US Army Corps of Engineers
Louisville District

Site Investigation of 21 Areas of Concern Former Lockbourne Air Force Base Columbus, Ohio

Final Report
Volume I

Prepared for
U.S. Army Corps of Engineers
Louisville District
Contract No. DACW27-98-D-0022 • Delivery Order 0011

Prepared by

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June 2006

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June 29, 2006

PN 776047

Mr. Jay Trumble
US Army Corps of Engineers, Louisville District
600 Dr. Martin Luther King, Jr. Place
Room 921
Attn: CELRL-ED-EE(TRUMBLE)
Louisville, Kentucky 40402-2230

Re: Final Site Investigation Report
Former Lockbourne Air Force Base
Contract No. DACA27-98-D-0022, D.O. 11

Dear Mr. Trumble:

Please find enclosed two (2) copies of the Final Site Investigation Report for the Former Lockbourne Air Force Base. Also included are copies of the responses to the comments received on the draft document. If you have any questions or comments, please contact me at (513) 782-4745 or e-mail to Karl.VanKeuren@shawgrp.com. Thank you.

Sincerely,

SHAW ENVIRONMENTAL, INC.

Karl Van Keuren, P.G.
Project Manager

cc: Diana Bynum
John Lengel
CT-C (Shirley Garvey)
Laurie Eggert
Paul Kennedy
Bonnie Buthker

Attachments

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Responses to Ohio EPA Comments Dated September 17, 2003
Former Lockbourne Air Force Base
Columbus, Ohio

General Comments:

1. Elimination of chemicals - Many times in the responses to comments, detected chemicals are being eliminated even when they exceed a screening level. Please follow the criteria as listed in the work plan for this project, Section 5.1 Data Quality Assessment and Data Validation, pages 5-1 and 5-2.

Response: Based on Comments #1, 2, and 3, the following screening criteria will be used in the revised report:

- **The metals results will be screened against background.**
- **If a metals result exceeds background, it will be screened against the Region 9 Commercial/Industrial PRGs if it is a carcinogen and 1/10 the Commercial/Industrial PRG if it is a non-carcinogen.**
- **Organic compounds will be screened against the Region 9 Commercial/Industrial PRGs if it is a carcinogen and 1/10 the Commercial/Industrial PRG if it is a non-carcinogen.**
- **For groundwater and surface water samples the samples will be screened against the tap water PRGs (1/10 the PRG for non-carcinogens) and will be compared to the MCLs (but not as a part of the screening criteria).**

2. Comment 1 from Ohio EPA's October 23, 2002 letter - See the first part of the comment. Screening criteria from one project does not automatically apply to other projects. Criteria should be agreed to on a site by site basis. In addition, the evaluation of residential Preliminary Remediation Goals (PRGs) against site data will assist decision making and the determination of institutional controls.

Response: Please see response to Comment 1. Anticipated future land use is Commercial/Industrial and remediation decisions should be made on that basis. Since PRGs and exposure criteria are continually updated, if a residential land use evaluation is required, it will be done when needed.

3. Comment 3 from Ohio EPA's October 23, 2002 letter - The work plan for this project does not state that the Environmental Baseline Survey qualitative risk assessment would be followed for this project. For carcinogenic compounds, the whole PRG value is used as the screening value. For non-carcinogenic compounds, the PRG value is adjusted by 1/10th and the adjusted value is used to screen contaminants that are considered non-carcinogens. This approach provides an order of magnitude margin of error built into the screening process, which allows multiple chemical exposure to be evaluated without exceeding the risk goal of 1E-5 and an HI = 1 from exposure to a single chemical. Please note that during the screening stage, non-carcinogens are not to be evaluated or segregated based on mechanism

or mode of action, or target organ. All non-carcinogenic compounds are considered to be additive in the screening stage of an area of concern (AOC) evaluation. This approach is consistent with the work plan and consistent with Ohio EPA's approach.

Response: Please see response to Comment 1.

4. Comment 4 from Ohio EPA's October 23, 2002 letter - Fate and migration are key aspects of any environmental investigation and risk assessment. Contaminants are present in soil, and therefore, the potential for these to migrate to ground water exists. The soil screening levels (SSLs) included in the PRG tables provide a mechanism to evaluate migration to ground water and should be used to evaluate this pathway.

Response: Soil analytical results will be screened against the SSL (DAF=20) criteria (when available) to evaluate the migration to groundwater pathway. In determining whether further evaluation is warranted based on results of the SSL screen, results from site-specific groundwater analytical results will be considered in assessing the risk due to this pathway.

Specific Comments:

5. Comment 9 from Ohio EPA's October 23, 2002 letter - Ohio EPA agrees with the response as given, however, the first part of Comment 9 was not addressed and needs to be provided..

Response: AOC 109 will be added to the list of sites for no further action and will be added the no further action report. The revised no further action report will be submitted with revised SI report.

6. Comment 10 from Ohio EPA's October 23, 2002 letter - AOC "19" is a typographical error. The comment should have listed AOC 109. It was decided that no further action was needed for AOC 109.

Response: AOC will be removed from page 1-3 and added to the list of sites for no further action.

7. Comment 11 from Ohio EPA's October 23, 2002 letter - The underground storage tanks (USTs) may have been part of the scope that included the 21 AOCs that this report covers, however, the USTs should have their own set of reports. This site investigation (SI) report should cover only the 21 AOCs as given in the work plan.

Response: The UST text will be removed from the SI Report. A letter report will be submitted that covers AOCs 88 and 89 plus comment responses for the AOC 91 Closure Report will be submitted and the report will be revised.

8. Comment 13 from Ohio EPA's October 23, 2002 letter - When might responses to comments and the report for AOC 91 be expected?

Response: The UST comment responses are attached. The revised UST report will be sent

with the revised SI Report.

9. Comment 23 from Ohio EPA's October 23, 2002 letter - In addition to sampling areas near soil boring 17SB02SO01, soil boring 19SB02SO01 should also be sampled at depth.

Response: Section 4 will be revised to recommend additional soil sampling at AOCs 17 and 19 to delineate the vertical extend of PAHs in the unsaturated zone.

10. Comment 26 from Ohio EPA's October 23, 2002 letter - In checking with the Division of Hazardous Waste Management, I was informed that the plume is still moving. This concern remains.

Response: The bullet referencing IRP Site 1 will be removed.

11. Comment 30 from Ohio EPA's October 23, 2002 letter - The discussion of arsenic should not be removed from the report. Arsenic in soil is above background. Also, the soil analyses for AOC 19 are missing from this report. Metals should not be ignored. See Comment 9 above regarding subsurface sampling at AOC 19.

Response: The discussion of arsenic will not be removed – the comment response was referring only to removing the discussion of arsenic relative to the PRG for AOC 17, since arsenic at AOC 17 is not above background. The soil results for AOC 19 will be included in Appendix K. Any additional samples will probably be analyzed for VOCs and metals also.

12. Comment 31 from Ohio EPA's October 23, 2002 letter - Metals found in soil above screening levels should not be eliminated at this point. Arsenic is above background and its PRG and the discussion should not be removed from this report.

Response: The response was only referring to removing the discussion of arsenic relative to the PRG when arsenic is below background.

13. Comment 32 from Ohio EPA's October 23, 2002 letter - Carbazole was detected and should not be removed from the text.

Response: Carbazole was detected and will not be removed from the text.

14. Comment 34 from Ohio EPA's October 23, 2002 letter - The response should be added to the report.

Response: Text will be added that describes additional investigation activities described in the response.

15. Comments 35, 36, 37 and 39 from Ohio EPA's October 23, 2002 letter - According to the work plan, a second soil boring would be used to attempt the collection of ground water. Was this done? A discussion should be added regarding this effort, along with the revisions already proposed.

Response: As stated in Section 2.2 of the Work Plan, "...If the presumed down gradient boring does not yield sufficient volume for sampling, then another boring may be selected. A maximum of two hours will be allowed for groundwater sample collection." The objective was to allow up to 2 hours per AOC for groundwater recharge. Since a saturated zone was encountered at the presumed down gradient borings, it appeared likely that a sample could be collected and the selected boring at each AOC was allowed to recharge for 2 hours. However, at some AOCs, the boring did not yield sufficient water for sample collection. In some instances, the geoprobe drive shoes smear the borehole wall such that a hydraulic connection between the surrounding formation and the screen-point samplers can not be established. In many cases, the hydrostatic pressure will break the smear zone resulting in a hydraulic connection that is sufficient to collect a groundwater sample. However, the smear zone can periodically prevent sample collection. In addition, since there is no sand filter pack, the 0.004 slot screen in the screen-point samplers are susceptible to clogging from fines. This discussion will be added to the text.

16. Comment 40 from Ohio EPA's October 23, 2002 letter - Metals should not be eliminated from the investigation. Barium was detected in soil above background, and therefore, a ground water sample should have been collected from this location. The work plan did not distinguish between screening numbers regarding this proposal. Also, some discussion should be included outlining the concern with volatile organic compounds (VOCs).

Response: The recommended sampling will include metals in groundwater. Also, the following text will be added to Section 3.12. "Although detected VOC concentrations in the groundwater sample were below respective screening criteria, the limited nature of investigations completed to date can not rule out the potential that higher VOC concentrations exist."

17. Comments 41 and 42 from Ohio EPA's October 23, 2002 letter - The responses should be added to the report.

Response: The information presented in responses to comments 41 and 42 will be included in the final report.

18. Comment 43 from Ohio EPA's October 23, 2002 letter - Additional sampling should be conducted at AOC 97. Sediment samples should be collected at depth and the bottom of the lagoon determined. Also, the barrier to installing the piezometer should be determined. Where were the attempts made? Does the lagoon have a liner? More information is needed before a determination can be made regarding AOC 97.

Response: The following discussion will be added to Section 3.14. "Fifteen attempts to install a piezometer down gradient (south) of the lagoon each resulted in refusal at approximately 4 to 5 feet bgs. This area is heavily wooded and tree roots might be responsible for refusal." Additional sampling will be recommended to determine the thickness of the lagoon sediment, to determine if a liner is present, and to further characterize the sediment.

19. Comment 44 from Ohio EPA's October 23, 2002 letter - Please note that cumulative risk must be evaluated in the revised report for all exposed receptors, unless discussion and justification is provided to show that receptors not evaluated are inherently protected by the receptors that are evaluated.

Response: The revised report will include text that justifies the receptors evaluated in the cumulative risk evaluation.

20. Comment 46 from Ohio EPA's October 23, 2002 letter - An explanation is needed detailing why ground water was not available for sample analysis. For example, soil boring 98SB01 is a total of twelve feet deep. The bottom half of the boring is sand, with the water table at eight feet. Why is it that water was not available? The other two soil borings at this location are also twelve feet deep, with the water table at eight feet and the bottom five feet in sand. All three locations would appear to be good candidates for obtaining ground water samples.

Response: See response to Comment #15.

21. Comment 49 from Ohio EPA's October 23, 2002 letter - The lead concentration in surface water at AOC 99 exceeds the MCL and this needs to be stated as part of the discussion. Because the surface water is contained within a package aeration plant, it could probably remain there until the plant is dismantled. In addition, heptachlor should not be eliminated because it exceeds the PRG for that chemical. MCLs and PRGs should be used in conjunction with each other such that the lower value is used for screening and selecting chemicals of potential concern (COPC).

Response: The text will state that the lead concentration is above the drinking water action level. Heptachlor will not be eliminated. The PRGs (or 1/10th the PRG) will be used for screening as described in the response to Comment #1. The contaminants will also be compared to the MCLs, but now as part of the initial screen.

22. Comment 51 from Ohio EPA's October 23, 2002 letter - The information requested in this comment needs to be addressed. The response indicates that construction had not started on the passenger terminal nor had the monitoring wells been abandoned at the time the SI report was written. According to my field log book, the monitoring wells had been abandoned some time before March 12, 2002. I was onsite that date and was informed that the wells had been abandoned. In addition, construction of the passenger terminal had already begun. The SI report was dated June 2002. Also, it was Ohio EPA's understanding that the abandoned monitoring wells would be replaced. This should be discussed.

Response: The report was several months in preparation and was originally submitted to USACE as a draft in March 2002. However, a figure will be included in the revised report that depicts the location of the terminal relative to the groundwater contamination and text will be added to state that the wells were abandoned by the RPA during terminal construction. Additional investigation is already proposed for AOC 19. It will be noted that any future investigations will need to take into consideration the redevelopment of the site.

23. Comment 53 from Ohio EPA's October 23, 2002 letter - The extent of source contamination has not been determined. The highest ground water contamination at AOC 19 is located at an area where there is a lack of soil analyses. More investigation and characterization is needed before a "presumptive remedy" of natural attenuation can be considered. In addition, natural attenuation is not working at Site 41 under the Air Force Real Property Agency (AFRPA). Levels of certain VOCs are well above MCLs and continue to increase over time.

Response: The revised report will not include remediation recommendations.

24. Comment 54 from Ohio EPA's October 23, 2002 letter - The second part of Comment 54 needs to be addressed.

Response: The reference to the surface soil being removed will be deleted from the text regarding soil at AOCs 17, 18, 19, and 103. Additional investigation will be recommended.

25. Comment 56 from Ohio EPA's October 23, 2002 letter - The rationale for selecting the MCL as the remediation goal (in lieu of the PRG) when the MCL is higher than the PRG must be provided. In addition, cumulative exposure must be evaluated to ensure that the cumulative target risk goal is not exceeded and associated residual risks are acceptable. Also, it is too soon to be discussing a remedial design. More information needs to be provided before a decision can be made.

Response: Recommendation of remedial actions will be removed from the text.

26. Comment 57 from Ohio EPA's October 23, 2002 letter - The portion of the comment regarding source areas needs to be addressed. Also, prior to conducting sampling for remedial design, the remedial investigation/feasibility study (RI/FS) needs to be conducted, followed by the proposed plan and the decision document. It appears that this report is projecting too far into the future. The RI/FS may be tailored towards fast-tracking the process, but it should be conducted.

Response: Recommendation of remedial actions will be removed from the text. Additional investigation will be recommended.

27. Comment 62 from Ohio EPA's October 23, 2002 letter - Guidance states that the maximum detected concentration should be used as the default when the calculated value is greater than the maximum detected concentration. The report should be revised accordingly.

Response: The representative concentrations presented on Table 2-8 will be revised to be the maximum detected concentration in instances where the UTL is greater than the maximum detected concentration.

28. Comments 64, 65, 70 and 71 from Ohio EPA's October 23, 2002 letter - See Comment 3 of this letter and revise footnotes b and c as specified in the October 23, 2002 letter.

Response: The tables referenced in these comments will have the footnotes revised to be consistent with the screening process presented in response to Comment #1.

29. Comment 67 from Ohio EPA's October 23, 2002 letter - Comment 67 needs to be addressed. Vinyl chloride exceeded its MCL.

Response: Tables will be reviewed to verify that all analyte concentrations that exceed screening criteria are flagged.

30. Comment 69 from Ohio EPA's October 23, 2002 letter - The second part of Comment 69 needs to be addressed.

Response: Table 3-18 will be reviewed to verify that all detected chemicals listed on Table 3-13 are listed on Table 3-18.

31. Comment 72 from Ohio EPA's October 23, 2002 letter - PRGs should be used for screening when the MCL is higher.

Response: The PRGs will be used as the screening criteria, but the results will also be compared to the PRGs.

32. Comment 73 from Ohio EPA's October 23, 2002 letter - Prior to using a surrogate for screening purposes, the Ohio EPA risk assessor should be consulted to ensure appropriate use and selection of a surrogate. In addition, chemicals that do not have a toxicity value or appropriate surrogates are not to be dropped from the COPC list. They must be retained and discussed qualitatively in the risk assessment.

Response: The revised report will discuss qualitatively chemicals that do not have a toxicity value or an appropriate surrogate.

33. Comment 77 from Ohio EPA's October 23, 2002 letter - My copy of the report does not have the referenced compounds flagged.

Response: It will be verified that the appropriate compounds are flagged. However, the compounds above MCLs appear to be flagged with "{ }" brackets.

Response to USACE Comments Received by OEPA March 15, 2004
Former Lockbourne Air Force Base
Columbus, Ohio

1. Comment 1 - Inorganic results from soil analysis should be screened against Region 9 Preliminary Remediation Goals (PRGs) even though the results do not exceed the background value. Also, maximum contaminant levels (MCLs) and PRGs should be used to screen ground water samples so that the lower value is used as the point value for screening and selecting chemicals of potential concern (COPCs).

Response: The metals results were screened against background and against the Region 9 Commercial/Industrial PRGs.

2. Comment 8 - The UST comment responses were not attached to the letter and still need to be provided.

Response: The UST comment responses will be provided.

3. Comment 15 - The work plan states that closed screen samplers were to be used when collecting ground water samples with geoprobes and should have helped keep clogging from being much of a concern. Was the work plan followed? Also, a second borehole was to be attempted in locations where no ground water was obtainable. This information has been requested three times and an answer is expected. Ground water was noted in most of the boreholes but was not obtainable (This statement should remain in the report.) The text states that no ground water was present in many of the boreholes yet the logs indicate that ground water was encountered.

Response: The work plan was followed. Groundwater samples were not collected from borings if sufficient volume (for all analyses) was not available after two hours' recharge. One reason for the lack of volume may have been that the hydraulic connection between the surrounding formation and the screen-point sampler could not be established. The second possible reason for the lack of volume is that the 0.004 slot screens in the screen-point samplers are susceptible to clogging from fines, thereby not allowing water to pass. A second boring was an option ("may be selected") but was not mandatory.

4. Comment 20 - See the previous comment. At this AOC, the boreholes are twelve feet deep at three locations. At one location, sand was six feet thick, and at the other two locations, it was five feet thick. All thicknesses were at the bottom of the boreholes. In all instances, ground water was found at eight feet below ground surface. By using a closed screen sampler, there should not have been much of a problem with clogging or smearing.

Response: See response to issue No. 3.

5. Comment 23 - Will the requested sampling be conducted?

Response: The decision for additional sampling is not Shaw's decision.

6. Comment 25 - The first part of the comment was not responded to.

Response: The discussion on remediation goals was removed from the document, in response to an earlier comment (see responses to comments date 9/17/2003, item No. 25).

7. Comment 31 - Is the response to this comment correct? Should the comparison be to the MCL and not the PRG as stated here?

Response: The response was incorrect. It should have read, "The PRGs will be used as the screening criteria, but the results will also be compared to the MCLs."

8. Comment 33 - Not all of the chemicals exceeding their MCLs have been flagged at two soil boring locations. In addition, total 1,2-DCE should be broken down into trans and cis forms where they exceed their respective MCLs. Using total 1,2-DCE does not give a true picture. It has no MCL. This comment applies to Figures 3-8, 4-1 and 4-2.

Response: The laboratory reported the total 1,2-DCE concentration, not the *trans* and *cis* forms.

Responses to Ohio EPA Comments on the Draft Site Investigation Report for the Former Lockbourne Air Force Base

Ohio EPA received the Draft Report, Site Investigation for Areas of Concern at the Former Lockbourne Air Force Base, Columbus, Ohio, on July 25, 2002, and has the following comments.

General Comments:

1. Chemicals with a reporting limit exceeding a screening level should be included in the appropriate tables as a chemical of potential concern (COPC). In addition, if any screening levels are exceeded, these chemicals should not be eliminated at this time.

   Response: The method detection limits are much lower than the reporting limits and are below the commercial/industrial PRGs for soil. For water, a few of the tap water PRGs are very low and are below the MDLs. Non-detected analytes were not considered COPCs in the Environmental Baseline Survey that was done on the Air Force property at the facility.

2. The report title should include a reference to the fact that 21 AOCs were investigated. There is more than one project being conducted at the Former Lockbourne AFB.

   Response: The report will be titled "Site Investigation of 21 Areas of Concern..."

3. For non-carcinogenic compounds, the Preliminary Remediation Goal (PRG) is used at 1/10th of its given value to screen contaminants. This approach provides an order of magnitude margin of error built in to the screening process, which allows multiple chemical exposure to be evaluated without exceeding the risk goal of 1E-5 and HI = 1 from exposure to a single chemical. Please note that during the screening stage, non-carcinogens are not to be evaluated or segregated based on mechanism or mode of action, or target organ. All non-carcinogenic compounds are considered to be additive in the screening stage of an area of concern (AOC) evaluation. This approach is used to screen site related data initially during a site investigation. Revise all tables and areas of this report to reflect this comment.

   Response: The qualitative risk assessment in this SI was done in accordance with the work plan and was consistent with the Environmental Baseline Survey that was done on the Air Force property at the facility.

4. Soil results should be evaluated against the Region 9 PRGs soil screening levels to evaluate the potential for the migration of contaminants from soil to groundwater, prior to recommending no further action.

