Final

Former Lockbourne Air Force Base Landfill Site Investigation Report
FUDS Site: G05 OH0007

Prepared for

U.S. Army Corps of Engineers
Contract No. W912QR-04-D-0020
Delivery Order No. 0029

May 2009

CH2MHILL

CH2M HILL STATEMENT OF TECHNICAL REVIEW

Former Lockbourne AFB Site Inspection Report

US ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT

The A/E firm of CH2M HILL has completed the **(Draft, Final)** submittal of the **"Former Lockbourne AFB Landfill Site Inspection Report."** Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Quality Control Plan. 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, procedures and material used in analyses; 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 the law and existing Corps policy.

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	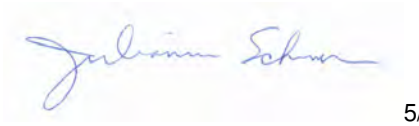
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CH2M HILL STATEMENT OF SIGNIFICANT ITRT COMMENTS

Document: **Former Lockbourne AFB Site Inspection Report**

Significant concerns expressed by the CH2M HILL ITRT review and the explanations of the resolution are as follows:

Minor editing comments regarding presentation of summary and conclusions.

As noted above, all concerns resulting from CH2M HILL ITR of the document have been considered.

CH2M HILL STATEMENT OF TECHNICAL REVIEW COMPLETION

Former Lockbourne AFB Site Inspection Report

US ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT

Verification/Acknowledgment

This is to certify that the CH2M HILL Project Team and Independent Technical Review Team (ITRT) have met and reviewed the attached comments generated by the CH2M HILL ITRT during its review of the **(Draft, Final) "Former Lockbourne AFB Landfill Site Inspection Report."** All comments resulting from the CH2M HILL ITRT have been resolved and incorporated. (Exceptions to be noted on attached pages.)

Document: Final Former FB Landfill Site Inspection Report

Date Received: 5/8/09

Attachments: ITRT Review Comments, Responses, & Status

Project Manager	ITRT Leader
	
5/8/09	5/8/09
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Executive Summary

The U.S. Army Corps of Engineers (USACE), Louisville District contracted CH2M HILL to conduct an additional site investigation (SI) at the former Lockbourne Air Force Base (AFB) landfill near Columbus, Ohio (Figure 1-1), under Contract No. W912QR-04-D-0020, Delivery Order No. 0029. Prior investigative work has been conducted at the former landfill and is summarized in several reports including the *Former Lockbourne AFB Landfill Site Investigation Work Plan* (CH2M HILL 2008). The intent of the additional investigations is to further supplement prior data collection and support completion of the remedial investigation (RI)/feasibility study (FS) process. This SI report includes the results of this additional investigation. After regulatory review of this report, the SI will be included as an addendum to the RI report.

During the SI, the following tasks were completed:

- Test pit trenches were installed to better characterize the limits of waste disposal at the site and evaluate the relationship of these findings to previously observed electromagnetic (EM) anomalies.
- Geophysical survey work involving EM was conducted in select areas to assist in mapping waste disposal extents.
- Landfill gas samples were collected to determine if the former landfill is generating methane gas and for use in the FS to determine the type of landfill cover or cap required.

Multiple attempts were made to locate seeps from the former landfill, but no seeps were identified.

Observations and conclusions made during the SI included:

- Waste encountered during trenching included municipal solid waste, construction and demolition debris, lime sludge, and black material that was similar in appearance to coal ash.
- The EM survey data were consistent with results expected for trench and fill landfill techniques, and identified anomalies consistent with buried construction debris.
- Landfill gas monitoring points were installed, and measurement of the landfill gas has indicated low concentrations of methane. Based on the landfill gas sampling completed in February and March 2009, methane higher than 0.1 percent was not detected at most of the locations.

Based on previous investigations and observations made during the SI, CH2M HILL has redefined the entire site into two areas of concern (AOCs): AOC-1 and AOC-2. These redefined AOCs will carry forward through future RI and FS work efforts. Investigation conducted in the area identified as AOC-2 did not reveal the presence of waste materials.

