analysis – Soil Removal
b. Soil Removal

Activity: Soil Removal **Analyzed by/date: ____**
Reviewed by/date: ____ (/ /) **Approved by/date: ____ (/ /)**

PRINCIPLE STEPS	POTENTIAL SAFETY/HEALTH HAZARDS	RECOMMENDED CONTROLS
• Excavate soil and direct load into dump trucks • Collect waste characterization samples ***Stop work and notify your supervisor if you are not sure how to perform your task!***	**Physical Hazards**	
	General heavy equipment hazards	Safety training, personal awareness, and safety devices Maintain a safe equipment distance exclusion zone Use hand signals See *Section 8.3.2.1* for general heavy equipment controls
	Power and hand tools hazard	See *Section 8.3.2.2* for power and hand tool controls
	Electrical shock	Locate and shut down all utilities in work zone, obtain dig permit, watch out for overhead power lines, use GFCI on all temporary electrical devices
	Noise	Use hearing protection if noise exceeds 85 dBA, see *Section 8.3.2.8*
	Cold or heat stress	Wear appropriate clothing and follow recommended work schedules and monitoring controls as stated in *Sections 8.3.2.6 or 8.3.2.7*
	Manual lifting	Use proper lifting techniques as discussed in See *Section 8.3.2.10*
	Slip, trip, and fall hazards	Safety training and personal and situational awareness, see *Section 8.3.2.11*.
	Electrical storm	Shut down operations, follow the 30/30 rule, see *Section 8.3.2.12*
	Chemical Hazards	
	Exposure to contaminants in soil, primarily explosives.	Minimize dust generation, wash hands and face, see *Section 8.3.3* for chemical hazard controls Modified Level D PPE will be required, see Section 8.6
	Cross Contamination	Avoid spillage from excavator bucket, utilize plastic sheeting where spillage may occur
	Biological Hazards	
	Ticks	Tape pant legs to boots, avoid tall grass and bushes if possible, check for ticks frequently, see *Section 8.3.4.1*
	Stinging insects	Watch out for and avoid stinging insects, see *Section 8.3.4.2*
	Spiders	Watch out for and avoid black widow and brown recluse spiders, see *Section 8.3.4.3*
	Poisonous Plants ***Stop work and notify your supervisor if you are not sure how to perform your task!***	Watch out for and avoid poisonous plants, avoid contact with plant oils that may be present on clothes or equipment, wash hands to prevent spreading oils, see *Section 8.3.4.6* ***Stop work and notify your supervisor if you are not sure how to perform your task!***
EQUIPMENT TO BE USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
Excavator, shovels	Daily inspection and maintenance of equipment	All site workers must have OSHA Training in accordance with 29 CFR 1910.120 All site workers must attend the Daily Safety Meetings Hazard Communication for all site workers Appropriate heavy equipment and/or power tools training

* See SWMU 51 IMWP (Shaw, 2008)

Physical Hazards

This section discusses specific physical hazards that may be encountered at RFAAP during the removal actions. If additional hazards other than the ones listed in this section are encountered, this SSHP will be revised to address these hazards.

Heavy Equipment

Tests shall be made at the beginning of each day during which the equipment is to be used to determine that the brakes and operating systems are in proper working condition and that all required safety devices are in place. Whenever any machinery or equipment is found to be unsafe or a deficiency which affects the safe operation of equipment is observed, the equipment shall be immediately taken out of service and shall not be used until all of the unsafe conditions are corrected. Machinery and mechanized equipment shall be operated by designated qualified personnel. Equipment safety requirements must be in accordance with 29 CFR 1926 and EM 385-1-1, Section 16 and the guidelines listed below:

- Operation of heavy equipment will be limited to properly trained personnel.
- Operator's certifications, qualification letters, and necessary SOPs will be maintained on site.
- Operator shall use the safety devices provided with the equipment (i.e., seatbelts, backup warning indicators, and horns).
- Visually inspect equipment daily, prior to operation, and report any deficiencies. Document observations.
- Good housekeeping practices will be maintained in the cab area of heavy equipment.
- Additional riders shall not be allowed on equipment, unless it is specifically designed for that purpose.

As presented in **Appendix E**, Shaw Procedure HS810, Commercial Motor Vehicle Operation and Maintenance, will be implemented.

Power and Hand Tools

By their very nature, power tools have great capability for inflicting serious injury upon site personnel if they are not used and maintained properly. Use of improper or defective tools can contribute significantly to the occurrence of accidents on site. To control the hazards associated with power and hand tool operation, the requirements outlined in EM 385-1-1 and the safe work practices listed below shall be observed when using these tools:

- Operation/use will be conducted by authorized and experienced personnel.
- Tools will be inspected prior to use, and defective equipment will be removed from service until repaired.
- Tools will be selected and used in the manner for which they were designed and in accordance with manufacturer's recommendations.
- Be sure of footing and grip before using any tool.
- Power tools designed to accommodate guards will have such guards properly in place prior to use.
- Do not use tools that have split handles, mushroom heads, and worn parts.
- Safety glasses or a face shield will be used if use of tools presents an eye or face hazard.
- Do not use makeshift tools or other improper tools.
- Use non-sparking tools in the presence of explosive vapors, gases, or residue.
- Loose-fitting clothing or long hair will not be permitted around moving parts.
- Hands, feet, etc. will be kept away from moving parts.

- Maintenance and adjustments to equipment will not be made while equipment is in operation. Power will be disconnected prior to maintenance.
- An adequate operating area will be provided, allowing sufficient clearance and access for operation.
- Proper PPE in accordance with equipment operating manual will be used (i.e., chainsaw chaps, leather gloves, hard hats, hearing protection, shin guards, face shield, safety glasses, etc.).

Excavations and Trenching

Excavation activities will be conducted in accordance with EM 385-1-1, Section 25 and Subpart P of 29 CFR 1926. As presented in **Appendix E**, Shaw Procedure HS307, Excavation and Trenching, will be implemented during excavation and trenching operations. The guidelines below are intended to reflect minimum requirements to be followed on this site:

- Prior to initiation of any excavation or trenching activity, the location of underground installations will be determined in accordance with Shaw Procedure HS308.
- The excavation(s) will be inspected and documented daily by the SSHO or by the Competent Excavation and Trenching person prior to commencement of work activities.
- Evidence of cave-ins, slides, sloughing, or surface cracks will be cause for work to cease until necessary precautions are taken to safeguard workers.
- Excavations 5 ft or deeper where employees must enter and cannot be sloped will require a registered civil engineer to design a protective system.
- Protective systems shall be selected from OSHA 29 CFR 1926 Subpart P and/or designed by a registered professional civil engineer.
- Spoils and other materials will be placed 2 ft or more from the edge of the excavation.
- Materials used for sheeting, shoring, or bracing will be in good condition.
- Timbers will be sound, free of large or loose knots, and of appropriate dimensions for the excavation.
- Safe access will be provided into the excavation(s) by means of a gradually sloped personnel access/egress ramp or ladders.
- Excavations 4 ft or more in depth will have a means of egress at a frequency such that lateral travel to the egress point does not exceed 25 ft.

Manual Lifting

Investigation and IM activities may require personnel to move large, heavy objects by hand. The human body is subject to severe damage in the forms of back injury and hernia if caution is not observed when handling, lifting, or moving these large, heavy objects.

The following fundamentals should be followed while manual lifting objects:

- The size, shape, and weight of the object to be lifted must be considered. Site personnel will not lift more than they can handle comfortably. No individual employee is permitted to lift any object that weighs over 60 pounds. Multiple employees or the use of mechanical lifting devices are required for objects over the 60-pound limit.
- A firm grip on the object is essential; therefore, the hands and objects shall be free of oil, grease, and water.
- The hands and fingers shall be kept away from any points that could cause them to be pinched or crushed, especially when setting the object down.
- The item shall be inspected for metal slivers, jagged edges, burrs, and pinch points, and gloves shall be used to protect the hands.

- The feet will be placed far enough apart for good balance and stability.
- Personnel will ensure that solid footing is available prior to lifting the object.
- To lift the object, the legs are straightened from their bending position.
- Never carry a load that you cannot see around.
- When placing an object down, the stance and position are identical to that for lifting.
- If needed, back support devices will be provided to aid in preventing back injury.

The following steps will be followed during manual lifting:

- Ensure the route on which you will carry the object is clear and free from trip hazards.
- Get a good footing.
- Place feet about one shoulder-width apart.
- Bend at knees to grasp weight.
- Keep the back straight.
- Get a firm hold.
- Lift gradually by straightening the legs.
- If weight is uncomfortable to lift, get help.

Slips, Trips, Falls

Field operations may place personnel in situations where they may be exposed to slip, trip, and fall hazards. Slipping hazards will exist when the ground is wet, or on steep slopes. Tripping hazards will exist on rough, uneven terrain, or if the work area is cluttered with tools, equipment, debris, soil piles, etc. Falling hazards will exist as a result of slip or trip hazards, or in elevated work areas with inadequate railing.

The following precautions should be followed by all site personnel:

- Field personnel shall become familiar with the general terrain of the site and potential physical hazards (i.e., rocky conditions, uneven terrain) that would be associated with accidental slips, trips, and falls.
- Be cautious after periods of heavy rainfall, which may cause earth movement and slides.
- Be attentive where you walk since pits, holes, or similar hazards may be partially covered or visually obstructed.
- Be cautious around soil or terrain which recently may have been disturbed, relocated, or otherwise made less stable.
- Avoid the top edges of drop-off areas whether they have been disturbed or not.
- Use the three-point rule when getting on and off heavy equipment.

Chemical Hazards

This section discusses chemical hazards that may be encountered at RFAAP during the IM at SWMU 51. Chemical hazards can be encountered either from chemicals brought on site by the contractor for use during activities, chemicals stored at the site, or chemicals that have been released to the environment and are present in various media such as air, soil, or water.

Site-Related Chemicals

1,3 DNB, 2,4 DNT, 2,6 DNT, NG, 2- and 4-NT, 2,4,6-TNT, dioxins/furans, aluminum, and lead were identified equal to or above the calculated RGs of 100, 60.5, 14, 10000, 310, 43, .0125, 40041, and 400 mg/kg, respectively, during the RFI investigation at SWMU 51 (Shaw, 2008) as presented on **Figure 2-2**.

Exposure Pathways

Chemicals may pose a hazard to humans when inhaled, ingested, or through dermal absorption. Inhalation can occur when chemicals are present as vapors, aerosols, or attached to airborne dust particles. Ingestion usually occurs incidentally, as chemicals present in the air enter the mouth or nose, or from hand to mouth activities such as eating, drinking, and smoking. Dermal absorption occurs when chemicals contact unprotected skin.

Exposure Assessment

The toxic hazards to site personnel associated with chemicals can be assessed through comparison of actual exposures with several established occupational exposure limits using quantitative collection and analysis through real-time and/or time-integrated personal air sampling.

Permissible Exposure Limits (PELs) are established by OSHA. TLVs are established by ACGIH. Immediately Dangerous to Life or Health (IDLH) values are established by NIOSH. **Table 8-6** presents occupational exposure limits (if available) for potential chemicals, including OSHA PELs, ACGIH TLVs, and NIOSH IDLH values. The table also indicates if there are potential significant contributions to the overall exposure for the chemical of concern through dermal contact, and identifies the acute symptoms resulting from exposure.

The occupational exposure limits are described as follows:

PELs may be expressed as an 8-hour Time-Weighted Average (TWA), a Short-Term Exposure Limit (STEL), or a ceiling limit. Ceiling limits may not be exceeded at any time. PELs are enforceable by law. STELs are allowable exposure limits for durations ranging from 5 to 15 minutes, without causing the 8-hour TWA to be exceeded.

The ACGIH TLV is defined as the TWA concentrations for a substance to which nearly all workers (8 hours/day, 40 hours/week) may be repeatedly exposed, day after day, without experiencing adverse health effects. For some substances, the overall exposure to a substance is enhanced by skin, mucous membrane, or eye contact. These substances are identified by “yes” in the skin notation column.

The IDLH values represent the maximum concentrations from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing symptoms or any irreversible health effects.

Table Error! No text of specified style in document.**-1**
Occupational Health Exposure Guidelines for Potential Contaminants

Contaminant	Acute Symptoms of Exposure	PEL (TWA unless otherwise noted)	TLV-TWA	Skin Notation (Yes/No)	IDLH
1,3-DNB	Anoxia, cyanosis; visual disturbance, central scotomas; bad taste, burning mouth, dry throat, thirst; yellowing hair, eyes, skin; anemia; liver damage	1 mg/m^3	1 mg/m^3	Y	50 mg/m^3
2,4-DNT as DNT	Anoxia, cyanosis; anemia, jaundice; reproductive effects; [potential occupational carcinogen]	1.5 mg/m^3	1.5 mg/m^3	Y	50
NG	Throbbing headache; dizziness; nausea, vomiting, abdominal pain; hypotension; flush; palpitations; methemoglobinemia; delirium, central nervous system depression; angina; skin irritation	2 mg/m^3	0.1 mg/m^3 Short Term	Y	75 mg/m^3
2-NT	Anoxia, cyanosis; headache, lassitude (weakness, exhaustion), dizziness; ataxia; dyspnea (breathing difficulty); tachycardia; nausea, vomiting	30 mg/m^3 5 ppm	11 mg/m^3 2 ppm	Y	200 ppm
4-NT	Anoxia, cyanosis; headache, lassitude (weakness, exhaustion), dizziness; ataxia; dyspnea (breathing difficulty); tachycardia; nausea, vomiting	30 mg/m^3	11 mg/m^3	Y	200 ppm
2,4,6-TNT	Irritation skin, mucous membrane; liver damage, jaundice; cyanosis; sneezing; cough, sore throat; peripheral neuropathy, muscle pain; kidney damage; cataract; sensitization dermatitis; leukocytosis (increased blood leukocytes); anemia; cardiac irregularities	1.5 mg/m^3	0.5 mg/m^3	Y	500 mg/m^3

Table 8-6 (Continued)
Occupational Health Exposure Guidelines for Potential Contaminants

Contaminant	Acute Symptoms of Exposure	PEL (TWA unless otherwise noted)	TLV-TWA	Skin Notation (Yes/No)	IDLH
Dioxin/Furans	Cough, dyspnea (breathing difficulty), wheezing; decreased pulmonary function, progressive respiratory symptoms (silicosis); irritation eyes; [potential occupational carcinogen]	NE	NE	Y	NE
Aluminum	Irritation eyes, skin, respiratory system	15 mg/m^3 (total) 5 mg/m^3 (resp)	10 mg/m^3 (total) 5 mg/m^3 (resp)	Y	ND
Lead	Lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypotension	0.05 mg/m^3	0.05 mg/m^3	Y	100 mg/m^3

Leahy, Timothy

From: McKenna, James J CIV (US) [james.j.mckenna16.civ@mail.mil]
Sent: Tuesday, March 02, 2010 2:51 PM
To: 'diane.wisbeck@arcadis-us.com'; 'Geiger.William@epamail.epa.gov'; 'jerome.redder@atk.com'; 'jim spencer'; 'jlcutler@deq.virginia.gov'; Mendoza, Richard R Mr CIV USA IMCOM; 'Meyer, Tom NAB02'; 'Parks, Jeffrey N'; Leahy, Timothy; 'Tina_Devine@URSCorp.com'
Subject: Draft meeting notes from the partnering meeting at Philadelphia, PA for Wed Feb 24, 2010 (UNCLASSIFIED)
Attachments: Draft Feb-2010 RFAAP Partnering Meeting Notes 02 Mar 2010.doc

Importance: High

Classification: UNCLASSIFIED
Caveats: FOUO

All,

Subject as above is in the attached file.

Will, like to get some feedback on meeting at RFAAP on June 17.

Thanks,
Jim

Classification: UNCLASSIFIED
Caveats: FOUO

DRAFT NOTES FROM THE RADFORD ARMY AMMUNITION PLANT (RFAAP)
EPA/VDEQ PARTNERING MEETING
February 24, 2010

Attendees:	Organization:
Jim McKenna	Radford AAP
Thomas Meyer	USACE, Baltimore
Jerry Redder	ATK/Radford AAP
William Geiger	EPA-Region III
Mike Cramer	EPA-Region III
Betty Ann Quinn	EPA-Region III
Jim Cutler	VDEQ/Federal Facilities Project Manager
Jim Spencer	URS Group
Tina DeVine MacGillivray	URS Group
Jeff Parks	Shaw Environmental
Tim Leahy	Shaw Environmental
Robin Sims	Shaw Environmental

Status of EPA and VDEQ reviews

Jim McKenna started off the meeting with a discussion of the status of report reviews.

- EPA/VDEQ comments on SWMUs 48/49 were received. The EPA may have a couple more comments coming shortly, but that's it.
- The reports for SWMU 41, 43, and Area P are the next that the regulators will review. The initial order of review they had for these three reports was 43, then P, and then 41. They will continue to be reviewed in this order.
- Regulators have not looked at the SWMU 13 RTCs yet.
- Jim McKenna gave Jim Cutler a list of all reports that are in play right now. This document can be copied for others that may want it.
- The Army's goal is to complete the reports that are in play so that EPA can have them to include in the permit renewal public notice tentatively scheduled for September 30, 2010. In this way the stakeholders can further document final site decisions.
- Jim Cutler asked the Army if there was another PBC coming up soon. Tom Meyer and Jim McKenna responded by saying that there is one planned and being worked through procurement.
- Reminder that the next RAB meeting (another poster session) is planned for March 18th.
- Will Geiger (EPA) indicated EPA/VDEQ approved the final SWMU 45 SSP Report. EPA/VDEQ will provide the final approval letter.
- RFAAP is waiting on an approval letter for the final IM Completion Reports for SWMUs 51, 39, and FLFA. Shaw stated the SWMU 54 Final Work Plan was approved. Start of work is weather-dependent.
- On a side note, Jim Cutler stated that he is looking to have the NRU comments to the Army by March 5, 2010.

SWMUs 35, 37, 38, and AOC Q RFI Report - URS

Per the 12/8/09 e-mail from Will Geiger (EPA), EPA/VDEQ approved the RTCs for the RFI report with the exception of Comment #34 and recommended that a hydrogeologically downgradient well be installed on the east side of SWMU 37. URS presented a map identifying the proposed additional well location for SWMU 37 as requested by the EPA/VDEQ. Jim Spencer (URS) discussed the installation of the additional well, sampling of the well for VOCs, and collection of an additional round groundwater level measurements for SWMU 37, SWMU 38, and AOC Q including the additional well to be installed at SWMU 37 and the wells associated with HWMU 7 and SWMU 9 which are located in the general SWMU 37/38 area. EPA/VDEQ approved the well location and sample parameters.

Study Area at SWMU 13 RFI Report - URS

URS presented the response to USEPA and VDEQ comments for the Study Area at SWMU 13 RFI Report. Jim Spencer (URS) discussed Comment # 1 relating to "hot spot" analysis. Betty Anne Quinn will review the available data to determine if further analysis of lead concentrations within the study area (i.e., based on smaller areas) is warranted utilizing the adult lead model. Jim Cutler (VDEQ) requested an analysis of potential erosion and runoff at the site to confirm that the site does not represent a potential future source of excessive lead loading to the New River. URS will provide the requested analysis. The USEPA and VDEQ will review the comment responses and provide any additional comments.

SWMU 45 SSP Report - URS

Will Geiger (EPA) will provide the approval letter for the SWMU 45 SSP Report.

SWMUs 48 and 49 - Shaw

Shaw and the Army received the EPA/VDEQ RTCs.

- In response to Mike Cramer's EPA Memo, in the next version of the report, Shaw will add in maps with groundwater plumes on them.
- Based on RTC #14, Shaw will add the data from the upgradient well at the burning ground that shows no detections. They will show this well on the plume maps.
- Based on RTC #6, for the Eco Risk Assessment, Shaw feels that even if the chemicals were getting to the New River, concentrations would be below levels of concern.
- The regulators want proof of MNA as the chosen remediation alternative. They want proof that MNA parameters currently exist to know that MNA would work. They do not want the MNA sampling to simply show that dilution is happening. Daughter products supporting MNA need to be shown more clearly in the current data.
- Shaw added that the plume chemicals are not being detected in the wells offsite and downgradient of the site. Other wells are showing that the plume chemicals are also not getting into the river.
- Shaw added that there are karst conditions on site and this was determined by a fracture trace analysis done before 2007. The well locations chosen in the 2007 work plan were based on this analysis. Shaw can pull the results of this analysis into the report.
- Jim Cutler (based on RTC #27) stated that the basis for MNA should show that the concentrations throughout the whole plume should be decreasing and the data should back this up. Jim McKenna recommended that Shaw review the HWMU 5 permit modification where MNA was approved for corrective action.

- The SSL exceedance table confusion was figured out and will be fixed in the next version of the report. VDEQ and Shaw were in fact looking at two different tables since Shaw had already updated the tables to the new SSLs before responding to comments.