   Response: The qualitative risk assessment in this SI was done in accordance with the work plan and was consistent with the Environmental Baseline Survey that was done on the Air Force property at the facility.

5. An explanation is needed showing how it was determined that exposure to multiple PAHs detected at levels above the PRG was determined to be within the acceptable risk range? Was cumulative exposure to multiple contaminants in multiple media via multiple pathways evaluated to ensure that the target risk goal of 1E-5 for cumulative risk was not exceeded? If so, explain how this was conducted.

Response: The qualitative risk assessment in this SI was done in accordance with the work plan and was consistent with the Environmental Baseline Survey that was done on the Air Force property at the facility. However, in the revised report cumulative risk will be evaluated in cases were multiple chemicals exceed the PRGs.

6. Any AOCs moving forward to a baseline risk assessment will require the evaluation of the construction worker scenario.

Response: Exposure scenarios will be detailed in the work plan for additional work at the site.

Specific comments:

7. Section 1.0 Introduction, page 1-1, first paragraph - The text states that 30 sites were eliminated as AOCs. It might be more correctly stated to say that 23 sites were eliminated because they need no further action and that seven other sites were or will be handled under other programs.

Response: The text will be revised as suggested.

8. Section 1.1 Background, page 1-1, first paragraph, first sentence - The Former Lockbourne Air Force Base (FLAFB) is located in central Ohio and not south central Ohio as stated here.

Response: The text will be revised.

9. Section 1.1 Background, page 1-2, list of AOCs that have been eliminated - AOC 109, Building 1071, needs to be added to this list and added to the report titled "Justification for No Action under DERP/FUDS for 22 Areas of Concern at the FLAFB" dated February 1999. In addition, comments were provided by Ohio EPA on March 11, 1999 to this report, and, to date, have not been addressed. Ohio EPA realizes that funding constraints are holding up the finalization of this report, however, we had three comments and Camp Dresser & McKee had four comments. It seems that it would not take much effort to complete this project.

Response: The comments requested that documentation be provided for agreements between RPA and USACE regarding two sites and for notification of the Navy about possible AOCs on their property. USACE is currently working on providing this documentation.

10. Section 1.1 Background, page 1-3, second list - AOC 19 should be removed.

Response: AOC 19 appears to belong on the list.

11. Section 1.2 UST Removals, page 1-4 - Why are underground storage tanks (USTs) discussed in this report? Only the 21 AOCs investigated in this site investigation (SI) should be discussed. AOCs 90, 91, 92 and 98 have their own reports and, in fact, could be referred to in Section 1.1 Background. That leaves AOCs 88 and 89 needing reports. I am open to suggestions as to how this should be documented. Would a letter report suffice?

Response: The USTs were initially investigated as part of the scope and this section presents information about the geophysical surveys not presented in the closure reports. All the information regarding AOCs 88 and 89 is presented in this section. No additional reports are planned.

12. Section 1.2.2 AOC 89 - UST at Fire Station, page 1-5, line 21 - Dick Haines was the former fire marshal and not the former fire chief as stated here.

Response: The text will be revised.

13. Section 1.2.3 AOC 90 - USTs at Bldg. 320 and 323, page 1-6; Section 1.2.4 AOC 91 - UST at Readiness Crew Bunker, pages 1-6 and 1-7; Section 1.2.5 AOC 92 - UST at Alert Hanger, page 1-7; and Section 1.2.6 AOC 98 - UST at Transmitter Facility, pages 1-7 and 1-8 - On December 5, 2000, Ohio EPA submitted a comment letter regarding these UST removals. The comments were never addressed nor were any final documents received. In addition, Ohio EPA was asked to sign-off on AOC 91 because it was not a BUSTR site and verification of completeness was needed from the State. It appears that Ohio EPA was left out of the loop. No copies of no further action letters were received by this office from BUSTR and no report for AOC 91 has been submitted for approval.

Response: The comments will be responded to and the AOC 91 report will be submitted to Ohio EPA for review. The no further action letters from BUSTR were included in Appendix B of the SI report.

14. Section 1.5.2 Regional Setting, page 1-9 - Lines 7 and 8 need to be joined.

Response: The revision will be made.

15. Section 1.5.3 Site-Specific Geology, page 1-9, line 17 and Section 1.6.1 Regional Hydrogeology, page 1-10, line 21 - The thickness of the gray till is described as at least 10 feet thick in the former section and as at least five feet thick in the latter section. Please correct the text.

    Response: The text will be revised to indicate the till is at least 10 feet thick.

16. Section 1.8.1 Adjacent Land Use, page 1-13, line 2 - It might be more appropriate to refer to the area as the Rickenbacker International Airport.

    Response: The text will be revised.

17. Section 2.2.4.2.3 Groundwater Purging and Sampling Procedures, page 2-6, first paragraph - From the text, it appears that all the monitoring wells in this study were purged dry. Is this true?

    Response: Most, but not all, of the wells were purged dry. The sentence will be revised to read: "The samples were collected after the wells had been purged dry, or a minimum of three well volumes had been removed and the pH, temperature, and conductivity readings had stabilized, or six well volumes had been removed."

18. Section 2.2.7 Impounded Water and Sediment Sampling, page 2-8, first paragraph - Clarification is needed. Section 2.7 is referenced here but it covers record keeping. Was the reference to Section 2.7 in the Field Sampling Plan (FSP)? In addition, the second paragraph refers to Section 2.4 in the FSP for decontamination procedures. Section 2.4 in the report also covers decontamination.

    Response: The reference to Section 2.7 will be removed since the analytical parameters are discussed in Section 3.0 of the report. The reference to the FSP will be removed.

19. Section 2.2.7 Impounded Water and Sediment Sampling, page 2-8, fourth paragraph - This paragraph contradicts itself and needs to be rewritten.

    Response: The paragraph will be rewritten to clarify that the VOC samples were placed directly into the sample containers.

20. Section 2.8 Laboratory Analysis, page 2-15 - The Data Validation Summary Reports in Appendix C indicate that Quanterra was used for the first phase of sample analysis. This section should note that Quanterra was bought out by Severn-Trent Laboratories, Inc. (STL).

    Response: The section will note that the lab is now owned by Severn-Trent.

21. Section 2.9 Data Evaluation, page 2-15, first paragraph - This paragraph should state that the quality control results are found in Tables 2-2 through 2-6. Table 2-1 gives the survey results. In addition, in the third paragraph, there should a discussion of the 2-butanone and toluene found in the trip blanks.

Response: The requested revisions will be made.

22. Section 2.11 Method of Risk Screening, page 2-17, lines 6-9 - A discussion of the hazard index (HI) equaling 1 for non-carcinogens should be added to this paragraph.

Response: The requested revisions will be made.

23. Section 3.2.1 Phase I Site Investigation Field Work, page 3-3, second paragraph - The polyaromatic hydrocarbon (PAHs) soil results for AOC 17 could be compared against numbers showing that the results are related to airport operations after deeper soil samples are collected to determine depth of contamination. For this report, the text should state that the contamination is likely to be non-AOC related but detailed proof needs to be presented in the next phase. This discussion also applies to AOC 19.

Response: Deeper samples (between 6 and 10 feet) were collected from the other two borings at AOC 17 and did not contain PAHs. Therefore, PAHs appear to only be present in the shallow soil. Section 4 will be revised to recommend additional soil samples in the area of 17SB02SO01 to establish that the SVOCs are only in the shallow soil and therefore probably anthropogenic.

24. Section 3.2.1 Phase I Site Investigation Field Work, page 3-4, lines 4 through 19 - Some of the statements made in these three paragraphs do not agree with the information in the related tables. For AOC 18, it states that no semi-volatile organic compounds (SVOCs) were detected and two volatile organic compounds (VOCs) were above screening levels in the ground water. Table 3-12 indicates that two SVOCs were detected and three VOCs were above screening levels. The maximum contaminant level (MCL) was exceeded for lead as well as arsenic. For AOC 19, PAHs should not be eliminated if they are above the PRGs. In addition, vinyl chloride is not the only VOC to exceed a limit. MCLs should also be taken into consideration. For AOC 103, MCLs also need to be taken into account. PRGs are not the only screening tool.

Response: The information in the text will be corrected to match the table. In cases where multiple chemicals exceed the PRGs, a cumulative risk calculation will be done. The MCL screening will be discussed for AOCs 19 and 103.

25. Section 3.2.1 Phase I Site Investigation Field Work, page 3-4, first bullet - Soil Boring 103SB03 should be 103SB01. Also, the sand seams are described as being 1.5-2 feet thick. According to the soil boring logs, the thicknesses are 2-3 feet and could be thicker at one location. The bottom of the boring was in sand.

Response: The text will be revised.

26. Section 3.2.1 Phase I Site Investigation Field Work, page 3-4, third bullet - The plume at Site 1 is approximately 300 feet downgradient of the source, however, this plume is still moving downgradient and has currently reached the farthest monitoring wells from the source.

Response: The results from the downgradient wells at Site 1 fluctuate between low detections and non-detects. Therefore, the plume appears to be stable.

27. Section 3.2.1 Phase I Site Investigation Field Work, page 3-5 - In the first bullet, the compound concentrations should be added to the discussion. In the second bullet, some SVOCs were detected in ground water.

Response: The text will be revised to reflect these results.

28. Section 3.2.2 Phase II Site Investigation Field Work, page 3-5, first paragraph - Clarifications and corrections are needed in this paragraph. Monitoring Well 18MW02 was installed near Soil Boring 18SB03 and not 18SB02 as stated in this paragraph. Monitoring Well 18MW04 was installed close to Soil Boring 18SB02. In addition, Monitoring Well 103MW01 is not close to Soil Boring 103SB01. Also, Monitoring Well 103MW03 is not between AOCs but is a downgradient monitoring well.

Response: The text will be revised to clarify the well locations.

29. Section 3.2.3 Additional AOC 19 Investigation, page 3-8, lines 15 and 16 - The cited sentence refers the reader to Figure 3-8 to locate Soil Boring 19SB02R. The boring needs to be added to the figure. In addition, Figure 3-12 is referred to on page 3-9, line 18. This should be Figure 3-8.

Response: The figure and text will be revised as requested.

30. Section 3.2.4 Risk-Based Evaluation, page 3-9 - The background concentration for arsenic should be used for screening at these AOCs and not the PRG. In addition, the PAHs should be evaluated for this AOC.

Response: The PRG discussion for arsenic will be removed. It will be noted that PAHs were not detected in the two subsurface samples collected at the AOC.

31. Section 3.2.4 Risk-Based Evaluation, page 3-10, first paragraph - Metals found in soil above screening levels should not be eliminated at this point.

    Response: The discussion of arsenic above the PRG will be removed since it is below background.

32. Section 3.2.4 Risk-Based Evaluation, page 3-10, second paragraph - Arsenic and SVOCs should not be eliminated from consideration at this time. In addition, carbazole was listed in this paragraph as being above its PRG but is not flagged in Table 3-23. It might also be mentioned that none of the detected metals has a MCL.

    Response: Cumulative risk will be calculated for this AOC. Carbazole was not detected – it will be removed from the text. It will be noted that none of the metals detected in the groundwater has an MCL.

33. Section 3.2.4 Risk-Based Evaluation, page 3-11, first paragraph - The background concentration in soil for arsenic should be the screening value to use for this project. VOCs should not be eliminated at this time. It should also be stated that the metals detected did not have MCLs.

    Response: The discussion of the arsenic PRG will be removed. VOCs were not eliminated. It will be noted that there are not MCLs for the metals detected.

34. Section 3.3 AOC 49 - Building 783, Small Arms Firing Range, page 3-12, fourth paragraph - The rationale for continuing investigation at this AOC needs more details.

    Response: Additional investigation was proposed to help verify that higher concentrations of VOCs are not present. An additional well will be proposed in the area between 783MW01 and 783MW02, since neither of those wells is directly downgradient of the AOC.

35. Section 3.4 AOC 55 - Possible Waste Disposal Location, page 3-13, second paragraph - Ground water was encountered at all three soil borings at this AOC. An explanation is needed detailing the reasons for not being able to collect a ground water sample.

    Response: The text will be revised to indicate that although the borings penetrated the water table, there was insufficient yield to collect a sample within the time frame specified in the work plan (two hours). The phrase "groundwater was not present in any of the borings" will be removed.

36. Section 3.5 AOC 55A - Possible Waste Disposal Location, page 3-13, third paragraph - Ground water was encountered at two of the three soil borings at this AOC. An explanation is needed detailing the reasons for not being able to collect a ground water sample.

Response: The text will be revised to indicate that although the borings penetrated the water table, there was insufficient yield to collect a sample within the time frame specified in the work plan (two hours). The phrase "groundwater was not present in any of the borings" will be removed.

37. Section 3.6 AOC 56 and AOC 72 - Possible Waste Disposal Location, page 3-14, third paragraph - An explanation is needed detailing the reasons for not being able to collect a ground water sample at either of these AOCs. Soil Boring SB03 had four feet of sand at the bottom of the boring and water was encountered.

Response: The text will be revised to indicate that although the borings penetrated the water table, there was insufficient yield to collect a sample within the time frame specified in the work plan (two hours). The phrase "groundwater was not present in any of the borings" will be removed.

38. Section 3.7 AOC 57 - Possible Waste Disposal Location, page 3-15, line 13 - The AOC listed here should say AOC 57. In addition, in lines 21-25, it should state that the arsenic result for soil is below the background value.

Response: The text will be revised to indicate AOC 57. Since arsenic is below background, the PRG discussion will be removed.

39. Section 3.10 AOC 69 - Possible Waste Disposal Location, page 3-17, second paragraph - An explanation is needed detailing the reasons for not being able to collect a ground water sample at this AOC. Soil Boring SB01 encountered ground water at eight feet.

Response: The text will be revised to indicate that although the borings penetrated the water table, there was insufficient yield to collect a sample within the time frame specified in the work plan (two hours). The phrase "groundwater was not present in any of the borings" will be removed.

40. Section 3.12 AOC 94 - Stained Soil Near Precision Maintenance Lab, page 3-19, second paragraph - Barium has been detected in soil above background. It was agreed that a ground water sample would be collected wherever metals were detected above background in soil. In addition, in the third paragraph, it is stated that additional investigation would be proposed for this area. Details are needed on what the proposed work would be and should also be added to Section 4.3 Proposed Further Action for AOCs 49 and 94.

Response: Barium was below the PRG. Additional investigation was proposed to help verify that higher concentrations of VOCs are not present. The exact details of any additional work will be presented in a work plan, but would probably consist of some limited additional soil and groundwater sampling.

41. Section 3.13 AOC 96 - Well #2, page 3-19 - The monitoring well abandonment form should be added to this report.

Response: The abandonment form could not be located in the Air Force or RPA files.

42. Section 3.14 AOC 97 - Sewage Treatment Facility and Lagoon, page 3-19, first paragraph - This section should include a discussion of the disposal of sludge from this operation. Was it spread on a nearby field?

Response: Dick Haines, AFCEE field Engineer, checked with Dave Edwards (who used to be in charge of the base sewage operations) about the lagoon. Dave said they never had to remove sludge from the lagoon because most of it was removed by the package plant treatment systems at the trailer court and the dog kennel. The sludge that accumulated in the package plants was generally removed by a vacuum truck and taken to the City of Columbus sewage plant. On several occasionally the sludge was removed and disposed of in an on-base sanitary sewer and was subsequently treated at the on-base treatment plant.

43. Section 3.14 AOC 97 - Sewage Treatment Facility and Lagoon, page 3-20, third paragraph - More details are needed on the lagoon. What is the depth of the sediment in this lagoon? Were samples collected beneath the lagoon? Is there a possibility that ground water has been impacted?

Response: The depth of sediment in the lagoon is not known. Only surface samples were collected. Fifteen attempts were made to install a piezometer. Refusal occurred in every hole at approximately 4 to 5 feet. No groundwater sample was collected.

44. Section 3.14 AOC 97 - Sewage Treatment Facility and Lagoon, page 3-20, lines 30-33 - PCBs should be screened against their respective PRG value. In addition, explain how cumulative risk was evaluated to determine that exposure to multiple contaminants via multiple pathways/routes did not exceed the target risk range.

Response: PCBs were screened against the PRGs but the TSCA cleanup criteria were also considered. The qualitative risk assessment was done in accordance with the work plan and was consistent with the Environmental Baseline Survey that was done on the Air Force property at the facility. Cumulative risk will be evaluated in the revised report, but only for commercial/industrial worker cumulative exposure to soil or tapwater.

45. Section 3.14 AOC 97 Sewage Treatment Facility and Lagoon, page 3-21, lines 1 and 2 - Chemicals that do not have PRGs available are not to be excluded as potential chemicals of concern using the rationale that there is no value to compare to.

Response: Table 3-55 indicates that benzo(g,h,i)perylene and endrin aldehyde are not excluded. However, the text will be revised to indicate that the concentrations of both chemicals are well below the PRGs for the respective surrogate compounds pyrene and endrin.

46. Section 3.15 AOC 98 Base Communications Center and Transmitter Facility, page 3-21, third paragraph - An explanation is needed detailing the reason(s) for not being able to collect a ground water sample in any of the three soil borings installed in this AOC. All three borings encountered ground water at eight feet below the surface. There was a minimum of five feet of sand in two of the borings and a minimum of six feet in the third boring.

Response: The text will be revised to indicate that although the borings penetrated the water table, there was insufficient yield to collect a sample within the time frame specified in the work plan (two hours). The phrase "groundwater was not present in any of the borings" will be removed.

47. Section 3.15 AOC 98 Base Communications Center and Transmitter Facility, page 3-21, line 33 - Figure 3-23 should be referenced. In addition, line 35 should probably state that the Aroclor detected in Transmitter #1 is 1260 and the result should be listed in Table 3-58.

Response: The figure reference will be added. The text and table will be corrected to indicate Aroclor 1260 was detected in Transformer #1.

48. Section 3.15 AOC 98 Base Communications Center and Transmitter Facility, page 3-22, second paragraph - Aroclor 1260 needs to be added to Table 3-60.

Response: Table 3-60 should be titled "Soil" not "Transformer Oil" and will be corrected.

49. Section 3.16 AOC 99 Package Aeration Plant, page 3-23, lines 14 and 15 - The sentence referring to lead should indicate what action level is being referred to. The previous sentence mentions three possibilities. In addition, an explanation should be included providing the rationale for recommending no further action when heptachlor exceeds screening criteria.

Response: The text will be revised to indicate that the lead concentration is below the surface water background value. The reference to the action level will be removed. The text will be revised to indicate that heptachlor is eliminated because it is less than the MCL.

50. Section 4.0 Recommendations, page 4-1 - This section may need to be revised upon resolution of the comments on this report. Further investigation may be needed at the lagoon located at AOC 97 and there is some uncertainty associated with the lack of ability to collect ground water samples at AOCs 55, 55A, 56, 68 and 98. In addition, the discussion on PAHs in lines 10-13 may need to be revised to reflect earlier comments. It may be too early in the investigation to determine what has caused the PAH contamination of soil at AOCs 17 and 19. Possible sources and non-point sources should be discussed using them to determine whether the contamination is source related. The extent needs to be determined at AOCs 17 and AOC 19.

Response: The recommendations section will be revised to reflect the resolution of comments on other sections of the report.

51. Section 4.1 Proposed Further Actions for AOCs 17, 18, 19 and 103, pages 4-2 through 4-8 - Before proposing the remedial actions for these AOCs, some additional information and investigation is needed. Firstly, a discussion is needed covering the construction of the passenger terminal at AOC 19 and how this impacts the environmental investigation in this area. In addition, three monitoring well were abandoned during the construction of the terminal. That was not discussed, nor was a figure (uncluttered) included depicting the location of the terminal and the location of ground water contamination. Secondly, data gaps at AOCs 18, 19 and 103 should be identified and discussed.

Response: At the time the report was prepared, the passenger terminal had not been constructed and the monitoring wells had not been abandoned. The construction of the terminal and abandonment of the wells were performed by RPA. If this information is provide by RPA, it will be included in the revised report.

52. Section 4.1 Proposed Further Actions for AOCs 17, 18, 19 and 103, page 4-2, third paragraph - On

line 26, add OEPA as one of the signatories.

Response: The text will be revised as requested.

53. Section 4.1 Proposed Further Actions for AOCs 17, 18, 19 and 103, page 4-3 - The proposal of using a "presumptive remedy" as determined by the Superfund Acceleration Cleanup Model (SACM) is premature and may not be appropriate. The geology is similar, however, no comparison of chemical concentrations has been made between these AOCs and the referenced sites. In addition, the extent of source contamination has not been determined. The highest ground water contamination at AOC 19 is located at an area where there is a lack of soil analyses. In summary, proof is needed to use a "presumptive remedy". The remedial investigation/feasibility study conducted on Air Force Base Conversion Agency property may not be used for the above four AOCs without showing that natural attenuation will work.

