West Lake Landfill Vicinity

Radiological Survey and Sampling
November 4-6, 2015
Final Report

Hazardous Waste Program
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Table of Contents

1.0 Introduction 1
2.0 Site Description 1
3.0 Site Selection and Field Surveys 2
3.1 Field and Bench-top Equipment Description 2
3.2 Radiological Field Surveys 4
3.3 Settled Dust 5
4.0 Laboratory Procedures and Results 6
4.1 Laboratory Quality Assurance / Quality Control 6
4.2 Data Quality Objectives 7
4.3 Settled Dust 8
4.4 Surface Soil and Sediment 9
4.5 Surface Water 12
5.0 Conclusion 13
6.0 References 15
Appendix A: Tables 16
Appendix B: Figures 25
Appendix C: Photograph Log 32
Appendix D: Chain of Custody 36
Appendix E: Level IV Data Packets 40
Appendix F: Radiological Field Equipment 41
Appendix G: Previous Investigations 42
Appendix H: Field Data Logs 43
Appendix I: MDNR Meteorological Data 62
Appendix J: Field Book Notes 63

Tables

Table 1: Comparison of Selected Dust Swipe Sample Results to Free Release Criteria 9
Table 2: Comparison of Soil Sample Results to Site-Specific Preliminary Remedial Goals 11
Table 3: Comparison of Water Sample Results to Drinking Water Regulations 13
Table 4: Survey Ranges for All Gamma Walkovers 17
Table 5: Screening Values for all Dust Swipe Sample Analyses Using Equipment E 18
Table 6: Equipment E Response Checks 19
Table 7: Dust Sample Screening Values using EPA Equipment Z 19
Table 8: All Gamma Survey Results Used to Determine Soil Sample Locations 20
Table 9: Summary of Laboratory Results for Dust Swipe Samples 21
Table 10: Summary of Laboratory Results for Soil and Sediment Samples 22
Table 11: Summary of Laboratory Results for Soil and Sediment Samples (Continued) 23
Table 12: Summary of Laboratory Results for Surface Water Samples 24

Photograph Log

Photograph 1: EPA Ludlum 2221 with NaI 44-20 detector with attachment 32
Photograph 2: Gamma walkover survey conducted at Spanish Village Park 32
Photograph 3: One minute count being conducted on equipment B 33
Photograph 4: Soil sampling with Split Spoon sampler 33
Photograph 5: Soil and sediment samples being prepared for shipment 34
Photograph 6: Surface water samples being prepared for shipment 34
Photograph 7: Collection of dust swipe sample D02A 35
Photograph 8: Testing of Dust Swipe Sample D04B with Equipment E 35

Figures

Figure 1: Map of Sampling Locations 26
Figure 2: Sampling Locations North of Area 2 27
Figure 3: Sampling Locations Southeast of Area 1 28
Figure 4: Sampling locations at Spanish Village Park south of WLL 29
Figure 5: Additional Sampling Locations South of West Lake Landfill 30
Figure 6: Sampling Location in Wooded Area South of West Lake Landfill 31

List of Acronyms

α	Alpha radiation
β	Beta radiation
γ	Gamma radiation
µR	MicroRoentgen
ASPECT	EPA's Airborne Spectral Photometric Environmental Collection Technology
BMAC	Bridgeton Municipal Athletic Complex
cm	Centimeters
DHSS	Missouri Department of Health and Senior Services
DNR	Missouri Department of Natural Resources
DOE	U.S. Department of Energy
dpm	Disintegrations Per Minute
DUP	Laboratory Duplicate Sample
EML	U.S. Department of Energy Environmental Measurements Laboratory Procedures Manual
EMSI	Engineering Management Support, Inc.
EPA	United States Environmental Protection Agency
FD	Field Duplicate Sample
FRC	U.S. Nuclear Regulatory Commission Free Release Criteria
FUSRAP	Formerly Utilized Sites Remedial Action Program
g	Grams
hr	Hour
ID	Identification
LANL	Los Alamos National Laboratory
L	Liter
LCS	Laboratory Control Sample
LEPS	Low Energy Photon Spectroscopy
MB	Method Blank
MDA	Minimum Detectable Activity
MSD	Metropolitan St. Louis Sewer District
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
NUREG	Nuclear Regulatory Commission technical report designation
pCi	Pico Curies
PRP	Potentially Responsible Parties
QA / QC	Quality Assurance and Quality Control
QAPP	Quality Assurance Project Plan
RIM	Radiologically Impacted Material
ROD	Record of Decision

SAP	Sampling and Analysis Plan
VOC	Volatile Organic Compounds

1.0 Introduction

On November 4 through November 6, 2015 the Missouri Department of Natural Resources (DNR) and Missouri Department of Health and Senior Services (DHSS) performed radiological surveys and sampling at locations in the vicinity of West Lake Landfill (site). The Environmental Protection Agency (EPA) also assisted in this event by providing additional equipment and staff. Sampling activities were conducted in publically accessible and private property areas near the perimeter of the site, as well as near residential areas, to determine if there is evidence of potential current exposures to the public. Where practical, the DNR performed gamma surveys to support selection of soil and sediment sampling at nine locations. Additionally, surface water sampling was performed at one location and settled dust swipe samples were collected at six locations. All dust swipe samples were analyzed using a bench top meter at the DNR's Florissant Field Office. Two of these samples along with all soil, sediment, and water samples were sent to the Eberline Services laboratory for further analysis. An interim summary report of this sampling effort was produced on January 25, 2016 and detailed the field screening and instrumentation information.

This final report updates the previous interim information and identifies the selected sampling locations, details the radiological survey and testing methods, presents all field and laboratory results, and includes recommendations based on all results. In a joint effort, the Missouri Department of Health and Senior Services performed radiological air sampling and will present their results separately from this report. All results are being shared with EPA, which is the lead regulatory agency for the radiologically impacted areas of the site. Overall, laboratory results identified private property that has two sample locations above EPA criteria for unrestricted use, which will require additional investigation. This finding is consistent with conclusions identified in EPA's 2008 OU-1 Record of Decision (EPA 2008.)

2.0 Site Description

The site is located on a parcel of approximately 200 acres within the city limits of Bridgeton, Missouri and was listed on the National Priorities List (NPL) in 1990 by EPA (Figure 1). The site consists of the Bridgeton Sanitary Landfill, which stopped receiving waste on December 31, 2004, and several old inactive areas with municipal solid waste and demolition debris. The site is divided into two Operable Units, or OUs. OU-1 consists of radiological areas (Area 1 and Area 2), and OU-2 consists of the other landfill areas, which are not known to be impacted by radionuclide contaminants.

The site is located approximately one mile north of the Interstate-70/270 interchange. The Missouri River lies approximately 2 miles north and west of the landfill and Lambert International Airport lies approximately 2 miles to the east-southeast. St. Charles Rock Road defines much of the eastern boundary of the site, with Boenker Lane/Old Saint Charles Road marking the southern and western boundaries.

3.0 Site Selection and Field Surveys

Preliminary sampling locations and areas of interest were selected during a field reconnaissance performed on October 20, 2015 and discussed in the November 2015 Radiological Survey and Sampling Plan (SAP). Selection was generally based on visual examination of the overall site's geographic layout with consideration given to:

- Historic sampling efforts listed in Appendix G;
- Prevailing wind direction at the site;
- Water drainage patterns;
- Evidence of erosion or sediment deposition; and
- Proximity to residential communities

After the preliminary reconnaissance and site selection, the sampling team returned to the selected locations on November 4 and utilized field equipment to screen each site in order to determine the need for further investigation in addition to selecting soil and sediment sampling locations. The previously published interim report provided a brief discussion of the sampling procedures and field investigation results as well as field logs and field notes of each sample location. This final report incorporates the results of the interim report and provides a full discussion of all the sampling procedures and results obtained during the investigation including laboratory sample analyses. Chain of Custody sheets and standard Level IV Report of lab analyses are available in Appendix D & E of this report.

Sampling and surveying was performed by four DNR personnel in groups of two. Where practical, soil samples taken from the sampling locations identified in Figure 1 were collected based on notable fluctuations in the radiological surveying equipment. Specifically, each soil sample collected came from locations exhibiting the highest readings in any one area, and thus biased the sampling location based on the highest gamma readings measured in the field. Recorded weather data during the sampling event was either estimated based on hourly meteorological data provided by the DNR station located off of St. Charles Rock Road to the east of the site, or local data reported from a weather mobile phone application. Hourly meteorological data has been included in Appendix H.