In response to Will Geiger's Comments:

- Shaw stated that the ash layer was first found during a test pit dug at the initial assessment long ago. It was found at 8-11 ft bgs. The highest concentration of explosives was found in one sample at that depth and Shaw hasn't been able to duplicate those results.

In response to Jim Cutler's Comments:

- Jim Cutler stated that in Shaw's work plan they stated that they would dig up the contamination and then delineate later. But, they aren't doing that now. So, nowhere in the draft RFI/CMS report did they explain why the soil contamination is okay to remain in place when it is a possible source. Shaw didn't sample the ash layer when they went back. So, the TNT hotspot is still there. If Shaw finds that the hotspot is within the ash layer but the ash layer is not the whole hotspot, then that must be stated in the report. Overall, the argument has not been made well enough that the ash layer is not a problem. Jeff Parks responded by saying that Shaw doesn't see the hotspot as a problem because there is 8 ft of cover over it and they have sampled around it, which shows no migration of explosives in soil or to the groundwater. Jim Cutler said that MNA cannot be an alternative if contamination is left in place. He doesn't think the argument demonstrates that the ash layer isn't a risk. He sees two possible solutions to this problem. 1) Recharacterize the ash layer some more (with additional samples). 2) Remove ash layer. 3) LUCs could be put into place.
- Jerry Redder thought it is very odd that DNT wasn't detected alongside the TNT, because DNT is generated in the manufacturing process.
- Tim Leahy added that Shaw's thinking about the two trenches at 48 were that one trench has no TNT detected in it and no ash layer, so it is assumed that not much was done there (maybe just mixing or stockpiling).
- Jim Cutler went back to his original thought that Shaw hasn't demonstrated that the ash layer isn't a problem and they need to sample more.

Mike Cramer had another comment that Shaw should sample for 1,4-Dioxane in the groundwater, before the permit renewal, because it may be present in groundwater where TCA has been detected . However, 1,4-Dioxane does not respond to MNA which is the proposed remedy for the site. He also thinks Shaw needs to show a plume map with all the wells on the figure.

- The EPA stated that in order to keep the permit renewal on track, they might be able to say that the remedy is contingent upon completing these extra sampling events.

Jim Cutler had another suggestion for Shaw that might help the report flow better. The Nature and Extent section might benefit from a new organization strategy. The SSL exceedance section should be its own separate section, since it discusses the potential for groundwater contamination. In addition, discussion of the SL exceedances should be in their own section. The Fate and Extent section should summarize the overall extent of contamination based on conclusions from the entire dataset. Jim Cutler wanted to make sure that no chemicals had been preliminarily eliminated, and all were then carried through the risk assessment.

Jim McKenna would like to keep SWMUs 48 and 49 on the list and on track for including in the September 30, 2010 public notice since so much effort has been expended on the sites to date and is near reaching an approved final RFI/CMS report.

Betty Anne Quinn had a few comments to share. One was a new comment that she said she could send in writing, if needed. It was concerning comment #40, and basically she would like the RTC Shaw sent to be included in the report as additional explanation.

SWMU 54 - Shaw

The recent snow has held back the start of work at this site. However, before the snow, some delineation and waste characterization sampling had been completed. The point of doing this first was to try and narrow down what areas of soil would be hazardous versus non-hazardous (in terms of disposal). Shaw hopes to begin work again week of March 15th. Shaw will write a separate MNA work plan later.

MNA Work Plans – Shaw

Shaw wanted to consult with Jim Cutler and get his input for the work plans. Jim Cutler informed Shaw that there is no set template, but the EPA has developed MNA protocols (may be a few years old) that they could examine. Jim Cutler explained that one important part of the work plans would be to provide enough indicators that show that MNA would work at the sites. The first of the groundwater monitoring could be part of the proof that MNA would work. The work plans need to show if the groundwater conditions are oxidizing or reducing. Shaw needs to make sure they don't try and fight the conditions nature is providing. The work plans need to include a time frame that will work and have triggers that say if certain concentrations are not reached by a certain time, then the system will be tweaked and be more aggressive in order to keep the natural attenuation occurring (not the whole plan changed). What VDEQ doesn't want to see is the contractor showing that the concentrations during the monitoring events are going down, and then attribute that to natural attenuation, when it is really only dilution occurring. MNA daughter products need to also be shown. Jim Cutler has the contingent ROD at the supply center that would be a good example. The basic idea of the work plan would be to state how the chemical(s) you are trying to remediate are supposed to react to your plan of action and then prove that they are doing that. As long as progress is shown, that is okay. Jim McKenna recommended that Shaw look at the HWMU 5 permit modification as MNA was approved for correction action of TCE. Shaw confirmed that they are okay with the frequency of monitoring being quarterly for the first couple years. Shaw asked if anyone had heard of the typically karst type of monitoring that is 3 times a year (for high, low, and base flow). Tom Meyer confirmed that he had heard of this and that he thought it had been performed at Ft. Detrick.

Army Reserve Small Arms Range - Shaw

Shaw has not sent this report out yet. However, they are planning on scraping out the lead-contaminated soil layer off the top (not more than 1 ft deep) of the contaminated area of the site. They wondered if the regulators would be okay with them streamlining the RFI/CMS. Shaw would plan on doing the report the same as pervious reports up until the risk assessment section. Then, for the risk assessment, they would do a sample-by-sample comparison to criteria instead of the usual comparison. Will Geiger responded that he doesn't really have a problem with it,

but he thinks the management at the EPA may have issues with it. Confirmation should still remain a part of it. Shaw added that they would make it like SWMU 39 and perform XRF screening with 10% lab confirmation sampling. At minimum, it should become a "not to exceed" risk assessment. Jim McKenna added that Shaw should also check with Dennis Druck at USACHPPM to get their input before they go too far along with t okay with preparing this plan.l. Jim Cutler asked if CERCLA has a preferred remedy for small arms ranges. It was stated that someone thought their remedy is to dig up the top 6" of sites. Betty Ann Quinn warned Shaw that they need to be very precise when they do this and need to go through to the confirmation sampling stage. Mike Cramer added that it might be good if Shaw sent the EPA their outline for the MNA report so the EPA would know in advance what Shaw had in mind before they did it.

Scheduling Next Meeting

Perhaps either:

- June 17th, 2010 at RFAAP (the same day as the RAB meeting)

OR

- July 21st in Philadelphia

Will Geiger will send an email (by the beginning of next week) stating whether or not the June date works for the EPA.

Wrap up and Adjourn

Wrap up issues:

SWMU 48 - There is a need to further discuss the possibilities for more sampling at SWMU 48. Shaw is considering making perpendicular transects in the trenches down to the ash layer, so that they can find and see the ash layer on the trench sidewalls. The first trench would be dug across where the high explosive hit was found. Shaw does not have a set number of samples that they plan to take. It depends upon what they find in their initial samples. If they find the ash layer at first, then they will move out 25-50' or so to see if the ash layer is still there, etc. They won't stop until they can assess its extent. Shaw plans to dig at least two trenches to start, that will cross from one of the original SWMU 48 trenches through the other one. Jeff Parks brought up the idea that Jerry Redder came up with. Jerry Redder thought that since there was only a 2-inch ash layer that perhaps explosives were not disposed of there and instead the site was simply used for short-term storage or just the remnant of the contamination being scraped away already. Jim McKenna and Tim Leahy said to Jim Cutler it is possible that he would be able to see the open trenches the day of the March RAB meeting, depending on the weather. Shaw asked the EPA if they need to perform/write a new risk assessment using the new data collected from the test pits they plan to dig. Betty Ann Quinn said that she thinks they would need to do this, but if it doesn't change the concentration frequency much it may not be worth it.

Potential MNA Sampling – Jeff Parks asked if it would be acceptable if Shaw sampled for 1,4-Dioxane at the same time they sampled for MNA parameters. Shaw realizes that if they find 1,4-Dioxane, they may have to reassess MNA. If they do not find 1,4-Dioxane, then the MNA parameters could be used as their 1st MNA sampling round. The regulators agreed with this idea and said to go for it.

The meeting adjourned and the Army and contractors then met for a short private meeting.

Leahy, Timothy

From: Geiger.William@epamail.epa.gov
Sent: Friday, February 19, 2010 4:19 PM
To: McKenna, James J CIV (US)
Cc: diane.wisbeck@arcadis-us.com; jim spencer; Parks, Jeffrey N; jerome.redder@atk.com; jlcutler@deq.virginia.gov; Mendoza, Richard R Mr CIV USA IMCOM; Leahy, Timothy; Tina_MacGillivray@URSCorp.com; Meyer, Tom NAB02
Subject: Fw: SWMU 48 & 49 response to comments
Attachments: mem_046_GW_Comments_SWMU_48_and_49_Draft_RFI_CMS_rev_01.doc

ok, these are not final, but I wanted to give you guys a chance to look at them before the meeting so we can discuss. Mike's comments are attached as well.

William A. Geiger
Remedial Project Manager
Office of Remediation (3LC20)
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029
Phone: 215.814.3413
Geiger.William@epa.gov

----- Forwarded by William Geiger/R3/USEPA/US on 02/19/2010 04:16 PM -----
From: "Cutler, Jim (DEQ)" <James.Cutler@deq.virginia.gov>
To: William Geiger/R3/USEPA/US@EPA
Date: 02/18/2010 10:42 AM
Subject: SWMU 48 & 49 response to comments

Will,

I have the following comments to Radford's response to our comments on the RFI/CMS:

General

This report summarizes the results of many separate investigations at the sites and presents a lot of data in the text and numerous tables. There appear to be inconsistencies between the text and tables and between tables themselves. It is difficult to follow the different lines of evidence and conclusions are made in separate sections throughout the report. In light of the above, Section 4 should be restructured and expanded to provide more robust arguments for the nature and extent conclusions that support the proposed remediation. The 2007 Shaw investigation and results could be reported in a stand alone section with data tables specific to that investigation. The Nature and Extent Summary and Conclusion section would be just that with summary figures and tables as required. The section could be organized as follows:

4.1- Soil summary highlighting those compounds that exceed risk-based screening levels (RBCs). Include justification for conclusions using figures when necessary.

4.2- Summary of SSL exceedances with tables.

4.3- GW results with discussion. Refer to SSL results to support GW characterization.

Specific

1. It has not been adequately demonstrated that explosives (2,4,6-TNT in particular) are not COIs at SWMU 48.

Comment 56- The text in Section 8.1 states that there were only **two** detections of TNT out of **23** samples and that they could not be replicated. The RTC referred the reviewer to Section 4. Table 4-7 in section 4 lists **2** detects out of **9** samples for TNT. Table 4-5 (SSL exceedances) indicates that **19** soil samples were analyzed for TNT. The text in 4.3.1.1 indicates that TNT was found in **three** samples (7A, 7B and TP1). As indicated above there appear to be many inconsistencies throughout the report. The ash layer appears to represent the source of explosives above risk criteria. A low FOD over the entire site does not imply adequate characterization or eliminate an identified source from further consideration. See also comment 24.

Comment 24- The RTC states that samples collected from the ash layer in 2002 were unable to confirm detections found in 1998. Table 2-1 indicates that soil samples were collected in three locations (8,9,10) in 2002. Figure 2-2 and the RTC to EPA Comment 11on Work Plan 19 indicates that samples 8 and 9 were collected outside of the trench containing the ash layer. It is not stated if location 10 was selected to delineate and/or confirm. The text in Section 2.6.5 also directs the reader to Section 4 for a discussion of the results. There is no argument in the text or RTC supporting the conclusion that TNT has been sufficiently characterized.

2. Comment 25. The RTC does not address how “negative impacts” have been mitigated. The last sentence does not follow from the above discussion. A decrease from 3570 to 3500 TPH is not meaningful. It is not clear where other confirmation samples were collected. Based on the previous data what are the assumptions regarding the extent of the contamination? What is the lateral extent? What do the non-detects indicate? Again, additional figures may help illustrate your assumptions.

3. Comment 26. See above general comment regarding structure of the report.

4. Comments 22 and 23. Based on the RTC it appears that we are looking at two different tables. Table 4-5 (page 1 of 2) in the report indicates that five VOCs had at least one SSL exceedance. It also indicates that eleven VOCs were detected. Nine explosives were listed with at least one SSL exceedance (page 2 of 20) and ten were detected. VDEQ also concurs with EPA’s original comment #23. These comments may be more easily rectified at our next meeting.

I think that’s it. Let me know if you need additional response to these or other comments.

Thanks,

Jim

James L. Cutler Jr.

Federal Facilities Project Manager

Office of Remediation Programs

Virginia Dept. of Environmental Quality

804-698-4498

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

SUBJECT: Response To Ground Water Comments Re: RAAP SWMU 48 and 49 RFI/CMS Report Draft dated February 2009 (Revised Comments) and SWMU 50 and 59 Draft RFI dated May 2009 **DATE: 02/19/10**

FROM: Michael P. Cramer
LCD OTAS (3LC10)

TO: Will Geiger
Office of Remediation (3LC20)

Review comments the RFI/CMS for SWMU 48 (RAAP-18), the Oily Water Burial Area, and SWMU 49 (RAAP-13), the Red Water Ash Burial Area #2 appear below. The Master Work Plan Addendum 19 Final Document, dated July 2007, includes the work plan for these activities and adjacent SWMU 50, and SWMU 59. Groundwater in this area is considered as one unit for these SWMU.

This memo is a follow-up to the response by RAAP to EPA/VADEQ comments on the Draft RFI/CMS for SWMU 48 & 49.

The RFI/CMS does not make a comprehensive plume delineation presentation. Wells at the open burning ground and at other area SWMU which can be used to delineate the plume should be included in this report. The ground water results from four SWMU are to be included in this presentation.

The report does not sufficiently present the complex geology and it effect on ground water plume migration. Ground water is obviously affected by the sharp decrease in land surface elevation closer to the river, but the karst nature of the bedrock is minimally considered.

In the RTC for comment number 14, there is acknowledgement of the usefulness of upgradient wells at the open burning ground for downgradient monitoring of the subject SWMU, but there is no commitment to use the data (either existing or future) to provide either plume delineation or to satisfy LTM proposals.

The RTC for comment number 6 stands on natural attenuation of chemicals in ground water. The evidence is limited and does not rise to a level above mere dilution. In fact, the response relies completely on dilution in the New River to abate the ground water plume. This is in direct contrast to EPA requirements that COC not be merely passed from one media to another.

Any additional existing monitoring wells used to characterize, or otherwise relied on for ground water assessment at these SWMU must be added to the appropriate figures in the report.

Please add a discussion of the fate of risk drivers by natural attenuation factors to Section 5.3. In the alternative, please propose new field work which will lead to a discussion of the fate of risk drivers by natural attenuation factors.

Comments 62 and 65: To reiterate, quarterly sampling is required for the first to years to establish a baseline. If progress is satisfactory, the sampling may be reduced to semiannual for years 3 through 5.

Sample results include the presence of TCA in wells 48MW1, 48MW-06, and 48MW-04. Groundwater should be tested for 1,4-Dioxane, using the proper method.

Leahy, Timothy

From: McKenna, James J CIV (US) [james.j.mckenna16.civ@mail.mil]
Sent: Wednesday, December 16, 2009 11:29 AM
To: Geiger.William@epamail.epa.gov; Cutler,Jim
Cc: anne.greene@atk.com; diane.wisbeck@arcadis-us.com; jim spencer; Parks, Jeffrey N; jerome.redder@atk.com; Mendoza, Richard R Mr CIV USA IMCOM; Leahy, Timothy; Meyer, Tom NAB02; Jeremy Flint (jeremy.flint@atk.com); Tina_MacGillivray@URSCorp.com
Subject: RE: SWMUs 48 & 49 RFI/CMS comments (UNCLASSIFIED)
Attachments: EPA_VDEQ_SWMU4849_ RTCs12-10-2009.doc

Importance: High

Classification: UNCLASSIFIED
Caveats: FOUO

This time I'm attaching the file.

-----Original Message-----
From: McKenna, Jim J Mr CIV USA AMC
Sent: Wednesday, December 16, 2009 10:35 AM
To: 'Geiger.William@epamail.epa.gov'; Cutler,Jim
Cc: anne.greene@atk.com; diane.wisbeck@arcadis-us.com; jim spencer; Parks, Jeffrey N; jerome.redder@atk.com; Mendoza, Richard R Mr CIV USA IMCOM; Timothy.Leahy@shawgrp.com; Meyer, Tom NAB02; Jeremy Flint (jeremy.flint@atk.com); Tina_MacGillivray@URSCorp.com
Subject: RE: SWMUs 48 & 49 RFI/CMS comments (UNCLASSIFIED)
Importance: High

Classification: UNCLASSIFIED
Caveats: FOUO

All,

Here are our responses to the subject comments.

Note I'll be on leave from Friday 12/18/2009 to Friday January 1, 2010, returning to the office Monday January 4, 2010.

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

Merry Christmas and Happy New Year.

Jim McKenna

-----Original Message-----
From: Geiger.William@epamail.epa.gov [mailto:Geiger.William@epamail.epa.gov]
Sent: Wednesday, July 01, 2009 10:56 AM
To: McKenna, Jim J Mr CIV USA AMC
Cc: anne.greene@atk.com; diane.wisbeck@arcadis-us.com; jim spencer; Parks, Jeffrey N; jerome.redder@atk.com; jlcutler@deq.virginia.gov; Mendoza, Richard R Mr CIV USA IMCOM; Timothy.Leahy@shawgrp.com; Llewellyn, Tim;

Tina_Devine@URSCorp.com; Meyer, Tom NAB02
Subject: SWMUs 48 & 49 RFI/CMS comments

Attached are EPA/VDEQ comments on the SWMUs 48 and 49 RFI/CMS. Please call or email me with any questions.

(See attached file: SWMU 48 & 49 comments.doc)

William A. Geiger
Office of Remediation (3LC20)
USEPA Region III
1650 Arch Street
Philadelphia, PA 19103
(215)814-3413

Classification: UNCLASSIFIED
Caveats: FOUO

Classification: UNCLASSIFIED
Caveats: FOUO

Presented below are EPA/VDEQ comments on the *Draft Solid Waste Management Units 48 and 49 RCRA Facility Investigation/Corrective Measures Study Report*, Radford Army Ammunition Plant (RFAAP), Virginia, dated February 2009 (RFI/CMS Report).

GENERAL COMMENTS

1. The RFI/CMS Report lacks an adequate presentation of the nature and extent of contamination. The data for previous investigations is, in general, presented separately from the data collected in 2007. Section 4.3, Nature and Extent Summary and Conclusions, presents only limited evaluation of the site's entire data set. This evaluation does not address whether contaminants exceeding applicable screening criteria have been adequately bounded in all directions, including vertically. Figure 3-2, Groundwater and Soil Results at SWMU 48 and SWMU 49, attempts to show those samples which exceeded applicable screening criteria, but its utility is limited. It does not differentiate between surface soil samples and samples collected at depth. It also does not define which specific constituents were detected at each location (and instead only refers to sample exceedances by analyte class such as volatile organic compounds [VOCs], metals, etc.) And finally, groundwater contamination is a concern at both SWMUs but the RFI/CMS has not presented any plume maps which show the limits of the groundwater contamination. Please revise the RFI/CMS to include a more robust evaluation of the nature and extent of contamination which includes data from all investigations at the site. This evaluation should describe the horizontal and vertical limits of contamination in all site media. This evaluation should also be supplemented with appropriate figures, such as isoconcentration maps for key constituents in surface soil, subsurface soil, and groundwater. Plume maps showing the extent of groundwater contamination at different times (i.e., using data collected from 1996 and 2007) are also recommended to show trends over time and lend further confidence to any conclusions regarding the practicality of monitored natural attenuation (MNA) at the sites.

   RESPONSE: Shaw has always presented their Nature and Extent section in this manner. The beginning of the section lays out what was found in the latest investigation and then the summary and conclusion section describes what was found in all investigations. Groundwater isoconcentration maps will be included in the final report. Soil isoconcentration maps are generally inappropriate; Soil constituents at older sites are usually relatively insoluble and are present in localized "hotspots" that do not follow a migration/distribution pattern that is implied by an isoconcentration map.

2. The extent of groundwater contamination at SWMUs 48 and 49 does not appear to have been defined during the RFI. Section 4.3.2, Groundwater, notes that the 2007 data indicated that the highest VOC concentrations of trichloroethylene (TCE) and carbon tetrachloride were detected in well 48MW2. Figure 2-7, SWMU 48 and SWMU 49 Potentiometric Surface Map, shows that well 48MW2 is the most downgradient well at the sites. The extent of contamination beyond well 48MW2 is unknown, yet this has not been identified as a data gap in the RFI or CMS. This represents a significant data gap. If groundwater and/or surface water data are available from SWMU 13, located downgradient of the sites, it may be useful in further defining the extent of contamination associated with SWMUs 48 and 49. Please revise the RFI/CMS to address how the

horizontal and vertical extent of contamination will be fully defined at SWMUs 48 and 49. It is also noted that bedrock in the area of the site is "highly weathered with many solution cavities" (Section 2.4). Any assessment of groundwater contamination will need to address the uncertainties associated with this highly variable hydrogeologic regime. It should also be noted that an approach to filling this data gap could be included with remedy implementation, if sufficient data exists to adequately assess the proposed remedial alternatives.