    Response: Additional information will be added that compares the chemical concentrations. The document titled "Two-Year Review of Remedial Actions Performed at IRP Sites 2, 21, 42, and 43" was submitted to Ohio EPA by AFCEE in December 2002. This document indicates that hot spot removal and natural attention is effective at the facility.

54. Section 4.1.1.1 Summary of Soil Contamination at AOCs 17, 18, 19 and 103, page 4-4, lines 14 and 15 - Are you certain that surficial soil will be removed? In addition, the extent of soil contamination has not been determined. Before conducting a source removal, the extent of soil contamination is needed.

    Response: The text will be revised to reflect the actual redevelopment that has occurred.

55. Section 4.1.2 Recommendations of Further Action for AOC 19, page 4-5 - Comparisons are made between AOC 19 and Sites 21 and 42, however, chemical concentrations also need to be compared to show that the levels of contamination are similar.

    Response: A discussion of the chemical concentrations will be added.

56. Section 4.1.2 Recommendations of Further Action for AOC 19, page 4-7, line 19 - MCLs and PRGs may be used as action levels, depending on which number is lower. In addition, the last paragraph discusses a hot spot removal. Where is this hot spot located given that it appears that this has yet to be defined?

    Response: USACE proposes using the MCLs as the remediation goal in cases where the MCL is higher than the PRG. The hot spot removal refers to removal of aquifer material, not vadose zone contamination. The exact area to be removed will be determined as part of the remediation design.

57. Section 4.1.3 Recommendation of Further Action for AOC 18 and AOC 103, page 4-8, lines 5 through 15 - Soil samples should be collected for analysis from the proposed sampling area to determine vertical and horizontal extent. This is needed to determine any source areas. A risk evaluation or risk assessment would be needed and the data would need to be validated. Only monitoring well samples for VOC analysis is acceptable for a risk assessment.

    Response: The groundwater at AOCs 18 and 103 exceeds the MCLs, which are the proposed remediation goals. Therefore, the proposed use of the additional data is remediation design, and the need for data validation and risk assessment is not clear.

58. Section 4.2 Proposed Further Action for AOC 75, page 4-9, line 1 - Sampling of ground water should also be conducted beneath the old runway.

    Response: The text will be revised to indicate that the soil and groundwater beneath the runway should be sampled.

59. Section 4.3 Proposed Further Action for AOCs 49 and 94, page 4-9 - General details should be given outlining the additional work.

    Response: General details have not been established yet. This will likely involved discussions between USACE and Ohio EPA and could be affected by the availability of funding.

60. All tables should be checked and revised to address specific comments regarding footnotes.

    Response: The table footnotes will be checked and revised as necessary.

61. Table 2-7 Analytical Results of Trip Blanks - Clarification is needed. The report text states that two trip blanks had 2-butanone and toluene in them. This table shows only one chemical in two different samples.

    Response: The report text cited could not be located.

62. Tables 2-8 Soil Background Concentrations, 2-9 Groundwater Background Concentrations, 2-10 Sediment Background Concentrations and 2-11 Surface Water Background Concentrations - If the 95% upper tolerance limit (UTL) exceeds the maximum detected concentration for a chemical, then the representative background concentration of the chemical defaults to the maximum concentration detected. For instance, the representative concentration of aluminum should be

1.9E+4 instead of 2.2E+04 mg/kg. Revise these tables so that the representative concentration of each individual chemical is the lower value of the maximum detected concentration vs. the 95% UTL. Chemicals with a sample size of less than five should be included in this summary table and evaluation. Typically, a limited number of samples are collected during site investigations, so the low sample size is not unusual and the results of chemicals having five or less samples must be included in this summary table and background evaluation.

Response: The background values are based on the 95% UTL not the maximum detection when lower, which is consistent with previous work at the facility. Results were not eliminated based on the frequency of detections or number of samples.

63. Table 3-1 Summary of Risk Based Screening and Recommendations - Explain how cumulative risk was evaluated to ensure that the PRG risk of 10E-5 is not exceeded. For example, this is stated in AOC 97.

Response: The text states that the cumulative risk would be in the target risk range, which USEPA defines as between 10^{-6} and 10^{-4}. Only two compounds exceeded 10^{-6} and both were less than 10^{-5}, so cumulative risk could not exceed 10^{-4}. Cumulative risk will be calculated for AOCs that have multiple chemicals above the PRGs.

64. Table 3-5 Risk Based Evaluation of Soil for AOC 9 Building T-263 Photo Lab - See Comment 2. In addition, Footnote b should be revised.

Response: It is assumed this comment is actually referring to Comment 3. The chemicals were screened against the PRGs which is consistent with the site investigation work done by AFCEE at the facility.

65. Table 3-6 Risk Based Groundwater for AOC 9 Building T-263 Photo Lab - See Comment 2 and revise Footnote c.

Response: It is assumed this comment is actually referring to Comment 3. The chemicals were screened against the PRGs which is consistent with the site investigation work done by AFCEE at the facility.

66. Tables 3-7 Soil AOC 17 Building T-530 Base Engineer's Shop, 3-8 Soil-AOC 18 Building T-532 Base Engineers Maintenance and Inspection, 3-9 Soil AOC 19 Building T-535 Engine Cleaning Building and 3-10 Soil AOC 103 Building T-531 Battery Shop - Add the depth of each soil sample to each of these tables. In addition, the footnote regarding the result exceeding the MCL should be removed because these values do not apply to soils.

Response: The requested changes will be made.

67. Table 3-14 Groundwater - AOC 103 Building T-531, Battery Shop - Sample results exceeding a MCL should be flagged.

Response: Results exceeding MCLs were flagged.

68. Table 3-16 Groundwater Levels and Elevations, AOCs 18, 19 and 103 - The water level and groundwater elevation values for Monitoring Wells 18-MW02 and 103-MW02 have been switched and need to be corrected. See Figure 3-6 in this report.

Response: The table is correct. The figure will be corrected.

69. Table 3-18 Analytical Results Summary AOC 19 Former Building 535 - State whether these results reflect ground water or soil data and add the date of the sampling event. In addition, all of the chemicals detected and listed on Table 3-13 are not listed on Table 3-18. They should be.

Response: The table will be revised to indicate it is DSITMS groundwater data from May 2001.

70. Table 3-19 Risk Based Evaluation of Soil for AOC 17 Building T-530 Base Engineer's Shop; Table 3-20 Risk Based Evaluation of Groundwater for AOC 17 Building T-530; Table 3-21, Table 3-23, Table 3-24, Table 3-25, Table 3-26, Table 3-31, Table 3-32, Table 3-34, Table 3-36, Table 3-38 and Table 3-40 - See Comment 2 and revise Footnote b accordingly.

Response: It is assumed this comment is actually referring to Comment 3. The chemicals were screened against the PRGs which is consistent with the site investigation work done by AFCEE at the facility.

71. Table 3-28 Soil AOC 49 Building 789 Small Arms Firing Range; Table 3-33 Soil AOC 55; Table 3-35 Soil AOC 55A; Table 3-37 Soil AOCs 56 and 72; and Table 3-39 Soil AOC 57 - See the second part of Comment 64.

Response: It is assumed this comment is actually referring to Comment 3. The chemicals were screened against the PRGs which is consistent with the site investigation work done by AFCEE at the facility.

72. Table 3-63 Risk Based Evaluation of Surface Water for AOC 99 Building 777 Package Aeration Plant and Table 4-3 Chemicals of Interest in Groundwater for AOCs 18 and 103 - Clarify what

footnote "f=action level" corresponds to. What action level are you referring to?

Response: Lead and Copper do not have MCLs, which are health based, but do have action levels in the National Primary Drinking Water Regulations. This will be added to the footnote on all appropriate tables.

73. Table 4-1 Chemicals of Interest in Soil for AOCs 17, 18, 19 and 103 - Revise Footnote b to include chemicals that are detected but do not have screening criteria as COPCs. Revise all tables where this comment is applicable.

Response: In the revised report, chemicals that do not have a PRG or MCL will be screened against a surrogate if available. Chemicals that do not have toxicity values or appropriate surrogates will not be retained as COPCs, since it is not possible to evaluate the risk associated with them.

74. Table 4-4 Comparison Between AOC 15 and Sites 21 and 42 - AOC 15 should be AOC 19.

Response: The table will be revised.

75. Figure 3-9 AOC 49 - The label for Monitoring Well 783MW01 should be moved. The outline for the old leach field obscures part of the well label.

Response: The label will be moved.

76. Figure 4-1 AOC 19 TCE, Vinyl Chloride and DCE in Groundwater - This figure needs to be simplified to make it readable. It should show the new passenger terminal, new roads and the monitoring wells that were abandoned.

Response: The figure will be revised.

77. Figure 4-2 AOCs 18 and 103 TCE, Vinyl Chloride and DCE in Groundwater - Concentrations that exceed MCLs should also be flagged.

Response: The results that exceed MCLs are already flagged as noted in the legend.

78. Appendix C - The reason codes used in the Data Validation Summary Report should be explained.

Response: A table of reason codes will be added to Appendix C.

79. Appendix E - Field Borehole Log for lagoon piezometer - A discussion of the failure to install a piezometer should be included in the text of the report, including the reasons for the failure.

Response: The reason a piezometer was not installed (refusal) will be explained in the text.

80. Appendix Q - The TCLP sampling results should be included in this appendix.

Response: The TCLP results are archived off-site and cannot be easily retrieved.

FINAL REPORT

SITE INVESTIGATION
OF
21 AREAS OF CONCERN
FORMER LOCKBOURNE AIR FORCE BASE
COLUMBUS, OHIO

Project No. 776047
Contract No. DACA27-98-D-0022, Delivery Order 11

PREPARED FOR

U.S. Army Corps of Engineers
Louisville District

PREPARED BY

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June 2006

CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Shaw Environmental, Inc., has completed the Site Investigation, Former Lockbourne Air Force Base. Notice is hereby given that an independent technical review (ITR) has been conducted that is appropriate to the level of risk and completely inherent in the project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions, methods and procedures used in the analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing Corps policy. In addition, the ITR verified that the document is consistent with the Site Investigation Report described in the Work Plan; the format (e.g., headers, spacing) is consistent and in accordance with professional standards; and data presented in text, tables, and appendices are consistent with each other.

Karl Van Keuren
Project Manager

6/29/2006
Date

Ida Bennett
Independent Technical Reviewer

6-29-2006
Date

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List of Acronyms

AFBCA	Air Force Base Conversion Agency
AFCEE	Air Force Center for Environmental Excellence
AOCs	Areas of Concern
ARARs	Applicable, Relevant and Appropriate Requirements
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
BRAC	Base Realignment and Closure Program
BTEX	benzene, toluene, ethylbenzene, and xylene
BUSTR	Bureau of Underground Storage Tanks
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
cm/sec	Centimeters per second
COC	chain-of-custody
DCA	dichloroethane
DCE	dichloroethene
DERP/FUDS	Defense Environmental Restoration Program/Formerly Used Defense Site
DoD	Department of Defense
DOT	Department of Transportation
DSITMS	Direct Sample Ion Trap Mass Spectrometer
DVSR	data validation summary report
EBS	Environmental Baseline Survey
FID	flame ionization detector
FLAFB	Former Lockbourne Air Force Base
FSP	Field Sampling Plan
gpm	gallons per minute
GPS	Global Positioning System
ID	inside diameter
IDW	investigative derived waste
IRP	Installation Restoration Program
IT	IT Corporation
MCL	Maximum Contaminant Level
µg/L	microgram per liter
µg/kg	microgram per kilogram
mg/kg	milligrams per kilogram
ml	milliliter
MSL	mean sea level
NDAI	No DoD Action Indicated
NTU	nephelometric turbidity unit
O.D.	outside diameter
OEPA	Ohio Environmental Protection Agency
OHANG	Ohio Air National Guard
PAH	polyaromatic hydrocarbons
PCB	polychlorinated biphenyls
PETG	polyethylene terephthalate, glycol modified

List of Acronyms (continued)

PID	photoionization detector
PRAC	Preplaced Remedial Action Contract
PRG	Preliminary Remediation Goal
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
QC	quality control
RADD	Remedial Action Decision Document
RANGB	Rickenbacker Air National Guard Base
RI/FS	Remedial Investigation/Feasibility Study
RPA	Rickenbacker Port Authority
SI	Site Investigation
SVOC	semivolatile organic compounds
TAL	Target Analyte List
TCL	Target Compound List
TCE	trichloroethene
TSCA	Toxic Substance Control Act
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tank
UWBZ	upper water-bearing zone
UXO	unexploded ordnance
VC	vinyl chloride
VOA	volatile organic analysis
VOC	volatile organic compound

List of Appendices

1.0 Introduction

This Site Investigation (SI) Report involves the investigation of a Defense Environmental Restoration Program/Formerly Used Defense Site (DERP/FUDS) site known as the Former Lockbourne Air Force Base (FLAFB). Originally 51 sites were identified as potential Areas of Concern (AOCs) at this facility. Twenty-three of the sites were eliminated as AOCs because they need no further action and seven other sites were or will be handled under other programs as described in Section 1.1 of this report. The remaining 21 sites were investigated to determine if the sites could be closed out with a "No DoD (Department of Defense) Action Indicated" (NDAI) determination, if interim removal actions are required, or if additional investigation is required. This SI Report presents the results of the investigations conducted by Shaw Environmental, Inc. (Shaw) at the 21 sites. This project was conducted under contract to the United States Army Corps of Engineers (USACE), Louisville District.

This section of the report describes a brief history of the facility; an inventory of the sites that were investigated; a description of the installation that includes the site geology, hydrology, ecological settings, and community settings; and a description of the components of this report.

1.1 Background

FLAFB is located in central Ohio, 12 miles southeast of downtown Columbus and one-half mile east of the village of Lockbourne (Figure 1-1). The base is located in Franklin and Pickaway Counties. FLAFB was originally named the Northeastern Training Center of the Army Air Corps and later renamed the Lockbourne Air Force Base. Construction on the base began in 1942. The base consisted of 1,574 acres by the end of 1942 and had two runways; a north-south and an east-west, and an X-shaped taxiway system connecting the two. The current runway configuration was constructed in 1951 while the base was occupied by the Strategic Air Command. The base at that time encompassed over 4,000 acres. The base was renamed Rickenbacker Air Force Base in 1974. In 1980, the base was closed, transferred to the Ohio Air National Guard (OHANG), and renamed the Rickenbacker Air National Guard Base (RANGB). In 1982, the base began the process of disposing of properties, including the transfer of 1,642 acres to the Rickenbacker Port Authority (RPA) in 1984 and 1985. The RPA name was later changed to the Columbus Regional Airport Authority (CRAA). The property owned by the CRAA is named the Rickenbacker International Airport.

The CRAA identified 51 areas that could potentially be AOCs. Approximate locations of the 51 areas are shown on Figure 1-2. After reviewing historical documentation and performing site visits, 22 of the 51 potential AOCs did not need to be included in the scope of this SI. These sites were eliminated because the sites had been extensively redeveloped, were not on property deeded to the CRAA, had never existed, or had been mitigated. The AOCs that have been eliminated are as follows:

- AOC 1 - Aircraft gasoline pipeline
- AOC 6 - Armament storage
- AOC 7 - Oil storage
- AOC 8 - Aircraft refueling
- AOC 14 - Pumphouse battery
- AOC 27 - Warehouse and ordnance office
- AOC 28 - Ordnance ammunition
- AOC 29 - Magazine for pyro storage
- AOC 30 - Igloo for black powder
- AOC 31 - Magazine for segregated storage
- AOC 35 - Fuel storage crew house
- AOC 37 - EXP gasoline tank
- AOC 41 - Skeet range
- AOC 52 - Aircraft weapons calibration
- AOC 85 - Underground storage tank (UST) at hospital
- AOC 86 - Transformer area at hospital
- AOC 87 - UST
- AOC 93 - UST at Rickenbacker FTZ 138
- AOC 95 - Stained soil near maintenance hangar
- AOC 105 - Magazine for SA, AM
- AOC 106 - Non-conventional weapons assembly and storage
- AOC 107 - Diesel fill pipe

These AOCs have been addressed in the *Draft Justification for No Action under DERP/FUDS for 22 Areas of Concern, Former Lockbourne Air Force Base, Ohio* (IT, 1999a).

The following six AOCs involve underground storage tanks that were removed under the USACE Preplaced Remedial Action Contract (PRAC):

- AOC 88 - UST north of Bldg. 250
- AOC 89 - UST at Fire Station
- AOC 90 - UST at Bldg. 320 and 323

- AOC 91 - UST at Readiness Crew Bunker
- AOC 92 - UST at Alert Hangar
- AOC 98 - UST at Transmitter Facility

Documentation of the removals is presented in a letter report under a separate cover.

The following two AOCs require additional work prior to conducting Site Investigation activities for contamination:

- AOC 61 - Target butt
- AOC 74 - Area extending from target butt to calibration pad.

Specifically, the target butt needs to be inspected for structural integrity since it is badly damaged by unexploded ordnance (UXO) demolition conducted there in the past. The target butt and the area between the target butt and the calibration pad may also require a UXO clearance prior to conducting site investigation activities.

The following AOC was not investigated as part of this project because the facility has been used since the property was transferred to CRAA:

- AOC 109 - Non-destructive inspection shop

The remaining 21 AOCs are the subject of this report. These AOCs are:

- AOC 9 - Photo lab
- AOC 17 - Base engineer's shop
- AOC 18 - Base engineer's maintenance and inspection
- AOC 19 - Engine cleaning building
- AOC 49 - Small arms firing range
- AOC 55 - Possible waste disposal location
- AOC 55A - Possible waste disposal location
- AOC 56 and 72 - Possible waste disposal locations
- AOC 57 - Possible waste disposal location
- AOC 65 - Horse barn and stable
- AOC 68 - Possible waste disposal location
- AOC 69 - Possible waste disposal location
- AOC 75 - Indoor firing range
- AOC 94 - Stained soil near Precision Maintenance Lab
- AOC 96 - Well #2

- AOC 97 - Sewage treatment facility and lagoon
- AOC 98 - Base communication center and transmitter facility
- AOC 99 – Lift station
- AOC 103 – Battery maintenance facility
- AOC 108 – Dry cleaning operations.

1.2 Project Objectives

The purpose of this DERP/FUDS identified project was to investigate AOCs identified by the CRAA on their property and to determine if they could be closed out with a NDAI determination, if interim removal actions were required, or if additional investigation is required. Specific objectives were to:

- Collect biased and systematic samples of environmental media (soil and groundwater) to determine the presence or absence of contamination to the environment at the selected sites.

- Screen chemical data from select sites against action levels to determine the need for future action.

- Provide recommendations of NDAI status for those sites with no significant contamination, and provide suggested future activities for any sites requiring additional investigation or remediation.

1.3 Installation Description

This section presents the site topography, surface water characteristics, regional and local geology, the groundwater flow across the base, ecological setting, and community setting. Much of this section was taken from previous studies at the FLAFB.

1.4 Geology

1.4.1 Topography

The topography of the area is flat to gently rolling, with very little relief. Elevations range from 710 feet above mean sea level (MSL) to greater than 750 feet MSL [Parsons Engineering-Science, 1996]. The United States Geological Survey (USGS) topographic map is shown as Figure 1-3 (USGS, 1992).

1.4.2 Regional Setting

The geology in the central portion of Ohio where the site is located consists of glacial deposits overlying shale bedrock. The bedrock beneath the site has been identified as Ohio Shale and

Olentangy Shale undivided (ODNR, 1995). The bedrock surface consists of a series of former drainage valleys that have been buried by glacial sediments. The top of the bedrock beneath the site has been mapped at an elevation between 500 and 550 feet MSL. The glacial deposits in the area fall into one of two categories, till or outwash. The till deposits consist primarily of clay and silt with varying amounts of sand and gravel. The outwash deposits consist primarily of sand and gravel with varying amounts of silt and clay; the surficial till is mapped as ground moraine across almost the entire area and overlies the outwash deposits. Till layers are also interbedded with the outwash deposits. The outwash deposits account for the majority of material present in the buried valleys (IT, 1998a).

1.4.3 Site-Specific Geology

The surficial geology at the site consists of two distinct glacial till deposits overlying glacial outwash deposits. The uppermost till unit consists of silty clay and a clayey silt with varying amounts of sand and gravel. This unit grades in color from brown to gray with depth. Isolated lenses of sand and gravel occur within the unit. The unit ranges in thickness from less than 3 feet to greater than 30 feet thick. The second till unit consists of gray silt and clay with varying amounts of fine sand and gravel. The gray till is typically at least 10 feet thick and is reported in water well boring logs as being over 120 feet thick in places. Both the uppermost till and the gray till are laterally continuous at the site (IT, 1998a).