Field and office equipment were used to survey sites for Alpha, Beta, and Gamma radiation. All types of radiation are present at low levels in the environment due to naturally occurring radionuclides. Therefore, radiation detection by the team's field equipment was expected. None of the results presented an immediate concern for worker safety; however, some dust swipe results warranted further laboratory analysis due to equipment response that deviated from what was typically encountered during the investigation. Equipment used for field measurements are summarized in Section 3.1.

3.1 Field and Bench-top Equipment Description

The equipment used for field measurements during this event is summarized below. Each item has been given a letter identifier which is referenced for the remainder of this report.

Equipment operation checks were performed consistent with standard operating procedures and numerous response verification checks were made during the sampling effort. Sampling equipment and tools were decontaminated consistent with standard operating procedures. Additional information for each piece of equipment is provided in Appendix F.

Equipment A: Ludlum model 2221 with 43-5 ZnS Scintillator detector - For this event, the meter was read as an instantaneous rate to search for hotspots, scan dust swipe samples prior to bench testing, and scan personnel at the end of daily sampling activities. Cumulative counts for 1 minute were taken when instantaneous readings detected any activity.

Equipment B: Ludlum model 2221 with 44-10 NaI Gamma Scintillator detector - The meter was utilized to collect instantaneous gamma readings of larger areas (gamma surveys) where practical in order to identify locations with values in the higher range of each area. One-minute readings of each identified location were then collected in order to select each soil and sediment sample location.

Equipment D: The Ludlum model 19A µR meter probe was utilized for gamma surveys where soil and dust swipe samples were collected. The instrument was held horizontally near waist height. The instrument was preset to alarm at a reading of 50 µR/hr, which represents an approximate annual exposure rate of 0.438 REM.

Equipment E: Ludlum model 2929 with 43-10-1 swipe counter - This bench top meter was used to perform alpha counts and combined beta-gamma counts of dust swipe samples. A Thorium 230 check source was periodically used to confirm equipment response.

EPA Equipment Y: Ludlum model 2221 with 44-20 NaI Gamma Scintillator detector – This field equipment was brought by and periodically used by EPA personnel at some sampling locations(Photograph 1.)

EPA Equipment Z: Ludlum model 3030 with ZnS (Ag) Scintillator detector and shielded 2-inch sample tray – This bench top meter and probe is owned by EPA and was used for simultaneous alpha and beta sample counts of selected dust swipe samples. Readings are in CPM for alpha and combined beta gamma.

3.2 Radiological Field Surveys

Radiological field surveys or "gamma" surveys were conducted where practical in order to obtain instantaneous data for an overall assessment of gamma radiation activity in an area. For all practical survey locations, the field team predominately surveyed areas exhibiting erosional and depositional features in order to improve the likelihood of biased soil sampling locations. Due to the discriminate nature of the performed surveys, the results by themselves do not provide sufficient data to draw any conclusions regarding the absence or the extent of the presence of surficial radiologically impacted material. However, the data can be used to indicate a need for further investigation and attempt to bias soil sampling locations. For soil sample locations, gamma survey readings were the first step in identifying what location to obtain a surface soil sample. For dust sample locations, gamma surveys were utilized to complement dust sample results in order to determine if additional investigation within the area may be warranted.

Procedure: For all soil and dust sample locations, equipment B or D was utilized to obtain instantaneous gamma readings where practical at sample areas identified in Figures 1 through 6. Locations within each area identified for soil sampling that had comparatively higher instantaneous readings were flagged for longer scans using equipment B. Some areas were surveyed several times, as shown in Table 4, during this sampling event. Photograph 2 shows an instantaneous gamma survey being conducted at Spanish Village Park.

Results: Survey values revealed the vast majority of instantaneous readings in each area fell in the lower range of the detected values for gamma radiation, with brief fluctuations to comparatively higher values. Gamma surveys around soil sample locations S03 and S06 were not practical due to the dense vegetation present in those areas. Soil sample locations S02, located on or immediately adjacent to restricted private property to the north, and S10, located on or immediately adjacent to restricted private property northwest of Area 2, had some persistent readings approximately 20% to 30% higher than other readings within the same area. The areas around S02 and S10 were subsequently surveyed again during the following day with equipment B and EPA Equipment Y to verify previous observations. Additional procedures for obtaining soil samples in addition to soil sample results are discussed in Section 3.3. Gamma surveys conducted in areas near dust sampling locations did not reveal significant observations. Table 4 displays the range of instantaneous gamma readings for all surveyed locations.

3.3 Settled Dust

Dust swipe samples were used in conjunction with gamma surveys as an additional screening tool. The use of dust or "smear" sampling provides a quick, semi-quantitative result for removable contamination. Each swipe was bench-tested for gross alpha and gross beta-gamma to assist in determining if additional investigation for an area may be warranted. As with field gamma surveys, swipe sampling has limitations that significantly affect the usability of data results (EPA 2011, Frame and Abelquist.) The dust swipe results from this investigation cannot by themselves confirm that removable radioactivity is absent in an area, only that removable radioactivity is present. In addition, swipe sampling and testing methods have considerable inefficiencies that make it difficult to accurately identify and quantify the activity on a sample. EPA 600/R-11/122 (EPA 2011) provides a detailed summary of the state of practice and inherent limitations of swipe sampling and methods.

Procedure: Dust swipe samples were obtained at each selected area using dry standard cloth swipes. A preliminary alpha scan of each swipe was performed using Equipment A prior to analyzing the swipe samples on Equipment E for 10-minute count duration alpha and beta - gamma counts. Photographs 7 and 8 show examples of dust sample collection and bench-top tests. Bench-top tests of dust swipe samples were performed first in order to obtain immediate and relatively inexpensive determination of potential presence and activity level of removable radioactive contamination. The results were compared to empty tray counts, and all samples that substantially deviated from empty tray values were flagged for additional analysis. As an additional quality control check, analysis using EPA equipment Z was performed on the flagged samples in addition to an equal number of samples exhibiting typical investigation results. The flagged samples were then sent to Eberline Laboratory for additional analyses. Laboratory results are discussed in Section 4.1.

Results: Eight locations were originally chosen for dust swipe samples, including two locations (D03 and D05) that had been previously tested by DNR on May 16, 2013. Of the eight planned locations, swipe samples were obtained for six locations, while two locations, D06 and D08 were not sampled due to site access or lack of adequate surface for sampling. A total of 18 swipe samples were collected from the six locations which are labelled first by the general location, then sequentially by letter for each separate object that was swiped. For example, all swipe samples collected at Spanish Village Park were identified as D04, and then each sample collected from separate locations at Spanish Village Park was labeled D04A, D04B, and D04C. DNR bench-top and quality control results are listed in Table 5 & 6.

Of the 18 samples analyzed, samples D05A and D07A were flagged for additional analysis. Sample D05A showed comparatively elevated alpha counts that incrementally decreased through each successive test down to values typically encountered during the

investigation. Sample D07A also showed comparatively elevated alpha count values that were sustained through each successive test. After being analyzed four times on Equipment E, these two samples, along with D04A and D01D for comparison purposes, were taken to EPA's local office for additional bench-top testing on November 16 using EPA Equipment Z. EPA bench-top tests generally confirmed the results of Equipment E, and these results are presented in Table 7.

Based on screening results of D05A and the gamma survey, follow-up investigation for the immediate area was limited to laboratory analysis of D05A. Due to the proximity of sample locations S09 and S10 in addition to sampling in the immediate area by DHSS (MDHSS, 2016), follow-up investigation was limited to laboratory analysis of D07. Both samples D05A and D07A were sent to Eberline Services laboratory for additional analysis using non-destructive analytical techniques. The laboratory results are discussed in Section 4.3.

4.0 Laboratory Procedures and Results

Environmental media that were sampled and analyzed includes surface soil and sediment from zero to six inches below ground surface, surface water, and settled dust. Laboratory testing for soil and sediment include the following radionuclides of interest: Uranium-234 (U-234); U-235; U-238; Thorium-228 (Th-228); Th-230; Th-232; Radium-226 (Ra-226); Ra-228; and Lead-210 (Pb-210). Levels of Gross Alpha, Gross Beta and Gamma radiation were also examined. Laboratory testing for water samples includes total U, Ra-226, Ra-228, Gross Alpha, and Gross Beta. All radionuclides of interest are naturally occurring and will be present at low levels in the environment.