The following observations were made regarding waste characteristics in AOC-1:

- The former heavily used area A (HU-A) was the only area where all four types of wastes were encountered.
- In HU-A, municipal solid waste (MSW) was detected in the northern and southern portions of HU-A, while the western-central quadrant of HU-A contained both MSW and lime sludge.
- Large quantities of MSW also were found at HU-B, along with black material that was similar in appearance to coal ash, and construction and demolition debris.
- The majority of black material that was similar in appearance to coal ash in HU-A resided in the northern portion, while construction and demolition debris was confined to an area along the eastern portion of HU-A.
- In the former unused to moderately used (UMU) areas, UMU-B waste consisted almost entirely of construction and demolition debris, though MSW was detected sporadically. Black material that was similar in appearance to coal ash was found in UMU-C.
- Based on EM survey and test pits, it is estimated that approximately 40 acres, located at the north and northeast portion of the site, contain no waste material.

Contents

Acronyms and Abbreviations

AFB	Air Force Base
ANG	Air National Guard
AOC	area of concern
EM	electromagnetic
FDEM	frequency domain electromagnetic
FS	feasibility study
GPS	global positioning system
Grumman	Grumman Exploration, Inc.
HU	former heavily used area
Hz	Hertz
MAT	Magnetic Anomaly Test Pit Location
MSW	municipal solid waste
RI	remedial investigation
SI	site investigation
UMU	former unused to moderately used
USACE	United States Army Corps of Engineers

SECTION 1

Introduction

The U.S. Army Corps of Engineers (USACE), Louisville District contracted CH2M HILL to conduct an additional site investigation (SI) at the former Lockbourne Air Force Base (AFB) landfill near Columbus, Ohio (Figure 1-1), under Contract No. W912QR-04-D-0020, Delivery Order No. 0029. Prior investigative work has been conducted at the former landfill and is summarized in several reports including the *Former Lockbourne AFB Landfill Site Investigation Work Plan* (CH2M HILL 2008). The intent of the additional investigation is to further supplement prior data collection and support completion of the remedial investigation (RI)/feasibility study (FS) process. This SI report includes the results of this additional investigation. After client and regulatory review of this report, the SI will be included as an addendum to the RI report.

The principal objectives of this SI work, as specified in the work plan (CH2M HILL 2008), were to:

- Install trenches to better characterize the limits of waste disposal at the site and evaluate the relationship of these findings to previously observed electromagnetic (EM) anomalies.
- Perform geophysical survey work involving EM induction so that recent geophysical data may be compared with results from trenching, potentially allowing EM data to be used to map waste disposal. This information will be used to help delineate and revise the historical nomenclatures of "heavily used area (HU)" and "unused to moderately used areas (UMU)."
- Collect landfill gas samples to determine if the former landfill is generating methane gas. The sample results also will be used in the FS to determine the type of landfill cover or cap required.
- Collect seep samples, if any, to evaluate the existence or potential of fluid leaching from the former landfill via groundwater. Seep sample analytical results will be used in the FS to determine the type of cover or cap appropriate for the landfill.

This report is organized as follows:

- Section 2: Site description and historical use
- Section 3: Narrative of field activities
- Section 4: Findings from the site investigation
- Section 5: Conclusions from the site investigation
- Section 6: References cited in this report

SECTION 2

Site Background

This section provides a description of the physical site settings as well as a general historical understanding of the use of the former Lockbourne AFB landfill. Information contained in this section was obtained from the following sources:

- Engineering Science, Inc. May 1992. *Final Site Investigation Report, Rickenbacker Air National Guard Base, Columbus, Ohio.*
- National Cooperative Soil Survey. 1980.
- Ellis Environmental Group. May 2007. *Draft Remedial Investigation Report: Former Lockbourne Air Force Base Landfill.*

2.1 Facility Description

The former Lockbourne AFB is located east of Interstate 71 in Franklin and Pickaway counties, just east of the village of Lockbourne, Ohio (Figure 1-1). The former AFB covers approximately 4,371 acres, and the site is now occupied by the Columbus Regional Airport Authority (CRAA), the 121st Air Refueling Wing of the Ohio Air National Guard (ANG), the Ohio Army National Guard, Lane Aviation, various retail and service businesses, and a Naval Reserve Center. The former landfill is located within an area of approximately 135 undeveloped acres west of the developed portion of former Lockbourne AFB, with only a portion of the 135 acres used for waste disposal.