1.5 Hydrogeology

1.5.1 Regional Hydrogeology

The hydrogeology in the area has been previously characterized as consisting of three distinct water-bearing zones; the upper water-bearing zone (UWBZ), the intermediate aquifer, and the deep aquifer. The UWBZ consists of the saturated portion of the uppermost till unit and laterally discontinuous sand and gravel lenses (IT, 1998a).

The sand and gravel valley train deposits are completely saturated in the area of the base. The valley train deposits have been described as actually containing two distinct aquifers, referred to as the intermediate aquifer and the deep aquifer. The majority of water wells in the area utilize the sand and gravel deposits between 10 and 90 feet below the surface, and some utilize the sand and gravel deposits below 135 feet. The City of Columbus operates a well field located approximately 2 miles to the west of the site. The wells in the City of Columbus well field are installed in the valley train deposits. However, there does not appear to be a separate intermediate and deep aquifer in that area. The saturated zones in the valley train deposits are up to 86 feet thick (IT, 1998a).

The regional buried valley aquifer has reported individual well yields of greater than 1,000 gallons per minute (gpm). The aquifer is present for at least 2.5 miles in every direction from the site. The area beneath, and immediately surrounding, the base is mapped as capable of producing up to 500 gpm from large diameter wells (Schmidt, 1993).

Figure 1-4 is a base-wide potentiometric surface map prepared with groundwater level measurements collected on July 1, 1996. This figure was generated using a computer contouring program (Surfer®) and was edited to take into account the positions of surface water bodies. The software uses an algorithm that interpolates clustered data points. Therefore, while the figure presents a good representation of the potentiometric surface at a base-wide scale, it does not necessarily indicate the flow direction at individual AOCs. The map is also drawn at a 10-foot contour interval, which tends to smooth out local variations in the potentiometric surface. A groundwater divide that exists in the central portion of the site corresponds with the topographic high and surface water divide noted at the site. Generally, groundwater flow is toward the nearest point in the drainage ditch.

1.5.2 Site-Specific Hydrogeology

The results of previous investigations conducted at the base indicate that a laterally continuous gray till confining layer at least 10 feet thick separates the UWBZ from the intermediate aquifer. The principal zone of yield in the UWBZ appears to be the sand and gravel lenses that occur within the upper brown and gray till and at the contact between the upper till and the underlying gray till. The top of the water table at the site is typically less than 10 feet bgs. The lower gray till appears to form a laterally continuous aquitard (low permeability boundary) between the UWBZ and the lower aquifers. The lower gray till is believed to be an effective aquitard because of its continuous lateral extent, thickness, low hydraulic conductivity, and density (IT, 1998a). The saturated zone of the brown till is generally on the order of 10 feet thick (IT, 1995). Based on slug tests performed for previous investigations at the base, the calculated hydraulic conductivity values for silts and clays are on the order of 10^{-7} centimeters per second (cm/sec) and the hydraulic conductivity values for the discrete sand or sand/gravel layers are on the order of 10^{-6} to 10^{-3} cm/sec (IT, 1998b).

1.6 Ecological Setting

Ecological reconnaissance surveys were conducted from September 13 to 15, 1993. The survey was performed for RANGB property that lies adjacent to the FLAFB and the ecological conditions between the two facilities are comparable. The surveys were conducted to collect qualitative information on the types, nature, and locations of biological resources at the Base (Parsons Engineering-Science, 1996). Dominant plant species were identified, plant communities were defined based on dominant species observed, and fauna was observed. The survey identified protected species or habitats in the study area. The ecological characterization is described in terms of terrestrial communities, aquatic and wetland communities, and ditches.

Terrestrial Communities

> "Based on dominant vegetation, the general ecological communities in the assessment area on RANGB are open fields, agricultural land, urban land, and remnant forest.
>
> The open fields that occur throughout the Base are primarily associated with areas that are mowed infrequently. Such areas include open land around abandoned buildings, the closed landfill, and abandoned agricultural fields. Wildlife in this community is characterized by species that prefer the low cover provided by the brushy habitat.
>
> Agricultural land, including corn and soybean, is present throughout the area. Wildlife on the agricultural land is limited, consisting mainly of individual species found in open fields.
>
> Urban land is found in the residential housing area, parks, and industrial and flightline areas, all of which are routinely mowed. Most vegetation is herbaceous. Wildlife in this community includes birds and, around shade trees and fence lines, woodchuck and fox squirrel.
>
> Remnant forests are found near intermittent drainage ditches, swales, and isolated tributaries converging into localized drainages that ultimately discharge into Little Walnut Creek and Big Walnut Creeks. These drainages and two creeks have associated riparian stands of vegetation that include hardwood trees, shrubs, and herbaceous ground cover. The width of these stands varies from approximately 30 feet each side of the drainage to larger remnant forest tracts. The plants vary from mowed grasses to a dense canopy of hardwoods with limited herbaceous ground cover. Fauna of the forest community includes American robin, blue jay, mourning dove, northern mockingbird, house sparrow, European starling, eastern cottontail, eastern fox squirrel, woodchuck, raccoon, opossum, and white-tailed deer (Parsons Engineering-Science, 1996)."

Aquatic and Wetland Communities

> "Aquatic communities on RANGB consist of intermittent watercourses associated with the major drainage ditches. All surface water runoff from the base eventually discharges into the storm drain network. Water courses in the assessment area include approximately 8,600 linear feet of drainage ditches. These ditches vary in width from about 20 feet to minor intermittent swales less than 2 feet deep. Standing water usually is not present in most of the ditches, even when the soil is saturated. Drift marks on the sides of the major ditches are evidence of water levels in excess of 4 feet during extreme storm events (Parsons Engineering-Science, 1996)."

The follow-up jurisdictional wetland survey documented in the USAF Final EIS (USAF, 1995) identified over 50 distinct wetlands on and around FLAFB (AFCEE, 1995).

Aquatic life observed to be present at FLAFB include fish, crawfish, frogs, and turtles.

Ditches

> "Ditches throughout the Base are maintained as a major storm-water drainage relief system. Many of these ditches have steep banks (2 to 1 slope). Hydrophytic vegetation is limited to isolated areas where the ditch bed is wider or the bank less steeply sloped. Throughout the base, roadside drainage swales and secondary drainage ditches support a variety of wetland vegetation. The swales are typically 2 to 6 feet wide and provide surface drainage from adjacent developed areas (Parsons Engineering-Science, 1996)."

1.7 Community Setting

The FLAFB lies primarily in Franklin County with a small portion in Pickaway County. The nearest population centers are Lockbourne, one-half mile west of the base; Duvall, 1½ miles to the south; Groveport, 3 miles to the northeast; and Canal Winchester, 5 miles to the northeast. The closest metropolitan area is Columbus, located approximately 12 miles to the north.

1.7.1 Adjacent Land Use

The Rickenbacker International Airport area has experienced significant industrial/commercial growth and more than 110 companies have operations in the area. Thirteen industrial parks are located to the north of the Rickenbacker International Airport. Directly adjacent to the property on the north side of an existing rail spur is privately owned multifamily housing. The largest concentration of residential development is in Groveport, a town of approximately 3,000 people, situated approximately 2 miles northeast of the runways.

The incorporated village of Lockbourne is adjacent to Rickenbacker International Airport property immediately west of the base. Small industrial operations are located to the west of the Rickenbacker International Airport along Canal Road. Located beyond Canal Road is a corridor for the Chesapeake & Ohio and Norfolk & Western Railroads. Additionally, railway easements are located to the southwest, on the far side of the South Perimeter Road. These corridors are used largely for transporting goods through the region. The majority of the surrounding area is agricultural (RPA, 2001).

1.7.2 On-Base Land Use

Rickenbacker International Airport is a high-speed international logistics hub. It comprises a 5,000-acre logistics hub, an adjacent industrial park, and an on-site Foreign-Trade Zone.

The airport specializes in air cargo and features parallel 12,000-foot-long runways capable of handling all types of aircraft around the clock. The airport has 120 acres of ramp space, 25 hydrant fueling stations, and 500,000 square feet of cargo terminal space.

Sixty companies currently have operation at Rickenbacker. These include six international airfreight companies, two E-commerce operators, 11 logistics operations, and distribution centers for 32 businesses. In addition to these businesses, units of the Ohio Air National Guard, Ohio Army National Guard, Army Reserve, and Navy Reserve are stationed at the facility. The Columbus District Office of United States Customs is located within the Foreign-Trade Zone (RPA, 2001).

1.8 Report Organization

This report organizes the SI information as follows:

- Section 2.0 – Project Activities describes the field laboratory and data evaluation activities conducted during the SI.
- Section 3.0 – Site Investigation describes each of the 21 sites in terms of a brief history, samples collected, analytical results, and results of the risk-based evaluation.
- Section 4.0 – Recommendations provides recommendations for sites requiring further action.
- Section 5.0 – References provides a list documents cited throughout this report.
- Appendices provide ancillary information such as a photo log, soil boring and sample collection logs, laboratory data, chains-of-custody (COCs), vapor intrusion model results, and data validation summary reports (DVSRs).

2.0 Project Activities

Shaw conducted initial SI field activities at the FLAFB November 9-17, 1999. Subsequent follow-up investigations were performed in 2000 and 2001.

Procedures used to conduct the field investigation are detailed in Sections 2.1 through 2.6. Section 2.7 presents descriptions of the field documentation maintained. Section 2.8 identifies the analytical laboratory. Sections 2.9 through 2.11 detail data evaluation procedures, data quality assessment and validation procedures, and the methods used for risk screening.

2.1 Field Activities

SI data collection activities included drilling and sampling of soil borings, direct-push drilling techniques; installation and sampling of temporary piezometers; surface soil sampling; impounded water and sediment sampling; and, monitoring well installation and sampling. All SI data collection procedures were consistent with guidelines published in the United States Environmental Protection Agency (USEPA) "Test Methods for Evaluating Solid Wastes" (SW-846, Third Edition) and "Engineering and Design, Chemical Quality Management for Hazardous, Toxic, and Radioactive Waste Remedial Activities, ER 1110-1-263," (USEPA, April 1996).

2.2 Sampling Activities

2.2.1 Selection of Sample Locations

Because no sampling was previously conducted at these AOCs, the proposed sampling locations were based on the physical characteristics, building location, building layout, and presumed operational history. The sampling locations chosen were those locations presumed to have the highest probability of being contaminated. In cases where the building was no longer present and the building layout was not known, the sample locations were generally placed evenly around the perimeter of the former building location, with one location on the presumed down-gradient side, based on the basewide potentiometric surface shown on Figure 1-4. Specific sampling locations are described for each AOC in Section 3.0..

At most AOCs, three Geoprobe® borings were drilled. The soil borings were drilled to the top of the water table (approximate depth of less than 12 feet) and were continuously sampled using direct-push drilling techniques. One soil sample from each boring was analyzed. The soil sample was collected from the two-foot interval in each boring with the highest photoionization detector (PID) readings and/or visual contamination. If none of the soil samples had elevated PID readings or visual contamination, the soil sample from the two-foot interval directly above the water table was analyzed. Additionally, at least one sample was collected from the 0- to 2-foot interval. If the 0- to 2-foot interval did not have the highest PID reading on any of the borings, an additional sample was collected from this interval. At most AOCs, a temporary piezometer was installed in the downgradient boring based on basewide groundwater flow (Figure 1-4) and an attempt was made to collect a groundwater sample. The sampling rationale and locations for AOCs with sampling other than Geoprobe® soil and groundwater sampling are described by AOC in Section 3.0.

2.2.2 Drilling Procedures

Borings used to characterize site geological features and to provide soil samples for chemical analyses were drilled using direct push technologies. Groundwater monitoring wells were installed using rotasonic drilling techniques. A stratigraphic log was completed for each boring. The following sections present the details of each drilling method and associated sampling procedures.

2.2.2.1 Direct-Push Drilling Procedures

Direct-push borings were advanced using a van/truck-mounted hydraulic sampler using 2-inch inside diameter (ID) by 4-foot lead samplers and drive-shoes and 1-inch probe rods through the application of downhole pressure. Each soil boring was continuously sampled by advancing the lead sampler and drive shoe at 4-foot increments until target depth or refusal. Soil sampling was conducted by using a polyethylene terephthalate (PETG) clear liner.

2.2.2.2 Rotasonic Drilling Procedures

The Rotasonic drilling technique used simultaneous high-frequency vibrational and low speed rotational motion to advance the cutting edge of a hollow circular drill stem. This dual action created a uniform borehole while providing relatively continuous cores of both unconsolidated and consolidated material. During the drilling process, minimal amounts of drill cuttings, mixed with drilling fluid (potable water) were generated. The Rotasonic rig pushed a 4-inch ID core barrel for sampling inside of a 6-inch drive casing. The core barrel was advanced ahead of the drive casing, in 10-foot increments to collect samples from undisturbed soils. After advancement of the core barrel, the drive casing was advanced to just ahead of the leading edge of the core barrel using potable water as a drilling fluid. The core barrel was then removed from the borehole and the stratigraphy logged.

2.2.2.3 Cone Penetrometer Drilling Procedures

Some borings were installed using USACE-Savannah District's cone penetrometer truck. The temporary well points for groundwater sampling were installed using 1.87-inch outside diameter (O.D.) rods. The temporary well points were made of polyvinyl chloride (PVC) and include ¾-inch screens and risers. The well points were connected to disposable drive points that were inserted into the end of the drive rods. When the drive rods were at the desired sample depth, the rods were retracted to expose the screen. The PVC screen and riser were left behind and sampled after the drilling rig was moved. This was done during this investigation because of the slow groundwater yield at most of the sample locations.

2.2.3 Soil Sampling

During soil sampling, clean new disposable nitrile gloves were donned by the sampling teams at each sampling location prior to commencement of sampling.

2.2.3.1 Surface Soil Sampling Procedures

Surface soil samples were collected using pre-cleaned stainless steel spoons or trowels and pre-cleaned stainless steel bowls. Samples for volatile constituents were placed directly into the sample containers. Samples for non-volatile constituents were collected after compositing the soil obtained from the top 6 inches of soil in a stainless steel bowl. Any vegetation, debris or organic matter at the surface was removed prior to sampling.

The collected soil was placed into laboratory pre-cleaned glass sample jars with Teflon® lined lids, labeled, sealed, and immediately placed on ice. Decontamination of sampling equipment, including stainless steel bowls and spoons, were performed in accordance with Section 2.4. Sample handling, packaging, and shipping were performed following the procedures outlined in Section 2.5.

2.2.3.2 Subsurface Soil Sampling Procedures

Upon removal of the core barrel from the borehole, (described in Section 2.2.2.1 and 2.2.2.2) a volatile organic compound (VOC) sample was collected immediately after the liner had been removed and opened. A headspace sample was then taken from the interval to perform field screening and the stratigraphy logged. The soil description included the depths of changes in strata, locations of seepage zones, and depth to groundwater. The remaining soil in the interval was placed in a stainless steel bowl and covered with aluminum foil, pending the headspace readings for all the intervals. The sample interval with the highest headspace reading was composited in a stainless steel bowl and placed in a sample container. The VOC samples collected from the remaining intervals became investigative derived waste (IDW). Semivolatile organic compounds (SVOCs), pesticides, PCBs, and Target Analyte List (TAL) metal samples were then collected.

2.2.4 Groundwater Sampling

2.2.4.1 Direct-Push Groundwater Sampling Procedures

To collect a groundwater sample, 1-inch diameter temporary piezometers were placed in the Geoprobe® boreholes. Groundwater was then recovered using disposable polyethylene tubing and a peristaltic pump. The tubing was inserted into the piezometer screen and then attached to the pump. Low flow pumping rates were maintained to minimize agitation of suspended solids in the screen point. As specified in the work plan, the screen points were not purged prior to sampling, due to low yield.

Groundwater samples were collected directly from the disposable Teflon® lined polyethylene tubing. The samples were not filtered prior to collection. The VOC samples were collected first, followed by the SVOC samples. When collecting VOC samples, the pumping rate was lowered to minimize turbulence and aeration of the sample. Volatile organic analysis (VOA) vials were then filled until a positive meniscus was achieved above the rim of the sample bottle. The vials were immediately capped and then gently tapped to verify that no air bubbles were present in the sample. If bubbles were detected, the vial was opened and more sample was added. Collected samples were capped, labeled, and immediately placed on ice. Pre-preserved sample containers were provided by the analytical laboratory. The pH of the preserved VOC samples was not checked in the field. A groundwater sample collection log was completed during sampling.

2.2.4.2 Monitoring Well Construction and Design

Monitoring wells were installed in accordance with the USACE manual EM 1110-1-4000, "Engineering and Design - Monitoring Well Design, Installation, and Documentation at Hazardous Toxic, and Radioactive Waste Sites" (USACE, 1998) and the Ohio Environmental Protection Agency (Ohio EPA) "Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring" (Ohio EPA, 1995). Monitoring well installation was started within 48 hours of borehole completion. Installation of each monitoring well was performed by using cleaned and decontaminated equipment and supplies per procedures outlined in Section 2.4. Potable water used during the drilling and construction of the monitoring wells (for drilling, bentonite pellet hydration, decontamination) was obtained from an onsite source. A monitoring well installation sheet and well material summary sheet was completed for each well.

The monitoring wells were constructed using flush-threaded two-inch diameter Schedule 40 PVC casing and screen. The well screen was 10-foot long 0.010 inch continuous slotted PVC. The bottom of the screen was capped. The annular space was filled with clean #8 silica sand to above the top of the screen. Following the verification of the top of the sand pack a bentonite pellet seal was placed. The casings were cut about 3 inches below the land surface and furnished with a water-tight casing cap. Flush-mounted protective covers were installed over each well.

2.2.4.2.1 Monitoring Well Development

Development of newly installed wells began no sooner than 48 hours and no later than 7 days after installation. Development was accomplished using a submersible pump, surge block, and bailers. During development discharge (pumping) rates were measured using a graduated container (i.e., plastic bucket) prior to containerization.

A minimum of five well volumes were removed from the monitoring well during development. The well volume was defined as the volume of submerged casing, screen, and filter pack, minus the estimated volume of the sand in the filter pack.

Development of the well was continued until the turbidity was ≤5 nephelometric turbidity unit (NTU), and when the stabilization of pH, temperature and specific conductance had occurred. Stabilization was defined as when pH was within ±0.1 unit, temperature was within 1°C, and specific conductance was within ±10% over at least 3 successive well volumes. In some instances, collection of non-turbid samples was difficult or unattainable. If a well did not provide a sediment-free sample, and/or stabilization of pH, temperature, and specific conductance did not occur, development was stopped when:

- A maximum of 10 well volumes had been removed, in addition to any volume of water or fluid that may have entered the well and formation during construction and/or

- Temperature, conductivity, and pH had stabilized to the above criteria over at least three successive well volumes, and the turbidity remained within a 10 NTU range for at least 30 minutes.

In other instances, a well might have been purged dry during development. In such cases, the water level was allowed to recharge to at least fifty percent of the static water level, and the well was purged dry a total of three times. After each recharge, the above parameters were measured to confirm stabilization. If stabilization did not occur, the well was sampled after the third purge.

No detergents, soaps, acids, bleaches, or other additives were used to develop a well. All development equipment was decontaminated according to the specifications documented in Section 2.4. A monitoring well development/purge log was completed for each well.

2.2.4.2.2 Groundwater Level Measurements

The groundwater level at each newly installed well was measured approximately 24 hours after installation, prior to development and prior to sampling of the well. One additional set of groundwater levels was conducted at the conclusion of the field investigation. Groundwater levels were measured from each well within a single 24-hour period. A water level indicator was used to measure water level to the nearest 0.01 foot. The portion of the water level indicator cable that entered the well casing was decontaminated by wiping the cable with paper towels soaked with laboratory-grade detergent followed by paper towels soaked with deionized water. The cable was wiped as it is retrieved from the well. Care was taken to prevent decontamination solutions from entering the well and to prevent the cable from touching the ground. Clean paper towels were used each time the water level indicator was decontaminated. A groundwater elevation log was completed for each round of groundwater measurements.

If a well casing cap was airtight prior to the removal of the cap, the well was allowed to equilibrate to atmospheric pressure for several minutes. In this case, a series of water level readings, separated by a minimum of 5 minutes, were conducted to assure equilibration to $\pm$0.01 feet.

2.2.4.2.3 Groundwater Purging and Sampling Procedures

Due to the low yield of the wells, a peristaltic pump was used to collect the groundwater samples. The samples were collected after the wells had been purged dry, or a minimum of three well volumes had been removed and the pH, temperature, and conductivity readings had stabilized, or six well volumes had been removed. The samples were collected as described in Section 2.2.4.1.

A groundwater development/purge log and a groundwater sample collection log were completed during sampling.