4.1 Laboratory Quality Assurance / Quality Control

Laboratory Quality Assurance and Quality Control (QA/QC) are necessary to enhance and document the quality and reliability of analytical data. While QA concentrates on the planning and implementation processes for establishing the reliability of laboratory data; QC procedures are the tools used to achieve data reliability. Accuracy and precision are important parameters for determining the quality and reliability of data provided by the lab.

Field QA/QC methods for sampling are detailed in DNR Federal Facility Section Quality Assurance Project Plan (QAPP) and Sampling Plan. A summary of, and rationale for field duplicate samples are summarized in this section.

Eberline Services laboratory performs a number of QA/QC checks that have been included in Eberline's Level IV reporting packet available in Appendix E. The QA/QC procedures assist in determining the error, minimum detectable activity (MDA), and qualifiers that are reported in the summarized tables within the report. A brief description of some of the QA/QC protocol has been provided below to assist in distinguishing laboratory QA/QC data provided from Eberline's data packet from results of field samples.

Field Duplicate: A field duplicate (FD) is a separate sample collected at the same time and sampling location under identical conditions and then treated exactly the same throughout the laboratory processes. The results obtained for field duplicates give a measure of the precision associated with sample collection, preservation, storage as well as the analytical test methods used. These samples were labeled in the field similar to other samples, but noted on the Chain of Custody only as FD. For this study, field staff collected one field duplicate sample for each matrix. A total of one soil/sediment duplicate sample and one surface water duplicate were collected.

Laboratory Duplicate: A laboratory duplicate (DUP) is prepared by taking two sample portions from the same sample container and then processing and analyzing as two separate samples. Analysis results are used to measure analytical precision from the sample digestion/extraction step through the analysis process. One laboratory duplicate was analyzed for water samples, and two for soil/sediment samples.

Laboratory Method Blank: A method blank (MB) is prepared to represent the matrix as closely as possible without analytes of interest, and is prepared/extracted/digested and analyzed exactly like the field samples. Its purpose is to assess any contamination potentially introduced during sample preparation activities.

Laboratory Control Sample: A laboratory control sample (LCS) is a controlled matrix, known to be free of analytes of interest. Known analytes are then added or "spiked" to the controlled matrix at verified concentrations, and then analyzed using the same laboratory procedures. The LCS spiked sample results are then compared to the known value of the spike to evaluate the accuracy and performance of the analytical procedure, including all preparation and analysis steps.

4.2 Data Quality Objectives

The purpose of this investigation, as stated in the SAP, is to determine if there is a current potential exposure to the public relative to the potential presence of radiologically impacted material at or near the ground surface. Our data quality objective is to provide sufficient sampling technique and analysis of sufficient quality, as outlined in DNR's QAPP and SAP, to incorporate generated data into ongoing radiological characterization activities at the West Lake Landfill site.

Due to the discriminate and limited nature of investigation activities discussed in this report, it would be inappropriate to use the laboratory results by themselves to make a determination of the absence of contamination within a broader area based on negative laboratory results. Similarly, positive laboratory results by themselves do not definitively determine the extent of contamination, and therefore do not quantify any potential radiological health risk within the area in which a positive sample is obtained. Positive sample results may indicate the need for further characterization activity, or in other words, additional investigation

regarding the presence and extent of contamination in the area in which the positive sample is found. Once an area is characterized, then a risk assessment can be made and health risks quantified. The results of this investigation can supplement on-going characterization activities currently being performed by the Potentially Responsible Parties (PRPs.)

4.3 Settled Dust

Procedure: As noted in Section 3.3, Samples D05A and D07A were sent to Eberline Services laboratory based on comparatively higher alpha counts. Eberline was initially requested to perform gross alpha and gross beta analysis on the samples in order to validate and quantify the results obtained during field testing. An informal gamma spectroscopy screening was requested for sample D07A in order to determine the source of beta activity detected from the initial analysis. Following the informal scan, a formal Low Energy Photon Spectroscopy (LEPS) analysis was requested.

The swipe sample laboratory results obtained during the investigation are compared to Nuclear Regulatory Commission (NRC) free release criteria for comparison (Table 1.) These criteria are used to assist in determining if NRC permitted facilities are sufficiently radiologically de-contaminated to be released for unrestricted use. The swiped surface area for each sample was variable and greater than 100 cm^2, but the resulting values have been compared to 100cm^2 surface area free release requirements as a conservative comparison.

Results: Samples D05A and D07A were tested by Eberline Services laboratory for Gross Alpha & Gross Beta using Method LANL MLR-100 Modified. A duplicate test on D05A was performed in addition to a laboratory control sample and method blank for quality assurance purposes. Quality assurance testing indicates acceptable results, and the results are summarized in Table 9. Overall, gross alpha and beta activity for all samples fall below NRC free release criteria (NRC, 1974). The Report of Analysis is available in Appendix E

After reviewing the results of the gross alpha and beta analysis, an informal gamma spectroscopy screening for D07A was requested in order to determine if the detected beta activity was potentially associated with radionuclides of interest or from activity associated with Potassium 40(K-40), a naturally occurring isotope that is not known to be associated with radiologically impacted material (RIM) originating from OU-1. Gamma screening with Canberra Gamma Apex software was performed, and based on the results of this informal scan, K-40 was ruled out as a primary beta emitter. Since Pb-210 was identified as a radionuclide of potential concern, a formal scan using LEPS was requested and performed using Method LANL ER-130 Modified in order to determine if Pb-210 was the primary beta emitter. Laboratory results indicated potential Pb-210 concentration, but the value was below Minimum Detectable Activity, and therefore is considered non-detect. Overall, gross alpha and beta activity for all

samples fall below Nuclear Regulatory Commission free release criteria (NRC, 1974.) However, the results from sample D07A in combination with soil laboratory results and gamma surveys indicate a probable need for additional investigation in the area near dust sample location D07A.

Laboratory results of gross alpha and beta concentrations in Sample D05A, and the laboratory duplicate, were unremarkable so further isotopic analysis was not pursued. Bench-top results for Sample D05A and empty tray analysis during the second equipment check suggests that the activity may have been related to short-term changes in the testing environment. Rain occurring during this time may have affected the radon activity in the indoor environment where testing was performed.

Table 1: Laboratory Results of Selected Dust Swipe Samples Compared to Free Release Criteria

Sample ID	Laboratory measured Alpha* ($dpm/100cm^2$)[A]	Laboratory measured Beta* ($dpm/100cm^2$)[A]
D05A	1.35	2
D05A DUP	1.29	2.49
D07A	4.42	12.08
	FRC[B]: 20 dpm/ 100 cm^2	FRC[B]: 1000 dpm/ 100cm^2

* Laboratory results were reported in pCi/sample, and D05 results are J-coded or estimated values. A conversion factor of 1pCi = 2.22 dpm was used for comparison purposes

[A] Swipe area assumed to be equal to 100 cm^2. Actual swipe area was larger.

[B] FRC = NRC Free release criteria based on removable contamination (NRC, 1974)

4.4 Surface Soil and Sediment

Procedure: As noted in section 3.2, equipment B and D were utilized to take area-wide instantaneous gamma readings of each soil sample location where practical. Based on the results of the gamma surveys, flags were placed in locations that had comparatively higher instantaneous values in each area. One-minute duration gamma readings using Equipment B were then collected for each flagged location (Photograph 3). Generally, six 1-minute measurements were taken for each area and the location with the highest reading was selected to collect the soil sample. Table 8 shows the instantaneous gamma ranges for each soil sample location in addition to 1-minute duration gamma counts performed in order to bias each soil and sediment sample.

Surface soil and sediment samples were collected using a slide hammer and split spoon sampler fitted with a plastic sleeve. The resulting sample, encased in a 2-inch diameter

by 6-inch long plastic sleeve, was sealed on each end with a plastic cap then taped. (Photographs 4 - 5)

No difficulties were encountered with the field measuring or sampling tools. Some soil sampling locations were substantially moved from the original location selected during field reconnaissance due either to access issues or preferential selection based on surface erosional and depositional features. Sample location S02 located north of Area 2 appeared to contain crushed red brick debris which may have contributed to the comparatively elevated gamma readings, so an additional more segregated sample (S02B) was collected in an effort to potentially determine the source of the elevated gamma readings. An additional quality control field duplicate sample (S02C) was collected and sent for laboratory analysis.