The site is bordered by Vause Road to the north, Tank Truck Road to the southeast, and CSX Railroad tracks to the southwest. A high-tension power line crosses the northwest side of the site parallel to Tank Truck Road. There is an inactive second power line that runs east-west from Tank Truck Road through the site, ending shortly after crossing the main site access road. North and south of the site are rural residences. East of the site is Rickenbacker ANG Base; while west of the site is the village of Lockbourne, Ohio.

2.2 Physical Description

The main landfill investigation area consists of approximately 135 acres of partially open areas surrounded by densely wooded and overgrown areas. Grass and low weeds cover large regions of the former landfill. There are localized areas containing tall, dense brush, trees, and visible debris. The ground surface is generally hummocky as a result of former waste disposal trenches and uneven settling of the ground surface.

The former Lockbourne AFB is located in the Central Lowland Province, which is characterized by low relief and elevation, and is located in the western half of Ohio. The Central Lowland Province is made up of the Lake Plain and Till Plains physiographic sections. The former Lockbourne AFB lies within the Till Plains section of the Central Lowland Province. The Till Plains are extensive areas with a flat to slightly undulating

surface, consisting of a mixture of clay, sand, gravel, and boulders deposited by glaciers of the Pleistocene Age.

The former Lockbourne AFB is located on the drainage divide between Big Walnut Creek and Walnut Creek, with the site lying within the Big Walnut Creek basin. Surface drainage at the site is controlled through an extensive network of storm drains, which include corrugated metal, concrete drainage pipes, and open drainage ditches. Surface water is routed through an oil/water separator prior to release into the surrounding surface streams (Engineering Science 1992).

The site geology consists of unconsolidated deposits underlain by bedrock. The uppermost unconsolidated unit consists of about 80 feet of clayey, silty till with alternating sand and gravel deposits. This till is underlain by two sand-and-gravel deposits, which are approximately 50 to 100 feet deep and separated by a layer of clay and silt, which is up to 60 feet thick. Shale underlies the unconsolidated deposits. Shallow wells screened in the uppermost, unconsolidated geologic unit reveal a shallow water table with flow directed west and southwest.

The U.S. Department of Agriculture Soil Conservation Service has described the soils in the vicinity of the former Lockbourne AFB landfill to be of two series: the Crosby series and the Kokomo series (National Cooperative Soil Survey 1980). The Crosby series consists of deep, somewhat poorly drained, slowly permeable soils formed in high-lime glacial till on uplands; slope ranges from 0 to 6 percent. The Kokomo series consists of deep, very poorly drained, moderately slowly permeable soils formed in high-lime Wisconsin Age glacial till on uplands; slope ranges from 0 to 2 percent.

2.3 Historical Use

Historical activities at the former Lockbourne AFB site date back to 1942 and include aircraft fueling, preparation, supplying, arming, and air-delivered ordnance removal and handling. Background information reviewed concerning the former landfill indicates that from 1951 to 1979, 51 of the 135 acres, historically referred to as the "heavily used area (HU)," were used for burning and burying wastes from the base. The remaining 84 acres, historically referred to as the "unused to moderately used area (UMU)," were used for surface disposal of various wastes, primarily construction and demolition debris. The nomenclature of "heavily used" and "unused to moderately used" is historical nomenclature that has been carried forward only for consistency in characterization during the investigative approach and is not reflective of the limits of impact in the undeveloped area. Figure 2-1 depicts these areas.

The former landfill received municipal solid waste (MSW), construction and demolition debris, and lime sludge from the base. The MSW is believed to be generated from base housing and other buildings on base. Construction and demolition debris were believed to be generated during base renovations. Pavement debris is visible on the surface at some locations of the former landfill. The lime sludge is assumed to have been generated by the base water treatment plant.

SECTION 3

Field Activities

The SI field activities and procedures discussed in this section are in accordance with the procedures outlined in the *Former Lockbourne AFB Landfill Site Investigation Work Plan* (CH2M HILL 2008) and approved by USACE and the Ohio Environmental Protection Agency (Ohio EPA). The work plan was implemented as stated, except where noted below.

CH2M HILL field personnel mobilized to the site between September 17 and 19, 2008, to perform pre-excavation activities. These activities included staking and locating trenches using global positioning system (GPS), locating and installing landfill gas sampling points, attempting (without success) to locate previously identified seeps, and supervising the activities of the geophysical surveyor.