2.2.4.3 Cone Penetrometer Groundwater Sampling Procedures

VOC samples were collected at each location using a stainless steel bailer. The bottom-filling bailer was 5/8-inch diameter and 2-feet long. The location of each well point was determined with a Global Positioning System linked to an onsite base station. This setup provided horizontal control that is accurate to within 1 foot.

2.2.5 Abandoning Borings

Small diameter boreholes remaining after the completion of direct-push and cone penetrometer sampling were backfilled with granular bentonite. Direct-push and cone penetrometer well points were removed prior to placement of the bentonite backfill. All abandoned boreholes were checked 24 to 48 hours after bentonite pellet emplacement to determine whether curing had caused significant settling. If so, a sufficient amount of bentonite was added to attain its initial level. In areas where borings were advanced through pavement, the surface was repaired with concrete.

2.2.6 PCB Sampling Procedures

Soil samples for PCB sample analysis were collected at AOC 65 and AOC 98 in accordance with USEPA guidance "Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup" (USEPA, 1986). Sample points were measured and staked using clean sample flags. Soil samples were collected from a 10 centimeter (cm) by 10 cm area. Soil samples were collected by scraping soil to a depth of approximately 0 to 6 inches. The soil was placed in the sample container. Any vegetation, debris or organic matter at the surface was removed prior to sampling.

Samples of transformer fluid were collected from transformers by opening the access port and using a disposable glass drum thief to collect 40 milliliters (mL) of the fluid. A new drum thief was used for each transformer. The fluid was placed in a properly labeled scintillation vial. The access port was then closed.

A composite sample of the concrete pad was obtained using a decontaminated metal chisel. The work plan called for preferential sampling of stained areas, but no staining was noted. The chips were less than 1 cm deep.

2.2.7 Impounded Water and Sediment Sampling

Impounded water and sediment samples at AOCs 97 and 99 were collected. Sampling equipment was decontaminated in accordance with Section 2.4. If both surface water and sediment samples were to be collected at a specific location, surface water samples were obtained first. Sample containers were prepreserved.

Impounded water was collected using a clean bailer that was dipped into the water so that bottom sediments were not disturbed and then was used to fill the sample containers for analysis. Care was taken to avoid disturbing the sediment, since suspended sediment in the water sample could have affected the analytical results.

Sediment samples for all parameters except VOCs were collected using a stainless steel spoon to transfer sediments into a stainless steel bowl. The VOC samples were transferred directly from the stainless steel spoon to sample containers. Organic material and cobbles were discarded and the remaining sediments homogenized. The spoon was used to transfer samples to the appropriate sample container.

Following sample collection, sample containers were immediately placed in a sample cooler with ice. Sample handling, packaging, and shipping were performed following the procedures outlined in Section 2.5

2.3 Field Measurements

The following section describes the methodology, equipment and procedures that were used to collect field measurements during the SI.

2.3.1 Field Screening of Soils

Soil samples were screened using a PID for volatile organic compounds to determine the depth from which the laboratory analytical samples were collected. During drilling activities, head space readings were recorded from collected soils. The collected soil from each sample interval was placed in a clean Ziplock® baggie (no more than half full), and sealed. Each headspace sample was allowed to sit for at least ten minutes. The baggie was then opened just enough to insert the PID probe tip and a reading of the results were recorded. All the samples from a given boring were tested at the same time.

2.3.2 Field Parameters for Water Samples

Temperature, pH, specific conductance, and turbidity were measured during monitoring well development, purging, and following collection of groundwater samples. The results are noted on the Groundwater Collection Logs presented in Appendix G. All monitoring equipment was calibrated at the beginning and end of each day in accordance with manufacturer's specifications.

2.4 Equipment Decontamination

The following section described the procedures used to decontaminate sampling equipment. Prior to commencement of field activities, a decontamination area was established. All sampling equipment that was directly or indirectly in contact with samples was decontaminated before use. Sampling equipment (i.e., stainless steel bowls, and trowels or spoons, core barrels, split spoons, etc.) was decontaminated in the following sequential steps:

- Washed and scrubbed equipment with a solution of potable water and laboratory-grade nonphosphate detergent.
- Rinsed several times with potable water.
- Rinsed with 10% hydrochloric acid solution.
- Rinsed with American Society for Testing and Materials (ASTM) Type II water.
- Rinsed with pesticide-grade isopropanol.
- Rinsed with ASTM Type II water.
- Allowed equipment to air dry.
- Wrapped in aluminum foil, shiny side out.

Drilling equipment was steam cleaned prior to drilling each boring, installation of each monitoring well, and before leaving the site. Monitoring well casing material that arrived on-site sealed in factory supplied packaging was not decontaminated prior to using in the well. Any casing material or well screen that was not sealed when it arrived at the wellhead was steam cleaned and allowed to air dry prior to use in the monitoring well.

Potable water used during the field investigation was obtained from an onsite source. One potable water sample was collected for offsite chemical analysis.

All decontamination solutions were stored and dispensed in proper containers. All fluids generated during decontamination activities were placed in 55-gallon steel closed top drums. All drums were properly labeled as to content and were staged in a central location for temporary storage pending removal and disposal.

2.5 Sample Handling

This section describes the sample identification and numbering system, sample preservation requirements, packaging and shipment procedures, and sample holding times. Pre-cleaned sample containers were provided by the analytical laboratory through a second-source distribution. The sample containers were certified to meet or exceed analyte specifications established by USEPA in "Specifications and Guidance for Contaminant-Free Sample Containers," (USEPA, 1992).

2.5.1 Sample Identification and Numbering System

The following information was written in the logbook and on the sample label when samples are collected for laboratory analysis:

- Project identification (name and number)
- Sample identification number
- Sample location
- Preservatives added
- Date and time of collection
- Requested analytical methods
- Sampler's name

Each sample was assigned a unique identification number that describes where the sample was collected. The number was a maximum 9 digit alphanumeric code as follows:

xxxyyzzaabb

where:

xxx	represents the AOC number
yy	represents the location type (e.g., SB - Soil Boring, SS – Surface Soil, MW - Monitoring Well, SW - Surface Water, SD - Sediment)
zz	represents the location number (e.g., 01, 02, 03, etc.)
aa	represents the medium (e.g., GW=groundwater, SO=soil, SW=surface water, SD=sediment)
bb	represents the sample interval (01, 02, etc.)

A list of sample numbers was maintained by the field coordinator.

The field coordinator maintained a list that describes how each quality control (QC) sample corresponds with specific environmental samples. QC samples were designated with a "50's" series number where the second digit indicates the sample interval (bb).

2.5.2 Sample Preservation Requirements, Packaging and Shipping Procedures, and Sample Holding Times

Samples for this project were handled in accordance with the "Final Work Plan, Site Investigation for Areas of Concern, Former Lockbourne Air Force Base, Columbus, Ohio (IT,1999c). All samples were shipped to the analytical laboratory in properly packed and iced coolers in accordance with United States Department of Transportation (DOT) regulations via overnight courier. Samples were shipped daily or on alternate days in order to meet parameter holding times.

2.5.3 Sample Custody

Transportation and custody procedures met DOT and USEPA requirements (40 CFR Parts 170-179). COC procedures documented sample possession from the time of collection to disposal in accordance with Shaw internal procedures and federal guidelines. A sample was considered in custody if:

- It was in the sampler's or the transferee's actual possession.
- It was in the sampler's or the transferee's view, after being in his/her physical possession.
- It was in the sampler's or the transferee's physical possession and then he/she secured it to prevent tampering.
- It was placed in a designated secure area restricted to authorized personnel.

Field custody procedures include the following activities:

- Before sampling began, field personnel reviewed COC procedures.
- The quantity and types of samples were reviewed.
- Sampling locations were finalized and annotated on a site map.
- The field coordinator determined whether proper custody procedures and report forms were used during the field work and documented findings in the field log book.

- The field coordinator had overall responsibility for the care and custody of the samples collected until they are transferred or properly dispatched to the laboratory. Each individual who collected a sample was responsible for its custody until it was transferred to someone else via the COC Record.

- Shipment information was recorded in the field logbook at the end of the shift, day or collection period.

Transfer of custody and shipping procedures included the following activities:

- A COC was maintained in the field by each sampling team for each day of sampling. One copy of this record accompanied each sample and one carbon copy was retained at the site.

- Two COC seals per shipping container were used to secure the lid and provide evidence that samples had not been tampered with. Seals were placed such that they span both the lid and the body of the cooler. The seals were covered with clear tape to prevent damage to the seals.

- If the laboratory sample custodian judged the sample custody to be invalid (e.g., samples arrive damaged), a Nonconformance Report form would have been initiated by the laboratory. The Shaw Project Manager would have conferred with the USACE Project Manager to determine the fate of the sample(s) in question. The sample(s) would either have been processed "as is" with custody failure noted along with the analytical data, or rejected, with sampling rescheduled if necessary. The project manager and quality assurance manager would have signed the Nonconformance Report, noting the reason for disposition [nonconformance reports are discussed more fully in the Quality Assurance Project Plan (QAPP)], "Final Quality Assurance Project Plan, Site Investigation for Areas of Concern, Former Lockbourne Air Force Base, Columbus, Ohio (IT, 1999b).

- Each time responsibility for custody of the sample changed, the new custodian signed the record and noted the time and date.

- The custody of individual sample containers was documented by recording each container's identification on a COC.

- The analyses to be performed for each sample were recorded on the COC. The original copy accompanied the samples. A copy was retained at the site.

- The signed original COCs were returned with the analytical reports.

2.5.4 Field Quality Control Samples

To evaluate the reliability of field sampling procedures, field QC samples were collected or prepared for each media sampled and each sample shipment. QC samples were used for data evaluation and data validation (described in the QAPP). The field QC samples and their frequency of collection are outlined in the Work Plan. Field QC samples included matrix spikes, matrix spike duplicates, duplicates, and trip blanks.

2.6 Surveying

The boring and monitoring well locations were surveyed by Judge Engineering, Inc. The horizontal datum was the North American Datum of 1927. The vertical datum is Mean Sea Level. The survey results are shown in Table 2-1.

2.7 Record Keeping

The following section describes the field documentation procedures that were followed as a means of recording observations and findings during field activities. Field documentation was in the form of in field logbooks, various sample and calibration forms, site photographs, and drawings/sketches. All documentation was completed in indelible ink and corrections were clearly stricken out and initialed.

2.7.1 Field Logbook

Logbooks with sequentially numbered pages were kept at the site during all field activities and were assigned to each sample team. These logs were updated continually and constitute the master field investigation documents. Information recorded in the logs included, but was not limited to, the following:

- Project identification
- Field activity subject
- General work activity, work dates, and general time of occurrence
- Unusual events
- Subcontractor progress or problems
- Weather conditions (ambient air temperature, sky conditions, precipitation, and personal observations of wind conditions)
- Shaw personnel, subcontractors, and visitors on site
- Sample number and time of day for each sample collected for analysis

- Accomplishment of required calibration checks
- Accomplishment of well point purging, with time and/or volume
- Well water levels and field measurements
- Variances from project plans and procedures
- Head space screening results

2.7.2 Field Equipment Logbook

A field equipment logbook was kept on site to document the proper use, maintenance, and calibration of field testing equipment. Accompanying the field equipment logbook was a three-ring binder containing operator manuals, specifications, and calibration requirements and procedures for all field testing equipment. Information recorded in the field equipment logbook includes:

- Equipment calibration status
- Equipment inspection and repair records
- Name and signature of person making entry
- Date of entry
- Name of equipment and its identifying number
- Measurement results.

2.7.3 Sample Collection Log

A sample collection log form was completed for each sample collected during the investigation. Information on the form included:

- Date and time of sample collection
- Sample location
- Sample type (i.e., surface soil, sediment, groundwater, etc.)
- Sample volumes and container types.

2.8 Laboratory Analysis

The analytical laboratory for this project was Quanterra; which is now owned by Severn-Trent Laboratories, Inc., North Canton, Ohio. Samples were shipped to:

Severn-Trent Laboratories, Inc.
4101 Shuffel Drive, NW
North Canton, Ohio 44720
Telephone: 330-497-9396

2.9 Data Evaluation

The analytical results for the quality control samples along with the original samples were compiled into tables and separated by media. QC results are tabulated in Tables 2-2 through 2-7:

- Duplicates (Tables 2-2 to 2-6)
- Trip Blanks (Table 2-7)

All detected concentrations for each site and media were compared with background, Preliminary Remediation Goals (PRGs), and Maximum Contaminant Levels (MCLs) where applicable. As with the duplicate tables and all subsequent data tables (presented in Section 3), concentrations exceeding the PRG are surrounded by "( )". It should be noted that, in the data tables, the non-carcinogenic PRGs are not adjusted by a factor of 1/10. Concentrations exceeding the background values are surrounded by "[ ]" and those that exceed the MCL are surrounded by "{ }". In addition, soil concentrations were compared to Soil Screening Levels (SSLs). These comparisons are presented in tables in Appendix Q.

In a review of the trip blank results, methylene chloride was found to be present at levels that would affect the evaluation of environmental samples. The methylene chloride concentration in five samples was less than the trip blank levels; therefore, these sample results were U-qualified (i.e., determined to be non-detects). Other compounds (i.e., acetone, 2-butanone, chloroform, toluene) found in the trip blanks had no affect on the environmental samples because the sample results were either non-detects or greater than 5 times the levels in the trip blanks.

2.10 Data Quality Assessment and Data Validation

The data validation results are discussed in the Data Validation Summary Report (Appendix A). To ensure data completeness and quality, all samples were subjected to a validation that included a review of the following items:

- Sampling dates and holding times
- Transcription errors
- Initial and continuing calibration verification
- Determination of bias (i.e., percent recovery)
- Precision (e.g., replicate analysis)
- Detection limits
- Field and laboratory blanks.

All laboratory data underwent a USEPA Level III validation. The validation was performed in accordance with USEPA documents "National Functional Guidelines for Organic Data Review" (USEPA, 1991), "Functional Guidelines for Evaluating Inorganic Analytes" (USEPA, 1988) and the project QAPP. These documents specify performance requirements for the field contractor and laboratory. The items reviewed included, at a minimum, those listed above and the following:

- Preservation
- Instrument performance
- Initial and continuing calibration
- Interference check standards
- Field duplicates
- Identification and quantification of analytes.

As the result of the validation, the analytical results were qualified as acceptable without qualification (=), rejected (R), estimated (J or UJ), or below detection (U). Results were rejected (R) when the established criteria were significantly exceeded or the results were deemed unusable; results were qualified as estimated (J or UJ) when a criterion was exceeded but the results were still deemed usable. If dilutions or re-analyses were performed, the validation determined which results were more suitable for use. The unused results were flagged with a Z-qualifier.

2.11 Method of Risk Screening

The risk-based evaluation conducted on the 21 AOCs consists of a comparison of the maximum detected constituent concentration to background concentrations for soil, groundwater, surface water, and sediment inorganics established in the "Final Phase II Remedial Investigation Report for Rickenbacker Air National Guard Base" (IT, 1998a). In addition to the background comparison, detected constituent concentrations (maximum values) were compared with the October 2004 USEPA Region 9 PRGs for industrial use established at a target cancer risk of 1×10^{-6} or an adjusted noncancer hazard index of 0.1. A factor of 1/10 is applied to non-carcinogens to add a ten-fold measure of safety to ensure that multiple chemicals that could result in a hazard index (HI) greater than 1 are not eliminated from the assessment. Soil and sediment concentrations were compared to the soil PRGs for industrial exposure scenarios, while groundwater and surface water were compared with the tap water PRGs. In the case of soil lead, a screening level of 800 milligrams per kilogram (mg/kg) of lead in soil (USEPA, 2004). The maximum detected concentrations of lead in groundwater were conservatively compared with USEPA's drinking water action level of 0.015 mg/L (USEPA, 2004). The PRG for chromium VI was chosen as a screening concentration for all chromium in soil as a conservative measure.

Site data were compared with the PRGs for industrial soil because of current and future anticipated land use. Currently the area is industrial in nature, with most of the area having been converted into the Rickenbacker International Airport. The industrial soil PRGs are conservatively derived for exposures via incidental ingestion, inhalation, and dermal absorption of chemicals in soil by commercial/industrial workers. These workers are assumed to be exposed for 250 days/year over 25 years at the site. The exposure parameters apply to outdoor workers and would be expected to be protective of other potential receptors with less exposure frequency and duration, such as indoor workers, site visitors, or construction workers. There are no specific industrial PRGs for water. Instead, the PRGs for water are derived for ingestion and inhalation of chemicals assuming the domestic use of tap water for 350 days/year over 30 years. Therefore, the tap water PRGs are protective of industrial workers that would have relatively less exposure to water in the workplace. The area is not currently being used for residential purposes, nor is residential use part of the long-term land-use plans for the CRAA.

Typically, an AOC is considered to pose acceptable or insignificant risk if concentrations of individual analytes are:

- Below natural background concentrations presented in Tables 2-8 through 2-11;
- Above background concentrations, but below the applicable PRGs or applicable, relevant and appropriate requirements (ARARs).

AOCs determined to pose acceptable or insignificant risk are recommended for NDAI status. AOCs are considered to pose potential risk, and warrant further action, if concentrations of individual analytes are:

- Above natural background concentrations and there are no applicable PRGs or ARARs
- Above natural background concentrations and above the applicable PRGs or ARARs.

AOCs determined to pose potential risk are recommended for further action. A contaminant concentration that exceeds a PRG level does not, in itself, mean that there is an unacceptable health threat. However, exceeding a PRG suggests that further evaluation of potential risks may be appropriate.

Risk Screening Tables presented throughout Section 3.0 summarize the risk-based evaluation for each of the AOCs and the media sampled in each. In each table, numbers are presented that represent the range of detected values (minimum and maximum), background data used to evaluate a given media, the media-specific screening criteria, and the results of the comparison of media concentration to background and screening criteria. Chemicals exceeding the screening criteria are denoted as a chemical of interest. For AOCs where more than one chemical is denoted as a chemical of interest, a risk-based cumulative evaluation was provided. This evaluation addresses the concern of cumulative exposure to multiple contaminants in multiple media exceeding the target risk goal of 1E-5 for cumulative risk. For this risk-based cumulative evaluation, risk and hazard are calculated based on a ratio of the site concentration to the PRG value corresponding to a risk of 1×10^{-6} or a hazard of 1. Using benzo(a)pyrene (with a soil concentration of 27 mg/kg) as an example, this risk is calculated as follows:

(Site concentration * target risk or hazard)/PRG = risk or hazard

$(2.7 \times 10^{+1} * 1 \times 10^{-6})/2.1 \times 10^{-1} = 1.3 \times 10^{-4}$

The risk and hazard for each single chemical are then summed to determine the cumulative cancer risk or hazard to commercial/industrial workers for the site.

This information was used to determine if a site could be closed out with a NDAI determination if additional investigation is required. As previously discussed, the PRG is conservatively derived for multiple pathways and is protective of anticipated receptors at the site.

3.0 Site Investigation

This section describes the field, laboratory, and data evaluation activities conducted during the SI. A majority of the field activities were performed from November 9 through November 17, 1999. Supplemental activities were also performed in 2000 and 2001. This section is organized by AOC. Each AOC section includes a brief history of why the AOC was included in the investigation, a description of the sampling activities, a summary of the analytical results, a discussion of the risk screenings and recommendations are made for "NDAI" or "further action." Table 3-1 summarizes the information presented in this section. Table 3-2 presents a summary of the groundwater sampling parameters collected during the course of field investigations. Other support documentation is included as the following appendices:

- Appendix B – Photographic Log
- Appendix C – Visual Classification of Soils
- Appendix D – Soil Sample Collection Logs
- Appendix E – Groundwater Elevation Logs
- Appendix F – Groundwater Well/Monitoring Point Purge Logs
- Appendix G – Groundwater Collection Logs
- Appendix H – Well Diagrams
- Appendix I – Laboratory Data
- Appendix J – Chains of Custody

3.1 AOC 9 - Photo Lab

The photo lab (Building T-263) was included as an AOC because of the general nature of activities that would have occurred within the building. Fluids used for developing and processing film typically contained VOCs, metals (particularly silver), and cyanide. The photo lab was noted on a basic layout drawing for Lockbourne AFB, dated February 1945, revised January 9, 1948. The building layout is shown on Figure 3-1.

The photo lab was demolished and no drawings could be located that indicated the placement of doorways, bays, and other areas where releases most likely would have occurred. Because this information was not available, three boring locations were determined using the estimated groundwater flow direction. The soil borings were advanced and soil samples were collected on November 9, 1999. Boring location 9SB03 was placed at the most downgradient point on the site and the two remaining boring locations, 9SB01 and 9SB02, were distributed evenly around the former building location. The boring locations for AOC 9 are shown on Figure 3-1. Soil samples from each boring (Sample IDs: 009SB01SO07, 009SB02SO05, 009SB03SO01, and 009SB03SO05) were analyzed for Target Compound List (TCL) VOCs, TCL SVOCs, Target Analyte List (TAL) metals, and cyanide. A groundwater sample (Sample ID: 009SB03GW01) was collected from boring 9SB03 on November 10, 1999 and analyzed for TCL VOCs, TCL SVOCs, and cyanide. The laboratory data and COCs are presented in Appendices I and J and a summary of the detected analytes is presented in Tables 3-3 and 3-4.