RESPONSE: Shaw altered Section 2,5 of the report by adding the following statement: "Wells downgradient of the sites (at SWMU 13) were found to be clean with no detections of TCE or carbon tetrachloride. A steep hill exists between SWMU 49 and SWMU 13; therefore it is not possible to drill any additional wells in between those areas."

3. For the selection of chemicals of potential concern (COPCs) in the human health risk assessment (HHRA), maximum contaminant concentrations were compared to the October 2007 EPA Region 3 Risk-Based Concentrations (RBCs) for soil and tap water. It should be noted; however, that Region 3 now relies on the Regional Screening Level (SL) table available at the website (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm developed by Oak Ridge National Laboratory under an Interagency Agreement with EPA as an update of the EPA Region 3 RBC Table, Region 6 HHMSSL Table and the Region 9 PRG Table. It is recommended that future evaluations use the Regional SL table.

   The SLs may substantially differ from the RBCs since they address dermal, oral, and inhalation exposure while the RBCs only address ingestion exposure. In addition, the SLs no longer support route-to-route extrapolation and the most current toxicity data are reflected in the SL table. The impact of using outdated screening levels should be discussed in the uncertainty analysis.

   From a review of the toxicity data, it appears that the risk assessment utilizes outdated toxicity data for various compounds. For example, Table E.1-43 lists the oral cancer slope factor (CSFo) for TCE as 4.0E-01 $(mg/kg\text{-}day)^{-1}$. However, the Regional SL table lists a CSFo of 1.3E-02 $(mg/kg\text{-}day)^{-1}$ for TCE, as established by California EPA (Cal-EPA). Additionally, Table E.1-43 and E.1-44 do not include any toxicity data for cobalt, but the Regional SL Table includes an oral reference dose for this constituent. Please revise the HHRA to include a discussion in the uncertainty analysis regarding the impact of using outdated screening values and toxicity data, or revise the HHRA to utilize the updated values and toxicity data.

   RESPONSE: Per agreements reached in the June 2008 EPA/VDEQ/Army partnering meeting, RFIs that were complete, or substantially complete, prior to the release of the Regional Screening levels would continue to use the October 2007 RBCs. The RFI for SWMUs 48 and 49 had been initiated before the Regional SL table had become available. To be consistent with the screening values utilized in the evaluation of nature and extent, the Region 3 Risk-Based Concentration (RBC) tables had been used in the HHRA. Similarly, the toxicity values used in the HHRA matched those used to develop the Region 3 RBCs.

4. The HHRA does not appear to have included all available data for SWMU 48 in the evaluation of site risk. Table 2-1, Previous Investigations Samples and Analyses, indicates that soil samples were analyzed for dioxins/furans during the 2002 Site Characterization conducted by IT Corporation. However, it does not appear that 2,3,7,8-TCDD toxicity equivalent factors (TEFs) were calculated for the soil samples associated with this sampling event and these constituents were; therefore, not included in the COPC selection process for SWMU 48. Appendix E-3, Calculations for 2,3,7,8-TCDD Equivalents – SWMU 48 and 49 Groundwater, only includes TEF calculations for soil samples associated with SWMU 49. Section 4.3.1.1, SWMU 48, indicates that dioxins/furans associated with the 2002 sampling event reported screening limit exceedances, which also suggests that these constituents would likely have been selected as COPCs in soil at SWMU 48 and carried through the risk evaluation. Please revise the HHRA to include all applicable site data in the evaluation of site risk, including the 2002 dioxin/furan data set from SWMU 48, and revise any conclusions as necessary based on the outcome of this evaluation.

   RESPONSE: The HHRA will be updated with the correct 2002 dioxins/furans data.

5. The Screening Level Ecological Risk Assessment (SLERA) indicates that it used Steps 1, 2, and 3a described in the *1997 USEPA Ecological Risk Assessment Guidance for Superfund* as well as other relevant guidance documents. However, the document does not follow or contain the standard components of a SLERA. The document is difficult to follow and blends components of all three SLERA steps at inappropriate junctures. The following summarizes the changes necessary to complete the SLERA;

   a. The document needs to be reformatted to follow a standard EPA guidance outline. The document indicates that it follows Steps 1, 2 and 3a of the Ecological Risk Assessment (ERA) process yet it does not provide the standard elements of each step. Step 1 needs to describe the site setting, problem formulation, endpoints and conceptual site model as well as a discussion of data adequacy for the SLERA. Step 2 provides the methods and results of the screening-level evaluation based on using community-level and individual-level receptor group risk assessments where food chain modeling of bioaccumulative chemicals is also accomplished. The output from Steps 1 and 2 supports the first Scientific Management Decision Point (SMDP). Step 3a uses more refined measurement tools (e.g., background comparisons, exclusion of common elements, evaluating the frequency of detection/frequency of exceedance, refined exposure dose modeling). The document blends all of these lines of evidence together and does not delineate the 'step-wise' process or the SMDP process.

   RESPONSE: Although the SLERA does not follow the "standard" EPA guidance in a step-wise fashion that exactly mirrors Steps 1, 2, and 3a, all of these three elements are present. The SLERA approach was developed following USEPA guidance in addition to the Tri-Service Guidance for ERAs, and the approach was presented in the RFAAP Final MWP and the RFAAP Site Screening Process that was previously reviewed by BTAG. The current SLERA approach has been used by Shaw for numerous sites at the Facility for many years and has previously been acceptable to regulators. Reformatting of the SLERA would result in a document that is inconsistent with previous Facility SLERAs and would make comparisons between SWMUs difficult. As no substantive difference in SLERA conclusions would result from the recommended reformatting, it is recommended that these revisions not be performed.

b. The document needs to discuss the data adequacy of the data set used in the SLERAs. Section 7.1.2 briefly describes the steps for deriving a site-specific dataset, but does not provide summary statistics or describe the process by which (and the studies from which) the data were obtained. Please provide a better presentation by showing the entire data set, its sources (i.e., past studies), the locations of the samples, descriptive statistics, and laboratory detection and reporting limits.

RESPONSE: Summary statistics (i.e., minimum, maximum, arithmetic mean, range of detection limits, frequency of detection, and calculated 95% UCL) as well as the statistical tests used are presented in Tables 7-6 through 7-8 (SWMU 48) and 7-13 through 7-16 (SWMU 49). The data used for the SLERA is presented in Section 2.0 and Section 3.0 Tables, and summary sample lists are provided in Tables 7-5 (SWMU 48) and 7-12 (SWMU 49). Sample collection methods and sample locations are presented in Section 3.0 of the report, while past studies are discussed in Section 2.0. The electronic (excel) versions of the tables include custom views that can be used to see detected (standard view) or all analyzed compounds. The SLERA is one section of the report and information presented in earlier sections is not necessarily duplicated in each subsequent section, as this would quickly become very burdensome for the reader

c. The current and anticipated future land uses for each site need to be described. The entire document before the SLERA focused on Human Health risk analysis, suggesting that future ecological based land uses are not intended. The SLERAs evaluate potential current conditions using historic data going back to 1998. No mention is made about the uncertainties associated with using these older data to assess current exposures. Please describe the anticipated land uses and the future ecological setting associated with the two sites and the potential issues associated with using older data.

RESPONSE: The SLERA assumes current and future land use is similar at each site. Even if it was conservatively assumed that future land use was 100 percent undeveloped (i.e., assuming all structures were removed), the SLERA approach would not change, because the ecological receptors evaluated in the SLERAs were not chosen for their ability to be impartial to human disturbances. It is not anticipated that COPEC concentrations would increase or become more toxic overtime, so older data (e.g., from 1998) is still relevant and potentially more conservative. This discussion will be added to the Uncertainty Section of the SLERAs.

d. The document lacks a fully developed Conceptual Site Exposure Model (CSEM) describing the contaminant fate and transport pathways, potential exposure pathways and potential ecological receptors affected by the exposure. Instead, only an abbreviated food web showing the relationship between receptors of concern is provided. Please develop CSEMs similar to those provided for the Human Health Risk Assessment (Figures 6-1 and 6-2).

RESPONSE: A more fully developed CSEM will be developed for the SWMUs, showing sources, transport pathways, exposure routes, and receptors.

e. Step 3a should not be used in a SLERA because it is the first step of a Baseline Ecological Risk Assessment (BERA), unless agreed otherwise with the Agency. Combining Steps 1 and 2 of the SLERA with Step 3a of the BERA precludes the SMDP which occurs after Step 2. A SMDP represents a point where the risk assessor, risk managers, and stakeholders reach consensus on the elements of the risk assessment, including risk management objectives, endpoint selection, and decision criteria before proceeding to BERA, if necessary. Combining these three steps resulted in an unconventional SLERA which did not follow EPA's ERA guidelines. Please justify this atypical approach, and revise the SLERAs as appropriate.

RESPONSE: As discussed in response to Comment No.5a, the current SLERA approach has been used by Shaw for numerous sites at the Facility for many years and has previously been acceptable to regulators. Based on Shaw's experience performing ERAs for over 10 years at DOD sites through the US, the utility of performing a SLERA that only contains Steps 1 and 2 is of little utility, as the conservativeness of the SLERA approach almost always results in estimates of potential ecological hazard. A fundamental component of the RFAAP SLERA process is the addition of Step 3a in the deliverable, so that stakeholders will have additional information available on which to reach a decision.

6. The document states that a direct connection to surface water does not exist (pages 7-1, 7-4). However, two potential indirect pathways could transport COPECs to the New River. These pathways consist of storm water carrying surface materials (if exposed; where in fact 'subsidence' of trenches in SWMU 48 have been noted (pages 2-1 and 2-4)), and (b) groundwater recharge of surface water. Page 2-1 in the report indicates that 'the site setting is situated on a bluff overlooking the New River…based on topography, surface water runoff is expected to flow approximately 700 ft south to the New River' (Page 2-1). The purpose of a SLERA is to address all potentially viable pathways to ecological receptors. The SLERAs should evaluate the subsurface materials given the potential for buried wastes to be exposed (i.e. via storm water erosion or flooding) or for contaminated groundwater to recharge the New River. For conservative purposes, the subsurface soils should be evaluated as well as the groundwater. Applicable SLERA benchmarks (such as those already provided in the document for the terrestrial receptor assessment, and the Virginia State Water Control Board Surface water quality standards [VSWCB, 2008]) should be applied using terrestrial and aquatic endpoints. Please revise the document to evaluate risk to terrestrial receptors exposed to subsurface materials, as well as risk to aquatic organism as related to groundwater (to surface water) exposure.

RESPONSE: The exposure (via erosion, etc.) and transport of subsurface soil COPECs to surface soil or to the New River is highly unlikely and is not considered a complete exposure pathway. Typical storm water erosion or flooding in this area would not exposure subsurface soils (subsoil is defined herein as a depth greater than 2 feet bgs). As the sites are not located adjacent to high energy water features such as a coastal area with direct wave action, quantification of these pathways is not necessary. Ground subsidence at the trench locations is not a predictor of future subsoil erosion potential. This information will be added to the SLERA.

As stated in Section 7.1.1.3, as the New River is approximately 700 feet from the Sites, groundwater COPECs are not expected to discharge to surface water. As discussed in Section 9.2, natural attenuation of chemicals in groundwater is shown to be occurring. Therefore, even if groundwater COPECs were to migrate from the sites to the New River, their resultant concentrations would be expected to be very low. Finally, dilution of any groundwater that did reach the New River would be expected to be significant, and resultant water column concentrations would be expected to be below toxicologically significant concentrations.

7. The document repeatedly states that 'soil at SWMU 48 was considered sufficiently characterized (e.g., page 3-1)'. The small size of the site makes it easy to believe that enough data have been gathered by the numerous studies which comprise the data set. However, the surface soil data for SWMU 48 are not consistently presented and raise issues on the adequacy of the data set to support a risk assessment. For instance, 'surface' is defined as 0 – 2 feet (ft) below ground surface (bgs) (as defined in section 7.1.2.1 Data Organization, page 7-6). Hence, drill profile portions and dedicated surface soil samples should comprise this depth-defined data set. Table 7-5 (page 7-21) shows sample 'groupings' comprised of samples collected 0 – 0.5 ft bgs (see Table 3-1, page 3-1), and 0-15 ft bgs (sample groupings 48SB09A and 48SB08a). It does not appear that the soil sample group for SWMU 48 meets the definition of "surface soil". Table 7-5 also lists two sample groups twice (48SB09A and 48SB08a); the summary statistics (Table 7-10) indicate that at most five samples were collected while Table 7-5 suggests that at least six are available. Similar concerns were found with the SWMU 49 site characterization information (section 7.3.1, page 7-37) which indicates that up to nine sample groupings comprised the dataset, yet in certain cases the frequency of analysis was less than nine (see Table 7-13). Please address these issues and clearly discuss the data sets used in the SLERA.

   RESPONSE: The repeated samples (48SB09A and 48SB08a) will be removed from Table 7-5, as these were a typo. There were up to six possible samples (and one duplicate) available for the SLERA, as shown in Table 7-5. However, some analytes were not analyzed in all samples. The frequencies of detection (FOD) presented in Appendix F-2 Table F-30 reflect the correct FOD, such as a 0/6 count for explosives. Regarding SWMU 49, there were nine possible samples (and one duplicate) available for the SLERA, as shown in Table 7-12. Similar to SWMU 48, some analytes were not analyzed in all samples (e.g., acetone was only analyzed in five of the samples, and Aroclor 1254 was only analyzed in six of the samples.

8. The assessment of the invertebrate community was not addressed or presented adequately. Soil invertebrates are a standard community level receptor group which should be evaluated in a SLERA. This document does not present methods or results for this receptor group. Section 7.1.1.1 (page 7-2) states that the RFAAP facility provides habitat to five state-listed plants, one invertebrate and several animals. Section 7.1.8 (page 7-17) describes how direct contact toxicity was evaluated, including using soil invertebrate benchmarks. Section 7.2.3.1 (page 7-26) and Section 7.2.7 (page 7-35)

indicate that the risk to soil invertebrates was characterized, but no text presented this characterization. Similarly, there is no mention of an analysis of impacts to soil invertebrates in the SWMU 49 text (see page 7-44). Soil invertebrates need to be included as a receptor group in the CSEM, the SLERA endpoints, the Step 2 screening process, and the Step 2 and Step 3a risk characterizations. Please revise this document accordingly.

RESPONSE: The invertebrate community was addressed using a direct contact toxicity assessment, for COPECs in soil (see Tables 7-10 and 7-17). As stated in Section 7.1.4, the selected assessment endpoints for SWMUs 48 and 49 are the protection of long-term survival and reproductive capabilities for populations of herbivorous, insectivorous, and carnivorous mammals, and omnivorous, piscivorous, and carnivorous birds, and the assessment endpoints for the base of the food chain are stated as the protection of long-term survival and reproduction of terrestrial plants and soil invertebrates, which are addressed through a direct contact assessment. In Section 7.1.4.2, the direct contact toxicity of COPECs to soil invertebrates was selected as a measurement endpoint for protection of long-term survival and reproductive capabilities for populations of insectivorous mammals and omnivorous birds, assuming soil invertebrates serve as a food supply for higher order consumers. It should be noted that as there are no documented threatened or endangered species of plants or invertebrates at either SWMU 48 or 49, the protection of plants and invertebrates, in and among themselves, was not selected as an assessment endpoint. This SLERA approach has been used for numerous sites over the years at the Facility, and has previously been acceptable to the Agency.

9. The background screening steps applied in the SWMU 48 SLERA are inappropriate. The background screen compares a 'point estimate' of either 'surface' soil or 'all' soil point values to background values. This comparison is inappropriate since the SWMU 48 'surface soil' data set includes two data groupings (i.e., 0-0.5 ft bgs and 0-15 ft bgs) which together do not meet the definition of "surface" soil but rather meet the definition of 'all' soil. Please revisit the data groupings to be used for SWMU 48 surface soil background comparison.

   RESPONSE: The background evaluation presented in Section 7.2.5 of the SLERA is for surface soil at SWMU 48, and is based on two-population statistical test results, not point estimates. Similarly, in Section 6.4.3 of the HHRA, two-population tests were used for surface soil and total soil. The data groupings used for the SWMUs do not need to be revisited.

10. The uncertainty analysis (Section 7.2.6 and 7.36) is inadequate. The text for SWMU 48 (pages 7-34 and 7-35) briefly describes the outcome of a screening to evaluate non-detect chemicals and the uncertainty associated with the food chain modeling of two COPECs (chromium and selenium). Also, the evaluation of non-detect Method Detection Limits (MDLs) as compared to screening values is inconsistent with other methods described in the document. Table F-32 summarizes a screening which relies on several different sources of screening benchmarks besides those used for the actual SLERA analysis. At a minimum, the non-detect screening should use the same conservative SLERA benchmarks. Furthermore, the results of this screening should be a part of the COPEC

selection process where the non-detected chemicals with elevated MDLs are retained through the SLERA process**.** An uncertainty analysis should identify all sources of uncertainty in the SLERA process. At a minimum, the data adequacy needs to be evaluated to describe if the data set is of sufficient quantity and quality for use in the risk analysis. The uncertainty assessment should then address sources of error in the CSM, screening-level methods and food chain analysis. Please rewrite the uncertainty analysis to provide a complete accounting of the sources of uncertainty in the SLERA.

RESPONSE: The screening benchmarks utilized in Table F-32 are appropriate for screening non-detected constituents. The non-detect screening benchmarks cannot be the same as those used in the actual SLERA analysis because the initial COPEC selection process in the SLERAs did not use screening benchmarks. As shown in Tables 7-6, 7-7, 7-13, and 7-14, initial COPECs were selected based on whether or not they were detected, or if they were important bioaccumulators. The direct-contact toxicity assessment, however, did use two additional screening value sources that were not used in the non-detect evaluation. These two additional sources were NOAA SQuiRT values and Canadian Council of Ministers of the Environment (CCME) values, and were used to provide additional lines of evidence for the direct contact evaluation, The uncertainties described in Sections 7.1.10, 7.2.6, and 7.3.6 adequately describe the general uncertainties of the SLERAs, however, the uncertainties associated with not using NOAA SQuiRT values and CCME values in the non-detect evaluation will be added to the uncertainties discussion.

11. The risk characterization summaries and SWMU-specific risk conclusions (i.e. sections 7.2.3 and 7.2.7 for SWMU 48; and sections 8.2.3 and 8.2.7 for SWMU 49) are inadequate and need further lines of evidence to help derive an appropriate SMDP. The summary information on the food chain and direct contact toxicity evaluations should be combined (along with other lines of evidence) to characterize the risk associated with each COPEC. The direct contact toxicity information is provided in cursory form by only stating the number of benchmarks exceeded. The comparisons provided in Table 7-10 should rely on Hazard Quotients (HQs) to put the degree of exceedance into context. Simplified statements such as those provided on page 7-33 (i.e. 'the manganese MDC exceeded three of the five available benchmarks…') do not help describe the risk associated with the chemical. A figure (such as Figure 3-2) showing the nature of a benchmark exceedance in a geospatial format would provide more useful information than brief summary statements. The document needs to bring together all the COPEC-specific lines of risk evidence, and present COPEC risk characterizations. Each COPEC risk characterization should follow the same format. A recommended format includes discussing the screening HQ exceedances (or lack thereof) for plants and invertebrates a discussion of the food chain receptor HQ analysis, and the direct contact toxicity analysis. Geospatial lines of evidence, including COPEC dispersion as related to habitat, the presence/absence of habitat and critical species and the land use setting (current and future) are more lines of evidence that should be included into the discussions in order to fully characterize the risk. Please revise this document to provide adequate risk characterization discussions for each COPEC to help draw a defensible SMDP conclusion.

RESPONSE: A sample point by sample point spatial illustration of HQs is not appropriate, as EPCs were calculated for each COPEC, to estimate site-wide exposure. In addition, the direct-contact toxicity assessments for plants and soil invertebrates focus on the potential reduction of these "base of the food chain" biota as a potential reduction in food supply for higher order wildlife consumers. As such, simple exceedance of the plant and invertebrate benchmarks (and not the magnitude of the exceedances) is the more relevant information. It should also be noted that an HQ greater than 1 is not a measure of the "degree" of risk (see Sections 7.1.7.2, 7.2.3.2, 7.3.3.2). Further lines of evidence are not necessary to reach a SMDP.