CH2M HILL was onsite between September 22 and 25, 2008, to conduct excavation activities. After CH2M HILL had demobilized from the field, USACE directed CH2M HILL to return to the field to install additional test pits and trenches in an area north of UMU-B (along a utility corridor) to confirm waste extents in that area. CH2M HILL remobilized to the site between October 9 and 10, 2008, to install additional test pits in an area north of UMU-B (adjacent to the utility corridor) to confirm waste extents in that area. During these activities, attempts were made to locate the previously reported seeps. All test pits were completed in September 2008, except for the additional test pits (AT-series), HU-A16, and points of interest UMU-C11 through UMU-C16.

The SI work plan directed that trench installation would be completed in a manner that minimized excavated materials while delineating the horizontal and vertical extent that provided information related to the limits of waste disposal. This approach resulted in the identification of 17 test pits. Site observations made during initial test pit trenching led the field team to deviate from installing these 17 test pits, as authorized in the work plan, to installing more than 100 test pits. These deviations were made based on field observations to support the goal of characterizing the limits of waste disposal. Additional test pits and trenches were installed in accordance with the work plan. No clearing of vegetation as described in the work plan was necessary during the field activities.

3.1 Test Pit Trenching

CH2M HILL selected test pit locations for the apparent fill boundary based on an interpretation of waste disposal areas from historical aerial photographs. The aerial photograph evaluation involved 10 aerial datasets that best represented the timeframe between 1950 and 1989 and identified surface features potentially relevant to the historical landfill activities. During this comprehensive review, CH2M HILL compared the historical aerial photographs with the results of the previous geophysical investigations. Based on the aerial photograph review and field observations, test pits were initially proposed adjacent to the expected limit of waste and progressed into the waste mass to identify the type of waste.

This method was selected to both delineate the extent of waste and to minimize the amount of waste excavated during the investigation.

Test pits were completed throughout the extent of the former landfill area. The test pit locations are shown on Figure 2-1. Observations made during test pit excavation are documented in Appendix A as photographs and in Appendix B as field notes.

Initial trenching at location HU-A1 became the basis for deviations from the SI work plan. Waste was encountered at shallower depths than anticipated, and the start location for test pit trenches was found to be close to the former landfill limits. The shallow depth of waste, combined with the accuracy of predicted test pit locations, allowed for more test pits to be completed in the same amount of time. At directions from USACE, CH2M HILL used the initial geophysical survey data (taken from the previous work in 1995) along with the encountered field conditions to determine additional locations for test pits throughout the site.

Trenches were excavated horizontally until waste was encountered, and the extent and characterization were determined. Trenches were excavated vertically in these areas until native soil was identified. The work plan states that the depth of the test pits will be the least of the following: 10 feet below grade, depth of groundwater, or depth of the bottom of the waste. Depth requirement for the AT-series test pits were 4 feet below grade. Any deviation to the above occurred when MSW was encountered upon excavation. Upon instructions from Ohio EPA, excavation was stopped upon encountering MSW at any location. Certain site conditions also prevented from proceeding after a certain depth because of obstructions, such as the presence of concrete slabs. Finally, as the objective was to delineate the horizontal extent of wastes, effort was made to cover as much ground as possible laterally rather than vertically.

Trenches were excavated using a CAT Mini Excavator as shown in the photographic log for HU-A1 (Appendix A). After the trenches were completed, the excavated materials were backfilled into the pit. Trench locations were documented with a GPS unit with submeter accuracy.

3.2 Geophysical Survey

Grumman Exploration, Inc. (Grumman) of Columbus, Ohio, conducted an EM terrain conductivity survey at the former landfill from September 18 to 25, 2008. The areas of investigation at the former landfill site consisted of the main landfill area and two sub-areas identified from a previous geophysical survey of the entire property. The main landfill investigation area covers an approximately 10-acre region in the central-western portion of the former landfill property. The two sub-area anomaly locations consist of a narrow swath parallel to the site entry road northeast of a telephone easement, and a localized potential EM anomaly area in the south-central region of the property located east and southeast of the main landfill area.