As shown in Table 3-5, 17 metals were detected in soil. Lead, selenium, and thallium were detected above background but below their respective PRG. Calcium, magnesium, and potassium were detected above background but are considered essential nutrients, and therefore, not chemicals of interest. Seven organic compounds were detected in soil. All maximum concentrations were detected below the PRG. As shown in Table 3-6, one organic compound (acetone) was detected in groundwater. The maximum concentration was detected below the PRG. As shown in Table Q-1 (Appendix Q), methylene chloride was detected above the SSL. However, methylene chloride was not detected in groundwater. NDAI status is recommended for AOC 9.

3.2 AOCs 17, 18, 19, and 103 - Base Engineer's Shop, Base Engineer's Maintenance and Inspection, Engine Cleaning Building, and Battery Shop

The following four facilities were included as AOCs because of the general nature of the activities presumed to have occurred in the building:

AOC 17 - Base engineer's shop (Building T-530)
AOC 18 - Base engineer's maintenance and inspection (Building T-532)
AOC 19 - Engine cleaning building (Building T-535)
AOC 103 - Battery shop (Building T-531)

Solvents, cleaners and other toxic or hazardous materials may have been used during the performance of activities in these buildings. All four facilities were noted on a basic layout drawing for the Lockbourne AFB, dated February 1945, revised January 9, 1948. The locations of the buildings are noted on Figure 3-2. The facilities located at AOCs 17, 19, and 103 have been demolished. Building 532, a World War II Era hangar located at AOC 18, is currently occupied by Lane Aviation.

These AOCs have been evaluated as one unit because of similar soil and groundwater contaminants found during the initial sampling efforts performed as part of the SI, their close proximity to each other, and similarities in the presumed activities performed at each facility. Sampling efforts at these AOCs were performed in several phases.

3.2.1 Phase I Site Investigation Field Work

Because a majority of the facilities were demolished and no drawings could be located that indicated the placement of doorways, bays, and other areas where releases most likely would have occurred, soil boring locations were determined using the estimated groundwater flow direction. Three soil borings and one groundwater sample were collected at each AOC on November 10 and 11, 1999. One sample was placed at the most downgradient point at each of the four AOCs (Boring Locations: 17SB03, 18SB03, 19SB03, and 103SB03) and the two remaining borings were distributed evenly around the building perimeters (Boring Locations: 17SB01, 17SB02, 18SB01, 18SB02, 19SB01, 19SB02, 103SB01, and 103SB02). Boring locations at the four AOCs are shown on Figure 3-2. Samples from each boring and a duplicate from 103SB03 (Sample IDs: 017SB01O04, 017SB02SO01, 017SB03SO05, 018SB01SO04, 018SB02SO01, 018SB03SO04, 019SB01SO04, 019SB02SO01, 019SB03SO04, 103SB01SO04, 103SB02SO01, 103SB03SO04, and 103SB03SO54) were analyzed for TCL VOCs, TCL SVOCs, and TAL metals. Groundwater samples were collected from the most downgradient boring locations at each AOC (Sample IDs: 17SB03GW01, 18SB03GW01, 19SB03GW01, and 103SB03GW01) and analyzed for TCL VOCs and TCL SVOCs. The laboratory data and COCs are presented in Appendices I and J, the soil analytical results are summarized in Tables 3-7 through 3-10, and the analytical results for the groundwater samples collected from the direct-push borings are summarized in Tables 3-11 through 3-14. The detected VOCs and SVOCs in soil are summarized on Figure 3-3. The VOCs detected in the boring groundwater samples are summarized on Figure 3-4.

Five VOCs were detected in the AOC 17 soil samples. All were below the PRGs. Nineteen SVOCs were detected in the soil samples from AOC 17, primarily polynuclear aromatic hydrocarbons (PAHs) in the surface soil sample from 17SB02. Five PAHs exceed the PRGs. This sample was collected in an area between a parking lot and a road and the PAHs are not considered to be AOC related. Due to prolonged vehicle and aircraft operations at the base, PAHs are fairly ubiquitous and should not necessarily be considered to have been caused by a "release", and should thus be considered an "exclusion" to the definition of a release under CERCLA. A CERCLA exclusion in this instance is defined as "(B) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine [Title 42 of the U.S. Code, Chapter 103, Section 9601(22(B)]. Additional SVOCs detected are below their respective PRG. All detected metals are below the PRG, below background, or are considered essential nutrients. One VOC was detected in groundwater at AOC 17 below the PRG. No SVOCs were detected in the groundwater.

Seven VOCs were detected in the soil samples from AOC 18, all below the PRGs except trichloroethene (TCE). No SVOCs were detected in the soil samples from AOC 18. One metal was detected above both background and the PRG (arsenic). Vinyl chloride and cis-1,2-dichloroethene (DCE) were detected above the PRGs and MCLs in the groundwater sample. SVOCs were detected in the groundwater.

Seven VOCs were detected in the soil samples from AOC 19, all below the PRGs. Seventeen SVOCs were detected, primarily PAHs in one surface soil sample. Five PAHs exceeded the PRGs. Only one PAH metal (arsenic) exceeded background and the PRG. Nine VOCs were detected in the ground water sample. Only TCE and VC exceeded the PRG. VC also exceeded the MCL. No SVOCs were detected in the groundwater.

Seven VOCs were detected in the soil samples from AOC 103, all below the PRGs except TCE. Eighteen SVOCs were detected in the soil at AOC 103, primarily PAHs in the surface soil sample. Only one (benzo(a)pyrene) exceeded the PRG. Only one metal (arsenic) exceeded background and the PRG. Three VOCs (methylene chloride, TCE, and cis-1,2-DCE) were detected in the groundwater sample from AOC 103, all above the PRGs and MCLs. No SVOCs were detected in the groundwater.

Based on the analytical results, AOCs 18, 19, and 103 were recommended for further action. The following observations were made from the data collected from the Phase I investigation:

- The soils encountered consisted of silty clays and clayey silts. Sand seams were encountered in borings 17SB01, 17SB02, 18SB03, 19SB02, 103SB01 and 103SB03, at depths of approximately 8 to 15 feet, and at or below the top of the water table. The sand seams are generally 1 to 3 feet thick and do not appear to be laterally continuous across the area.

- The soil samples that had VOCs present were collected near the top of the water table. Therefore, these results were believed to represent groundwater contamination that had impacted the soils near the top of the water table. Other than some slightly elevated PID readings at AOC 19, no indication of surface spills was observed.

- The TCE concentration in the groundwater sample from 103SB03 (19,000 µg/L) and in the soil samples from 103SB01 (1,100 µg/kg) and 18SB01 (280 µg/kg) were approximately 5 to 10 times the cis-1,2-DCE concentrations (103SB03 - 1,800 µg/L, 103SB01 - 240 µg/kg, 18SB01 - 24 µg/kg) . TCE was not detected in the groundwater sample from 18SB03 and only a trace of TCE was detected in the groundwater sample from 19SB03 (0.49 µg/L). The concentration of cis-1,2-DCE (71 µg/L and 13 µg/L) was approximately 14 times the concentration of trans-1,2-DCE (49 µg/L and 0.98 µg/L) in these samples (cis-1,2-DCE concentrations of 71 µg/L and 13 µg/L, respectively versus trans-1,2-DCE concentrations of 4.9 µg/L and 0.98 µg/L). Vinyl chloride was also detected in 18SB03 and 19SB03 at concentrations of 36 µg/L and 5.1 µg/L, respectively, but not in the samples from 103SB03. The high cis-1,2-DCE to trans-1,2-DCE ratio is typical of DCE generated by the degradation of TCE. The VC was also interpreted to be a degradation product. These results tend to indicate that borings 103SB01, 103SB03, and 18SB01 were either located closer to spill areas than borings 18SB03 and 19SB03 or the contamination in the areas of 18SB03 and 19SB03 was older.

- No SVOCs were detected in the 1999 groundwater samples from AOCs 17and 19. The only SVOCs detected in the groundwater samples from AOCs 18 and 103 were low concentrations of phthalates.

3.2.2 Phase II Site Investigation Field Work

To better delineate the nature and extent of groundwater contamination in the area and to establish the groundwater flow direction, 12 monitoring wells were installed at AOCs 18, 19, and 103 from September 20 through 26, 2000. The monitoring well locations are shown on Figure 3-5 and the survey results are in Table 3-15. These well locations were based on the analytical data from the Phase I of the SI, the presumed groundwater flow direction, and the typical migration distances of contaminants at other locations at the base. Wells 18MW01, 18MW02, 19MW01, and 103MW01 were installed at soil boring locations 18SB01, 18SB03, 19SB03, and 103SB02 from Phase I of the SI. Well locations 18MW03, 19MW02, 103MW02, and 103MW03 were installed to investigate the continuity of contamination between the AOCs. Well locations 18MW04, 18MW05, 103MW04, and 103MW05 were installed to delineate the limits of the contamination in the downgradient direction.

The wells were sampled between October 3 and 11, 2000, for TCL VOCs, TCL SVOCs, and TAL metals. The VOC data further defined the nature and extent of VOC contamination in the groundwater. The metals samples were collected from the wells due to background exceedances in the soil samples and since metals could not be tested in the Geoprobe® water samples collected during the Phase I SI activities due to turbidity concerns.

The laboratory data and COCs are presented in Appendices I and J and the groundwater samples collected from the direct-push borings are summarized in Tables 3-12 through 3-14. The detected chemicals in the monitoring well groundwater samples are summarized on Figure 3-5.

Water levels were collected from the wells located at AOC 18, 19, and 103 on January 22, 2001 and July 10, 2001. The water levels are presented in Tables 3-16 and 3-17. Figures 3-6 and 3-7 are potentiometric surface maps constructed from the water level data.

Thirteen VOCs were detected in the AOC 18 groundwater. All concentrations were below the PRGs with the exception of chloroform, dibromochloromethane, TCE, and VC. TCE and VC were also found above the MCLs. Two SVOCs were detected. Bis(2-ethylhexyl)phthalate was found above the PRG and MCL. The other SVOC was below both the PRG and MCL. Fifteen metals were detected, eleven were above background. However, all were below PRGs (if available) with the exception of aluminum, arsenic, manganese, and vanadium (all in 18MW04GW01). Iron concentrations were also above the PRG, but was below background. Three metals were found above MCLs: arsenic, lead (EPA's action level from the Primary Drinking Water Regulations), and nickel.

Ten VOCs were detected in AOC 19 groundwater. Four VOCs were above PRGs: 1,1-DCE, 1,2-dichloroethane (DCA), chloroform, and VC. VC was found above the MCL in 19MW01GW01, as was 1,2-DCA in 19MW02GW01. Manganese was detected above the PRG but was below background. Aluminum was detected above the background but below the PRG. Sodium, which has no PRG, was also detected above background. All other metals were detected below PRGs.

Ten VOCs were detected in AOC 103 groundwater. All detected concentrations were below PRGs with the exception of chloroform, dibromochloromethane, 1,2-DCA, TCE, and VC. TCE and VC also exceeded the MCLs. One SVOC was detected in groundwater below the PRG. Nine metals were detected, two were above background (aluminum and zinc). However, all were below PRGs.

The fairly even distribution and low concentration of the contaminants detected during this portion of the investigation also indicate that the contamination might be due to numerous small releases over a period of years, rather than from large releases. The VOC analytical results from the wells around Building 532 (AOC 18) indicate this site is showing several characteristics typical of contaminant degradation by microbial action. The TCE is at low concentrations - maximum detection of 59 micrograms per liter (µg/L) - and appears very degraded. DCE concentrations are higher than TCE concentrations in several wells and the DCE is primarily cis-1,2-DCE, indicating it is a degradation product, not a spill. Benzene, toluene, ethylene and xylene (BTEX) and acetone are present which act as co-metabolites to microbial degradation of the chlorinated solvents (AFCEE,1996), helping to explain the apparently highly degraded state of the contamination.

Chlorinated solvents have not been detected in the downgradient wells, indicating the contamination is localized around AOCs 18, 19, and 103. Given the minimum age of the release(s) (15+ years), the rate of contaminant migration and degradation might be at a steady state, meaning the contamination might not spread any further than it already has.

3.2.3 Additional AOC 19 Investigation

Because of the groundwater and soil contamination found in the former area of Building 535 at AOC 19 and because the CRAA was planning new construction in the area, additional investigations were performed at AOC 19 from May 8 to 12, 2001 and June 10 and 11, 2001. The purposes of the investigations were to:

- Delineate the extent of VOC contamination in the area of former Building 535.

- Assess the representativeness of the laboratory analytical data generated. Specifically, the field results from this investigation were used to determine the area(s) with the highest concentrations of VOCs and these locations were compared with the locations sampled during the Phase I and II investigations to determine if the most contaminated areas were previously sampled.

- Delineate the extent of the PAHs found in the shallow soil sample collected near Building 535.

In the area around AOC 19/Building 535, 14 additional borings were installed and groundwater samples were collected for onsite VOC analyses (Boring Locations: 19SB101R, 19SB102R, 19SB103R, 19SB105R, 19SB107R, 19SB108R, 19SB109, 19SB110, 19SB111, 19SB112, 19SB113, 19SB114, 19SB115, and 19SB116). The borings were installed using a USACE-Savannah District cone penetrometer truck. The locations of the borings are shown in Figure 3-8. The location of the new passenger terminal is also shown in Figure 3-8. Wells 19MW01 and 19MW02 were abandoned by CRAA during construction. The temporary well points for groundwater sampling were installed using 1.87-inch O.D. rods as described in Section 2.2.2.3. The temporary well points were made of PVC and included ¾-inch screens and risers. The well points were connected to disposable drive points that were inserted into the end of the drive rods. When the drive rods were at the desired sample depth, the rods were retracted to expose the screen. The PVC screen and riser were left behind and sampled after the drilling rig was moved. This was done during this investigation because of the slow groundwater yield at most of the sample locations. Initially, the screens and risers were left in the holes without any real seal above the screens. It was determined that perched water in the gravel beneath the pavement was entering the boreholes and probably affecting sample quality. Therefore, the sample results from these initial borings were not used and new screens and risers were installed in adjacent borings using disposable collars above the screen to seal off the interval being sampled (the top of the water table) from the perched water above. These reinstalled sample points were designated with an "R" after the sample ID. Given the very low hydraulic conductivity in the area, it is unlikely that the water that entered the original borings could have affected the formation to the extent that water quality in the replacement borings was affected.

Three existing groundwater monitoring wells (Well Locations: 18MW03, 19MW01, and 19MW02) were sampled and analyzed as part of this investigation. A soil boring (19SB02R) was also drilled adjacent to boring 19SB02 to delineate the vertical extent of PAH contamination in that area. The soil samples were collected from 2 to 4 feet and 6 to 8 feet for SVOC analysis. This soil boring was also installed using USACE-Savannah District cone petrometer truck. The locations of the soil borings and monitoring wells are shown on Figure 3-3.

The field analysis of the groundwater for VOCs was performed following USEPA Method 8265. The samples were analyzed using a sparge device that interfaced with a Direct Sample Ion Trap Mass Spectrometer (DSITMS) for the analysis of VOCs in groundwater samples. Groundwater samples were placed into 40-mL vials and then transported to the on-site locations of the DSITMS. The vials were attached to a vial-sparging device on the DSITMS. The sparging device uses a helium gas flow to strip the VOCs from the groundwater, and then the DSITMS provides real-time analysis. The instrument was calibrated for PCE, TCE, DCE, VC, chloroform, acetone, MTBE, benzene, and toluene. The analytical results from the DSITMS field analyses are presented in Table 3-18 and on Figure 3-8.

Three groundwater samples were submitted to a fix-based laboratory (Severn Trent Laboratories in North Canton, Ohio) for off-site confirmation analyses. These groundwater samples were collected to confirm the DSITMS data and were splits of the samples run on the DSITMS. The split samples were collected from wells 19MW01 and 19MW02 and soil boring 19SB110. A trip blank was also sent. The fixed-based laboratory results and the on-site analysis were in fairly close agreement. The laboratory data and COCs are presented in Appendices I and J, the soil analytical results are summarized in Table 3-9, and the groundwater sample analytical results from the Geoprobe® and cone penetrometer holes are summarized in Table 3-18.

The analytical results in Table 3-18 show the maximum concentration of DCE and VC were in the sample from boring 19SB114. DCE was detected at 5,200 μg/L and VC was detected at 3,300 μg/L. The maximum concentration of TCE detected was 51 μg/L in the sample from 19SB113. The soil samples collected from 19SB02 were non-detect for all SVOCs, indicating that the SVOCs are only present within the upper two feet of soil in that area (Table 3-9).

The Johnson and Ettinger vapor intrusion model was run as described in Appendix K using the maximum detected VC concentration of 3,300 μg/L. Although 3.300 μg/L is not the highest detect of any compound, all the VOCs present were reviewed, and this sample result yields the highest risk value. The model yielded a risk value of 3.5×10^{-4}, indicating that precautions should be taken to prevent vapor intrusion into the building. The data entry sheet and output for the vapor intrusion model are presented in Appendix L.

To better delineate the nature and extent of the contamination at AOC 19, five additional soil borings (Boring Locations: SB201, SB202, SB203, SB204, and SB205) were installed using Geoprobe® drilling techniques on July 10 and 11, 2001. The boring locations are shown on Figure 3-8. Groundwater samples (Sample IDs: SB202GW01, SB202GW01DUP, and SB204GW01) were collected and analyzed for VOCs and SVOCs. PAHs were not included in the analysis. Groundwater was not present in the remaining borings. The laboratory data and COCs are presented in Appendices I and J. The groundwater analytical results are summarized in Table 3-13 and presented on Figure 3-8.

In both SB202GW01 and SB202GW01DUP, levels of TCE, VC, and cis-1,2-DCE exceeded both the PRGs and MCLs. No contaminants were detected in SB204GW01.

3.2.4 Risk-Based Evaluation

Further action is recommended for AOC 17, but this recommendation is based on the proximity of AOC 17 to AOCs 18, 19, and 103. As shown in Table 3-19, 15 metals were detected in soil. All metals were below their respective background and/or PRG, if available, except calcium and magnesium, which are considered essential nutrients. Arsenic is within an order of magnitude of its PRG and, therefore, within the target risk range. Twenty-four organic compounds were detected in soil. Five PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene] were detected above their respective PRG. The levels of PAHs imply a risk above $1x10^{-4}$. As described in Section 2.11, an evaluation of cumulative exposure to the multiple contaminants detected at AOC 17 was conducted to confirm whether cumulative risk and hazard exceeded the target risk and hazard. As shown in Table 3-20, the cumulative hazard estimate is below 1, while the cumulative risk estimate is above the target risk goal. The surface soil sample location in which the PAHs were detected receives run off from an asphalt parking lot. The high levels of PAHs are, therefore, likely due to anthropogenic deposition of PAHs and not due to any AOC-related activity. As shown in Table 3-21, one organic compound (acetone) was detected in groundwater. The maximum concentration was detected below the PRG. As shown in Table Q-2 (Appendix Q), four PAHs and carbozole exceed the SSLs. These chemicals, however, were not detected in groundwater.

Further action is recommended for AOC 18. As shown in Table 3-22, 17 metals were detected in soil. Cobalt, copper, selenium, and zinc were detected above background, as well as essential nutrients magnesium and potassium. Arsenic was detected above both the background and PRG. All other metals were below their respective PRG, if available. Seven organic compounds were detected in soil. The maximum concentrations were detected below the PRG for all compounds except TCE. Because soil contains multiple chemicals of interest, a risk-based cumulative evaluation was performed. As shown in Table 3-23, the cumulative hazard estimate is less than 1. The cumulative risk estimate is above the target risk goal, primarily due to arsenic. As shown in Table Q-3 (Appendix-Q), methylene chloride, TCE, and arsenic exceeded their respective SSL. Of these, TCE and arsenic were detected in groundwater. As shown in Table 3-24, 15 organic compounds were detected in groundwater. Bis(2-ethylhexyl)phthalate, chloroform, dibromochloromethane, cis-1,2-DCE (total), TCE, and VC were detected above their respective PRG. The level of VC implies a risk above $1x10^{-4}$. Fifteen metals were detected in groundwater. All were detected above background. Aluminum, arsenic, barium, iron, lead, manganese, nickel, and vanadium exceeded the PRG. All other metals were below the PRG or were essential nutrients. Because there are multiple chemicals of interest in groundwater, a risk-based cumulative evaluation was performed. As shown in Table 3-25, the cumulative non-cancer hazard estimate was above 1, primarily due to cis-1,2-DCE, aluminum, iron, manganese, and vanadium. The cumulative risk estimate is above the target risk goal, primarily due to TCE, VC, and arsenic.