Results: All samples including a quality control duplicate sample S02C were sent to Eberline Services for laboratory analysis. The following methods were used to analyze the soil and sediment samples:

- Isotopic Uranium (Uranium-234, -235, -238) – Method EML U-02 Modified;
- Isotopic Thorium (Thorium-228, -230, -232) – Method EML U-01 Modified;
- Radium – 226 – EPA Method 903.0 Modified;
- Radium – 228 – EPA Method 904.0 Modified;
- Lead – 210 – EML Pb-01 Modified; and
- Gross Alpha/Beta – LANL MLR-100 Modified

Quality control testing demonstrated acceptable precision and accuracy parameters. With some exceptions, Minimum Detectable Activities were generally low enough to quantify isotope concentrations. One notable exception was the U-235 Isotope. None of the results for U-235 were detected at concentrations higher than the detection limit and may be considered non-detect.

Table 2 provides a comparison of calculated results to EPA Unrestricted Use Criteria in addition to Pb-210 results. Overall, radioactivity of Pb-210 was consistent with Radium-226 activity. Complete isotopic results are available in Table 10.

Table 2: Comparison of Soil Sample Results to Site-Specific Preliminary Remedial Goals

Soil Sample Results Compared to EPA Unrestricted Use Criteria[A] All units in pCi/g				
Sample ID	Thorium 230 + 232	Radium 226 + 228	Total Uranium	Lead-210
EPA Unrestricted Use value	7.9	7.9	54.5	No value established
WLL20151104-S01	3.1	2.3	1.8*	1.07
WLL20151104-S02	5.8	6.0	5.7*	3.28
WLL20151104-S02B	2.6	3.2	1.7*	1.59
WLL20151104-S02C (FD)	2.9	3.4	1.6*	1.48
WLL20151105-S03	3.8	3.4	1.8*	1.60
WLL20151105-S04	4.3	1.7*	1.6*	1.23
WLL20151104-S05	2.7	3.3	2.0*	1.12
WLL20151105-S06	1.7	2.4	1.6*	ND
WLL20151106-S08	3.7	3.7	1.8*	ND
WLL20151105-S09	9.2	3.6	1.9*	1.46
WLL20151104-S10	24.6	3.8*	2.0*	2.47

* Indicates one result was non-detect
[A] Reference value based on EPA Unrestricted Use Criteria
ND = Non-detect

Total radionuclide activity in soil sample S10 was notably more elevated compared to all other soil samples analyzed during the investigation. In addition to exceeding EPA unrestricted use level for Th-230 + 232, over 65% of the total activity in the sample is associated with the Th-230 Isotope. Data suggest radiologically impacted material (RIM) is present in sample S10, and additional investigation in the area surrounding this sample location is warranted.

Total radionuclide activity in soil sample S09 were comparatively higher than total activity found in most other samples, and also exceeded EPA unrestricted use level for Th-230+232. Nearly half of the laboratory detected activity is associated with the Th-230 isotope. Soil sample S09 is located in proximity to soil sample S10 and dust sample D07, with all samples being on private property. Data suggest that RIM is present in sample S09, and further investigation in the area surrounding sample location S09 is warranted.

Total radionuclide activity in soil sample S02 was also higher compared to typical activity found in other sample results for this investigation. It is noted that instead of having activity dominated by Th-230, the activity distribution of this sample was relatively even for thorium, radium and uranium isotopes. Sample S02 was observed to

contain red brick material at the time of collection. Since brick material has been shown to be a potential source of radioactivity (Eichholz, et al, NUREG 1501), an additional sample (S02B) was collected in an attempt to isolate any potential source of activity. Laboratory results for sample S02B, without brick material observed in the sample, showed decreased activity similar to typical soil sample results found in the investigation. A comparison of these two results in addition to the field duplicate suggests that the brick material may be the source of radiological activity. However, red brick may be part of demolition debris originally located within West Lake Landfill, so RIM related activity cannot be conclusively ruled out. Since the laboratory results of a sample show activity of both Thorium and Radium near EPA unrestricted use levels, and the 1-minute gamma results of this area have readings that are higher than all other areas surveyed, additional investigation may be warranted.

Total radionuclide activity in soil sample S04 was roughly mid-range in comparison to other sample results from this investigation, and was below EPA unrestricted use levels for the WLL site. However, Th-230 activity accounted for a notable portion of the total activity, and may indicate some influence from a non-natural source. Additional confirmatory investigation or further fate and transport study may be warranted to characterize the presence of site related contaminants. This recommendation is due to only a single sample being collected, and that sample laboratory results indicate there is comparatively higher Thorium concentration in the sample than other soil sample results. This investigation may need to extend toward the area surrounding sample location S03, also referred as the North Surface Water or North Surface Water Body (McLaren/Hart 1996, EMSI 2000), which also showed slightly higher Th-230 activity compared to overall activity in the sample.

4.5 Surface Water

Procedure: One surface water sample and one field duplicate quality control sample was collected into 4-liter cubitainers for laboratory analysis. The water samples were obtained in the wooded area southwest of the site where water had collected during the November 5 rain event (Figure 6). Photograph 6 shows the samples being prepared for delivery. No problems were encountered during sampling.

Results: The following methods were used to analyze the water samples:

- Total Uranium – Method ASTM D5174 Modified
- Radium – 226 – EPA 903.0 Modified
- Radium – 228 – EPA 904.0
- Gross Alpha/Beta – EPA 900.0 Modified

Quality control testing demonstrated acceptable precision and accuracy parameters.

Overall, sample results for radiological contaminants of interest were below laboratory detection limits or below regulatory action and screening levels. Due to the stringent standards for drinking water, water sample results were compared to state drinking water standards, and provided in Table 3.

Table 3: Comparison of Water Sample Results to Drinking Water Regulations

Comparison of Water Sample Results to Drinking Water Regulatory Action Levels[C]				
	Combined Radium (pCi/L)	Total Uranium (µg/L)	Gross Alpha[B] (pCi/L)	Gross Beta pCi/L
Regulatory Action Level[C]	5	30	15	50[D]
WLL20151105-W01	ND[A]	1.49	2.2	8.85
WLL20151105-W01 DUP	ND[A]	1.15	1.9	10.24
WLL20151105-W02 FD	ND[A]	ND[A]	ND[A]	10.10

[A] Radionuclide activity was not detected above Minimum Detectable Activity, and is indicated as non-detect (ND)
[B] Drinking water regulations assess Uranium limits separately from other Alpha emitters. Total Uranium activity was subtracted from Gross Alpha results in order to make an appropriate comparison.
[C] 10 CSR 60-4.060
[D] Screening value for drinking water testing for beta activity minus K-40

5.0 Conclusion

On November 4 through November 6, 2015 DNR and DHSS, with support from EPA, performed radiological surveys and sampling at locations in the vicinity of West Lake Landfill. Two dust swipe samples along with all soil, sediment, and water samples were sent to Eberline Services laboratory for further analysis. This final report updates the previous interim information and identifies the selected sampling locations, details the radiological survey and testing methods, presents all field and laboratory results, and includes recommendations based on all results.

Overall, all samples fell below site-specific action levels, with the exception of two soil samples that indicated the presence of site-related contaminants above EPA's unrestricted use level. However, due to the discriminate and limited nature of investigation activities associated with this report, it would be inappropriate to use these results by themselves to make definitive conclusions regarding the absence, extent of presence, or potential health risk of radioactive contamination found at investigated sites.

Listed below are the recommendations of this effort as based on the results of this investigation.

1. Recommendation Requiring Additional Site Characterization; Soil Sample locations S09 & S10: Survey and sample data suggests that the area located immediately northwest of, and adjacent to OU-1 Area 2 requires additional characterization. The supporting data includes persistent comparatively higher values from gamma surveys, comparatively higher alpha and beta activity on dust swipe sample D07A, and soil sample results from S10, and S09 that exceed EPA's unrestricted use levels. These sample results can supplement on-going characterization activities by incorporation into any additional investigation conducted by EPA and the PRPs. This conclusion is consistent with the need for additional investigation identified in EPA's 2008 OU-1 Record of Decision (EPA 2008.)

2. Results Suggesting Additional Evaluation; Soil Sample Location S02: Soil sampling results at location S02, while below site-specific action levels, did show comparatively higher activity levels. Laboratory results for sample S02B suggests the activity levels present in sample S02 may be attributable to brick material observed in the sample. However, given the limited number of samples collected from this area, and the unknown origin of the brick material, more evaluation may be needed to confirm the cause and extent of activity in this area.

3. Results Suggesting Additional Evaluation; Soil Sample Location S04: Although Sample S04 is below site specific action levels, additional evaluation of this area is recommended based on comparatively higher concentration of Th-230 activity, and the limited number of samples collected in proximity.

In conclusion, DNR has communicated all information and findings to EPA and any affected private property owners. This report will be posted to the Department's Westlake Landfill website. The DHSS radiological air sampling results will be presented in a separate report.