Frequency domain electromagnetic (FDEM) instruments (GSSI GEM-300 and EM Profiler EMP-400) were used to map and characterize subsurface conditions based on differences in electrical conductivity responses that occur across different materials present in the

subsurface. The two FDEM instruments provided two simultaneous measurements for the investigation:

- Quadrature phase measurement for differences in soils
- In-phase measurement for high-conductivity or metal identification

The quadrature phase measurements were used for mapping variations in soil and fill types based on contrasts in electrical conductivity. Low conductivity sand and gravel can often be distinguished from higher conductivity silts or clays. Moisture or saturation also influences conductivity. The identification of soil-type anomalies and degrees of heterogeneity are used to define fill and excavation boundaries based on differences in electrical conductivity between excavated filled areas, and different fill types, and natural undisturbed areas.

The in-phase measurement is highly sensitive to buried metallic objects and was used to locate and map potential buried steel objects such as tanks, 55-gallon barrels, utility lines, and other buried metallic structures or highly conductive debris. In general, the majority of the EM response is derived from the upper 10 to 15 feet of the subsurface, with high-frequency responses used for near surface and lower EM frequencies used to penetrate to deeper depths. Appendix C contains more detailed descriptions of the EM methodology.

The EM survey was used in conjunction with a GPS device (Trimble GeoXH handheld system with Zephyr antenna) to record the EM response and position information simultaneously for each survey area with respect to geographic coordinates (latitude and longitude per North American Datum of 1983/World Geodetic System 1984, State Plane [Ohio South], and Universal Transverse Mercator coordinates). Three EM frequencies (5,000 Hertz [Hz], 10,000 Hz, and 15,000 Hz) were recorded electronically at each measurement location. The in-line station spacing was approximately 2 to 3 feet. During the survey, more than 19,000 measurements of the quadrature phase and in-phase responses for three frequencies were recorded over the main landfill area. Data were contoured using a commercially available program (Surfer [Golden Software, Inc.]). Appendix C contains individual EM contour maps for each frequency used for both the quadrature phase and in-phase responses.

3.3 Methane Gas Sampling

Two rounds of methane gas sampling at the former landfill were completed on February 13-14 and March 19-20, 2009. Samples were collected when ground conditions were favorable. An attempt was made on February 27, 2009, to sample for methane; however, this effort was aborted because of unfavorable weather conditions and damage noted on the installed sampling points. Locations of methane sampling points are shown in Figure 3-1. The field notes from the methane sampling events are included in Appendix B.

3.4 Seep Sampling

Four attempts were made to locate the previously identified seeps at the site. Seeps were not found during the two September 2008 events, the October 2008, or the February 2009 field events. Representatives of CH2M HILL, Ohio EPA, and USACE agreed at an onsite meeting

on February 26, 2009, that the seeps do not exist at this time and will be excluded from the scope of the SI report.

SECTION 4

Investigation Findings

Test pits were excavated at locations previously identified in the *Former Lockbourne AFB Landfill Site Investigation Work Plan* (CH2M HILL 2008). Table 4-1 summarizes the findings from the SI by area as originally described in the *Former Lockbourne AFB Landfill Site Investigation Work Plan.* As described in Section 3, it was possible to excavate test pits at additional locations beyond the original scope. Table 4-2 summarizes the test pit dates of excavation, GPS locations, dimensions, and findings.

This section presents the information gathered during the installation of the test pits, the geophysical survey, and the landfill gas sampling during the SI activities.

4.1 Test Pit Trenching

Based on previous investigations and observations made during the SI, CH2M HILL has redefined the entire site into two areas of concern (AOCs): AOC-1 and AOC-2. AOC-1 includes all areas where waste has been encountered, and includes previously identified HUs and UMUs. AOC-2 is the area where no waste was encountered during the recent test pit activities. These redefined AOCs will carry forward through future RI and FS work efforts. The waste characteristics in AOC-1 are indicated below:

The former heavily used areas (HU-A and HU-B) were found to contain large quantities of MSW (Figure 4-1). Based on field observations and geophysical survey data, HU-A appeared to be the only area where fill was emplaced using trenches; for waste encountered in other test pits throughout the site, debris and fill apparently was placed somewhat randomly (that is, not placed in linear trenches). Several waste types were encountered in the HU-A area, including MSW, construction and demolition debris, black material that was similar in appearance to coal ash, and lime sludge (Figure 4-1). In the HU-A area, the majority of MSW existed in the northern and southern portions. The western-central quadrant of HU-A contains MSW and lime sludge. The majority of black material that was similar in appearance to coal ash in HU-A was found in the northern portion. Construction and demolition debris in the HU-A area was confined to an area along the eastern portion.