Further action is recommended for AOC 19. As shown in Table 3-26, 15 metals were detected in soil. Calcium and magnesium were detected above background but both are considered essential nutrients and are, therefore, not considered chemicals of interest. Arsenic was detected above both background and the PRG. All other metals were below their respective PRG, if available. Twenty-four organic compounds were detected in soil.

Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were detected above their respective PRG. As shown in Table 3-27, the cumulative non-cancer hazard estimate is less than 1. The cumulative cancer risk estimate is above the target risk goal, primarily due to benzo(a)pyrene and arsenic. As shown in Table Q-4 (Appendix Q), benzo(a)anthracene, benzo(b)fluoranthene, carbazole, and arsenic exceeded the SSLs. These chemicals were not detected in groundwater.

As shown in Table 3-28, 15 VOCs were detected in groundwater for AOC 19. Acetone, chloroform, DCA, 1,2-DCE (total), cis-1,2-DCE, TCE, trans-1,2-DCE, and VC were detected above their respective PRG. Six metals were detected in groundwater. All were below background or PRGs, or are considered essential nutrients. As shown in Table 3-29, the cumulative non-cancer hazard estimate is above 1, primarily due to cis-1,2-DCE and 1,2-DCE (total). The cumulative cancer risk estimate is above the target risk goal, primarily due to DCA, TCE, and VC.

Further action is recommended for AOC 103. As shown in Table 3-30, 16 metals were detected in soil. Arsenic was detected above both the background and PRG. Calcium, cobalt, copper, magnesium, potassium, and thallium were detected above background. All other metals were below background. Cobalt, copper and thallium were detected below their respective PRG. Calcium, magnesium, and potassium do not have PRGs; they are considered essential nutrients. Twenty-four organic compounds were detected in soil. All maximum concentrations were detected below the PRG except for TCE and benzo(a)pyrene. As shown in Table 3-31, the cumulative non-cancer hazard estimate was less than 1. The cumulative cancer risk estimate is above the target goal, primarily due to TCE and arsenic. As shown in Table Q-5 (Appendix Q), methylene chloride, TCE, and arsenic are above SSLs. Methylene chloride and TCE were detected in groundwater.

As shown in Table 3-32, 11 organic compounds were detected in groundwater. Seven compounds (chloroform, dibromochloromethane, DCA, cis-1,2-DCE, methylene chloride, TCE, and VC) were detected above their respective PRG. Seven metals were detected in groundwater. All were detected below background or PRGs or were essential nutrients. As shown in Table --33, the cumulative non-cancer hazard estimate is above 1, primarily due to cis-1,2-DCE, TCE, and aluminum. The cumulative cancer risk estimate is above the target risk goal, primarily due to methylene chloride, TCE, and VC.

3.3 AOC 49 – Building 783, Small Arms Firing Range

Building 783 is the control building for an active, outdoor, small arms range. It was included as an AOC because of a reported fuel release that was caused when a mower struck the supply line from an above ground heating oil tank. Above ground heating oil tanks are not regulated by BUSTR, but the site was investigated to determine if groundwater in the area was impacted, which is regulated by Ohio EPA. The site layout is shown on Figure 3-9.

On September 7, 2000, soil headspace measurements were taken from 13 soil boring locations (783SB01 through 783SB13) shown on Figure 3-9 to determine the location where three monitoring wells would be installed on the site. Geoprobe® borings were drilled to a depth of 8 feet and samples were collected from the 0 to 2 feet, 2 to 4 feet, 4 to 6 feet, and 6 to 8 feet. The soil samples were analyzed with a PID and a flame ionization detector (FID). The screening results and the background values are presented in Table 3-34. While the background reading was always found to be less than 1 part per million (ppm), the FID results ranged from 11.5 ppm to 523 ppm. The PID results ranged from 4.5 ppm to 105 ppm. The highest results were from the 6 to 8 feet range from soil boring 783SB12.

On September 21, 2000, 3 monitoring wells were installed and soil samples (Sample IDs: 783MW015004, 783MW025025, and 783MW85057.5) were collected and analyzed for TCL VOCs, TCL SVOCs, and TAL metals. Monitoring well 783MW01 was installed near 783SB13 in the leach field area where the fuel from the spill would have drained. Monitoring well 783MW02 was installed in a downgradient direction and 783MW03 was installed near 783SB10. The locations of the wells are shown on Figure 3-9 and the survey results for the wells are presented in Table 3-15. Groundwater samples were collected from each of the 3 monitoring wells along with a duplicate on October 12, 2000 (Sample IDs: 783MW01GW01, 783MW02GW01, 783MW03GW01, and 783MW03GW51). The groundwater samples were analyzed for TCL VOCs, TCL SVOCs, and TAL metals. A drinking water sample (Sample ID: BLDG 783112100) was collected from a drinking water well on November 21, 2000. The laboratory data and COCs are presented in Appendices I and J, the soil analytical results are summarized in Table 3-35, and the analytical results from the groundwater samples collected from the direct-push borings are summarized in Table 3-36.

Water levels were collected from the wells located at AOC 49 on September 29, 2000. The water levels are presented in Table 3-37 and the potentiometric map developed from the data is presented as Figure 3-10.

As shown in Table 3-38, 18 metals were detected in the soil at AOC 49. Selenium was detected above background. Selenium was, however, detected below its PRG. Arsenic was detected above both background and the PRG. Arsenic is within an order of magnitude of its PRG, and therefore, within the target risk range. All other metals were detected below their respective PRG or were essential nutrients. Eleven organic compounds were detected in soil. This included detection of TCE in the soil sample from 783MW02 and detection of DCE in the soil samples from 783MW01 and 783MW02. All organic compounds were detected below their respective PRG screening criteria. As shown in Table Q-6 (Appendix Q), no detected chemicals exceeded the SSLs.

As shown in Table 3-39, 10 metals were detected in the groundwater at AOC 49. Seven metals (aluminum, barium, iron, lead, manganese, sodium, and zinc) were detected above background. Aluminum, barium, iron, and manganese were also above the PRGs. Lead and zinc were detected below the screening value. Sodium is considered an essential nutrient. Arsenic was detected below background. Three VOCs were detected in groundwater. Chloroform was detected above the PRG. The remaining two VOCs (acetone and carbon disulfide) were detected below their respective PRG. As shown in Table 3-40, the cumulative non-cancer hazard estimate was above 1, primarily due to manganese. The cumulative cancer risk estimate was below the target risk. As shown in Table 3-36, chloroform is below the MCL, while arsenic is above the MCL

Further action is recommended for AOC 49. An additional investigation should be conducted to determine if higher concentrations of contaminants are present. TCE, DCE, and several SVOCs were detected in the soil samples and there is not a well located directly downgradient of the AOC. An additional downgradient well should be installed between 783MW01 and 783MW02 to determine if the groundwater contains significant concentrations of organic compounds.

3.4 AOC 55 - Possible Waste Disposal Location

AOC 55 was included as an AOC because a 1950 aerial photograph indicated the presence of disturbed earth. No other information was available for this area and current aerial photographs indicate this site is not currently being farmed, although immediately adjacent land has been used for growing crops. This could indicate the presence of rubble or other debris that would not be conducive to using farm machinery in the area.

Because the location of this AOC was not readily apparent, map coordinates (northing and easting) were obtained from the digitized aerial photograph. The location of the AOC was established in the field using a Global Positioning System (GPS) unit.

Three soil borings (55SB01, 55SB02, and 55SB03) were drilled at AOC 55 on November 15, 1999 and are shown on Figure 3-11. One soil sample from each boring (Sample IDs: O55SB01SO01, O05SB02SO04, and O55SB03SO04) was analyzed for TCL VOCs, TCL SVOCs, TAL metals, and pesticides/PCBs. The borings penetrated the water table, but there was insufficient yield to collect a groundwater sample in the time frame specified in the work plan (two hours). The laboratory data and COCs are presented in Appendices I and J and the soil analytical results are summarized in Table 3-41.

NDAI status is recommended for AOC 55. As shown in Table 3-42, 17 metals were detected in soil. All metals were detected below background except calcium, magnesium, manganese, potassium, selenium, and thallium. Selenium and thallium were below their respective PRG. The others are considered essential nutrients. One organic compound, methylene chloride, was detected in soil. Its maximum concentration was detected below the PRG. As shown in Table Q-7 (Appendix Q), all chemicals were below the SSLs, if available.

3.5 AOC 55A - Possible Waste Disposal Location

AOC 55A was included as an AOC because a 1950 aerial photograph indicated the presence of disturbed earth. This site was not initially included in the scope of work, but was added during a meeting with CRAA to discuss the nature of the other AOCs. No other information was available for this area and current aerial photographs indicate this site is being farmed.

Because the location of this AOC was not readily apparent, map coordinates (northing and easting) were obtained from the digitized aerial photograph. The location of the AOC was established in the field using a GPS unit.

Three soil borings (055ASB01, 055ASB02, and 055ASB03) were drilled at AOC 55A on November 11, 1999 and are shown on Figure 3-12. One soil sample from each boring (Sample IDs: 055ASB01SO06, 055ASB02SO01, and 055ASB03SO05) was collected and analyzed for TCL VOCs, TCL SVOCs, TAL metals, and pesticide/PCBs. The borings penetrated the water table, but there was insufficient yield to collect a groundwater sample in the time frame specified in the work plan (two hours). The laboratory data and COCs are presented in Appendices K and L and the soil analytical results are summarized in Table 3-43.

NDAI status is recommended for AOC 55A. As shown in Table 3-44, 15 metals were detected in soil. All the metals were detected below background except several essential nutrients. Six organic compounds were detected in soil. All maximum concentrations were detected below the PRG. As shown in Table Q-8 (Appendix Q), all detected chemicals were below SSLs, if available.

3.6 AOC 56 and AOC 72 - Possible Waste Disposal Location

AOC 56 and AOC 72 were included as AOCs because aerial photographs dated 1950 and 1964 indicated the presence of disturbed earth. The disturbed earth noted in the 1950 aerial photograph was labeled as AOC 56 and the disturbed earth noted in the1964 aerial photograph was labeled as AOC 72. These areas are very close to one another and likely represent one site. Personal communications with AFBCA indicate that this area was used for municipal type waste disposal (office waste, kitchen waste, etc.) from Lockbourne AFB. The Archive Search Report (USACE, 1997) indicates that the area was used as a landfill for lumber, paper and scrap metal and disposals were conducted from approximately 1942 to 1951.

Because the location of these AOCs were not readily apparent, map coordinates (northing and easting) were obtained from the digitized aerial photograph. The location of the AOCs was established in the field using a GPS unit.

Three soil borings (56SB01, 56SB02, and 56SB03) were drilled at AOC 56 and AOC 72 on November 15, 1999 and are shown on Figure 3-13. One soil sample from each boring and a duplicate (Sample IDs: 56SB01SO01, 56SB01SO51, 56SB02SO04, and 56SB03SO04) was collected and analyzed for TCL VOCs, TCL SVOCs, TAL metals, and pesticide/PCBs. The borings penetrated the water table, but there was insufficient yield to collect a groundwater sample in the time frame specified in the work plan (two hours). The laboratory data and COCs are presented in Appendices I and J and the soil analytical results are summarized in Table 3-45.

NDAI status is recommended for AOC 56 and AOC 72. As shown in Table 3-46, 18 metals were detected in soil. Calcium, copper, magnesium, and thallium were detected above background. Copper and thallium are below PRGs; calcium and magnesium are essential nutrients. Arsenic was detected above both background and the PRG. Arsenic is with an order of magnitude of its PRG, and therefore, is within the target risk range. All other metals were detected below their respective PRG, if available. Five organic compounds were detected in soil. All maximum concentrations were detected below the PRG. As shown in Table Q-9 (Appendix Q), all detected chemicals were below the SSLs, if available.

3.7 AOC 57 - Possible Waste Disposal Location

AOC 57 was included as an AOC because a 1950 aerial photograph indicated the presence of disturbed earth. No other information was available for this area and current aerial photographs indicate this site is being farmed.

Because the location of this AOC was not readily apparent, map coordinates (northing and easting) were obtained from the digitized aerial photograph. The location of the AOC was established in the field using a GPS unit.

Three soil borings (57SB01, 57SB02, and 57SB03) were drilled at AOC 57 on November 11, 1999 and are shown on Figure 3-14. One soil sample from each boring (sample ID: 057SB01SO05, 057SB02SO01, and 057SB03SO05) was analyzed for TCL VOCs, TCL SVOCs, TAL metals, and pesticides/PCBs. A groundwater sample was scheduled to be collected from one boring, however, groundwater was not present in any of the borings. The laboratory data and COCs are presented in Appendices I and J and the soil analytical results are summarized in Table 3-47.

NDAI status is recommended for AOC 57. As shown in Table 3-48, 16 metals were detected in soil. All metals except calcium, magnesium, and potassium were detected below background. These compounds are considered essential nutrients. Three organic compounds were detected in soil. All maximum concentrations were detected below the PRG. As shown in Table Q-10 (Appendix Q), all detected chemicals were below the SSLs, if available.

3.8 AOC 65 - Horse Barn

The horse barn (Building 788) was included as an AOC because it was used between 1980 and 1982 to store transformers prior to their disposal off-site. The building was demolished between 1984 and 1989.

The approximate location of AOC 65 is shown on Figure 3-15. Because the building is no longer standing, map coordinates (northing and easting) were obtained from site drawings. The location of the building was established in the field using a GPS unit.

On November 16, 1999, 37 surficial soil samples and 4 duplicates (Sample IDs: 065SS01SO01 through 065SS37SO01, 065SS01SO51, 065SS11SO51, 065SS21SO51, and 065SS31SO51) were collected from AOC 65 and analyzed for PCBs. Soil sampling locations were determined in accordance with USEPA guidance, "Field Manual for Grid Sampling of PCB Sites to Verify Cleanup" (USEPA, 1986). In accordance with this guidance, a hexagonal grid was imposed within the smallest circle containing all surfaces to be sampled. The radius of the circle was used to determine distance between adjacent sampling points (s) and the distance between successive rows (u). The area to be sampled was assumed to be the area encompassing Building 788 and extending to the driveway area.

Assuming this area, the radius (r) of the smallest circle was determined to be approximately 85 feet. In accordance with Table 1 of the guidance, a 37 point hexagonal sampling design was selected based on the size of the sampling circle radius. Using the recommended sample spacings of .30r (approximately 25.5 feet) and a row spacing, u, of .26r (approximately 22 feet) for a 37-point hexagonal sample design. The sample locations are shown on Figure 3-15. Sample points were located by first locating the center point using a GPS unit and then taping off the remaining points. There were no areas of dark stained soil visible during the sampling that would cause a sample to be moved or an additional sample to be collected.

NDAI status is recommended for the Former Horse Barn. Soil samples were only analyzed for PCBs; no PCBs were detected in any of the 37 soil samples. The laboratory data and COCs are presented in Appendices I and J.

3.9 AOC 68 - Possible Waste Disposal Location

AOC 68 was included as an AOC because a 1964 aerial photograph indicated the presence of disturbed earth. Air Force Center for Environmental Excellence (AFCEE) personnel indicated it may have served as a parking lot for an adjacent picnic area. No other information was available for this area.

Because the location of this AOC was not readily apparent, map coordinates (northing and easting) were obtained from the digitized aerial photograph. The location of the AOC was established in the field using a GPS unit.

Three soil borings (68SB01, 68SB02, and 68SB03) drilled at AOC 68 on November 15, 1999 and are shown on Figure 3-16. One soil sample from each boring and a duplicate (Sample IDs: 068SB01SO05, 068SB01SO55, 068SB02SO01, and 068SB03SO05) were analyzed for TCL VOCs, TCL SVOCs, TAL metals, and pesticide/PCBs. A groundwater sample was scheduled to be collected from one boring, however, no groundwater was present in any of the borings. The laboratory data and COCs are presented in Appendices I and J and the soil analytical results are summarized in Table 3-49.

NDAI status is recommended for AOC 68. As shown in Table 3-50, 17 metals were detected in soil. Calcium, magnesium, selenium, and thallium were detected above background. Selenium and thallium are below the PRG; calcium and magnesium are considered essential nutrients. All other metals were detected below background. One organic compound was detected in soil. Its maximum concentration was detected below the PRG. As shown in Table Q-11 (Appendix Q), all detected chemicals were below the SSLs, if available.

3.10 AOC 69 - Possible Waste Disposal Location

AOC 69 was included as an AOC because a 1964 aerial photograph indicated the presence of disturbed earth. AFCEE personnel indicated that this area served as a staging and parking area for contractors. A visual inspection of the site indicated the presence of a gravel base, with some concrete and asphalt rubble.

Three soil borings (69SB01, 69SB02, and 69SB03) were drilled at AOC 68 on November 15, 1999 and are shown on Figure 3-17. One soil sample from each boring (Sample IDs: 069SB01SO01, 069SB02SO05, and 069SB03SO04) were analyzed for TCL VOCs, TCL SVOCs, TAL metals, and pesticide/PCBs. The borings penetrated the water table, but there was insufficient yield to collect a groundwater sample in the time frame specified in the work plan (two hours). The laboratory data and COCs are presented in Appendices I and J and the soil analytical results are summarized in Table 3-51.

NDAI status is recommended for AOC 69. As shown in Table 3-52, 17 metals were detected in soil. Calcium, magnesium, selenium, and thallium were detected above background. Selenium and thallium were below PRGs; calcium and magnesium are essential nutrients. All other metals were detected below background. Arsenic was detected above both background and the PRG. Arsenic is within an order of magnitude of its PRG, and therefore, is within the target risk range. All other metals were detected below their respective PRG. Seven organic compounds were detected in soil. All maximum concentrations were detected below the PRG. As shown in Table Q-12 (Appendix Q), all detected chemicals were below the SSLs, if available.

3.11 AOC 75 - Indoor Firing Range

AOC 75 (Building 687) was included as an AOC because of the possibility of lead being present. The building is in disrepair and the floor is covered with approximately 6 inches to 3 feet of sand. The Archive Report (USACE, 1997) concluded that the indoor firing range was an "Area with potential, but not likely to contain ordnance."

The indoor firing range is approximately 40 ft by 80 ft (Figure 3-18). An approximate area of 40 ft by 60 ft of the floor is covered with approximately 6 inches to 3 feet of sand and gravel fill. The flooring below the fill is part of a runway that was built in 1942. A 10 ft by 10 ft grid was laid out and 9 grab samples of the sand and gravel fill (Sample IDs: 075SS01SO01 through 075SS09SO01) were collected at nine grid nodes as shown in Figure 3-19. The samples were collected from the entire depth of the fill and analyzed for TAL metals. The laboratory data and COCs are presented in Appendices I and J and the analytical results are summarized in Table 3-53.

As shown in Table 3-54, 18 metals were detected in sand in the building. Calcium, copper, magnesium, potassium, thallium, and zinc were detected above background but below their respective PRG or are essential nutrients. Antimony was above both background and the PRG. Lead was detected above both background and the screening level of 800 mg/kg. All other metals were below background.

To characterize the sand and gravel fill for possible disposal, a composite sample (Sample ID: 075COMPSO01) was collected from all nine grid nodes and analyzed for TCLP metals. The laboratory data and COCs are presented in Appendices I and J and the analytical results are summarized in Table 3-55. Lead was detected at 104 mg/L, which is above the TCLP regulatory level of 5.0 mg/L. Therefore, the sand and gravel fill is classified as a hazardous waste, and AOC 75 is recommended for further action.

3.12 AOC 94 - Stained Soil Near Precision Maintenance Lab

AOC 94 was included as an AOC because CRAA personnel (or their contractor) had noticed an area of stained soil during a visual site inspection. During a visual inspection conducted by Shaw, no stained soil was evident. This building has been demolished and is no longer present at the site.

Since the facility has been demolished and no drawings could be located that indicated the placement of doorways, bays, and other areas where releases most likely would have occurred, proposed sampling locations were determined using the estimated groundwater flow direction. One boring (94SB03) was placed downgradient of the former building location and the two remaining sampling points (94SB01 and 94SB02) were spaced evenly around the building. The soil borings were drilled on November 9, 1999 and the sampling locations for AOC 94 are shown on Figure 3-20. One soil sample from each boring and a duplicate (Sample IDs: 094SB01SO01, 094SB02SO04, 094SB03SO04, and 094SB03SO54) were analyzed for TCL VOCs, TCL SVOCs, and TAL metals. A groundwater sample (Sample ID: 094SB03GW01) was collected from boring 94SB03 on November 10, 1999 and was analyzed for TCL VOCs and TCL SVOCs. The laboratory data and COCs are presented in Appendices I and J. The soil analytical results are summarized in Table 3-56 and the groundwater results are summarized in Table 3-57.