6.0 References

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Appendix A: Tables

Table 4: Ranges for All Gamma Walkover Surveys

Location Description	Associated Sample IDs	Surface Type	Equipment		
			D (µR/hr)	B (1000 CPM)	EPA-Y (1000 CPM)
AAA Trailer Back Fence Line	D07A; S10	Grass; Gravel	8 – 15	7 - 15	*
AAA Trailer Back Fence Line	S10	Grass; Gravel	*	*	18 – 39[C]
AAA Trailer SW Corner	S09	Grass	*	10 – 12	*
Virbec	S04	Grass	5 – 10[C]	8 – 11[C]	*
Artur Trucking Back Lot	S01	Grass	*	8 – 11	*
Artur Trucking Back Lot	S02; S02B; S02C	Grass	*	7 - 14	12-16[C,D]; 25[C]
Drainage Area – Woods south of landfill	S06; W01; W02	Grass	*	9.8[C, B]	*
MSD Lift Station and Levee Gate	D05A; D05B; D05C; D05D	Grass; Gravel; Concrete	5 - 10	*	*
House on Hill	D03A; D03B	Grass; Concrete	7 – 13	*	*
Abandoned Gas Station	D02A-1; D02A-2; D02B	Grass; Concrete	7 – 15	*	*
13374 Lakefront Drive	None	Grass	8 – 13	*	*
Spanish Village Park	D04A; D04B; D04C	Grass; Concrete; Playground fill	8 – 10	*	*
Spanish Village Park	S05; D04A; D04B; D04C	Grass	10 – 15[A]	8 - 11	*
Ditch adjacent to St. Charles Rock Road and OU1 Area 2	S03	Grass	*	9.4[C, B]	*

*not surveyed
[A] Upper range of readings obtained near brick-walled restroom
[B] Point reading
[C] Light rain reported during survey
[D] Directional shield installed

Table 5: Screening Values for all Dust Swipe Sample Analyses Using Equipment E

Sample Location Description	Sample ID	Preliminary Alpha Result (CPM)	10-Minute Alpha Result (Total Count)	10-Minute Beta + Gamma Result (Total Count)
First equipment check was performed (see Table 6) prior to the following samples				
Spanish Village Park: Pavilion Rafter	D04A	0	4	431
Spanish Village Park: Upper Jungle Gym Slide Bay Floor	D04B	0	2	445
Spanish Village Park: Bathroom Air Inlet	D04C	0	4	432
Home on hill: Picnic Bench	D03A	0	2	443
Home on hill: Piano	D03B	0	2	400
MSD Lift Station: Top of Control Panel (tested three times)	D05A	0, 0, 0	12, 7, 6	431, 417, 437
Second equipment check was performed (see Table 6) prior to the following samples				
DNR Emergency Response Trailer (EER): Roof under AC Canopy	D01E	0	5	423
MSD Lift Station: Air Monitoring Station	D05B	0	4	421
MSD Lift Station: Road surface near entrance	D05C	0	3	428
MSD Lift Station: Levy Gate	D05D	0	3	430
DNR EER Trailer: Floor	D01C	0	4	416
DNR EER Trailer: Oven exhaust hood	D01A	0	4	436
DNR EER Trailer: Printer shelf	D01B	0	2	433
AAA Trailer: Radiation Warning Sign on fence (tested three times)	D07A	0, 0, 0	13, 18, 16	473, 439, 423
Third equipment check was performed (see Table 6) prior to the following samples				
DNR EER Trailer: Furnace Air Intake	D01D	0	6	438
Abandoned Gas Station Canopy Downspout: Sample 1 of 2	D02A-1	0	4	456
Abandoned Gas Station Canopy Downspout: Sample 2 of 2	D02A-2	0	3	394
Abandoned Gas Station: Trash can	D02B	0	3	419
MSD Lift Station: Top of Control Panel (4)	D05A	0	5	452
AAA Trailer: Radiation Warning Sign on fence (4)	D07A	0	17	474
Final equipment check was performed (see Table 6) to confirm equipment response				
Total counts may be converted to CPM by dividing the total count value by 10 Testing performed on November 5, 2015				

Table 6: Equipment E Response Checks Using 1) An Empty Tray and 2) Th-230 Check Source

Equipment Check Description and Time	10-Minute Alpha Result (Total Count)	10-Minute Beta + Gamma Result (Total Count)
First Equipment Check		
06:47 Empty Tray	2	416
07:00 Th-230 Check Source	9414	1764
Second Equipment Check		
09:28 Empty Tray(1)	3	394
09:49 Empty Tray(2)	5	411
10:00 Empty Tray(3)	0	417
10:13 Th-230 Check Source	9414	1783
Third Equipment Check		
14:09 Empty Tray(1)	2	423
14:25 Empty Tray(2)	2	407
14:36 Empty Tray(3)	3	413
14:47 Th-230 Check Source	9393	1741
Final Equipment Check		
19:04 Th-230 Check Source(1)	9601	1729
19:43 Th-230 Check Source(2)	9476	1715
19:56 Th-230 Check Source(3)	9402	1856
20:09 Empty Tray	3	427
Total counts may be converted to CPM by dividing the total count value by 10 Testing performed on November 5, 2015		

Table 7: Dust Sample Screening Values using EPA Equipment Z

Equipment Check	10 Minute Alpha Result (average CPM)	10 Minute Beta + Gamma Result (average CPM)
Equipment Check using Th230 (α) Check Source	3291[A]	*
Equipment Check using Sr90 (β) Check Source	*	1198[A]
Equipment Check with an Empty Tray	0	42
Sample ID	10 Minute Alpha Result (average CPM)	10 Minute Beta + Gamma Result (average CPM)
D04A	0	45
D01D	0	43
D05A	0	43
D07A	1	48
[A] One minute counts		
Equipment Checks and Testing completed between 12:30 and 14:15 on November 16, 2015		

Table 8: All Gamma Survey Results Used to Determine Soil Sample Locations

Location Description	Sample ID	1-minute Gamma Counts for soil sample location on Equipment B (CPM)						Area-wide Instantaneous Gamma Range	
								Equipment D (µR/hr)	Equipment B (1000 CPM)
Spanish Village Park	S05	10190	10148	10473[C]	10352	10293	9960	8-15	8-11
AAA Trailer Back Fence Line	S10	7785	10865	12482	12943	13303	13716[C]	8-15	7-15[B]
AAA Trailer Southwest Corner	S09	10957	11600[C]	10988	10805	*	*	*	10-12
Virbec	S04	10084	10436	11812[C]	8604	8488	*	5-10	8-11
Artur Trucking Back Lot	S01	9589	9637	9729	9817	10287[C]	8546	*	8-11
Artur Trucking Back Lot	S02	10360	10749	14437[C]	11249	14158	12228	*	7-14[B]
Drainage Area in woods south of landfill	S06	9800[C]	*	*	*	*	*	*	9.8[A]
Ditch adjacent to St. Charles Rock Road and OU1 Area 2	S03	9442[C]	*	*	*	*	*	*	9.4[A]

* Not surveyed
[A] Point reading
[B] Sustained upper range reading
[C] Soil sample location

Table 9: Summary of Laboratory Results for Dust Swipe Samples

Laboratory Analysis of Swipe Samples D05A and D07A **Gross Alpha & Gross Beta** Collection Date: November 4, 2015 Results in pCi/sample							
Sample ID	Sample Location	Gross Alpha			Gross Beta		
		Result	Error	MDA	Result	Error	MDA
WLL20151104-D05A	MSD Pump Station South of Bridgeton Landfill	0.61 J	0.29	0.32	0.90 J	0.48	0.74
WLL20151104-D05A DUP		0.58 J	0.28	0.32	1.12 J	0.49	0.74
WLL20151104-D07A	AAA Trucking Sign on Fence	1.99	0.49	0.41	5.44	0.71	0.73

MDA = Minimum Detectable Activity
J = Laboratory Data Qualifier: Value is estimated

Table 10: Summary of Laboratory Results for Soil and Sediment Samples

Laboratory Radionuclide Analysis of Soil and Sediment Samples
Collection Date: November 4-6, 2015
Results in pCi/g