12. The whole SLERA section needs to be thoroughly edited to remove extra terms and to reformat the document to meet standard guidance requirements. The document repeatedly uses the terms Tier I and Tier 2 to denote phases of SLERA decisions. The document should delineate Step 1, Step 2 and Step 3a elements from each other, and present clear SMDP decisions at the end of Step 2 and Step 3a. Other editorial issues include using surface water, sediment, and aquatic life terminology in the text and tables even though the document states that the SLERA does not address aquatic risk since site-related impacts to surface water are not believed to exist. Surface water and sediment exposure terms remain throughout the document (pages 7-1, 7-7, 7-8, and 7-13[and others]) and aquatic life exposure factors appear in various tables. Acronyms are also introduced but are not defined. Finally, several table and section call outs in the text are inaccurate (refer to specific comments below), and several sections have numbering conflicts. Please edit and revise the document accordingly.

    RESPONSE: Although there was no surface water or sediment present at either site, the statements on pages 7-1, 7-7, 7-8 clearly indicate these media were not considered because they were not present. On page 7-1 it states: "surface water was not present" and "there is no potential exposure for ecological receptors to surface water, sediment, or groundwater at the sites"; and on page 7-7 and/or 7-8 it reads "as surface water or sediment samples were not collected at SWMUs 48 or 49, exposures to these media were not included". To help clarify the description of site specific exposure estimation, references to aquatic receptors and media will be removed on pages 7-13 and 7-14. Other inappropriate references to surface water and or sediment were not found in the text.

13. The food chain calculations could not be verified based on the available information. Example food chain spreadsheets were provided but the formula codes appear to have been lost in the submittal. The document needs to provide examples of each step of the food chain modeling analysis (i.e. using bioaccumulation factors to calculate body burden in prey items) to allow for an independent review. Please revise the document to include this information.

    RESPONSE: Although Appendix F-2, Table F-22 provides example calculations and appears complete in the files we have, the formula codes will be double checked to ensure they are clearly transmitted in any future submittal. COPEC specific uptake equations and bioaccumulation factors are provided in Appendix F-2, Tables F-23 through F-25.

14. Long-Term Groundwater Monitoring (LTM) is included in Section 9.0 as part of Alternatives 2 and 3. The summaries presented on Pages 9-4 and 9-6 indicate that eight existing wells are proposed for inclusion in the LTM program. As the RFI/CMS Report was prepared in response to a Corrective Action Permit, Resource Conservation and Recovery Act (RCRA) requirements for a regulated unit (i.e., Solid Waste Management Unit (SWMU) 48 and 49) will apply. The RCRA requirements for long-term groundwater monitoring of a regulated unit specify that a minimum of one upgradient well and three downgradient wells be monitored. However, the monitoring network for SWMUs 48 and 49 do not include three downgradient wells. Only two downgradient wells are proposed for SWMU 49, and both of these wells (48MW2 and 48MW3) reported some of the highest detections of VOCs. In order to meet RCRA requirements, the RFI/CMS Report should include a proposal for the installation of a minimum of one additional downgradient well for SWMU 49. Placement of this well should be based on an evaluation of relevant site data (e.g., adjacent site and/or regional groundwater flow data), and factors influencing well placement should be discussed in the RFI/CMS Report. The RFI/CMS Report should also clarify how the final groundwater monitoring network and overall LTM program is sufficient to ensure that groundwater contaminants will not be overlooked if released from SWMU 48 and 49 over the long term.

    REPSONSE: VOCs are attributed to SWMU 49. Although the report also contains a discussion of data from SWMU 48, it would be inappropriate, and contradictory to the report to attribute the VOCs to both sites and develop two monitoring networks. The reviewer correctly points out the RCRA requirements of one upgradient and three downgradient wells, however, the reviewer seems to have missed that the VOCs are only attributed to SWMU 49 and the RCRA requirements do not need to be doubled for this site.

15. The RFI/CMS presents an inadequate assessment of the two proposed active remedies (Alternatives 2 and 3). No figure, schematic, or remedial design layout is presented for Alternative 3 which includes geoprobe injection of emulsified vegetable oil (EVO) along 25 foot centers, along two staggered lines. It is unclear along what trajectory these staggered lines would occur, and therefore, no assessment of the adequacy of this proposed alternative can be made. Please revise the RFI/CMS to include a figure, schematic, or a design layout for Alternative 3.

    Further, the ranking assessment presented in Section 11.0 is not sufficiently detailed. Any detailed assessment should incorporate an assessment of the first seven of the nine assessment criteria. Table 11-1, Ranking Assessment of Corrective Measures Alternatives, does not appear to adequately assess the subcategories in sufficient detail to incorporate each of the assessment criteria discussed in Section 10.0. For example, Alternatives 2 and 3 are ranked as “equal” for effectiveness according to Table 11-1, even though Alternative 3 will be more effective in the short-term, and will likely more readily attain a reduction in toxicity than Alternative 2. Further, as stated on the top of Page 9-6, Alternative 3 also creates a “bio-barrier” to protect the downgradient water from being impacted, which translates to greater overall protection of human health and

the environment. This is not reflected in the "equal" effectiveness ranking. Further, given that EVO alternative has a proven track record, that may not require additional logistical considerations, it does not appear to warrant a two evaluation unit downgrade; a one unit downgrade would be more representative. Please revise Section 11.0 and Table 11-1 to more accurately reflect the detailed assessment conducted in Section 10.0.

RESPONSE: The analysis of the alternatives does not need to be more fully developed if alternatives can be eliminated based on the analysis presented. The second part of the comment is opinion and is unsubstantiated. Rankings are based on final effectiveness and the conclusion that interim reductions would somehow be more effective is flawed. There are no current receptors for this groundwater and equal reductions prior to use of this groundwater are ranked equally.

SPECIFIC COMMENTS

16. **Executive Summary – Screening Level Ecological Risk Assessment, page ES-3:** The text summarizes the SLERA conclusions for SWMU 48 and 49 into an inclusive 'SWMU study area' summary. This approach is inappropriate since the two sites are physically separated and were independently evaluated. If these two sites were to be combined, then the entire SLERA would have to be based on a combined data analysis that would affect all the assumptions and exposure calculations. This information needs to be corrected and presented in a consistent manner with the independent SWMU risk conclusions. The text is also misleading by stating that the SLERA provide(s) 'an estimate of current and future ecological risk' even though future land use impacts and associated ecological assemblages were not described. In addition, the text revisits inappropriate background arguments, and discounts possible groundwater to surface water flow pathways with no substantiation. Please rewrite the Executive Summary to provide an accurate discussion of the SWMU-specific SLERA conclusions.

    RESPONSE: The information presented in the Executive Summary will be segregated into separate sections for SWMU 48 and 49, as requested. As current land use and future land use were considered to be identical in the SLERAs, the statements regarding future hazards are appropriate. As background statistical tests were based on two-population tests using USEPA's ProUCL software, for separate soil depth intervals, as appropriate for each receptor (surface soil and total soil), these results are appropriate. For the groundwater to surface water pathway, see response to Comment No. 6.

17. **Page 2-1, section 2.2.** The two sets of unlined trenches for SWMU 48 should be depicted on a referenced figure.

    RESPONSE: They are now depicted on Figure 2-1 and that figure is referenced in sections 2.1 and 2.2.

18. **Section 2.5, Site Hydrogeology, Page 2-6:** This section notes that well 49MW01 does not show a water level on Figure 2-7 because the well "was practically dry at the time of measurement (August 2007)." However, it appears that a groundwater sample was

collected from this well since analytical results are reported in Table 4-3, Analytes Detected in 2007 SWMU 48 and 49 Groundwater Samples. Furthermore, the field sampling form for this well, included in Appendix B-3, notes that this well was sampled with a bailer. Please provide further clarification for how a groundwater sample could be collected from a "practically dry" well. Furthermore, please discuss potential implications of sampling with a bailer versus the low-flow sampling that was proposed (i.e., potential loss of VOCs, etc.) and how this will affect the results. Additionally, the boring log for well 49MW01, included in Appendix B-1, appears to show that the well screen may not have been set deep enough to intercept the waterbearing zone at this location. Further, please address what actions will be taken to assure that a well of sufficient depth is available to monitor groundwater concentrations in the source area at SWMU 49. Lastly, for clarity and consistency, please discuss how water level data from this well can be incorporated into Figure 2-7.

RESPONSE: Additional wording was added to this section 2.5 to explain that the well had just enough water in it to collect a sample with a bailer. Water level was at depth in the well (121 ft bgs). This number was added to Figure 2-7. The well was installed at the depth of first encountered water to evaluate vertical migration from the site to the water table. The potential presence of TPH at this location guided the installation of the well so that part of the screen was above the water table to capture any potential free phase product. Despite the turbidity of the sample, the well is installed appropriately given the site conditions and is an acceptable monitoring point.

19. **Page 2-11, Section 2.6.2.** It would be helpful to augment the labeling system for text and tables to distinguish samples labeled 48 that were actually collected from SWMU 49.

    RESPONSE: The text was edited so that the confusing well samples are now referred to as "SWMU 49 well 48MW1", etc.

20. **Section 4.0, Nature and Extent of Contamination, Page 4-1:** This section uses the results of the human health based risk analysis to support the nature and extent discussions. Please rewrite this section to also accommodate the SWMU-specific SLERA findings.

    RESPONSE: This comment is incorrect. The Nature and Extent of Contamination section does not use the results of the HHRA. Screening values based on human health effects are used to give some comparison criteria to allow the reviewer to judge the chemical concentrations detected in environmental media relative to some benchmark. Although screening values based on ecological effects could be just as easily used, more reviewers are familiar with human health values. An additional screen is not necessary in this section as both a HHRA and a SLERA were performed and the results are included in the appropriate sections of the report.

21. **Section 4.1.1, Soil Analytical Results, Page 4-1:** Detected constituents are evaluated in this section by comparing them to residential and industrial RBCs and soil screening levels (SSLs). However, the description of the soil screening criteria presented in Section 4.0 does not define the SSLs and their basis. Furthermore, Table 4-1, Analytes Detected

in 2007 SWMU 49 Soil Samples, does not include a comparison of the detected analytes to SSLs for migration to groundwater. For clarity, please revise Section 4.1.1 of the RFI/CMS to limit the evaluation of detected analytes to a comparison to RBCs unless SSLs are described prior and SSLs are included on comparison tables. Since a more thorough evaluation of detected analytes to SSLs is presented in Section 4.2, the limited comparison in Section 4.1.1 appears unnecessary.

RESPONSE: Section 4.1.1 of the RFI/CMS was revised to limit the evaluation of detected analytes to a comparison to SLs only.

22. **Section 4.2, Soil Screening Level Comparison, Page 4-12:** The second paragraph states that three VOCS (benzene, vinyl chloride, and methylene chloride) were detected above their respective SSLs, one of which was methylene chloride which exceeded its SSL in "two of 28 samples." The description in the text is not consistent with that which is presented in Table 4-5, 1991-2002 SWMU 48 SSL Transfer Exceedance Summary. Table 4-5 shows SSL exceedances for five VOCs (including 1,2,4-trichlorobenzene and ethylbenzene). Additionally, methylene chloride exceedances were reported in ten of 20 samples. The text also indicates that there were four explosives-related compounds which reported exceedances; however, Table 4-5 shows nine explosives-related constituents. Please revise the RFI/CMS Report to specifically discuss explosives as an analyte group and to address these analytical summary discrepancies. Additionally, please revise any conclusions that are based on inaccurate information included in the text.

RESPONSE: It seems as though these observations are incorrect. Shaw's text is correct and matches what is shown in Table 4-5. It's possible that the author of this comment may have been looking at detections, not the number of SSL exceedances, which is what Shaw was referring to in the text. However, we did change the text so that the explosives results were discussed in a separate paragraph from pesticides and herbicides.

23. **Section 4.2, Soil Screening Level Comparison, Page 4-12:** The discussion of SSL exceedances is limited to VOCs, non-polynuclear aromatic hydrocarbons (nPAHs), pesticides, herbicides, explosives, and metals at SWMU 48. Table 4-5 shows that there were also SSL exceedances for two PAHs and one PCB, yet there is no mention of these constituents in the text. Furthermore, it is noted that several constituents exceeded SSLs at SWMU 49 but the RFI/CMS does not evaluate the potential for these constituents to impact site groundwater. Please revise the RFI/CMS to identify all constituents that exceeded SSLs at SWMUs 48 and 49, and evaluate their potential to impact site groundwater.

RESPONSE: At closer inspection of the table, the exceedances referenced here for PAHs and PCBs were not found in Table 4-5. There appear to be some detections, but no exceedances are found. However, we did add wording to explain how the exceeding analytes may impact groundwater.

24. Page 4-19. Section 4.3.1.1. Additional discussion is required to explain the methodology employed to confirm the presence of explosives in subsequent sampling. The ash layer at

6-7 feet is still present. The RFAAP response in Sept. 2007 to EPA Comment 11 indicated that soil removal at SWMU 48 was likely and additional delineation samples would be collected at that time. The depth of contamination (well within most models for soil contact risk) and the lack of "current" pathways are not sufficient justification for no further action

RESPONSE: Additional samples collected from the ash layer in 2002 were unable to confirm the detections found in the 1998 samples. It appears that the ash layer is very limited in extent and is buried under approximately 8 feet of cover material. As noted in the comment, this depth is within most soil contact models and was included in the data set used for the HHRA.

25. **Page 4-24, Section 4.3.1.2**. The highest concentration of PCB is found at 4-6 ft. bgs and TPH at 17-19 ft. To what extent were these areas delineated? It is not clear how subsequent additional soil sampling collected at different locations shows that soil impacts have been mitigated. For example, it appears that TPH at 48SB5A19 (3570) is compared to 49SB02D (3500) to illustrate a significant decrease in contamination. 2007 sampling focused on surface samples. Additional figures may help to present the rationale for no further action.

    RESPONSE: 2007 samples were collected from the surface soil due to the nature of the chemicals detected and suspected nature of the release. Given the highly immobile nature of PCBs, for instance, the detection at 4-6 ft bgs, could be an indication of much higher concentrations in the surface soil. The absence of these immobile constituents in the surface soil lends support to the idea that the PCBs were entrained with the oily water, and were able to migrate to some depth due to the increased solubility in hydrocarbons. TPH concentrations at 17-19 ft bgs in soil could be an indication of potential groundwater contamination and the wells installed were intended to assess the presence of TPH in groundwater.

26. **Page 4-24, Section 4.3.1.2.** At the end of the section screening level exceedances were compared to groundwater detections. Were these levels SSLs or risk-based or both? Report conclusions should address both in this section and other similar sections in the report. Some additional clarification is required to distinguish the exceedances being discussed.

    RESPONSE: These were only risk-based (SLs). SSLs discussions will be added.

27. **Page 4-25, Section 4.3.2.** A comparison of data from two sampling events does not necessarily indicate that concentrations have decreased. They could have migrated to another location.

    RESPONSE: The phrase "at this location" will be added to the text.

28. **Table 4-5, 1991-2002 SWMU 48 SSL Transfer Exceedance Summary, and Table 4-6, 1991-2007 SWMU 49 SSL Transfer Exceedances Summary:** Both of these tables use

"na" in several locations, but its meaning is not defined. For clarity, please define "na" in the notes section of the tables.

RESPONSE: This change was completed.

29. **Section 5.0, Contaminant Fate and Transport, Page 5-1:** This section uses the results of the human health based risk analysis to support the contaminant fate and transport discussion. Please rewrite this section to accommodate the SWMU-specific SLERA findings.

    RESPONSE: See response to Comment #20

30. **Section 5.0, Contaminant Fate and Transport, Page 5-1:** The last sentence of the second paragraph on this page states that a "discussion of the fate of risk drivers by natural attenuation factors is presented in Section 5.3." However, this discussion and Section 5.3 could not be located in the RFI/CMS. Please revise the RFI/CMS to address this inconsistency.

    RESPONSE: This sentence was removed.

31. **Section 5.2, Fate and Transport of Analytes Detected Above Screening Levels, Page 5-2:** The discussion of fate and transport characteristics is limited to four constituents: carbon tetrachloride, tetrachloroetheylene, TCE, and arsenic since these "were identified as risk drivers in the HHRA for SWMUs 48 and 49" (last line on Page 5-2). However, these four constituents were not the only risk drivers in the HHRA, and should not be presented as such. Table 6-4, Summary of Risks and Hazards, identifies multiple risk drivers, including 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, TCDD TE, 1,2-dichloroethane, bis(2-ethylhexyl)phthalate, and pentachlorophenol. Additionally, the HHRA found that lead fails the lead exposure assessment for the maintenance worker, industrial worker, adult resident, and child resident. However, the fate and transport characteristics of these constituents of concern are not described in Section 5.0. Please revise the RFI/CMS to include a more thorough discussion of the fate and transport characteristics of all of those constituents found to be risk drivers in the HHRA. A discussion of fate and transport characteristics by analyte class (i.e., VOCs, semi-volatile organic compounds, heavy metals, etc.) should also be presented for clarity.

    RESPONSE: The text will be changed on page 5-2 to state that the four compounds were identified as COIs based on the results of the Nature and Extent, Human Health and Screening Level Ecological Assessments.

32. **Table 6-1, SWMU 48 and SWMU 49 Sample Groupings, Page 6-2**: The third note at the bottom of the table states, "Based on proximity, the groundwater sampling group includes wells from SWMUs 48, 49, 50, and 59." However, the locations of the wells associated with SWMUs 50 and 59 have not been presented on site figures. Additionally, well construction details and groundwater data have not been provided for the wells from SWMUs 50 and 59, so it is unknown whether the data collected from these wells is actually applicable to SWMU 48 and SWMU 49. Please revise the RFI/CMS to identify

the locations of wells associated with SWMUs 50 and 59 on a site figure. Additionally, please provide the well construction details and groundwater monitoring results for these wells if they are to be used in the risk assessment.

RESPONSE: The report will be revised to include information on the SWMUs 50 and 59 well locations, well construction, and groundwater monitoring results.

33. **Section 6.1.1.1, Surface Soil and Total Soil, Page 6-3:** Soil samples used for COPC screening of SWMU 48 were collected during sampling events in 1991, 1994, 1998, 2002, and 2007. Table 3-1, 2007 RFI Samples and Analyses, appears to show that soil samples were not collected at SWMU 48 during the 2007 investigation. Thus, it is unclear what samples were used for the risk assessment. For clarity and defensibility, please address this apparent discrepancy.

    RESPONSE: As noted in the comment, no soil samples were collected at SWMU 48 during the 2007 sampling event. The year, 2007, was inadvertently listed in the text and will be deleted.

34. **Section 6.1.1.1, Surface Soil and Total Soil, Page 6-3:** This section defines surface soil as 0 to 0.5 ft bgs, and total soil as 1 to 15 ft bgs. Since total soil should include both surface soil and subsurface soil, it would appear that total soil should be defined as 0 to 15 ft bgs. Please revise the HHRA to address this discrepancy.

    RESPONSE: The text will be revised to define total soil depths as 0 to 15 ft bgs.

35. **Section 6.1.1.2, Groundwater, Page 6-3**: This section states that groundwater data from only 1998 and 2007 were considered in the risk assessment. According to Table 2-1, Previous Investigations Samples and Analyses, groundwater samples were also collected from several site wells in 2006. Since these data are more recent than the 1998 data set, it should also be included in the risk assessment. Please revise the risk assessment to include the groundwater data collected in 2006, or provide the justification for not considering these data in the risk assessment.

    RESPONSE: The 2007 groundwater data is the most recent data and consists of the newly installed wells in addition to the older wells. Since it is the most recent data, it is considered the most relevant to current conditions. The 2006 data only have the old well data. The 1998 data was simply used to assess trends.

36. **Section 6.1.2, Identification of COPCs, Page 6-4:** It does not appear that the COPC selection process outlined in this section was consistently applied. The third paragraph indicates that analytes for which no screening criteria exist were selected as COPCs. However, this does not appear to have been the case for endrin aldehyde detected in surface soil at SWMU 49. Table E.2-2 of Appendix E-2, RAGS Part D Tables – SWMU 49, indicates that endrin aldehyde was selected as a COPC because no toxicity information was available for this constituent (i.e., endrin aldehyde was designated as "NTX" in the Rationale for Selection or Deletion column of Table E.2-2). However, Table 6-3, Summary of Chemicals of Potential Concern at SWMU 49, does not identify

endrin aldehyde as a COPC for this SWMU. Please revise the RFI/CMS to consistently apply the COPC selection process to detected constituents at the site, and include endrin aldehyde as a COPC in surface soil for SWMU 49.

RESPONSE: Table E.2-2 should be corrected to show that endrin aldehyde should have been screened out as a COPC. Due to the similarity of endrin and endrin aldehyde, the screening value for endrin should have been applied as a surrogate. When this value is used, the maximum concentration of endrin aldehyde does not exceed. Other constituents in Table E.2-2 will be checked to ensure that constituents without screening values are carried through the quantitative HHRA.

37. **Section 6.2.1, Conceptual Site Model (CSM)/Receptor Characterization, Page 6-7:** This section indicates that a residential scenario is evaluated for clean closure requirements under RCRA. Tables E.1-1 and E.2-1, Selection of Exposure Pathways for SWMUs 48 and 49, respectively, also include off-site exposure scenarios associated with groundwater. However, these potential exposures are not described in Section 6.2.1 or included in the refined CSM for the SWMUs presented in Figure 6-2, Future Land Use Conceptual Site Model for SWMUs 48 & 49. Please revise Section 6.2.1 and both CSM figures in the text (i.e., Figures 6-1 and 6-2) to include off-site receptors since these receptors are evaluated quantitatively in the risk assessment.