As shown in Table 3-58, 17 metals were detected in soil. Barium, calcium, magnesium, potassium, thallium, and zinc were detected above background. Barium, thallium, and zinc were below the PRGs; calcium, magnesium, and potassium are considered essential nutrients. Arsenic was detected above both background and the PRG. Arsenic is within an order of magnitude of the PRG, and therefore, is within the target risk range. All other metals were detected below background. Four organic compounds were detected in soil. All maximum concentrations were detected below the PRG. As shown in Table Q-13 (Appendix Q), methylene chloride was detected above the SSL. Methylene chloride was not detected in groundwater.

As shown in Table 3-59, two VOCs were detected in groundwater. TCE was above the PRG, while acetone was below the PRG. As shown in Table 3-57, TCE was detected below the MCL; no MCL is available for acetone.

Further action is recommended for AOC 94. Barium was detected in soil above background; therefore, sampling of groundwater is recommended. Although detected VOC concentrations in the groundwater sample were below respective screening criteria, the limited nature of investigations completed to date can not rule out the potential that higher VOC concentrations exist. An additional investigation should be conducted to determine if higher concentrations of TCE and acetone are present.

3.13 AOC 96 - Well No. 2

AOC 96 was originally included as an AOC because it was thought that the well had not been properly abandoned and could act as a conduit for contamination to reach groundwater. However, during site work it was discovered that the well had been closed. The well was inspected by the sampling team and was determined to be grouted. The AFCEE Field Engineer confirmed that the well had been abandoned with the other supply wells. The CRAA and Air Force records were checked for an abandonment form, but one could not be located. NDAI status is recommended.

3.14 AOC 97 - Sewage Treatment Facility and Lagoon

AOC 97 was included as an AOC because of the potential for toxic or hazardous materials to have been discharged to the sewage treatment facility and eventually discharged to the environment. The sewage treatment facility (Facilities 780 and 781) is a package aeration plant that processed sewage generated from temporary quarters that housed personnel assigned to the base. The package plant consists of two concrete tanks in series. The first appears to be a primary settling basin. Effluent from this tank is piped to the smaller tank. Standing water is currently present in both tanks. Effluent from the package treatment plant was discharged to an unlined lagoon. Dick Haines, AFCEE Field Engineer, interviewed Dave Edwards of the Air Force (who used to be in charge of the base sewage operations) about the lagoon. Mr. Edwards indicated that they never had to remove sludge from the lagoon because most of it was removed by the package plant treatment systems at the trailer court and the dog kennel. The sludge that accumulated in the package plants was generally removed by a vacuum truck and taken to the City of Columbus sewage plant. On several occasionally the sludge was removed and disposed of in an on-base sanitary sewer and was subsequently treated at the on-base treatment plant. The location of AOC 97 is shown on Figure 3-21.

On November 17, 1999, a water sample with a duplicate (Sample IDs: 097SW03SW01 and 097SW03SW51) and a sediment grab sample (Sample ID: 097SD01SD01) were collected from the primary settling tank (Facility 780). A water sample (Sample ID: 097SW02SW01) was collected from the secondary tank at Facility 781. No sediment was present in the secondary tank, so a sediment sample could not be collected. The samples were analyzed for TCL VOCs, TCL SVOCs, pesticides/PCBs, and TAL metals. Additionally, 3 sediment grab samples and a duplicate (Sample IDs: 097SD04SD01, 097SD04S051, 097SD05SD01, and 097SD06SD01) were collected from the lagoon. No water was present in the lagoon, so surface water samples could not be collected. Sediment samples were analyzed for TCL VOCs, TCL SVOCs, TAL metals, and pesticide/PCBs. The laboratory data and COCs are presented in Appendices IK and J and the sediment sample results are summarized in Table 3-60 and the water sample results are summarized in Table 3-61. Fifteen attempts to install a piezometer down gradient (south) of the lagoon each resulted in refusal at approximately 4 to 5 feet bgs. This area is heavily wooded and tree roots might be responsible for refusal.

NDAI status is recommended for AOC 97. Sediment sampled from the lagoon and tank was compared to background soil concentrations and industrial soil PRGs. As shown in Table 3-62, nine metals were detected in sediment from the tanks. Aluminum, calcium, chromium, iron, lead manganese, and zinc were detected above background. All were below their respective PRG; calcium has no PRG, but is considered an essential nutrient. Arsenic and copper were detected below background, if available. Seven organic compounds were detected in the tank sediment. All maximum concentrations were detected below the PRG.

Water in the treatment tanks were compared to surface water background and tap water PRGs. As shown in Table 3-63, eight metals were detected in the tank water. Zinc was detected above background but below the PRG. Iron and manganese were detected above the PRG. The remaining seven metals were either considered essential nutrients or were below their respective background. Five organic compounds were detected in the treatment tank water. All maximum concentrations were below the PRG. As shown in Table 3-61, no chemicals were detected above the MCL, if available.

As shown in Table 3-64, 17 metals were detected in the sediment from the lagoon. All metals were detected above background except cadmium and lead. With the exception of arsenic, all metals were detected below their respective PRG, if available. Nineteen organic compounds were detected in the sediment from the lagoon. With the exception of benzo(a)pyrene and Aroclor-1260, all maximum concentrations were detected below the PRG. The maximum detected concentration of Aroclor-1260 is slightly above the Toxic Substance Control Act (TSCA) clean-up level of 1 ppm. As shown in Table 3-65, the cumulative non-cancer hazard estimate is below 1. The cumulative cancer risk estimate is the target risk goal, primarily due to arsenic. As shown in Table Q-14 (Appendix Q), all detected chemicals were below the SSLs, if available.

The chemicals that exceeded the screening criteria were Aroclor 1260, Benzo(a)pyrene, and Endrin Aldehyde. PCBs bind to soil and would not be expected to migrate to groundwater at low concentrations. The detection of Benzo(a)pyrene in one of the three samples, at a low concentration, is normal given the ubiquitous occurrence of PAHs in the environment. Similar to PCBs, PAHs bind to soil and would not be expected to migrate to groundwater at low concentrations.

3.15 AOC 98 - Base Communication Center and Transmitter Facility

AOC 98 was included as an AOC because the leach field could have been used for disposal of toxic or hazardous materials (Figure 3-22). A visual inspection of the facility revealed the presence of three transformers located on a concrete pad adjacent to the transmitter facility.

The following media were sampled:

- Transformers
- Transformer pad
- Soil near transformer pad
- Soil at leach field
- Groundwater.

On November 11, 1999, 3 soil borings (98SB01, 98SB02, and 98SB03) were drilled in the leach field area. The sampling locations are shown on Figure 3-22. One soil sample from each boring and a duplicate (Sample IDs: 098SB01SO01, 098SB02SO04, 098SB02SO54, and 098SB03SO04) were analyzed for TCL VOCs, TCL SVOCs, and TAL metals. The borings penetrated the water table, but there was insufficient yield to collect a groundwater sample in the time frame specified in the work plan (two hours). The laboratory data and COCs are presented in Appendices K and L and the soil analytical results are summarized in Table 3-66.

On November 16, 1999, one grab sample was collected of the oil from each of the three transformers located at the facility (Sample IDs: 098TR01TO01, 098TR02TO01, and 098TR03TO01) and analyzed for PCBs. The sample locations are provided on Figure 3-23. The laboratory data and COCs are presented in Appendices K and L and the analytical results are summarized in Table 3-67. Transformer No. 1 oil contained Aroclor 1260 at a concentration of 8,500 μg/kg. The oil in Transformers No. 2 and No. 3 did not contain PCBs above the reporting limit, which is well below the PRG.

A composite sample of the concrete from the transformer pad (Sample ID: 098TP01CO01) was collected to determine if the pad had been contaminated with PCBs. The laboratory data and COCs are presented in Appendices I and J and the analytical results are summarized in Table 3-68. The composite sample did not contain PCBs above the reporting limit, which is well below the PRG.

In addition, four surface soil samples (Sample IDs: 098SS01SO01, 098SS02SO01, 098SS03SO01, and 098SS04SO01) were collected from the area surrounding the transformer pad. The sample locations are provided on Figure 3-23. The laboratory data and COCs are presented in Appendices I and J and the analytical results are summarized in Table 3-69. The soils surrounding the transformer pads did not contain PCBs above the reporting limit, which is well below the PRG.

As shown in Table 3-70, 16 metals were detected in soil. Calcium, magnesium, and selenium were detected above background; all other metals were detected below background. Selenium was detected below the PRG; calcium and magnesium are essential nutrients. Eleven organic compounds were detected in soil. All organics were detected below the PRG. As shown in Table Q-15 (Appendix Q), all detected chemicals were below the SSLs, if available. On December 7, 2000, the three transformers located at Building 607 were removed. Additionally, an electrical switch, containing PCBs, located at Building 1074 was removed at this time. Information on the three transformers and the electric switch is provided in Appendix M.

Prior to removing the equipment for disposal, the dielectric fluids were pumped from the units into 55-gallon drums. The units were then transported off-site. The metals were cleaned and recycled, and the oils were incinerated. The removal and disposal work was performed by

Trans-Cycle Industries, Inc., from Pell City, Alabama. The disposal information is provided in Appendix N.

NDAI status is recommended for this site based on the risk screening and removal of PCB-containing materials.

3.16 AOC 99 – Package Aeration Plant (formerly called Lift Station)

AOC 99 was included as an AOC because of the potential for toxic or hazardous materials to have been discharged to the sewage treatment system. AFBCA personnel indicated that this was not a lift station, but a package aeration plant that serviced the dog kennel located in this area.

The location of the package aeration plant is shown on Figure 3-21. On November 17, 1999, one water sample (Sample ID: 099SW01SW01) was collected from the package aeration plant. The sample was analyzed for TCL VOCs, TCL SVOCs, TAL metals, and pesticide/PCBs. The laboratory data and COCs are presented in Appendices I and J and the analytical results are summarized in Table 3-71.

NDAI status is recommended for AOC 99. Impounded water at the station was compared with surface water background and tap water PRGs. As shown in Table 3-72, 12 metals were detected in the water. Chromium, copper, lead, and zinc were detected above background levels. All metals were detected below their respective PRG, if available, with the exception of copper. Three metals had no PRG available for comparison but are considered essential nutrients (calcium, magnesium, and sodium). Six organic compounds were detected in the water. With the exception or heptachlor, all maximum concentrations were below the PRG. As shown in Table 3-71, all maximum concentrations were below the MCL, if available, except lead. Lead was detected slightly above USEPA's action level from the National Primary Drinking Water Regulations (USEPA, 2004).

3.17 AOC 108 - Dry Cleaning Operations

The dry cleaning operations building (Building 314) was included as an AOC because of the general nature of activities presumed to have occurred within the building. Solvents were likely used during the performance of activities in this building. This building has been demolished. A large soil stockpile is currently located over part of the site.

This facility was demolished and no drawings could be located that indicated the placement of doorways, bays, and other areas where releases most likely would have occurred. Because this information was not available, sampling locations were determined using the estimated groundwater flow direction. One boring location (108SB03) was placed downgradient of the former building location and the two remaining boring locations (108SB01 and 108SB02) were distributed evenly around the former building location. Sampling was performed on November 11, 1999 and the boring locations for AOC 108 are shown on Figure 3-24. One soil sample from each boring and a duplicate (Sample IDs: 108SB01SO04, 108SB02SO05, 108SB03SO01, and 108SB03SO04) were analyzed for TCL VOCs. A groundwater sample (Sample ID: 108SB03GW01) was collected and analyzed for TCL VOCs. The laboratory data and COCs are presented in Appendices I and J, respectively. The soil analytical results are summarized in Table 3-73 and the groundwater analytical results are summarized in Table 3-74.

NDAI status is recommended for Building T-314. As shown in Table 3-75, four organic compounds were detected in soil. All maximum concentrations were detected below the PRGs. As shown in Table Q-16 (Appendix Q), all detected chemicals were below the SSLs, if available.

As shown in Table 3-76, four organic compounds were detected in groundwater. All maximum concentrations were detected below the PRGs. As shown in Table 3-74, all detected chemicals were below the MCLs, if available.

3.18 Investigative Derived Waste Disposal

On March 9, 2001, the IDW, 3.24 tons of groundwater and decontamination water and 2.88 tons of soil cuttings, was shipped to Suburban South Recycling facility at 3415 Township Road 447, Glenford, Ohio, for disposal as special waste. The waste profiles for the materials are provided in Appendix O. The waste manifest (No. 0034100) is provided in Appendix P.

4.0 Recommendations

Each of the 21 sites has been evaluated using the criteria described in Sections 2.0 and 3.0 of the report. Of the sites, 14 are recommended for no further action, and seven are recommended for further evaluation. Relevant site history and numbers of sampling locations, along with a summary of the screening results, are tabulated (Table 3-1). As noted in Table 3-1, at most sites, at least one chemical is above screening criteria. In many cases, as discussed in the text, concentrations are below background (e.g., arsenic) or not considered to be a significant health threat The PAHs are also believed to be present due to normal past and present commercial/industrial types of operations such as aircraft and vehicle traffic. As discussed in Section 3.0, PAHs resulting from aircraft and vehicle operations are exempt from regulation under CERCLA.

Of the 21 sites investigated, 14 sites are recommended for NDAI status because there is either no indication of a release or no release that would constitute a threat to human health or the environment:

- AOC 9 - Photo lab
- AOC 55 - Possible waste disposal location
- AOC 55A - Possible waste disposal location
- AOC 56 and 72 - Possible waste disposal locations
- AOC 57 - Possible waste disposal location
- AOC 65 - Horse barn and stable
- AOC 68 - Possible waste disposal location
- AOC 69 Possible waste disposal location
- AOC 96 - Well No. 2
- AOC 97 - Sewage treatment facility and lagoon
- AOC 98 - Base communication center and transmitter facility
- AOC 99 - Lift station
- AOC 108 - Dry cleaning operations.

Seven sites are recommended for further action:

- AOC 17 - Base engineer's shop
- AOC 18 - Base engineer's maintenance and inspection
- AOC 19 - Engine cleaning building
- AOC 49 - Small arms firing range
- AOC 75 - Indoor firing range

- AOC 94 - Stained soil near Precision Maintenance Lab
- AOC 103 - Battery maintenance facility.

4.1 Proposed Further Actions for AOCs 17, 18, 19, and 103

As presented in Section 3.2, because of the risks associated with residual contamination at AOCs 17, 18, 19, and 103, these AOCs need further evaluation to determine the potential need for remediation or additional investigation. These AOCs are being considered together because of their geographic proximity (as shown in Figure 3-2) and the similarity in the nature of contamination. The buildings associated with these AOCs are as follows:

- AOC 17 - Base engineer's shop (Building T-530),
- AOC 18 - Base engineer's maintenance and inspection (Building T-532),
- AOC 19 - Engine cleaning building (Building T-535)
- AOC 103 - Battery shop (Building T-531)

The facilities located at AOCs 17, 19, and 103 have been demolished. Lane Aviation currently occupies AOC 18.

4.1.1 Summary of Soil Contamination at AOCs 17, 18, 19, and 103

Table 4-1 presents a summary of soil contamination at AOCs 17, 18, 19, and 103. This table presents only those compounds identified in Section 3.2.4 as exceeding a screening criterion (such as USEPA Region 9 preliminary remediation goals [PRGs] for industrial/commercial soil). As can be seen from this table, almost all chemicals of potential concern in soil were found in surficial soils (0 to 2 feet) and appear to be related to surface runoff from nearby road surfaces and other anthropogenic activity. However, Ohio EPA has recommended that deeper samples be collected at the locations of 17SB02 to confirm that the PAHs are only at the surface. The one exception was arsenic found in 6 to 8-foot interval at 19SB01. Based on these results, it appears that soil contamination at these AOCs is surficial and confined to limited areas. The area has been redeveloped, so additional sampling would be required to establish current conditions.

4.1.2 Summary of Groundwater Contamination at AOCs 17, 18, 19, and 103

As presented in Section 3.2, groundwater contamination at these 4 AOCs appear to be the result of multiple release events. AOC 17 does not appear to have any groundwater contamination associated with it; thus, AOC 17 will not be discussed further.

Table 4-2 presents a summary of groundwater contamination at AOC 19, which appears to have contamination unrelated to the other AOCs. Table 4-2 presents only those compounds for AOC 19 identified in Section 3.2.4 as exceeding a screening criterion (such as USEPA Region 9 PRGs for tap water and maximum contaminant levels [MCLs] for drinking water) and includes all data collected at this site, including non-validated data. Figure 4-1 shows the location of monitoring wells at AOC 19 and the contamination detected at each well. As can be seen from this figure, it appears that the original spill of trichloroethene (TCE) may have been in the vicinity of 19SB202. Postulating that local groundwater flow was in the direction from 19SB202 towards 18MW03, it can be seen that the TCE has undergone significant biodegradation over the years leading to accumulation of the TCE degradation daughter products, 1,2-DCE and VC down-gradient of 19SB202. The TCE degradation is more pronounced with increased distance from the postulated TCE spill location. Thus, the highest 1,2-DCE and VC contamination can be seen at 19SB114. As is the case in every site investigated at RANGB, the low permeability of the soil coupled with low groundwater hydraulic gradients and low recharge rates (the site is paved over) have resulted in a very slow migration of the contaminants. The maximum downgradient extent of contamination appears to be only 130 feet from 19SB202.

Groundwater contamination at AOC 18 and 103 appear to be contiguous; thus, these two AOCs are discussed as one unit and Table 4-3 presents a summary of chemicals detected in the groundwater at these two AOCs. This table presents only those compounds for AOCs 18 and 103 identified in Section 3.2.4 as exceeding a screening criterion (such as USEPA Region 9 PRGs for tap water and MCLs for drinking water) and includes data collected from monitoring wells and soil borings. Figure 4-2 shows the location of these monitoring wells and soil borings and the contamination detected at each location. As can be seen from this figure, the highest level of contamination was found at 103SB03 (TCE at 19,000 μg/L). Significantly lower contamination levels were detected at the only other monitoring point (103MW01) in the vicinity of this soil boring. Lower levels of contamination were also detected at other boring locations around Building 532 (AOC 18).

4.1.3 Recommendation of Further Action for AOC 19

Additional sampling should be conducted at AOC 19 to assess current groundwater conditions. Some of the wells were abandoned during redevelopment, so some wells may need to be replaced and additional wells might be needed to fully assess the site.

4.1.4 Recommendation of Further Action for AOC 18 and AOC 103

AOC 18 and AOC 103 have the same physical site characteristics as AOC 19. Thus, contamination migration at this site is also likely to be slow. However, the extent of contamination downgradient from 103SB03 has not been fully delineated beyond the confirmation that it does not extend beyond 103MW03 approximately 180 feet away. Given the high levels of contamination found in 103SB03, additional borings appear warranted to better delineate the contamination.

4.2 Recommended Further Action for AOC 75

As presented in Section 3.11, 18 metals were detected in the sand and gravel fill located in the Indoor Firing Range. Antimony, copper, magnesium, thallium, and zinc were detected above background but below their respective PRG, if available. Arsenic was detected above the PRG but below background. Lead was detected above both background and the PRG. A composite sample collected of the sand and gravel fill material was analyzed for TCLP metals. Lead was detected at 104 mg/L, which is above the TCLP regulatory level of 5.0 mg/L. Based on this result, the sand and gravel fill is classified as a hazardous waste, and it is recommended that the sand and gravel be removed for proper disposal. Additional samples should be collected to ensure all of the hazardous waste has been removed. Given that prior use of the building as a range resulted in high levels of lead in the sand, it is likely that the interior walls and ceiling are contaminated. It is recommended that the inside of the building be tested. The building consists of an unpainted wooden frame covered with corrugated metal siding. Decontamination of the wooden frame may not be technically practical or feasible, or might be very costly. After additional testing, it may be found that demolition and disposal of the entire structure might be the only technically practical approach or at least a more cost-effective alternative to interior decontamination. The building sits on a portion of the abandoned 1942 runway. The runway surface should also be sampled and might also need to be decontaminated or demolished. If the runway surface is contaminated and is in poor condition, sampling of the underlying soil and groundwater should be considered.

4.3 Recommended Further Action for AOCs 49 and 94

At AOC 49, the Small Arms Firing Range, and AOC 94, the Precision Maintenance Lab, VOCs were detected in the groundwater. All the detected compounds were below the Tap Water PRGs. Based on the results to date, NDAI status would appear to be likely. However, due to the limited nature of these initial investigations, the possibility exists that higher concentrations of VOCs are present. Therefore, additional sampling is recommended for both sites to better establish the maximum concentrations of VOCs present and to help determine if NDAI status is appropriate.

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