Sample ID		Gross Alpha	Gross Beta	Lead-210	Radium-226	Radium-228	Thorium-228	Thorium-230	Thorium 232	Uranium-234	Uranium-235	Uranium-238
WLL-20151104-S01	Res	4.20	3.90	1.07	1.23	1.02	1.02	1.90	1.23	0.84	0.09	0.87
	Err	1.28	1.61	0.35	0.50	0.44	0.32	0.48	0.35	0.24	0.08	0.24
	MDA	1.81	2.95	0.64	0.31	0.83	0.20	0.11	0.11	0.06	0.07	0.10
	Q		J			J					J	
WLL-20151104-S02	Res	2.73	2.52	3.28	4.45	1.56	1.80	4.05	1.70	2.78	0.09	2.83
	Err	1.03	1.63	0.47	0.98	0.48	0.43	0.81	0.41	0.50	0.09	0.50
	MDA	1.48	3.16	0.68	0.29	0.87	0.08	0.09	0.07	0.08	0.11	0.07
	Q		U								U	
WLL-20151104-S02B	Res	4.21	1.44	1.59	1.43	1.79	1.19	1.48	1.10	0.87	0.05	0.76
	Err	1.35	1.77	0.38	0.61	0.53	0.35	0.41	0.33	0.25	0.06	0.23
	MDA	1.87	3.55	0.65	0.55	0.95	0.10	0.09	0.07	0.09	0.08	0.07
	Q		U								U	
WLL-20151104-S02C (FD)	Res	5.78	3.26	1.48	1.66	1.76	1.15	1.59	1.27	0.88	0.04	0.72
	Err	1.42	1.67	0.41	0.61	0.57	0.32	0.40	0.34	0.24	0.06	0.21
	MDA	1.76	3.13	0.74	0.40	1.03	0.08	0.07	0.09	0.07	0.10	0.07
	Q		J								U	
WLL-20151105-S03	Res	7.11	3.74	1.60	1.84	1.56	0.81	2.93	0.83	0.80	0.07	0.92
	Err	1.48	1.60	0.45	0.63	0.52	0.24	0.60	0.24	0.23	0.08	0.25
	MDA	1.33	2.90	0.81	0.40	0.95	0.08	0.05	0.08	0.06	0.11	0.06
	Q		J								U	
WLL-20151105-S04	Res	7.32	2.25	1.23	1.45	0.26	0.77	3.37	0.88	0.79	0.09	0.74
	Err	1.55	1.61	0.37	0.55	0.39	0.24	0.69	0.26	0.23	0.09	0.22
	MDA	1.58	3.08	0.66	0.30	0.81	0.12	0.09	0.08	0.08	0.11	0.07
	Q		U			U					U	
WLL-20151104-S05	Res	3.80	-0.20	1.12	2.11	1.15	1.09	1.09	1.07	1.05	0.06	0.84
	Err	1.18	1.51	0.38	0.63	0.46	0.31	0.31	0.30	0.29	0.08	0.26
	MDA	1.61	3.16	0.70	0.32	0.87	0.11	0.09	0.08	0.08	0.13	0.07
	Q		U			J					U	

Res = Results
Err = Error
MDA = Minimum Detectable Activity

Q = Laboratory Data Qualifier
U = Radionuclide was detected, but not detected above the MDA
J = Value is estimated

Table 11: Summary of Laboratory Results for Soil and Sediment Samples (Continued)

Laboratory Radionuclide Analysis of Soil and Sediment Samples (Continued) Collection Date: November 4-6, 2015 Results in pCi/g												
Sample ID		**Gross Alpha**	**Gross Beta**	**Lead-210**	**Radium-226**	**Radium-228**	**Thorium-228**	**Thorium-230**	**Thorium 232**	**Uranium-234**	**Uranium-235**	**Uranium-238**
WLL-20151105-S06	Res	6.08	3.76	-0.07	1.03	1.36	0.93	0.95	0.74	0.73	0.05	0.82
	Err	1.31	1.59	0.40	0.45	0.41	0.28	0.28	0.24	0.21	0.07	0.22
	MDA	1.10	2.88	0.85	0.24	0.73	0.08	0.08	0.06	0.06	0.10	0.06
	Q		J	U							U	
WLL-20151106-S08	Res	8.14	7.50	0.47	1.94	1.75	1.85	2.07	1.62	0.94	0.09	0.80
	Err	1.75	1.97	0.32	0.63	0.49	0.49	0.52	0.44	0.26	0.08	0.24
	MDA	2.01	3.37	0.62	0.32	0.85	0.13	0.09	0.12	0.09	0.09	0.07
	Q			U							U	
WLL-20151105-S09	Res	11.04	4.80	1.46	2.31	1.32	1.10	8.04	1.17	0.95	0.07	0.86
	Err	1.77	1.74	0.42	0.69	0.41	0.31	1.49	0.32	0.25	0.08	0.24
	MDA	1.48	3.06	0.76	0.39	0.73	0.07	0.08	0.06	0.09	0.11	0.08
	Q										U	
WLL-20151104-S10	Res	19.57	4.78	2.47	3.28	0.55	1.14	22.62	1.95	0.90	0.10	1.01
	Err	2.29	1.74	0.44	0.88	0.53	0.32	4.01	0.47	0.27	0.09	0.28
	MDA	1.55	2.98	0.68	0.36	1.08	0.10	0.10	0.08	0.10	0.10	0.08
	Q					U					U	

Res = Results
Err = Error
MDA = Minimum Detectable Activity

Q = Laboratory Data Qualifier
U = Radionuclide was detected, but not detected above the MDA
J = Value is estimated

Table 12: Summary of Laboratory Results for Surface Water Samples

Radionuclide Results for Surface Water Samples Collection Date: November 5, 2015 Results are in (pCi/L)									
Parameter	WLL20151105-W01						WLL20151105-W02		
	Sample			Lab Duplicate			Field Duplicate		
	Result	Error	MDA	Result	Error	MDA	Result	Error	MDA
Gross Alpha	3.65 J	2.03	3.48	3.04	1.38	1.53	2.04	1.54	2.67
Gross Beta	8.85	2.69	4.86	10.24	2.44	4.08	10.10	2.56	4.40
Radium-226	-0.04 U	0.13	0.44	0.34 U	0.36	0.54	-0.05	0.13	0.38
Radium-228	0.89 U	0.50	0.95	0.29 U	0.46	0.95	0.17	0.48	1.02
Total Uranium[A]	1.49	0.04	1.00	1.15	0.03	1.00	0.31	0.01	1.00

[A] Results are in µg/l

MDA = Minimum Detectable Activity
U = Laboratory Qualified Data: Radionuclide was detected, but not detected above the MDA
J = Laboratory Qualified Data: Value is estimated