RESPONSE: The last paragraph of Section 6.2.1 and Figure 6-2 will be revised to clarify that off-site groundwater is evaluated as a potential future exposure pathway. Figure 6-1 will be revised to show that the exposure pathways for COPCs in off-site groundwater are currently considered to be incomplete.

38. **Section 6.2.4, Quantification of Exposure: Calculation of Daily Intakes, Page 6-10:** The Johnson and Ettinger (JE) model was used to estimate indoor air concentrations of volatiles migrating from groundwater through the groundwater and into a structure. However, given the karst geology of the site, the JE model does not appear applicable. Section 2.4 notes that "karst topography is dominant throughout the area" and "in the outcrop along the slope, the tectonic breccias and the limestone and dolostone are highly weathered with many solution cavities." Appendix G-1 of the OSWER *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils*, November 2002, (Subsurface Vapor Intrusion Guidance) suggests a number of conditions that under most scenarios would preclude the application of the JE model as implemented by EPA, one of which is "the presence of heterogeneous geologic materials...between the vapor source and building." It further states that the "JE model does not apply to geologic materials that are fractured, contain macropores or other preferential pathways, or are composed of karst." Although a number of uncertainties associated with this model are addressed in Section 6.5, Uncertainties, those associated with karst geology and preferential pathways are not mentioned. Given the limitations of the JE model with respect to karst geology, please revise the HHRA to provide further justification for applying the model to estimate indoor air concentrations at the site. If adequate justification cannot be provided, RFAAP should review the applicable guidance (e.g., subsurface Vapor Intrusion Guidance), choose an alternative approach for characterizing risk and hazards via vapor intrusion, develop estimates of the risk and hazard estimates

for the vapor intrusion pathway based on the alternative approach, and revise the RFI/CMS Report accordingly.

RESPONSE: It is not clear from the comment as to what alternative approaches may be acceptable for evaluating hypothetical indoor air exposures at this site. For example, sub-slab soil gas sampling may be a more representative approach to evaluating potential vapor intrusion; however, there are currently no structures at the site. Other screening-level approaches would also pose some uncertainty and may not yield quantitative estimates of risk or hazards. As stated in Section 6.5.3 regarding subsurface characteristics… "Although there are a number of limitations associated with the Johnson & Ettinger Model, it is likely that similar limitations are encountered at other RCRA and Superfund sites. The results of risk assessments at RFAAP as well as others would be more uncertain if a less accepted or documented model was used." Similarly, there may be more uncertainty associated with an alternative approach.

In response to the comment, the model inputs will be reviewed to assure that these parameters are conservative. In addition, the discussion in Section 6.5.3 regarding the Johnson & Ettinger Model will be expanded to address the uncertainty associated with the karst geology at the site.

39. **Appendix E, Human Health Risk Assessment, Table E.1-11:** It is unclear why an exposure frequency (EF) of 50 days is being used for maintenance workers at SWMU 48. The footnote on this table indicates that site maintenance is anticipated to be conducted once a week with two weeks of vacation a year. However, please note that the *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites,* dated December 2002 (SSL Guidance), indicates that an EF of 225 days should be used for outdoor workers in roles including, but not limited to, groundskeepers, gardeners, specified mechanics and repairers, non-specified mechanics and repairers, construction and maintenance workers, and painters. While it appears that maintenance workers at SWMUs 48 and 49 may not encounter the site this frequently, the RFI/CMS Report should include further rationale for not selecting an EF of 225 days or other value falling between the value used by RFAAP and the EPA recommended value (e.g., 100 days, assuming 2 days per week per year, with 2 weeks vacation). Please revise the HHRA to further support the professional judgment that 50 days is the most representative EF for a maintenance worker at this site by describing the anticipated type of maintenance work that is likely to occur. The discussion should demonstrate why the proposed value of 50 days is more appropriate than the EF recommended in the SSL Guidance or any value between 50 and 225 days (e.g., 100 days). Alternately, revise the HHRA to use an EF of 225 days for maintenance workers or other value (e.g., 100 days) demonstrated to be more appropriate for this receptor type. This comment applies to the EF used for the maintenance worker at SWMU 48 and SWMU 49.

RESPONSE: The current/future maintenance worker has been distinguished from the future outdoor industrial worker in this HHRA. The current/future maintenance worker scenario addresses occasional exposures (i.e., non-routine exposures) to the site as opposed to the future outdoor worker scenario, which is based on routine exposures. Under current land use, on-site activities at SWMUs 48 & 49 consist of periodic maintenance of the grounds. The maintenance worker scenario is based on an exposure frequency (EF) of 50 days per year under the assumption that maintenance or

groundskeeping activities take place one day per week, except during two weeks of vacation. This exposure parameter is more representative of the infrequent activities at SWMUs 48 & 49. Furthermore, this EF has been accepted in past HHRAs prepared for the Installation and has been used in this HHRA for consistency.

It is noted that exposure parameters for routine outdoor workers have been addressed by including a future industrial worker in the HHRA. The EF for this receptor is 225 days/year, as cited above. Therefore, this HHRA presents a range of potential worker scenarios.

40. **Appendix E, Human Health Risk Assessment, Table E.1-14:** The EF for a construction worker is listed as 125 days per year. The 2002 SSL Guidance is cited as the source for this information. However, Exhibit 5-1, Page 5-3 of the SSL Guidance indicates that 250 days per year is the default EF for a construction worker scenario. Please revise the HHRA to use an EF of 250 days for the construction worker. This comment applies to the EF used for the construction worker at SWMU 48 and SWMU 49.

    RESPONSE: The EF of 125 days per year (or 4 months) is based on the relatively small sizes of the SWMUs 48 & 49 (approximately 1 acre and 0.1 acre, respectively). In addition, these sites are situated on a bluff approximately 120 ft above and overlooking SWMU 13 and the New River. They are within the active Magazine Area of the facility and any new construction would likely be precluded by the proximity to the magazines and the open burn area at the base of the bluff. Extensive or lengthy construction projects at these sites are not likely.

41. **Appendix E, Human Health Risk Assessment, Table E.1-15:** This table includes information for an outdoor industrial worker. However, the text and previous tables refer to this receptor as a maintenance worker. For clarity and consistency, please revise Table E.1-15 to refer to the receptor as a maintenance worker. It is further noted that an EF of 225 days is used for this receptor, which is inconsistent with the EF applied in previous tables (i.e., Table E.1-11). Revise the RFI/CMS Report to eliminate discrepancies regarding the value of EF for maintenance workers and present a consistent value throughout the text, figures, and tables.

    RESPONSE: Please see the response to Specific Comment 39.

42. **Appendix E, Human Health Risk Assessment, Table E.1-18:** The ingestion rate (IR) of tap water by an industrial worker (indoor and outdoor) is listed as 1 liter per day. However, Exhibit 1-2 of the SSL Guidance recommends an IR of 2 liters per day for both indoor and outdoor commercial workers. Please revise the HHRA to use an IR of 2 liters per day for commercial workers. This comment applies to the IR used for the industrial worker at SWMU 48 and SWMU 49.

    RESPONSE: The ingestion rate for tap water of 1 liter per day was applied to the industrial worker scenario to be consistent with past HHRAs at the Installation. In addition, using an ingestion rate of 2 liters per day would not change the conclusions for

this HHRA. At an ingestion rate of 1 liter per day, risk exceeds 1E-04 and the hazard index exceeds 1.

43. **Section 6.5, Uncertainties, Page 6-35:** When evaluating the uncertainties associated with use of the JE model, it is noted on top of page 6-35 that one assumption of the model was that a future building would be located in an area with the shallowest depth to groundwater, which is reported as 48.24 feet at SWMU 48 and 97.6 feet at SWMU 49. However, according to the model inputs listed in Appendix E-6, Johnson & Ettinger Model – Input and Output – SWMU 48 Groundwater, 2121 centimeters (69.5 feet) was used as the depth of groundwater for SWMU 48. Please revise the application of the JE model at SWMU 48 to utilize the shallowest depth to groundwater or provide justification for using a depth to groundwater of 69.5 feet at this location.

    RESPONSE: The average depth to groundwater (69.5 ft) was inadvertently used in the Johnson & Ettinger Model for SWMU 48. The model will be revised using the shallowest depth to groundwater (48.25 ft).

44. **Section 7.1.1.2, Surface Water and 7.1.1.3 Groundwater, Page 7-4:** The document needs to describe all the components of the CSEM (or lack thereof). The proximity of the sites to the New River create the potential for storm-water to carry surface and eroded subsurface materials, as well as groundwater recharge, to the river. The document needs to provide evidence to show that these pathways are incomplete before they can be dismissed. Otherwise, the SLERA needs to evaluate these two pathways. Please revise the two sections to describe the ecological site setting and CSM pathways associated with surface water runoff and groundwater recharge.

    RESPONSE: See response to Comment No. 6.

45. **Section 7.1.2.2, Descriptive Statistical Calculations, Page 7-7:** This section is misleading because the SWMU 48 data set was too small to calculate 95% UCL values. Please revise this section to describe the descriptive statistics developed and used in the SLERA.

    RESPONSE: A statement will be included that the 95% UCL was not calculated due to the small data set size for SWMU 48 and the maximum detected concentration was used as the EPC. However, it will be noted that 95% UCLs were used for SWMU 49, due to the larger data set size.

46. **Section 7.1.3.1, Terrestrial Receptors, Page 7-8:** The first paragraph states that qualitative observations of vegetative stress were collected as a line of evidence. This information can be useful but needs to be tracked with site-specific measures of COPECs. Photographs of the vegetation present at each of the sample locations are also required to support these claims. Finally, comparative 'background' conditions need to be documented to draw the no-effect conclusion. Please provide more information from previous studies to validate the claims of no vegetative stress made in this document.

RESPONSE: Additional information on qualitative observations of vegetation, including photographs, will be added to the SLERAs.

47. **Section 7.1.3.1, Terrestrial Receptors, Page 7-10 and Figure 7-1:** This section ends with a brief reference to the CSEM provided in Figure 7-1. The SLERA needs to provide a complete CSEM similar to those shown in Figures 6-1 and 6-2 for the human health risk assessment. The CSEM needs to show all potential sources, fate and transport pathways related to the sources, exposure pathways, and potential ecological receptors affected. The current figure and text focus only on the receptors evaluated and do not provide a comprehensive, site- related CSM. Please revise both the text and figure to address these concerns.

RESPONSE: This will be done, see response to Comment No. 5d.

48. **Sections 7.1.4.1 Assessment Endpoints, and 7.1.4.2 Measurement Endpoints, Page 7-12:** An endpoint provides a 'concise statement' on the environmental value to be protected (assessment endpoint), and the method by which the potential effects to the value will be measured (measurement endpoints). Endpoints should capture all levels of ecological organization (individuals, communities, populations, feeding guilds) as well as effect levels of concern (survival, growth, reproduction). These two sections are difficult to follow in this respect. The standard community level receptors of concern (plants and invertebrates) appear to have been omitted, and the measurement endpoint section doesn't clearly state the specific measurement endpoints to be evaluated in the SLERA. These two sections need to be revised to define the ecological endpoints. Once the COPECs have been evaluated in Step 2, these endpoints can be revisited to derive more applicable goals, and thus, more appropriate Step 3a endpoints (i.e., No Observed Adverse Effect Level (NOAEL) measurement endpoints in Step 2, and then Lowest Observed Adverse Effect Levels (LOAELs) in Step 3a). Please revise the document to include the Step 2 endpoints as well as the Step 3a endpoints.

RESPONSE: See response to Comment No. 8. Sections 7.1.4.1 and 7.1.4.2 will be revised for clarification, as requested.

49. **Section 7.1.5, Exposure Estimation, page 7-12:** The text states that an estimate of the nature, extent… of COPEC migration 'considering both current and reasonably plausible future use scenarios' was developed. This document does not clearly define the reasonably plausible future use scenario or the anticipated ecological setting. Please revise the text accordingly.

RESPONSE: See response to Comment No. 5c.

50. **Section 7.1.5.1, Intake, Page 7-13:** Several issues were identified with this section. Numerous references are made to 'Tier I and Tier 2' steps, as well as to evaluating aquatic wildlife, and drinking water exposure. The text needs to focus on the methods describing the surface soil exposure analysis only. In addition, the definitions for the equation variables need to be revised. The variable F_k is defined as the 'fraction of the k_{th}

food type that is contaminated' whereas this factor should be the fraction of the k_{th} food type in the receptor diet. Please review this entire section of text for inaccuracies and revise where appropriate.

RESPONSE: Reference to Tier I and Tier II in the context of this SLERA are deemed appropriate. These tiers refer to worst case and more realistic HQ estimation approaches. To help clarify the description of site specific exposure estimation, references to aquatic receptors and media will be removed from pages 7-13 and 7-14. Variable F_k will be defined as the fraction of the k_{th} food type in the receptor diet.

51. **Section 7.1.6.1, Selection of Literature Benchmark Values, Page 7-15:** The text refers to uncertainty factors (UFs) (Table F-29) used to extrapolate Toxicity Reference Values (TRVs) from laboratory studies. The information in Table F-29 provides the factors used for intra- and inter-species extrapolations, but not for 'endpoint' extrapolations (i.e. the UF applied for extrapolation of an LD50 to a NOAEL). Please provide more information to identify the endpoint UFs used in this document.

    RESPONSE: Appendix F-2 Tables F-27 and F-28 provide a summary of the adjustments made to toxicity data when NOAEL or LOAEL data were not available.

52. **Section 7.1.8, Approach for the Evaluation of Direct Contact Toxicity, Page 7-17:** Several issues were identified with this section. The treatment of soil invertebrates in the SLERA needs to be defined and addressed in this section. It also needs to describe the other types of receptors evaluated as part of the direct contact toxicity assessment (mammals, birds). Finally, it seems that this section lacks information since it contains only one subsection (7.1.8.1). It is recommended that subsurface soils also be evaluated using the direct contact toxicity assessment strategy. Please accommodate these recommendations and revise the text accordingly.

    RESPONSE: In these SLERAs, only soil invertebrates were evaluated for direct contact toxicity (therefore, a separate subsection is not needed and will be removed). Wildlife, including mammals and birds, were evaluated using a food chain model approach. For further discussion of direct contact toxicity, see response to Comment No. 8. For subsurface soil exposure, see response to Comment No. 6.

53. **Section 7.2.3.1, Terrestrial Plant Impact Assessment, Page 7-26:** This section needs to describe the results of soil invertebrate impact assessments completed for the SLERAs. Please revise this section to include this information

    RESPONSE: As stated in Section 7.1.4, the selected assessment endpoints for SWMUs 48 and 49 are the protection of long-term survival and reproductive capabilities for populations of herbivorous, insectivorous, and carnivorous mammals, and omnivorous, piscivorous, and carnivorous birds. The protection of long-term survival and reproduction of soil invertebrates are adequately addressed through the direct contact assessment.

54. **Section 7.2.3.2 Predictive Risk Estimation for Terrestrial Wildlife, Page 7-26:** This section indicates that Hazard Indices (HIs) were calculated for COPECs with similar toxicity mechanisms. However, the text then goes on to state that summaries were provided in the tables (but where not) and segregation of chemicals by toxicological action was not completed. Please revise the text by removing the reference about HI calculations.

RESPONSE: Summed HQs (or an HI) were calculated for COPECs. The simple HQ ratios were summed to provide conservative HI estimates for chemicals and exposure pathways for a given receptor. The summation of HQs into an HI was performed in the SLERAs as a conservative approach. To assess whether or not individual COPEC HQs should be segregated based on dissimilar modes of toxicological action, individual COPEC effects *could be* evaluated in detail. However, as risk drivers resulted in summed HQs ranging up to 292, segregation of COPECs by mode of toxicological action was not necessary, as it was assumed that the individual HQs would still exceed 1. Individual COPEC HQs are presented in the text at the end of Section 7.2.3.2, and several did exceed 1.0.

55. **Section 8.1, Summary of Chemicals of Interest, Page 8-1:** The risk assessment identified several risk drivers in groundwater for the future child resident (Table 6-5, Summary of Risks and Hazards), which include bis(2-ethylhexyl)phthalate, carbon tetrachloride, 1,2-dichloroethane, pentachlorophenol, TCDD TEF, tetrachloroethene, trichloroethene, and arsenic. Upon further review of risk table E.2-56, risks associated with ingestion of groundwater exceeded EPA's risk range used to manage site risk (1E-06 to 1E-04) for both carbon tetrachloride (1.3E-04) and arsenic (1.3E-04). Risks associated with dermal contact with groundwater also exceeded this risk range for TCDD TEF (3.4E-04). None of these constituents are mentioned in the discussion in this section on chemicals of interest, nor are they included as chemicals of interest (COI) for corrective measures. The rationale for excluding these risk drivers also has not been presented. Please revise the RFI/CMS to identify carbon tetrachloride, arsenic, and TCDD TEF as COIs in groundwater to be addressed by the CMS, or provide the justification for their exclusion from the COI list.

RESPONSE: The discussion in Section 8.1 is intended to present the rationale for identifying COIs for the CMS. Please review the uncertainty section of the HHRA for the rationale for excluding these risk drivers. Constituents that have been previously discounted were not carried into this section.

56. **Page 8-1, Section 8.1.** 2,4,6-TNT was not selected as a COI due to FOD and lack of reproducibility however these conclusions have not been adequately supported in this section or elsewhere in the document. Sample locations and delineation assumptions must be clearly documented and referenced. Different lines of evidence appear to be scattered throughout the report.

RESPONSE: Tables presenting the number of exceedences, number of detections and number of samples are presented in Section 4. As noted in other comment responses, Adding every line of evidence to every section would very quickly become cumbersome.

The sections of the report are clearly labeled so that the appropriate sections can be found by the reviewer.

57. **Section 8.1, Summary of Chemicals of Interest, Page 8-1:** The last sentence of the first paragraph states that the SLERA concluded that remedial measures solely to address ecological concerns were unwarranted for site soil. Given the numerous concerns identified in the SLERA, remedial measures to address ecological risks should be revisited once all concerns with the SLERA are appropriately addressed.

    RESPONSE: Comment Noted. No response required.

58. **Section 8.1, Summary of Chemicals of Interest, Page 8-1:** The risk assessment identified several metals that contributed to a total hazard index greater than 1 (aluminum, arsenic, barium, iron, manganese, nickel, thallium, vanadium) for ingestion of groundwater by a future child receptor (Page 6-40). Additionally, site concentrations were above the health protective criterion for lead, and the margin of exposure evaluation for iron indicated that the iron intake was above the allowable range. The discussion provided to eliminate these metals as COIs in groundwater in Section 8.1 lacks sufficient justification. It is stated that, "An analysis of the metals in groundwater indicates that the elevated concentrations are due to the high turbidity in some of the newly installed wells." Graphs plotting turbidity levels against chromium concentrations and the number of metals above the tw-RBC are provided. However, the evaluation does not compare dissolved metals results to total metals results, even though this information is available for the 1998 data set. Additionally, chromium has been selected as the example constituent, but chromium was not identified as a risk driver in the risk assessment. Please provide further justification for eliminating each individual metal that was identified in the risk assessment as a driver for carcinogenic risk or noncancer hazard. The assessment should also discuss those metals that were detected in wells included in the risk assessment, but were not initially installed to monitor groundwater at SWMUs 48 and 49 (i.e., 50MW01). Alternatively, an additional round of groundwater data should be collected for both dissolved and total metals in the wells used to assess groundwater conditions at Sites 48 and 49.

    RESPONSE: Please see Comment 55 regarding the rationale for identifying COIs for the CMS. Although we could present a comparison of 1998 total vs dissolved metals, it would not be all that helpful as the well in question was installed in 2007. Additional groundwater samples will be collected as part of the MNA program for the VOCs in groundwater. Metals could be added to the analytical program for the first round of sampling for that program.

59. **Figure 8-1, Metal Concentrations and Turbidity, and Figure 8-2, Chromium Concentrations and Turbidity, Page 8-3:** Both of these figures appear to include two 48MW01s even though different data are presented for each. Please clarify if this is a presentation of duplicate data. Additionally, neither of the figures identifies the source and date of the data that are presented. For clarity, please address these concerns.

RESPONSE: One of the wells is actually 49MW01 and will be corrected in the figures. The new wells included in these figures have only been sampled once, in 2007 and is the source of the data. The date will be added to the figure as well.