The HU-B area was found to contain MSW, black material that was similar in appearance to coal ash, and construction and demolition debris. A steep-sloped mound was visible from the road. Trench HU-B6 was dug into the face of this slope, and it was found to be a large mound of MSW. Various points of interest were also noted during the trenching process. Several drums were observed on the southeastern side of the hill or mound (this was marked as location HU-B7). Some of these drums were crushed, and others appeared to contain black material that was similar in appearance to coal ash or another grey solid material. Visual descriptions of point of interest materials are also summarized in Table 4-2, the field logs found in Appendix B, and the photo logs in Appendix C.

In the former unused or moderately used areas, trench UMU-B encountered mostly construction and demolition materials; however, there was an isolated area along the southeastern edge in the vicinity of points UMU-B2 and UMU-B2C where MSW was encountered. Large pieces of concrete and asphalt were found in UMU-B; some pieces were as large as 5 feet long and 3 feet thick.

UMU-C consists of randomly placed construction and demolition debris, lime sludge, and black material that was similar in appearance to coal ash. In several locations, no waste or other fill material was found; only what appeared to be native soils were encountered (Figure 4-1). Additional surficial points of interest were noted in area UMU-C. Locations UMUC11 – UMUC14 are noted on Figure 4-2. Materials noted at these locations included: concrete piles, rebar, a portable air conditioning unit, and various metal objects of unknown nature.

Visual descriptions of test pit materials are also summarized in Table 4-2 and in the field logs found in Appendix B, and the photo logs in Appendix C.

4.2 Geophysical Survey

The results of the multifrequency conductivity and in-phase measurements over the main landfill area are presented as contour diagrams on Figures 3 through 9 of Appendix C. The narrow, subparallel zones of alternating strong and moderate conductivity evident on the EM terrain contour diagrams (Figures 3, 5, and 7 of Appendix C) correspond to topographically low troughs. The troughs are believed to be compacted, settled waste disposal trenches, and the high conductivity responses over these is consistent with the anticipated EM response for fill containing refuse, demolition debris, or other highly conductive industrial material. Locations in trenches having the strongest conductivity measurements may correspond to zones of deeper/thicker fill, highly conductive fill, or a greater amount of metal mixed with the fill (see Figure 4-2 for topographic comparison to test pits/trenches installed). Test pits confirmed that these discrete linear features, identified with EM, contain waste materials.

The lower conductivity areas between the interpreted waste disposal trenches likely represent native soil. Low EM conductivity measurements were consistently observed in the wooded area north of the northernmost landfill berm. These low conductivity areas are believed to correspond to undisturbed, non-landfilled areas, and the toe of the northernmost berm appears to correspond to the northern limit of the former landfill. The parallel configuration and conductivity contrast of the waste disposal cells become less distinct moving southward across the site. This could be because of changes in the composition or thickness of the waste fill, or changes in the method of landfilling used over this area.

The results from the EM in-phase response portion of the EM survey in the main landfill area are shown on Figures 4, 6, and 8 of Appendix C. The strong in-phase anomaly locations suggest buried metallic objects or debris. The increased number and response strength of anomalies for the higher survey frequencies suggest that highly conductive landfill waste, including that with greater metallic content, may be concentrated close to the ground surface.

The two sub-areas surveyed include the "southern EM anomaly area" (Figures 9 through 14 of Appendix C) and the "telephone line area pathway" (Figure 15 of Appendix C). Strong EM conductivity and in-phase responses observed in the southern EM anomaly area could be because of buried reinforced concrete fragments, buried metal debris, or localized concentrations of highly conductive fill.

No anomalous linear structure was defined from the EM transects performed perpendicular to the telephone line easement. Strong EM responses across two EM transects appear to be from metallic debris visible at the ground surface rather than from buried pipe or cable.

4.3 Methane Sampling

Landfill gas sampling was conducted using a Landtec GEM 2000 (GEM). CH2M HILL installed 20 temporary sampling points across the site (Figure 3-1). The locations were based on field conditions and physical access during installation.