Appendix B: Figures

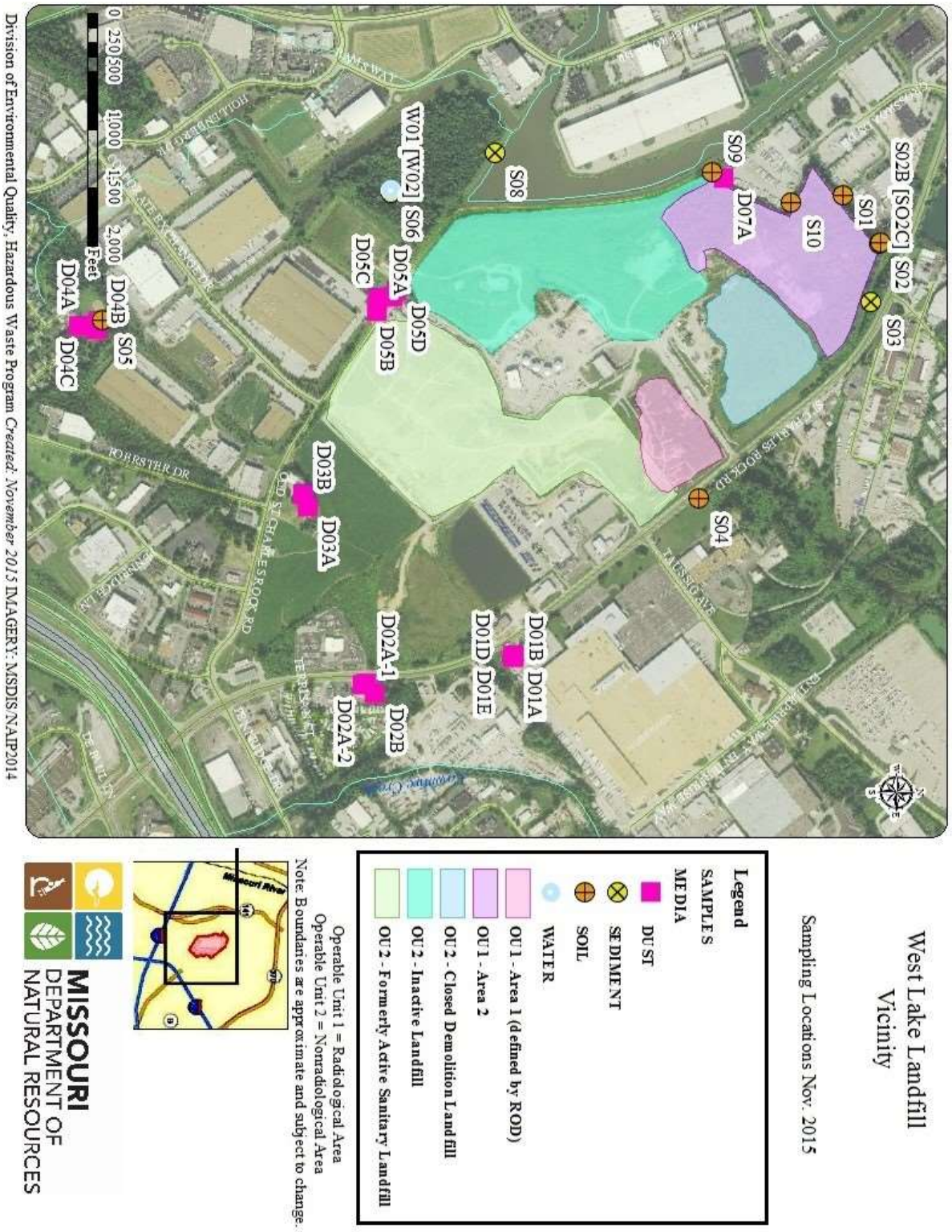


Figure 1: Map of Sampling Locations

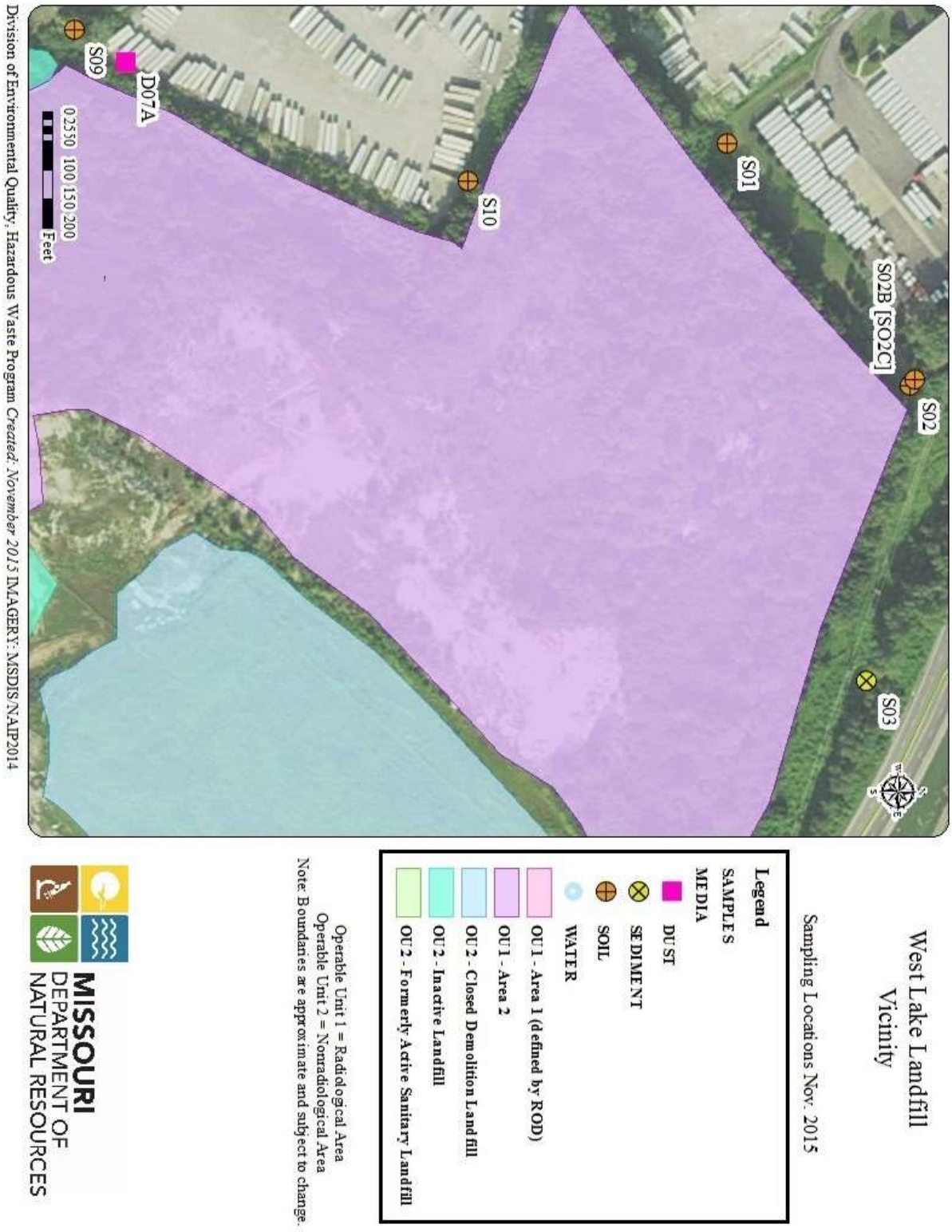


Figure 2: Sampling Locations North of Area 2

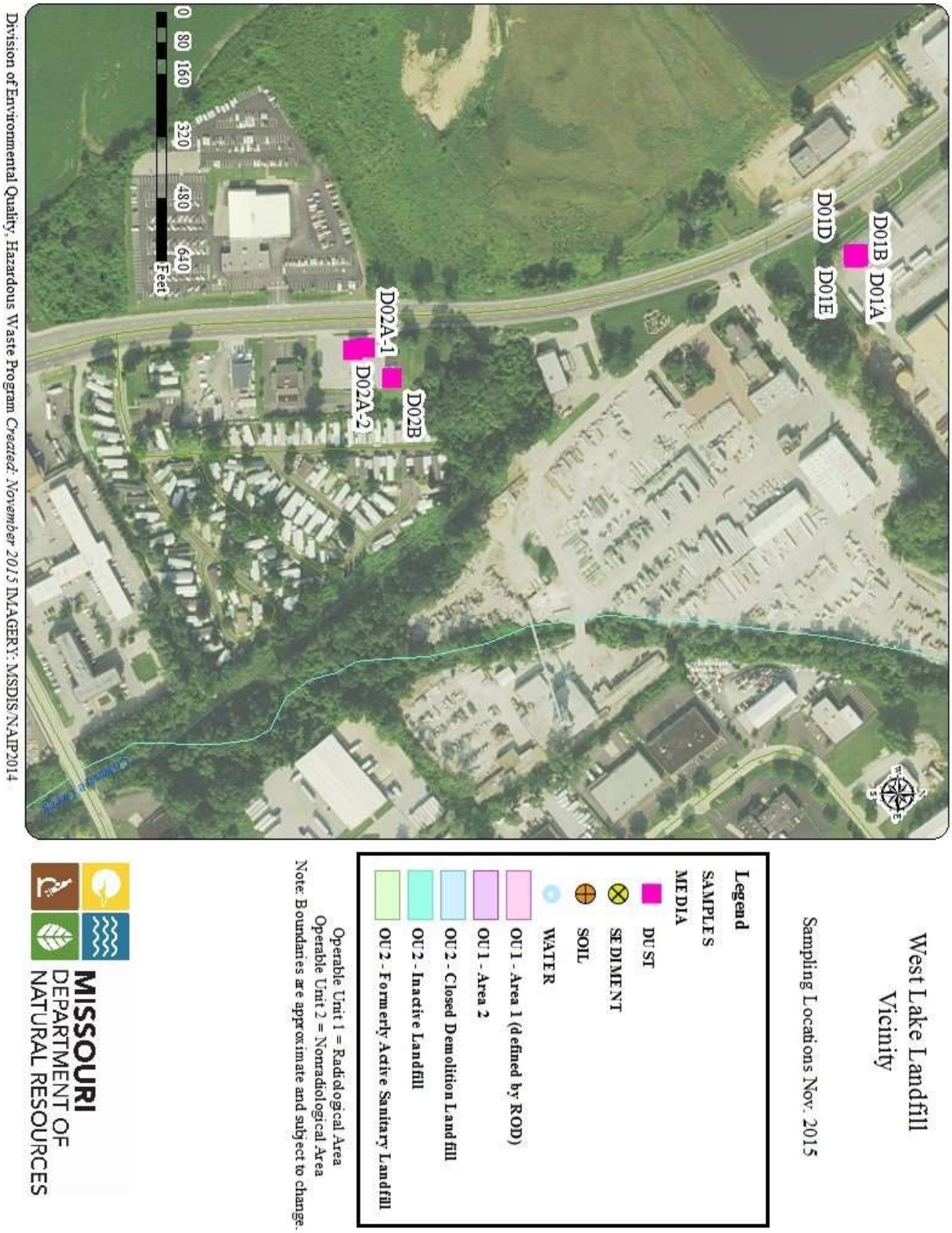