60. **Section 8.2, Remedial Goals, Page 8-4:** This section indicates that 1,2-DCE was identified as a potential risk driver for groundwater. However, the risk assessment tables in Appendix E appear to show that 1,2-dichloroethane (1,2-DCA) was the risk driver and not 1,2-DCE. Please revise the RFI/CMS to address this discrepancy. Furthermore, it is unclear why all of the potential risk drivers in groundwater are not addressed in this section. As previously noted, it is unclear why a remedial goal is not being considered for TCDD TEF. Table E.1-56 of Appendix E notes that the risk associated with TCDD TEF for a child receptor contacting groundwater is 3.4E-04, which is above EPA's risk range (1E-04 to 1E-06) used to manage site risks. Please revise the RFI/CMS to establish a remedial goal for this constituent unless adequate justification can be presented to eliminate this constituent from further consideration in the CMS.

    RESPONSE: Please see Comment 55 regarding the rationale for identifying COIs for the CMS.

61. **Section 8.3, Area and Volume of Contamination, Page 8-4:** It is anticipated that the volume estimate presented for impacted groundwater underestimates the total volume of contaminated media. This estimate will need to be revised and updated once the issues identified regarding the extent of contamination and constituents of concern have been addressed. Calculations and/or figures should be presented which demonstrate how the volume presented was derived. Please revise the RFI/CMS to update the volume estimate and present supporting documentation once the extent and constituent concerns have been addressed.

RESPONSE: Comment Noted. No response required.

62. **Section 9.2, Alternative Two: MNA and LTM, Page 9-1**: The second paragraph notes that TCE concentrations decreased in wells 48MW2 and 48MW3 between the 1998 and 2007 sampling events, and that this is evidence that natural attenuation is occurring. This section does not note, however, that there was an increase in TCE concentrations between 2006 and 2007 (as shown on Figure 9-1). Additionally, it does not appear that many daughter products of TCE degradation have been identified at the site (cis-1,2-dichloroethylene, vinyl chloride), so it is unclear whether MNA is a viable remedy. It is recommended that *EPA's Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater (MNA Guidance),* September 1998, be consulted in order to present a more defensible assessment of whether MNA is occurring at this site. When evaluating the viability of MNA, three lines of evidence should be considered, as outlined in EPA's guidance. These three lines of evidence include:

    1) Historical ground water and/or soil chemistry data that demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at

appropriate monitoring or sampling points. (In the case of a ground water plume, decreasing concentrations should not be solely the result of plume migration.)

2) Hydrogeologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes active at the site, and the rate at which such processes will reduce contaminant concentrations to required levels.

3) Data from field or microcosm studies (conducted in or with actual contaminated site media) which directly demonstrate the occurrence of a particular natural attenuation process at the site and its ability to degrade the contaminants of concern (typically used to demonstrate biological degradation processes only).

Additionally, Section 2.2 of the MNA Guidance, Initial Site Screening, should be followed and the results documented to provide further evidence that MNA is a viable remedial option for this site, particularly considering that Section 9.2 of the RFI/CMS indicates that conditions at the site may not be favorable for anaerobic biodegradation processes. As part of an MNA assessment, the types of natural attenuation processes active at the site need to be documented. Furthermore, the RFI/CMS should show that the source of the groundwater contamination has been adequately evaluated, and is sufficiently under control so as not to require any additional measures to achieve source control. Please revise the RFI/CMS to include an assessment evaluating whether MNA is a viable remedial option for this site in consideration of the three lines of evidence outlined above and the Initial Site Screening process included in the MNA Guidance, or revise the RFI/CMS to indicate this is a data gap which needs to be addressed. Please also revise the RFI/CMS to include documentation of source control. A contingent decision document might be a possibility where augmented remediation would be required if agreed upon MNA criteria is not met.

RESPONSE: The types of data requested would be collected as part of the baseline sampling for MNA. As suggested, a contingent decision, with an MNA baseline sampling event would be implemented that would allow for in situ enhanced bio-remediation (ISEB) if concentrations do not fall at the expected rates within the first five years of monitoring.

63. **Section 9.2, Alternative Two: MNA and LTM, Page 9-4:** The proposed analyses for LTM include VOCs and metals. The RFI/CMS does not specify total and/or dissolved metals nor does it state whether MNA indicator parameters will be sampled. Please revise the RFI/CMS to expand the parameter list to adequately assess the MNA process during LTM.

REPSONSE: This information will be added to the report**.**

64. **Section 9.2, Alternative Two: MNA and LTM, Page 9-4:** The wells proposed for LTM are identified under the subheading, Implementation/Rampdown Strategy. The descriptions of some of the wells do not appear accurate. For example, at SWMU 48, well 48MW06 is described as an upgradient well. However, Figure 2-7, Potentiometric Surface Map, shows 48MW06 downgradient of SWMU 48. Furthermore, 48MW07 is described as a downgradient well, but Figure 2-7 shows this well is upgradient of SWMU

48. Additionally, for SWMU 49, well 48MW01 is identified as being inside SWMU 49, but Figure 2-7 does not appear to show this well. Well 49MW01 is instead located inside SWMU 49. Please revise the RFI/CMS Report to address these discrepancies, and ensure that adequate justification for selection of proposed monitoring points is provided.

Further, Section 4.3.2, Groundwater, notes that the 2007 data indicated that the highest VOC concentrations of TCE and carbon tetrachloride were detected in well 48MW2. Figure 2-7, SWMU 48 and SWMU 49 Potentiometric Surface Map, shows that well 48MW2 is the most downgradient well at the sites. The extent of contamination beyond well 48MW2 is currently unmonitored. Therefore, it is unclear how the current monitoring well network would include an appropriate number of groundwater monitoring wells to evaluate the effectiveness of the proposed MNA remedial alternative. Please revise the RFI/CMS to propose a network of both ***new*** and existing groundwater monitoring wells that will be monitored to evaluate the effectiveness of MNA, and as noted previously, to satisfy the RCRA requirements for long-term groundwater monitoring of a regulated unit. In addition, please provide a discussion regarding how the existing monitoring well data are sufficient to establish baseline groundwater conditions and how the existing/to-be proposed monitoring network will be appropriate for assessing remedial effectiveness.

RESPONSE: The reviewer seems to have confused the two sites in this report. The VOCs appear to originate at SWMU 49, and upgradient/downgradient are relative to this site. Also see response to General Comment 5.

65. **Section 9.2, Alternative Two, MNA and LTM, Page 9-4**: The proposed approach to LTM does not incorporate the lack of a robust historical groundwater data set. Therefore, it is recommended that as part of the implementation of the LTM program, the initial monitoring period be more aggressive in order to develop a more robust data set. It is recommended that the initial two years of LTM include four rounds of sampling with a reduction to semi-annually from years 3 to 5. Then, a demonstration can be made after the first five years of monitoring that MNA parameters show groundwater is amenable to MNA. If a successful demonstration of reduction of contaminants can be made, then it is recommended that annual monitoring be conducted for the next 5 years. If reduction of MNA constituents to below MCLs can be confirmed over 5 rounds of annual groundwater sampling, then successful completion of the remedy can be established. An expanded monitoring duration needs to occur given that there was an increase in TCE concentrations between 2006 and 2007 (as shown on Figure 9-1), to address any potential rebounding or "bouncing" of MNA constituents which may be occurring.

RESPONSE: Agreed. The change will be made to Section 9.2. Also see response to Comment 62 regarding a contingent remedy that would allow for ISEB if concentrations do not decrease at expected rates.

MINOR COMMENTS

66. **Section 7.1.2 Methodologies for the Identification of COPECs and Concentration Statistics, Page 7-6:** This text contains a typographical error by calling out 'Sections 7.2.2 and 7.2.2' in the second full sentence. The sentence should read 'Sections 7.2.2 and 7.3.2.' Please correct this error.

    RESPONSE: This typographical error will be corrected.

67. **Section 7.1.2.5 Selection of COPECs, Page 7-7:** This text contains a typographical error by calling out 'Sections 2.2.2 and 3.2.2' in the second full sentence. The sentence should read 'Sections 7.2.2 and 7.3.2.' Please correct this error.

    RESPONSE: This typographical error will be corrected.

68. **Table 7-10.** The concentration units (mg/kg or ug/kg) need to be provided in this table.

    RESPONSE: There is a footnote in this table stating that "all values are presented in mg/kg." However, the units now have also been added to the column headings for additional clarification.

Leahy, Timothy

From: Geiger.William@epamail.epa.gov
Sent: Wednesday, July 01, 2009 10:56 AM
To: McKenna, James J CIV (US)
Cc: anne.greene@atk.com; diane.wisbeck@arcadis-us.com; jim spencer; Parks, Jeffrey N; jerome.redder@atk.com; jlcutler@deq.virginia.gov; Mendoza, Richard R Mr CIV USA IMCOM; Leahy, Timothy; Llewellyn, Tim; Tina_Devine@URSCorp.com; Meyer, Tom NAB02
Subject: SWMUs 48 & 49 RFI/CMS comments
Attachments: SWMU 48 & 49 comments.doc

Attached are EPA/VDEQ comments on the SWMUs 48 and 49 RFI/CMS. Please call or email me with any questions.

(See attached file: SWMU 48 & 49 comments.doc)

William A. Geiger
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Presented below are EPA/VDEQ comments on the *Draft Solid Waste Management Units 48 and 49 RCRA Facility Investigation/Corrective Measures Study Report*, Radford Army Ammunition Plant (RFAAP), Virginia, dated February 2009 (RFI/CMS Report).

GENERAL COMMENTS

1. The RFI/CMS Report lacks an adequate presentation of the nature and extent of contamination. The data for previous investigations is, in general, presented separately from the data collected in 2007. Section 4.3, Nature and Extent Summary and Conclusions, presents only limited evaluation of the site's entire data set. This evaluation does not address whether contaminants exceeding applicable screening criteria have been adequately bounded in all directions, including vertically. Figure 3-2, Groundwater and Soil Results at SWMU 48 and SWMU 49, attempts to show those samples which exceeded applicable screening criteria, but its utility is limited. It does not differentiate between surface soil samples and samples collected at depth. It also does not define which specific constituents were detected at each location (and instead only refers to sample exceedances by analyte class such as volatile organic compounds [VOCs], metals, etc.) And finally, groundwater contamination is a concern at both SWMUs but the RFI/CMS has not presented any plume maps which show the limits of the groundwater contamination. Please revise the RFI/CMS to include a more robust evaluation of the nature and extent of contamination which includes data from all investigations at the site. This evaluation should describe the horizontal and vertical limits of contamination in all site media. This evaluation should also be supplemented with appropriate figures, such as isoconcentration maps for key constituents in surface soil, subsurface soil, and groundwater. Plume maps showing the extent of groundwater contamination at different times (i.e., using data collected from 1996 and 2007) are also recommended to show trends over time and lend further confidence to any conclusions regarding the practicality of monitored natural attenuation (MNA) at the sites.

2. The extent of groundwater contamination at SWMUs 48 and 49 does not appear to have been defined during the RFI. Section 4.3.2, Groundwater, notes that the 2007 data indicated that the highest VOC concentrations of trichloroethylene (TCE) and carbon tetrachloride were detected in well 48MW2. Figure 2-7, SWMU 48 and SWMU 49 Potentiometric Surface Map, shows that well 48MW2 is the most downgradient well at the sites. The extent of contamination beyond well 48MW2 is unknown, yet this has not been identified as a data gap in the RFI or CMS. This represents a significant data gap. If groundwater and/or surface water data are available from SWMU 13, located downgradient of the sites, it may be useful in further defining the extent of contamination associated with SWMUs 48 and 49. Please revise the RFI/CMS to address how the horizontal and vertical extent of contamination will be fully defined at SWMUs 48 and 49. It is also noted that bedrock in the area of the site is "highly weathered with many solution cavities" (Section 2.4). Any assessment of groundwater contamination will need to address the uncertainties associated with this highly variable hydrogeologic regime. It should also be noted that an approach to filling this data gap could be included with remedy implementation, if sufficient data exists to adequately assess the proposed remedial alternatives.

3. For the selection of chemicals of potential concern (COPCs) in the human health risk assessment (HHRA), maximum contaminant concentrations were compared to the October 2007 EPA Region 3 Risk-Based Concentrations (RBCs) for soil and tap water. It should be noted; however, that Region 3 now relies on the Regional Screening Level (SL) table available at the website (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm developed by Oak Ridge National Laboratory under an Interagency Agreement with EPA as an update of the EPA Region 3 RBC Table, Region 6 HHMSSL Table and the Region 9 PRG Table. It is recommended that future evaluations use the Regional SL table.

   The SLs may substantially differ from the RBCs since they address dermal, oral, and inhalation exposure while the RBCs only address ingestion exposure. In addition, the SLs no longer support route-to-route extrapolation and the most current toxicity data are reflected in the SL table. The impact of using outdated screening levels should be discussed in the uncertainty analysis.

   From a review of the toxicity data, it appears that the risk assessment utilizes outdated toxicity data for various compounds. For example, Table E.1-43 lists the oral cancer slope factor (CSFo) for TCE as 4.0E-01 $(mg/kg\text{-}day)^{-1}$. However, the Regional SL table lists a CSFo of 1.3E-02 $(mg/kg\text{-}day)^{-1}$ for TCE, as established by California EPA (Cal-EPA). Additionally, Table E.1-43 and E.1-44 do not include any toxicity data for cobalt, but the Regional SL Table includes an oral reference dose for this constituent. Please revise the HHRA to include a discussion in the uncertainty analysis regarding the impact of using outdated screening values and toxicity data, or revise the HHRA to utilize the updated values and toxicity data.

4. The HHRA does not appear to have included all available data for SWMU 48 in the evaluation of site risk. Table 2-1, Previous Investigations Samples and Analyses, indicates that soil samples were analyzed for dioxins/furans during the 2002 Site Characterization conducted by IT Corporation. However, it does not appear that 2,3,7,8-TCDD toxicity equivalent factors (TEFs) were calculated for the soil samples associated with this sampling event and these constituents were; therefore, not included in the COPC selection process for SWMU 48. Appendix E-3, Calculations for 2,3,7,8-TCDD Equivalents – SWMU 48 and 49 Groundwater, only includes TEF calculations for soil samples associated with SWMU 49. Section 4.3.1.1, SWMU 48, indicates that dioxins/furans associated with the 2002 sampling event reported screening limit exceedances, which also suggests that these constituents would likely have been selected as COPCs in soil at SWMU 48 and carried through the risk evaluation. Please revise the HHRA to include all applicable site data in the evaluation of site risk, including the 2002 dioxin/furan data set from SWMU 48, and revise any conclusions as necessary based on the outcome of this evaluation.

5. The Screening Level Ecological Risk Assessment (SLERA) indicates that it used Steps 1, 2, and 3a described in the *1997 USEPA Ecological Risk Assessment Guidance for Superfund* as well as other relevant guidance documents. However, the document does not follow or contain the standard components of a SLERA. The document is difficult to follow and blends components of all three SLERA steps at inappropriate junctures. The following summarizes the changes necessary to complete the SLERA;

a. The document needs to be reformatted to follow a standard EPA guidance outline. The document indicates that it follows Steps 1, 2 and 3a of the Ecological Risk Assessment (ERA) process yet it does not provide the standard elements of each step. Step 1 needs to describe the site setting, problem formulation, endpoints and conceptual site model as well as a discussion of data adequacy for the SLERA. Step 2 provides the methods and results of the screening-level evaluation based on using community-level and individual-level receptor group risk assessments where food chain modeling of bioaccumulative chemicals is also accomplished. The output from Steps 1 and 2 supports the first Scientific Management Decision Point (SMDP). Step 3a uses more refined measurement tools (e.g., background comparisons, exclusion of common elements, evaluating the frequency of detection/frequency of exceedance, refined exposure dose modeling). The document blends all of these lines of evidence together and does not delineate the 'step-wise' process or the SMDP process.

b. The document needs to discuss the data adequacy of the data set used in the SLERAs. Section 7.1.2 briefly describes the steps for deriving a site-specific dataset, but does not provide summary statistics or describe the process by which (and the studies from which) the data were obtained. Please provide a better presentation by showing the entire data set, its sources (i.e., past studies), the locations of the samples, descriptive statistics, and laboratory detection and reporting limits.

c. The current and anticipated future land uses for each site need to be described. The entire document before the SLERA focused on Human Health risk analysis, suggesting that future ecological based land uses are not intended. The SLERAs evaluate potential current conditions using historic data going back to 1998. No mention is made about the uncertainties associated with using these older data to assess current exposures. Please describe the anticipated land uses and the future ecological setting associated with the two sites and the potential issues associated with using older data.

d. The document lacks a fully developed Conceptual Site Exposure Model (CSEM) describing the contaminant fate and transport pathways, potential exposure pathways and potential ecological receptors affected by the exposure. Instead, only an abbreviated food web showing the relationship between receptors of concern is provided. Please develop CSEMs similar to those provided for the Human Health Risk Assessment (Figures 6-1 and 6-2).

e. Step 3a should not be used in a SLERA because it is the first step of a Baseline Ecological Risk Assessment (BERA), unless agreed otherwise with the Agency. Combining Steps 1 and 2 of the SLERA with Step 3a of the BERA precludes the SMDP which occurs after Step 2. A SMDP represents a point where the risk assessor, risk managers, and stakeholders reach consensus on the elements of the risk assessment, including risk management objectives, endpoint selection, and decision criteria before proceeding to BERA, if necessary. Combining these three steps resulted in an unconventional SLERA which did not follow EPA's ERA

guidelines. Please justify this atypical approach, and revise the SLERAs as appropriate.

6. The document states that a direct connection to surface water does not exist (pages 7-1, 7-4). However, two potential indirect pathways could transport COPECs to the New River. These pathways consist of storm water carrying surface materials (if exposed; where in fact 'subsidence' of trenches in SWMU 48 have been noted (pages 2-1 and 2-4)), and (b) groundwater recharge of surface water. Page 2-1 in the report indicates that 'the site setting is situated on a bluff overlooking the New River…based on topography, surface water runoff is expected to flow approximately 700 ft south to the New River' (Page 2-1). The purpose of a SLERA is to address all potentially viable pathways to ecological receptors. The SLERAs should evaluate the subsurface materials given the potential for buried wastes to be exposed (i.e. via storm water erosion or flooding) or for contaminated groundwater to recharge the New River. For conservative purposes, the subsurface soils should be evaluated as well as the groundwater. Applicable SLERA benchmarks (such as those already provided in the document for the terrestrial receptor assessment, and the Virginia State Water Control Board Surface water quality standards [VSWCB, 2008]) should be applied using terrestrial and aquatic endpoints. Please revise the document to evaluate risk to terrestrial receptors exposed to subsurface materials, as well as risk to aquatic organism as related to groundwater (to surface water) exposure.

7. The document repeatedly states that 'soil at SWMU 48 was considered sufficiently characterized (e.g., page 3-1)'. The small size of the site makes it easy to believe that enough data have been gathered by the numerous studies which comprise the data set. However, the surface soil data for SWMU 48 are not consistently presented and raise issues on the adequacy of the data set to support a risk assessment. For instance, 'surface' is defined as 0 – 2 feet (ft) below ground surface (bgs) (as defined in section 7.1.2.1 Data Organization, page 7-6). Hence, drill profile portions and dedicated surface soil samples should comprise this depth-defined data set. Table 7-5 (page 7-21) shows sample 'groupings' comprised of samples collected 0 – 0.5 ft bgs (see Table 3-1, page 3-1), and 0-15 ft bgs (sample groupings 48SB09A and 48SB08a). It does not appear that the soil sample group for SWMU 48 meets the definition of "surface soil". Table 7-5 also lists two sample groups twice (48SB09A and 48SB08a); the summary statistics (Table 7-10) indicate that at most five samples were collected while Table 7-5 suggests that at least six are available. Similar concerns were found with the SWMU 49 site characterization information (section 7.3.1, page 7-37) which indicates that up to nine sample groupings comprised the dataset, yet in certain cases the frequency of analysis was less than nine (see Table 7-13). Please address these issues and clearly discuss the data sets used in the SLERA.

8. The assessment of the invertebrate community was not addressed or presented adequately. Soil invertebrates are a standard community level receptor group which should be evaluated in a SLERA. This document does not present methods or results for this receptor group. Section 7.1.1.1 (page 7-2) states that the RFAAP facility provides habitat to five state-listed plants, one invertebrate and several animals. Section 7.1.8 (page 7-17) describes how direct contact toxicity was evaluated, including using soil invertebrate benchmarks. Section 7.2.3.1 (page 7-26) and Section 7.2.7 (page 7-35) indicate that the risk to soil invertebrates was characterized, but no text presented this

characterization. Similarly, there is no mention of an analysis of impacts to soil invertebrates in the SWMU 49 text (see page 7-44). Soil invertebrates need to be included as a receptor group in the CSEM, the SLERA endpoints, the Step 2 screening process, and the Step 2 and Step 3a risk characterizations. Please revise this document accordingly.

9. The background screening steps applied in the SWMU 48 SLERA are inappropriate. The background screen compares a 'point estimate' of either 'surface' soil or 'all' soil point values to background values. This comparison is inappropriate since the SWMU 48 'surface soil' data set includes two data groupings (i.e., 0-0.5 ft bgs and 0-15 ft bgs) which together do not meet the definition of "surface" soil but rather meet the definition of 'all' soil. Please revisit the data groupings to be used for SWMU 48 surface soil background comparison.