The samples were collected using temporary gas probes constructed with expendable shield points and driven by hand to depths of 1 to 2 feet and sealed. Testing for methane was conducted by first connecting the infrared spectrophotometer (GEM) to the probe installation and using the instrument's internal pump to pull soil vapor until readings stabilized. The second reading was collected using an alternative method involving filling of a Tedlar® bag with an auxiliary gas-sampling pump and collecting a reading from the sample volume contained in the Tedlar® bag. This second method ensures that a constant flow rate is maintained and protects the instrument by reducing moisture in the sample. Either method is effective for methane gas screening. Calibration of the meter was checked with standard gas each day of testing. CH2M HILL surveyed each methane sample location to submeter accuracy using GPS technology, and mapped those using Ohio State Plane coordinates. The results are presented in Table 4-3. Methane higher than 0.1 percent was detected only at M-18 (0.6 percent) during the February 2009 event, while only at M-15 (0.7 percent) during the March 2009 event.

4.3.1 Observations

During the methane sampling events between February 13, 2009 and March 20, 2009, methane levels varied from 0 to 1.1 percent, carbon dioxide levels varied from 0 to 5.9 percent, and oxygen levels varied from 10.5 to 21.9 percent. Typical landfill off gas constitutes 45 to 57 percent methane, 40 to 48 percent carbon dioxide, and little if any oxygen (USACE 2008).

SECTION 5

Summary and Conclusions

The primary objective of the SI was to better characterize the limits of waste disposal in the former landfill. Specific objectives for the investigation were to:

- Install test pits to better characterize the limits of waste disposal in the northern and southern parts of the heavily used area and in the areas identified as being unused to moderately used
- Perform geophysical survey work, involving EM induction, so that recent geophysical data may be compared with results from trenching to establish a correlation between EM anomalies and field observations during trenching to map waste disposal
- Collect landfill gas samples to determine if the former landfill is generating methane gas

Effort was made to locate seeps at locations indicated by previous consultants. As indicated earlier, no seeps were found, and therefore no samples were collected.

The entire site was divided into two sections: AOC-1 and AOC-2. In order to achieve the above objectives, test pits have been excavated and geophysical survey has been completed using EM in both AOCs. In addition, methane sampling points were installed in AOC-1, and landfill gas was measured during two different field events.

No waste was encountered in AOC-2. Observations made from test pit excavations in AOC-1 showed that waste is composed of MSW, construction and demolition debris, black material that was similar in appearance to coal ash, and lime sludge. The following were noted:

- Systematic trenches were detected only at HU-A, while elsewhere throughout the site, debris and fill apparently was placed in a less systematic manner.
- HU-A was the only area where all four types of wastes were encountered.
- Large quantities of MSW were found at HU-A and HU-B areas.
- MSW was detected in the northern and southern portions of HU-A, while the western-central quadrant of HU-A contained both MSW and lime sludge.
- The majority of black material that was similar in appearance to coal ash in HU-A resided in the northern portion, while construction and demolition debris was confined to an area along the eastern portion of HU-A.
- HU-B contains MSW, black material that was similar in appearance to coal ash, and construction and demolition debris.
- In the unused to moderately used areas, UMU-B waste consisted almost entirely of construction and demolition debris; however, there was an isolated area along the

southeastern edge in the vicinity of points UMU-B2 and UMU-B2C where MSW was found.

- Concrete and asphalt were found in UMU-B, while construction and demolition debris, lime sludge, and black material that was similar in appearance to coal ash were found in UMU-C.

In an effort to horizontally delineate the waste, the EM survey was performed, and the following observations were made:

- EM survey suggested that highly conductive landfill waste, including that with greater metallic content, may be concentrated closer to the ground surface.
- Low EM conductivity measurements were consistently observed in the wooded area north of the northernmost landfill berm.
- EM survey identified several anomalies that were confirmed to be buried construction debris.

Based on the landfill gas sampling completed in February and March 2009, methane was not detected higher than 0.1 percent at most of the locations, indicating the former landfill is not generating landfill gas. No seep sampling was conducted, as no seeps were located.

Based on investigation results, the site has been divided into AOC-1 and AOC-2. No waste material was detected in AOC-2, which is located at the north-northeast portion of the site. The area covered by AOC-2 is approximately 40 acres. This also is confirmed from historical aerial photographs.

SECTION 6

References

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