10. The uncertainty analysis (Section 7.2.6 and 7.36) is inadequate. The text for SWMU 48 (pages 7-34 and 7-35) briefly describes the outcome of a screening to evaluate non-detect chemicals and the uncertainty associated with the food chain modeling of two COPECs (chromium and selenium). Also, the evaluation of non-detect Method Detection Limits (MDLs) as compared to screening values is inconsistent with other methods described in the document. Table F-32 summarizes a screening which relies on several different sources of screening benchmarks besides those used for the actual SLERA analysis. At a minimum, the non-detect screening should use the same conservative SLERA benchmarks. Furthermore, the results of this screening should be a part of the COPEC selection process where the non-detected chemicals with elevated MDLs are retained through the SLERA process**.** An uncertainty analysis should identify all sources of uncertainty in the SLERA process. At a minimum, the data adequacy needs to be evaluated to describe if the data set is of sufficient quantity and quality for use in the risk analysis. The uncertainty assessment should then address sources of error in the CSM, screening-level methods and food chain analysis. Please rewrite the uncertainty analysis to provide a complete accounting of the sources of uncertainty in the SLERA.

11. The risk characterization summaries and SWMU-specific risk conclusions (i.e. sections 7.2.3 and 7.2.7 for SWMU 48; and sections 8.2.3 and 8.2.7 for SWMU 49) are inadequate and need further lines of evidence to help derive an appropriate SMDP. The summary information on the food chain and direct contact toxicity evaluations should be combined (along with other lines of evidence) to characterize the risk associated with each COPEC. The direct contact toxicity information is provided in cursory form by only stating the number of benchmarks exceeded. The comparisons provided in Table 7-10 should rely on Hazard Quotients (HQs) to put the degree of exceedance into context. Simplified statements such as those provided on page 7-33 (i.e. 'the manganese MDC exceeded three of the five available benchmarks…') do not help describe the risk associated with the chemical. A figure (such as Figure 3-2) showing the nature of a benchmark exceedance in a geospatial format would provide more useful information than brief summary statements. The document needs to bring together all the COPEC-specific lines of risk evidence, and present COPEC risk characterizations. Each COPEC risk characterization should follow the same format. A recommended format includes discussing the screening HQ exceedances (or lack thereof) for plants and invertebrates a discussion of the food chain receptor HQ analysis, and the direct contact toxicity

analysis. Geospatial lines of evidence, including COPEC dispersion as related to habitat, the presence/absence of habitat and critical species and the land use setting (current and future) are more lines of evidence that should be included into the discussions in order to fully characterize the risk. Please revise this document to provide adequate risk characterization discussions for each COPEC to help draw a defensible SMDP conclusion.

12. The whole SLERA section needs to be thoroughly edited to remove extra terms and to reformat the document to meet standard guidance requirements. The document repeatedly uses the terms Tier I and Tier 2 to denote phases of SLERA decisions. The document should delineate Step 1, Step 2 and Step 3a elements from each other, and present clear SMDP decisions at the end of Step 2 and Step 3a. Other editorial issues include using surface water, sediment, and aquatic life terminology in the text and tables even though the document states that the SLERA does not address aquatic risk since site-related impacts to surface water are not believed to exist. Surface water and sediment exposure terms remain throughout the document (pages 7-1, 7-7, 7-8, and 7-13[and others]) and aquatic life exposure factors appear in various tables. Acronyms are also introduced but are not defined. Finally, several table and section call outs in the text are inaccurate (refer to specific comments below), and several sections have numbering conflicts. Please edit and revise the document accordingly.

13. The food chain calculations could not be verified based on the available information. Example food chain spreadsheets were provided but the formula codes appear to have been lost in the submittal. The document needs to provide examples of each step of the food chain modeling analysis (i.e. using bioaccumulation factors to calculate body burden in prey items) to allow for an independent review. Please revise the document to include this information.

14. Long-Term Groundwater Monitoring (LTM) is included in Section 9.0 as part of Alternatives 2 and 3. The summaries presented on Pages 9-4 and 9-6 indicate that eight existing wells are proposed for inclusion in the LTM program. As the RFI/CMS Report was prepared in response to a Corrective Action Permit, Resource Conservation and Recovery Act (RCRA) requirements for a regulated unit (i.e., Solid Waste Management Unit (SWMU) 48 and 49) will apply. The RCRA requirements for long-term groundwater monitoring of a regulated unit specify that a minimum of one upgradient well and three downgradient wells be monitored. However, the monitoring network for SWMUs 48 and 49 do not include three downgradient wells. Only two downgradient wells are proposed for SWMU 49, and both of these wells (48MW2 and 48MW3) reported some of the highest detections of VOCs. In order to meet RCRA requirements, the RFI/CMS Report should include a proposal for the installation of a minimum of one additional downgradient well for SWMU 49. Placement of this well should be based on an evaluation of relevant site data (e.g., adjacent site and/or regional groundwater flow data), and factors influencing well placement should be discussed in the RFI/CMS Report. The RFI/CMS Report should also clarify how the final groundwater monitoring network and overall LTM program is sufficient to ensure that groundwater contaminants will not be overlooked if released from SWMU 48 and 49 over the long term.

15. The RFI/CMS presents an inadequate assessment of the two proposed active remedies (Alternatives 2 and 3). No figure, schematic, or remedial design layout is presented for Alternative 3 which includes geoprobe injection of emulsified vegetable oil (EVO) along 25 foot centers, along two staggered lines. It is unclear along what trajectory these staggered lines would occur, and therefore, no assessment of the adequacy of this proposed alternative can be made. Please revise the RFI/CMS to include a figure, schematic, or a design layout for Alternative 3.

    Further, the ranking assessment presented in Section 11.0 is not sufficiently detailed. Any detailed assessment should incorporate an assessment of the first seven of the nine assessment criteria. Table 11-1, Ranking Assessment of Corrective Measures Alternatives, does not appear to adequately assess the subcategories in sufficient detail to incorporate each of the assessment criteria discussed in Section 10.0. For example, Alternatives 2 and 3 are ranked as "equal" for effectiveness according to Table 11-1, even though Alternative 3 will be more effective in the short-term, and will likely more readily attain a reduction in toxicity than Alternative 2. Further, as stated on the top of Page 9-6, Alternative 3 also creates a "bio-barrier" to protect the downgradient water from being impacted, which translates to greater overall protection of human health and the environment. This is not reflected in the "equal" effectiveness ranking. Further, given that EVO alternative has a proven track record, that may not require additional logistical considerations, it does not appear to warrant a two evaluation unit downgrade; a one unit downgrade would be more representative. Please revise Section 11.0 and Table 11-1 to more accurately reflect the detailed assessment conducted in Section 10.0.

SPECIFIC COMMENTS

16. **Executive Summary – Screening Level Ecological Risk Assessment, page ES-3:** The text summarizes the SLERA conclusions for SWMU 48 and 49 into an inclusive 'SWMU study area' summary. This approach is inappropriate since the two sites are physically separated and were independently evaluated. If these two sites were to be combined, then the entire SLERA would have to be based on a combined data analysis that would affect all the assumptions and exposure calculations. This information needs to be corrected and presented in a consistent manner with the independent SWMU risk conclusions. The text is also misleading by stating that the SLERA provide(s) 'an estimate of current and future ecological risk' even though future land use impacts and associated ecological assemblages were not described. In addition, the text revisits inappropriate background arguments, and discounts possible groundwater to surface water flow pathways with no substantiation. Please rewrite the Executive Summary to provide an accurate discussion of the SWMU-specific SLERA conclusions.

17. **Page 2-1, section 2.2.** The two sets of unlined trenches for SWMU 48 should be depicted on a referenced figure.

18. **Section 2.5, Site Hydrogeology, Page 2-6:** This section notes that well 49MW01 does not show a water level on Figure 2-7 because the well "was practically dry at the time of measurement (August 2007)." However, it appears that a groundwater sample was collected from this well since analytical results are reported in Table 4-3, Analytes Detected in 2007 SWMU 48 and 49 Groundwater Samples. Furthermore, the field

sampling form for this well, included in Appendix B-3, notes that this well was sampled with a bailer. Please provide further clarification for how a groundwater sample could be collected from a "practically dry" well. Furthermore, please discuss potential implications of sampling with a bailer versus the low-flow sampling that was proposed (i.e., potential loss of VOCs, etc.) and how this will affect the results. Additionally, the boring log for well 49MW01, included in Appendix B-1, appears to show that the well screen may not have been set deep enough to intercept the waterbearing zone at this location. Further, please address what actions will be taken to assure that a well of sufficient depth is available to monitor groundwater concentrations in the source area at SWMU 49. Lastly, for clarity and consistency, please discuss how water level data from this well can be incorporated into Figure 2-7.

19. **Page 2-11, Section 2.6.2.** It would be helpful to augment the labeling system for text and tables to distinguish samples labeled 48 that were actually collected from SWMU 49.

20. **Section 4.0, Nature and Extent of Contamination, Page 4-1:** This section uses the results of the human health based risk analysis to support the nature and extent discussions. Please rewrite this section to also accommodate the SWMU-specific SLERA findings.

21. **Section 4.1.1, Soil Analytical Results, Page 4-1:** Detected constituents are evaluated in this section by comparing them to residential and industrial RBCs and soil screening levels (SSLs). However, the description of the soil screening criteria presented in Section 4.0 does not define the SSLs and their basis. Furthermore, Table 4-1, Analytes Detected in 2007 SWMU 49 Soil Samples, does not include a comparison of the detected analytes to SSLs for migration to groundwater. For clarity, please revise Section 4.1.1 of the RFI/CMS to limit the evaluation of detected analytes to a comparison to RBCs unless SSLs are described prior and SSLs are included on comparison tables. Since a more thorough evaluation of detected analytes to SSLs is presented in Section 4.2, the limited comparison in Section 4.1.1 appears unnecessary.

22. **Section 4.2, Soil Screening Level Comparison, Page 4-12:** The second paragraph states that three VOCS (benzene, vinyl chloride, and methylene chloride) were detected above their respective SSLs, one of which was methylene chloride which exceeded its SSL in "two of 28 samples." The description in the text is not consistent with that which is presented in Table 4-5, 1991-2002 SWMU 48 SSL Transfer Exceedance Summary. Table 4-5 shows SSL exceedances for five VOCs (including 1,2,4-trichlorobenzene and ethylbenzene). Additionally, methylene chloride exceedances were reported in ten of 20 samples. The text also indicates that there were four explosives-related compounds which reported exceedances; however, Table 4-5 shows nine explosives-related constituents. Please revise the RFI/CMS Report to specifically discuss explosives as an analyte group and to address these analytical summary discrepancies. Additionally, please revise any conclusions that are based on inaccurate information included in the text.

23. **Section 4.2, Soil Screening Level Comparison, Page 4-12:** The discussion of SSL exceedances is limited to VOCs, non-polynuclear aromatic hydrocarbons (nPAHs), pesticides, herbicides, explosives, and metals at SWMU 48. Table 4-5 shows that there

were also SSL exceedances for two PAHs and one PCB, yet there is no mention of these constituents in the text. Furthermore, it is noted that several constituents exceeded SSLs at SWMU 49 but the RFI/CMS does not evaluate the potential for these constituents to impact site groundwater. Please revise the RFI/CMS to identify all constituents that exceeded SSLs at SWMUs 48 and 49, and evaluate their potential to impact site groundwater.

24. **Page 4-19. Section 4.3.1.1**. Additional discussion is required to explain the methodology employed to confirm the presence of explosives in subsequent sampling. The ash layer at 6-7 feet is still present. The RFAAP response in Sept. 2007 to EPA Comment 11 indicated that soil removal at SWMU 48 was likely and additional delineation samples would be collected at that time. The depth of contamination (well within most models for soil contact risk) and the lack of "current" pathways are not sufficient justification for no further action.

25. **Page 4-24, Section 4.3.1.2**. The highest concentration of PCB is found at 4-6 ft. bgs and TPH at 17-19 ft. To what extent were these areas delineated? It is not clear how subsequent additional soil sampling collected at different locations shows that soil impacts have been mitigated. For example, it appears that TPH at 48SB5A19 (3570) is compared to 49SB02D (3500) to illustrate a significant decrease in contamination. 2007 sampling focused on surface samples. Additional figures may help to present the rationale for no further action.

26. **Page 4-24, Section 4.3.1.2.** At the end of the section screening level exceedances were compared to groundwater detections. Were these levels SSLs or risk-based or both? Report conclusions should address both in this section and other similar sections in the report. Some additional clarification is required to distinguish the exceedances being discussed.

27. **Page 4-25, Section 4.3.2.** A comparison of data from two sampling events does not necessarily indicate that concentrations have decreased. They could have migrated to another location.

28. **Table 4-5, 1991-2002 SWMU 48 SSL Transfer Exceedance Summary, and Table 4-6, 1991-2007 SWMU 49 SSL Transfer Exceedances Summary:** Both of these tables use "na" in several locations, but its meaning is not defined. For clarity, please define "na" in the notes section of the tables.

29. **Section 5.0, Contaminant Fate and Transport, Page 5-1:** This section uses the results of the human health based risk analysis to support the contaminant fate and transport discussion. Please rewrite this section to accommodate the SWMU-specific SLERA findings.

30. **Section 5.0, Contaminant Fate and Transport, Page 5-1:** The last sentence of the second paragraph on this page states that a "discussion of the fate of risk drivers by natural attenuation factors is presented in Section 5.3." However, this discussion and Section 5.3 could not be located in the RFI/CMS. Please revise the RFI/CMS to address this inconsistency.

31. **Section 5.2, Fate and Transport of Analytes Detected Above Screening Levels, Page 5-2:** The discussion of fate and transport characteristics is limited to four constituents: carbon tetrachloride, tetrachloroetheylene, TCE, and arsenic since these "were identified as risk drivers in the HHRA for SWMUs 48 and 49" (last line on Page 5-2). However, these four constituents were not the only risk drivers in the HHRA, and should not be presented as such. Table 6-4, Summary of Risks and Hazards, identifies multiple risk drivers, including 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, TCDD TE, 1,2-dichloroethane, bis(2-ethylhexyl)phthalate, and pentachlorophenol. Additionally, the HHRA found that lead fails the lead exposure assessment for the maintenance worker, industrial worker, adult resident, and child resident. However, the fate and transport characteristics of these constituents of concern are not described in Section 5.0. Please revise the RFI/CMS to include a more thorough discussion of the fate and transport characteristics of all of those constituents found to be risk drivers in the HHRA. A discussion of fate and transport characteristics by analyte class (i.e., VOCs, semi-volatile organic compounds, heavy metals, etc.) should also be presented for clarity.

32. **Table 6-1, SWMU 48 and SWMU 49 Sample Groupings, Page 6-2**: The third note at the bottom of the table states, "Based on proximity, the groundwater sampling group includes wells from SWMUs 48, 49, 50, and 59." However, the locations of the wells associated with SWMUs 50 and 59 have not been presented on site figures. Additionally, well construction details and groundwater data have not been provided for the wells from SWMUs 50 and 59, so it is unknown whether the data collected from these wells is actually applicable to SWMU 48 and SWMU 49. Please revise the RFI/CMS to identify the locations of wells associated with SWMUs 50 and 59 on a site figure. Additionally, please provide the well construction details and groundwater monitoring results for these wells if they are to be used in the risk assessment.

33. **Section 6.1.1.1, Surface Soil and Total Soil, Page 6-3:** Soil samples used for COPC screening of SWMU 48 were collected during sampling events in 1991, 1994, 1998, 2002, and 2007. Table 3-1, 2007 RFI Samples and Analyses, appears to show that soil samples were not collected at SWMU 48 during the 2007 investigation. Thus, it is unclear what samples were used for the risk assessment. For clarity and defensibility, please address this apparent discrepancy.

34. **Section 6.1.1.1, Surface Soil and Total Soil, Page 6-3:** This section defines surface soil as 0 to 0.5 ft bgs, and total soil as 1 to 15 ft bgs. Since total soil should include both surface soil and subsurface soil, it would appear that total soil should be defined as 0 to 15 ft bgs. Please revise the HHRA to address this discrepancy.

35. **Section 6.1.1.2, Groundwater, Page 6-3**: This section states that groundwater data from only 1998 and 2007 were considered in the risk assessment. According to Table 2-1, Previous Investigations Samples and Analyses, groundwater samples were also collected from several site wells in 2006. Since these data are more recent than the 1998 data set, it should also be included in the risk assessment. Please revise the risk assessment to include the groundwater data collected in 2006, or provide the justification for not considering these data in the risk assessment.

36. **Section 6.1.2, Identification of COPCs, Page 6-4:** It does not appear that the COPC selection process outlined in this section was consistently applied. The third paragraph indicates that analytes for which no screening criteria exist were selected as COPCs. However, this does not appear to have been the case for endrin aldehyde detected in surface soil at SWMU 49. Table E.2-2 of Appendix E-2, RAGS Part D Tables – SWMU 49, indicates that endrin aldehyde was selected as a COPC because no toxicity information was available for this constituent (i.e., endrin aldehyde was designated as "NTX" in the Rationale for Selection or Deletion column of Table E.2-2). However, Table 6-3, Summary of Chemicals of Potential Concern at SWMU 49, does not identify endrin aldehyde as a COPC for this SWMU. Please revise the RFI/CMS to consistently apply the COPC selection process to detected constituents at the site, and include endrin aldehyde as a COPC in surface soil for SWMU 49.

37. **Section 6.2.1, Conceptual Site Model (CSM)/Receptor Characterization, Page 6-7:** This section indicates that a residential scenario is evaluated for clean closure requirements under RCRA. Tables E.1-1 and E.2-1, Selection of Exposure Pathways for SWMUs 48 and 49, respectively, also include off-site exposure scenarios associated with groundwater. However, these potential exposures are not described in Section 6.2.1 or included in the refined CSM for the SWMUs presented in Figure 6-2, Future Land Use Conceptual Site Model for SWMUs 48 & 49. Please revise Section 6.2.1 and both CSM figures in the text (i.e., Figures 6-1 and 6-2) to include off-site receptors since these receptors are evaluated quantitatively in the risk assessment.

38. **Section 6.2.4, Quantification of Exposure: Calculation of Daily Intakes, Page 6-10:** The Johnson and Ettinger (JE) model was used to estimate indoor air concentrations of volatiles migrating from groundwater through the groundwater and into a structure. However, given the karst geology of the site, the JE model does not appear applicable. Section 2.4 notes that "karst topography is dominant throughout the area" and "in the outcrop along the slope, the tectonic breccias and the limestone and dolostone are highly weathered with many solution cavities." Appendix G-1 of the OSWER *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils*, November 2002, (Subsurface Vapor Intrusion Guidance) suggests a number of conditions that under most scenarios would preclude the application of the JE model as implemented by EPA, one of which is "the presence of heterogeneous geologic materials...between the vapor source and building." It further states that the "JE model does not apply to geologic materials that are fractured, contain macropores or other preferential pathways, or are composed of karst." Although a number of uncertainties associated with this model are addressed in Section 6.5, Uncertainties, those associated with karst geology and preferential pathways are not mentioned. Given the limitations of the JE model with respect to karst geology, please revise the HHRA to provide further justification for applying the model to estimate indoor air concentrations at the site. If adequate justification cannot be provided, RFAAP should review the applicable guidance (e.g., subsurface Vapor Intrusion Guidance), choose an alternative approach for characterizing risk and hazards via vapor intrusion, develop estimates of the risk and hazard estimates for the vapor intrusion pathway based on the alternative approach, and revise the RFI/CMS Report accordingly.

39. **Appendix E, Human Health Risk Assessment, Table E.1-11:** It is unclear why an exposure frequency (EF) of 50 days is being used for maintenance workers at SWMU 48. The footnote on this table indicates that site maintenance is anticipated to be conducted once a week with two weeks of vacation a year. However, please note that the *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*, dated December 2002 (SSL Guidance), indicates that an EF of 225 days should be used for outdoor workers in roles including, but not limited to, groundskeepers, gardeners, specified mechanics and repairers, non-specified mechanics and repairers, construction and maintenance workers, and painters. While it appears that maintenance workers at SWMUs 48 and 49 may not encounter the site this frequently, the RFI/CMS Report should include further rationale for not selecting an EF of 225 days or other value falling between the value used by RFAAP and the EPA recommended value (e.g., 100 days, assuming 2 days per week per year, with 2 weeks vacation). Please revise the HHRA to further support the professional judgment that 50 days is the most representative EF for a maintenance worker at this site by describing the anticipated type of maintenance work that is likely to occur. The discussion should demonstrate why the proposed value of 50 days is more appropriate than the EF recommended in the SSL Guidance or any value between 50 and 225 days (e.g., 100 days). Alternately, revise the HHRA to use an EF of 225 days for maintenance workers or other value (e.g., 100 days) demonstrated to be more appropriate for this receptor type. This comment applies to the EF used for the maintenance worker at SWMU 48 and SWMU 49.

40. **Appendix E, Human Health Risk Assessment, Table E.1-14:** The EF for a construction worker is listed as 125 days per year. The 2002 SSL Guidance is cited as the source for this information. However, Exhibit 5-1, Page 5-3 of the SSL Guidance indicates that 250 days per year is the default EF for a construction worker scenario. Please revise the HHRA to use an EF of 250 days for the construction worker. This comment applies to the EF used for the construction worker at SWMU 48 and SWMU 49.

41. **Appendix E, Human Health Risk Assessment, Table E.1-15:** This table includes information for an outdoor industrial worker. However, the text and previous tables refer to this receptor as a maintenance worker. For clarity and consistency, please revise Table E.1-15 to refer to the receptor as a maintenance worker. It is further noted that an EF of 225 days is used for this receptor, which is inconsistent with the EF applied in previous tables (i.e., Table E.1-11). Revise the RFI/CMS Report to eliminate discrepancies regarding the value of EF for maintenance workers and present a consistent value throughout the text, figures, and tables.

42. **Appendix E, Human Health Risk Assessment, Table E.1-18:** The ingestion rate (IR) of tap water by an industrial worker (indoor and outdoor) is listed as 1 liter per day. However, Exhibit 1-2 of the SSL Guidance recommends an IR of 2 liters per day for both indoor and outdoor commercial workers. Please revise the HHRA to use an IR of 2 liters per day for commercial workers. This comment applies to the IR used for the industrial worker at SWMU 48 and SWMU 49.

43. **Section 6.5, Uncertainties, Page 6-35:** When evaluating the uncertainties associated with use of the JE model, it is noted on top of page 6-35 that one assumption of the model

was that a future building would be located in an area with the shallowest depth to groundwater, which is reported as 48.24 feet at SWMU 48 and 97.6 feet at SWMU 49. However, according to the model inputs listed in Appendix E-6, Johnson & Ettinger Model – Input and Output – SWMU 48 Groundwater, 2121 centimeters (69.5 feet) was used as the depth of groundwater for SWMU 48. Please revise the application of the JE model at SWMU 48 to utilize the shallowest depth to groundwater or provide justification for using a depth to groundwater of 69.5 feet at this location.

44. **Section 7.1.1.2, Surface Water and 7.1.1.3 Groundwater, Page 7-4:** The document needs to describe all the components of the CSEM (or lack thereof). The proximity of the sites to the New River create the potential for storm-water to carry surface and eroded subsurface materials, as well as groundwater recharge, to the river. The document needs to provide evidence to show that these pathways are incomplete before they can be dismissed. Otherwise, the SLERA needs to evaluate these two pathways. Please revise the two sections to describe the ecological site setting and CSM pathways associated with surface water runoff and groundwater recharge.

45. **Section 7.1.2.2, Descriptive Statistical Calculations, Page 7-7:** This section is misleading because the SWMU 48 data set was too small to calculate 95% UCL values. Please revise this section to describe the descriptive statistics developed and used in the SLERA.

46. **Section 7.1.3.1, Terrestrial Receptors, Page 7-8:** The first paragraph states that qualitative observations of vegetative stress were collected as a line of evidence. This information can be useful but needs to be tracked with site-specific measures of COPECs. Photographs of the vegetation present at each of the sample locations are also required to support these claims. Finally, comparative 'background' conditions need to be documented to draw the no-effect conclusion. Please provide more information from previous studies to validate the claims of no vegetative stress made in this document.

47. **Section 7.1.3.1, Terrestrial Receptors, Page 7-10 and Figure 7-1:** This section ends with a brief reference to the CSEM provided in Figure 7-1. The SLERA needs to provide a complete CSEM similar to those shown in Figures 6-1 and 6-2 for the human health risk assessment. The CSEM needs to show all potential sources, fate and transport pathways related to the sources, exposure pathways, and potential ecological receptors affected. The current figure and text focus only on the receptors evaluated and do not provide a comprehensive, site- related CSM. Please revise both the text and figure to address these concerns.

48. **Sections 7.1.4.1 Assessment Endpoints, and 7.1.4.2 Measurement Endpoints, Page 7-12:** An endpoint provides a 'concise statement' on the environmental value to be protected (assessment endpoint), and the method by which the potential effects to the value will be measured (measurement endpoints). Endpoints should capture all levels of ecological organization (individuals, communities, populations, feeding guilds) as well as effect levels of concern (survival, growth, reproduction). These two sections are difficult to follow in this respect. The standard community level receptors of concern (plants and invertebrates) appear to have been omitted, and the measurement endpoint section doesn't clearly state the specific measurement endpoints to be evaluated in the SLERA.

These two sections need to be revised to define the ecological endpoints. Once the COPECs have been evaluated in Step 2, these endpoints can be revisited to derive more applicable goals, and thus, more appropriate Step 3a endpoints (i.e., No Observed Adverse Effect Level (NOAEL) measurement endpoints in Step 2, and then Lowest Observed Adverse Effect Levels (LOAELs) in Step 3a). Please revise the document to include the Step 2 endpoints as well as the Step 3a endpoints.

49. **Section 7.1.5, Exposure Estimation, page 7-12:** The text states that an estimate of the nature, extent… of COPEC migration 'considering both current and reasonably plausible future use scenarios' was developed. This document does not clearly define the reasonably plausible future use scenario or the anticipated ecological setting. Please revise the text accordingly.

50. **Section 7.1.5.1, Intake, Page 7-13:** Several issues were identified with this section. Numerous references are made to 'Tier I and Tier 2' steps, as well as to evaluating aquatic wildlife, and drinking water exposure. The text needs to focus on the methods describing the surface soil exposure analysis only. In addition, the definitions for the equation variables need to be revised. The variable F_k is defined as the 'fraction of the k_{th} food type that is contaminated' whereas this factor should be the fraction of the k_{th} food type in the receptor diet. Please review this entire section of text for inaccuracies and revise where appropriate.

51. **Section 7.1.6.1, Selection of Literature Benchmark Values, Page 7-15:** The text refers to uncertainty factors (UFs) (Table F-29) used to extrapolate Toxicity Reference Values (TRVs) from laboratory studies. The information in Table F-29 provides the factors used for intra- and inter-species extrapolations, but not for 'endpoint' extrapolations (i.e. the UF applied for extrapolation of an LD50 to a NOAEL). Please provide more information to identify the endpoint UFs used in this document.

52. **Section 7.1.8, Approach for the Evaluation of Direct Contact Toxicity, Page 7-17:** Several issues were identified with this section. The treatment of soil invertebrates in the SLERA needs to be defined and addressed in this section. It also needs to describe the other types of receptors evaluated as part of the direct contact toxicity assessment (mammals, birds). Finally, it seems that this section lacks information since it contains only one subsection (7.1.8.1). It is recommended that subsurface soils also be evaluated using the direct contact toxicity assessment strategy. Please accommodate these recommendations and revise the text accordingly.

53. **Section 7.2.3.1, Terrestrial Plant Impact Assessment, Page 7-26:** This section needs to describe the results of soil invertebrate impact assessments completed for the SLERAs. Please revise this section to include this information

54. **Section 7.2.3.2 Predictive Risk Estimation for Terrestrial Wildlife, Page 7-26:** This section indicates that Hazard Indices (HIs) were calculated for COPECs with similar toxicity mechanisms. However, the text then goes on to state that summaries were provided in the tables (but where not) and segregation of chemicals by toxicological action was not completed. Please revise the text by removing the reference about HI calculations.

55. **Section 8.1, Summary of Chemicals of Interest, Page 8-1:** The risk assessment identified several risk drivers in groundwater for the future child resident (Table 6-5, Summary of Risks and Hazards), which include bis(2-ethylhexyl)phthalate, carbon tetrachloride, 1,2-dichloroethane, pentachlorophenol, TCDD TEF, tetrachloroethene, trichloroethene, and arsenic. Upon further review of risk table E.2-56, risks associated with ingestion of groundwater exceeded EPA's risk range used to manage site risk (1E-06 to 1E-04) for both carbon tetrachloride (1.3E-04) and arsenic (1.3E-04). Risks associated with dermal contact with groundwater also exceeded this risk range for TCDD TEF (3.4E-04). None of these constituents are mentioned in the discussion in this section on chemicals of interest, nor are they included as chemicals of interest (COI) for corrective measures. The rationale for excluding these risk drivers also has not been presented. Please revise the RFI/CMS to identify carbon tetrachloride, arsenic, and TCDD TEF as COIs in groundwater to be addressed by the CMS, or provide the justification for their exclusion from the COI list.

56. **Page 8-1, Section 8.1.** 2,4,6-TNT was not selected as a COI due to FOD and lack of reproducibility however these conclusions have not been adequately supported in this section or elsewhere in the document. Sample locations and delineation assumptions must be clearly documented and referenced. Different lines of evidence appear to be scattered throughout the report.

57. **Section 8.1, Summary of Chemicals of Interest, Page 8-1:** The last sentence of the first paragraph states that the SLERA concluded that remedial measures solely to address ecological concerns were unwarranted for site soil. Given the numerous concerns identified in the SLERA, remedial measures to address ecological risks should be revisited once all concerns with the SLERA are appropriately addressed.

58. **Section 8.1, Summary of Chemicals of Interest, Page 8-1:** The risk assessment identified several metals that contributed to a total hazard index greater than 1 (aluminum, arsenic, barium, iron, manganese, nickel, thallium, vanadium) for ingestion of groundwater by a future child receptor (Page 6-40). Additionally, site concentrations were above the health protective criterion for lead, and the margin of exposure evaluation for iron indicated that the iron intake was above the allowable range. The discussion provided to eliminate these metals as COIs in groundwater in Section 8.1 lacks sufficient justification. It is stated that, "An analysis of the metals in groundwater indicates that the elevated concentrations are due to the high turbidity in some of the newly installed wells." Graphs plotting turbidity levels against chromium concentrations and the number of metals above the tw-RBC are provided. However, the evaluation does not compare dissolved metals results to total metals results, even though this information is available for the 1998 data set. Additionally, chromium has been selected as the example constituent, but chromium was not identified as a risk driver in the risk assessment. Please provide further justification for eliminating each individual metal that was identified in the risk assessment as a driver for carcinogenic risk or noncancer hazard. The assessment should also discuss those metals that were detected in wells included in the risk assessment, but were not initially installed to monitor groundwater at SWMUs 48 and 49 (i.e., 50MW01). Alternatively, an additional round of groundwater data should be

collected for both dissolved and total metals in the wells used to assess groundwater conditions at Sites 48 and 49.

59. **Figure 8-1, Metal Concentrations and Turbidity, and Figure 8-2, Chromium Concentrations and Turbidity, Page 8-3:** Both of these figures appear to include two 48MW01s even though different data are presented for each. Please clarify if this is a presentation of duplicate data. Additionally, neither of the figures identifies the source and date of the data that are presented. For clarity, please address these concerns.

60. **Section 8.2, Remedial Goals, Page 8-4:** This section indicates that 1,2-DCE was identified as a potential risk driver for groundwater. However, the risk assessment tables in Appendix E appear to show that 1,2-dichloroethane (1,2-DCA) was the risk driver and not 1,2-DCE. Please revise the RFI/CMS to address this discrepancy. Furthermore, it is unclear why all of the potential risk drivers in groundwater are not addressed in this section. As previously noted, it is unclear why a remedial goal is not being considered for TCDD TEF. Table E.1-56 of Appendix E notes that the risk associated with TCDD TEF for a child receptor contacting groundwater is 3.4E-04, which is above EPA's risk range (1E-04 to 1E-06) used to manage site risks. Please revise the RFI/CMS to establish a remedial goal for this constituent unless adequate justification can be presented to eliminate this constituent from further consideration in the CMS.

61. **Section 8.3, Area and Volume of Contamination, Page 8-4:** It is anticipated that the volume estimate presented for impacted groundwater underestimates the total volume of contaminated media. This estimate will need to be revised and updated once the issues identified regarding the extent of contamination and constituents of concern have been addressed. Calculations and/or figures should be presented which demonstrate how the volume presented was derived. Please revise the RFI/CMS to update the volume estimate and present supporting documentation once the extent and constituent concerns have been addressed.

62. **Section 9.2, Alternative Two: MNA and LTM, Page 9-1**: The second paragraph notes that TCE concentrations decreased in wells 48MW2 and 48MW3 between the 1998 and 2007 sampling events, and that this is evidence that natural attenuation is occurring. This section does not note, however, that there was an increase in TCE concentrations between 2006 and 2007 (as shown on Figure 9-1). Additionally, it does not appear that many daughter products of TCE degradation have been identified at the site (cis-1,2-dichloroethylene, vinyl chloride), so it is unclear whether MNA is a viable remedy. It is recommended that *EPA's Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater (MNA Guidance),* September 1998, be consulted in order to present a more defensible assessment of whether MNA is occurring at this site. When evaluating the viability of MNA, three lines of evidence should be considered, as outlined in EPA's guidance. These three lines of evidence include:

    1) Historical ground water and/or soil chemistry data that demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring or sampling points. (In the case of a ground water plume, decreasing concentrations should not be solely the result of plume migration.)

2) Hydrogeologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes active at the site, and the rate at which such processes will reduce contaminant concentrations to required levels.

3) Data from field or microcosm studies (conducted in or with actual contaminated site media) which directly demonstrate the occurrence of a particular natural attenuation process at the site and its ability to degrade the contaminants of concern (typically used to demonstrate biological degradation processes only).

Additionally, Section 2.2 of the MNA Guidance, Initial Site Screening, should be followed and the results documented to provide further evidence that MNA is a viable remedial option for this site, particularly considering that Section 9.2 of the RFI/CMS indicates that conditions at the site may not be favorable for anaerobic biodegradation processes. As part of an MNA assessment, the types of natural attenuation processes active at the site need to be documented. Furthermore, the RFI/CMS should show that the source of the groundwater contamination has been adequately evaluated, and is sufficiently under control so as not to require any additional measures to achieve source control. Please revise the RFI/CMS to include an assessment evaluating whether MNA is a viable remedial option for this site in consideration of the three lines of evidence outlined above and the Initial Site Screening process included in the MNA Guidance, or revise the RFI/CMS to indicate this is a data gap which needs to be addressed. Please also revise the RFI/CMS to include documentation of source control. A contingent decision document might be a possibility where augmented remediation would be required if agreed upon MNA criteria is not met.

63. **Section 9.2, Alternative Two: MNA and LTM, Page 9-4:** The proposed analyses for LTM include VOCs and metals. The RFI/CMS does not specify total and/or dissolved metals nor does it state whether MNA indicator parameters will be sampled. Please revise the RFI/CMS to expand the parameter list to adequately assess the MNA process during LTM.

64. **Section 9.2, Alternative Two: MNA and LTM, Page 9-4:** The wells proposed for LTM are identified under the subheading, Implementation/Rampdown Strategy. The descriptions of some of the wells do not appear accurate. For example, at SWMU 48, well 48MW06 is described as an upgradient well. However, Figure 2-7, Potentiometric Surface Map, shows 48MW06 downgradient of SWMU 48. Furthermore, 48MW07 is described as a downgradient well, but Figure 2-7 shows this well is upgradient of SWMU 48. Additionally, for SWMU 49, well 48MW01 is identified as being inside SWMU 49, but Figure 2-7 does not appear to show this well. Well 49MW01 is instead located inside SWMU 49. Please revise the RFI/CMS Report to address these discrepancies, and ensure that adequate justification for selection of proposed monitoring points is provided.

Further, Section 4.3.2, Groundwater, notes that the 2007 data indicated that the highest VOC concentrations of TCE and carbon tetrachloride were detected in well 48MW2. Figure 2-7, SWMU 48 and SWMU 49 Potentiometric Surface Map, shows that well 48MW2 is the most downgradient well at the sites. The extent of contamination beyond well 48MW2 is currently unmonitored. Therefore, it is unclear how the current monitoring well network would include an appropriate number of groundwater monitoring wells to evaluate the effectiveness of the proposed MNA remedial

alternative. Please revise the RFI/CMS to propose a network of both ***new*** and existing groundwater monitoring wells that will be monitored to evaluate the effectiveness of MNA, and as noted previously, to satisfy the RCRA requirements for long-term groundwater monitoring of a regulated unit. In addition, please provide a discussion regarding how the existing monitoring well data are sufficient to establish baseline groundwater conditions and how the existing/to-be proposed monitoring network will be appropriate for assessing remedial effectiveness.

65. **Section 9.2, Alternative Two, MNA and LTM, Page 9-4**: The proposed approach to LTM does not incorporate the lack of a robust historical groundwater data set. Therefore, it is recommended that as part of the implementation of the LTM program, the initial monitoring period be more aggressive in order to develop a more robust data set. It is recommended that the initial two years of LTM include four rounds of sampling with a reduction to semi-annually from years 3 to 5. Then, a demonstration can be made after the first five years of monitoring that MNA parameters show groundwater is amenable to MNA. If a successful demonstration of reduction of contaminants can be made, then it is recommended that annual monitoring be conducted for the next 5 years. If reduction of MNA constituents to below MCLs can be confirmed over 5 rounds of annual groundwater sampling, then successful completion of the remedy can be established. An expanded monitoring duration needs to occur given that there was an increase in TCE concentrations between 2006 and 2007 (as shown on Figure 9-1), to address any potential rebounding or "bouncing" of MNA constituents which may be occurring.

MINOR COMMENTS

66. **Section 7.1.2 Methodologies for the Identification of COPECs and Concentration Statistics, Page 7-6:** This text contains a typographical error by calling out 'Sections 7.2.2 and 7.2.2' in the second full sentence. The sentence should read 'Sections 7.2.2 and 7.3.2.' Please correct this error.

67. **Section 7.1.2.5 Selection of COPECs, Page 7-7:** This text contains a typographical error by calling out 'Sections 2.2.2 and 3.2.2' in the second full sentence. The sentence should read 'Sections 7.2.2 and 7.3.2.' Please correct this error.

68. **Table 7-10.** The concentration units (mg/kg or ug/kg) need to be provided in this table.

DEPARTMENT OF THE ARMY
US ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
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MCHB-TS-REH

5 MAR 2009

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: Document Titled: "Draft RCRA Facility Investigation/Corrective Measures Study Report for SWMUs 48 and 49, Radford Army Ammunition Plant, Virginia, February 2009"

1. The US 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 and our previous comments on the internal draft report have been adequately addressed. We concur with the selection of remedial alternative two as being protective of human health and the environment.

2. 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-NE (IMNE-PWD-E)
USACE (CEHNC-CX-ES)
USAEC (IMAE-CD/Mr. Rich Mendoza)

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February 12, 2009

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, SWMUs 48 and 49 RCRA Facility Investigation/Corrective Measures Study Report, Draft Document, February 2009
EPA ID# VA1 210020730

Dear Mr. Geiger and Mr. Cutler:

Enclosed is the certification for the subject document that was sent to you on February 5, 2009. Also enclosed is the 5 February 2009 transmittal email.

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

Sincerely,

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

c: Karen Sismour
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09-815-30
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J. McKenna, ACO Staff
P.W. Holt
J. J. Redder
Env. File

Coordination: J. McKenna M. A. Miano

09-815-30
JMcKenna

Concerning the following:

Radford Army Ammunition Plant
SWMUs 48 and 49
RCRA Facility Investigation/ Corrective Measures StudyReport
Draft Document, February 2009

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 (P), US Army
Commanding

SIGNATURE:
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09-815-30
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Greene, Anne

From: McKenna, Jim
Sent: Thursday, February 05, 2009 3:56 PM
To: Greene, Anne; ealohman@deq.virginia.gov; Druck, Dennis E Mr CIV USA MEDCOM CHPPM; diane.wisbeck@arcadis-us.com; durwood willis2; Geiger.William@epamail.epa.gov; Redder, Jerome; jim spencer; jlcutler@deq.virginia.gov; kjsismour@deq.virginia.gov; Llewellyn, Tim; Mendoza, Richard R Mr CIV USA IMCOM; Meyer, Tom NAB02; Parks, Jeffrey N; Timothy.Leahy@shawgrp.com; Tina_Devine@URSCorp.com
Subject: FW: Radford AAP - SWMUs 48 and 49 RFI/CMS Report - Draft (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.

Immediately below are the POCs with tracking numbers:

Jim McKenna, RFAAP, 1Z63V8840193899529
Rich Mendoza, USAEC-RIA, 1Z63V8840194079967 William Geiger, US EPA Region III, 1Z63V8840194896182 Jim Cutler, VDEQ, 1Z63V8840192052579 Elizabeth Lohman, VDEQ, 1Z63V8840192878357 Tom Meyer, USACE-Baltimore, 1Z63V8840193388134 Dennis Druck, USACHPPM, 1Z63V8840190347746

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

Jim McKenna
540 731 5782
Classification: UNCLASSIFIED
Caveats: NONE