Figure 3: Sampling Locations Southeast of Area 1

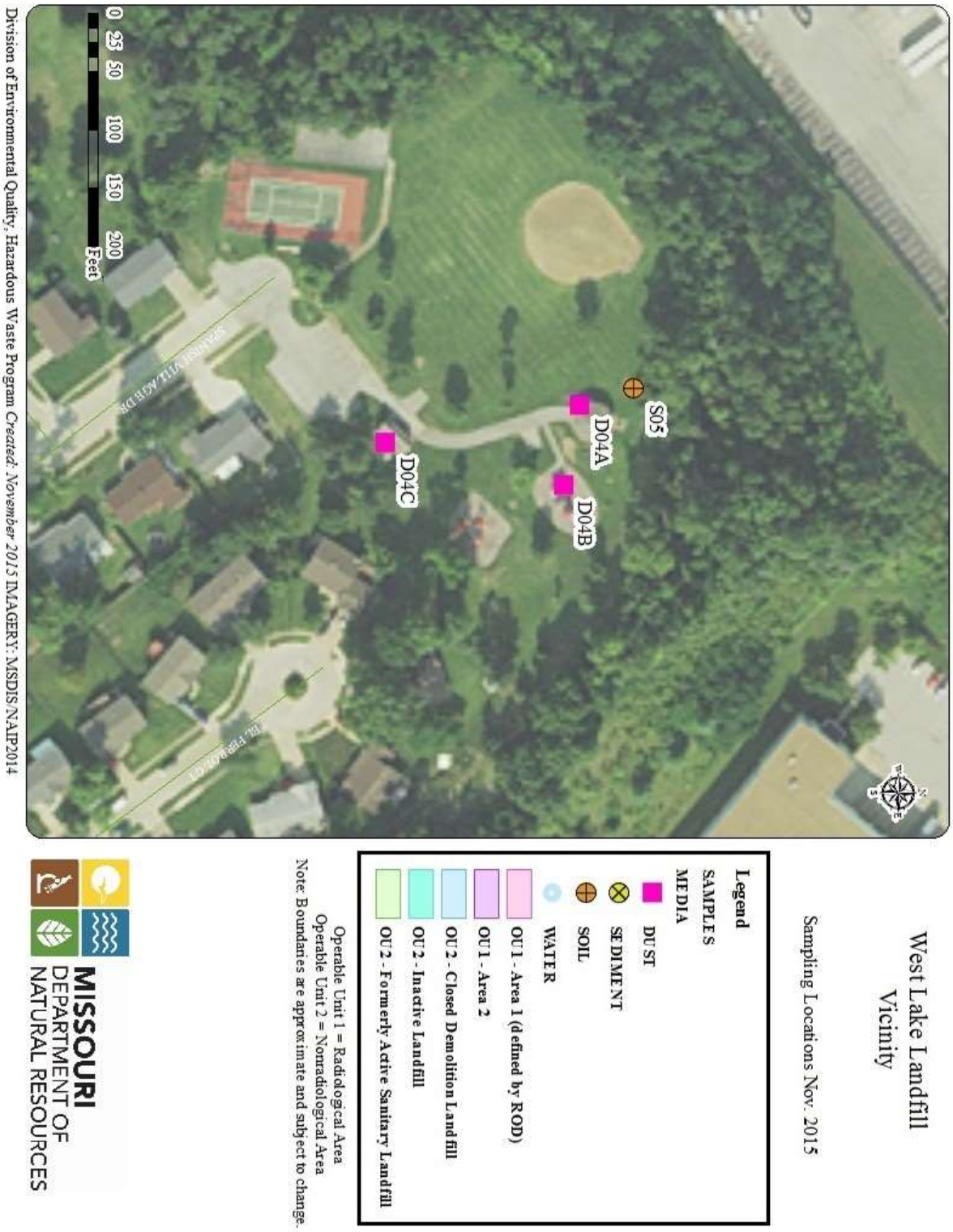


Figure 4: Sampling locations at Spanish Village Park south of WLL

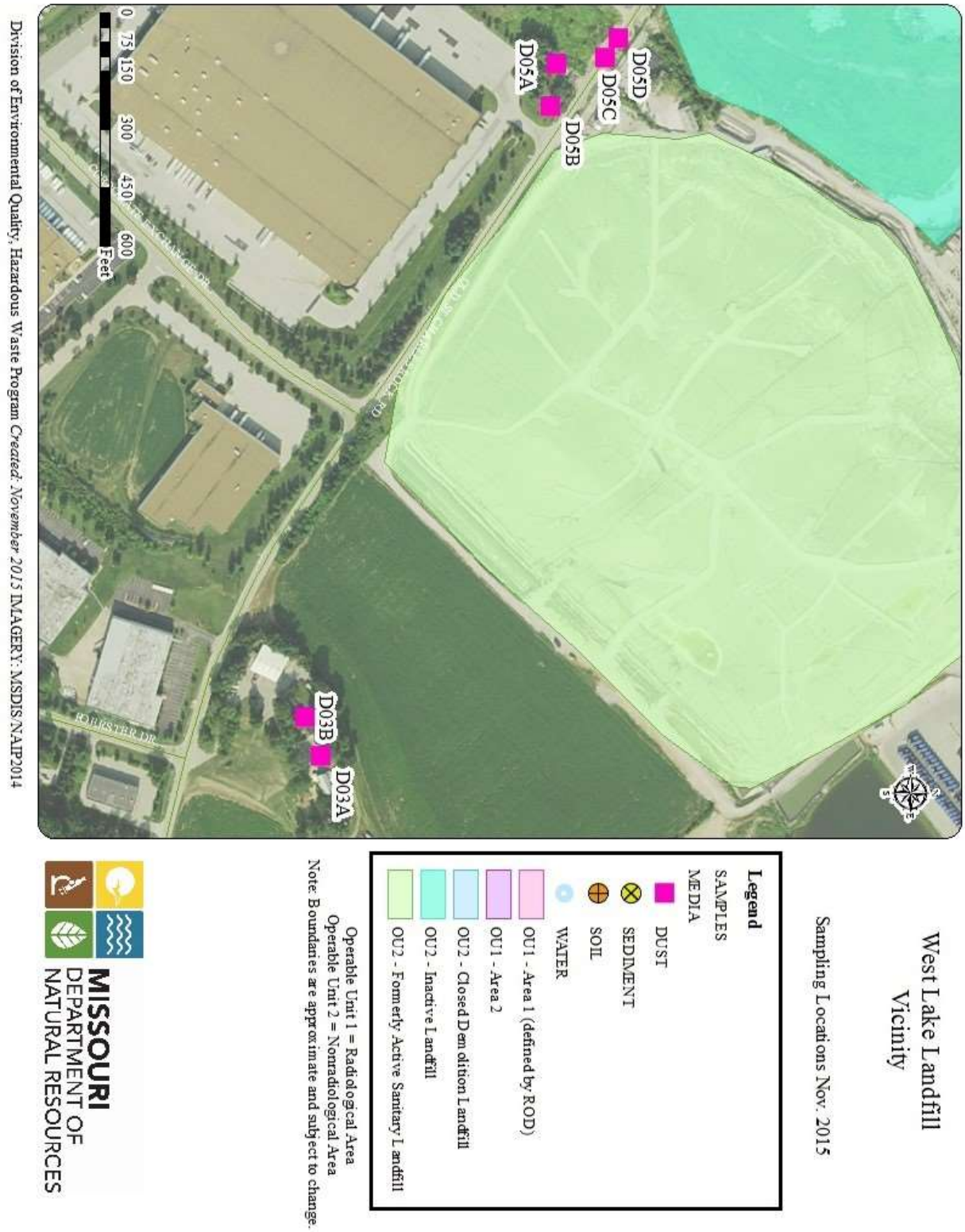


Figure 5: Additional Sampling Locations South of West Lake Landfill

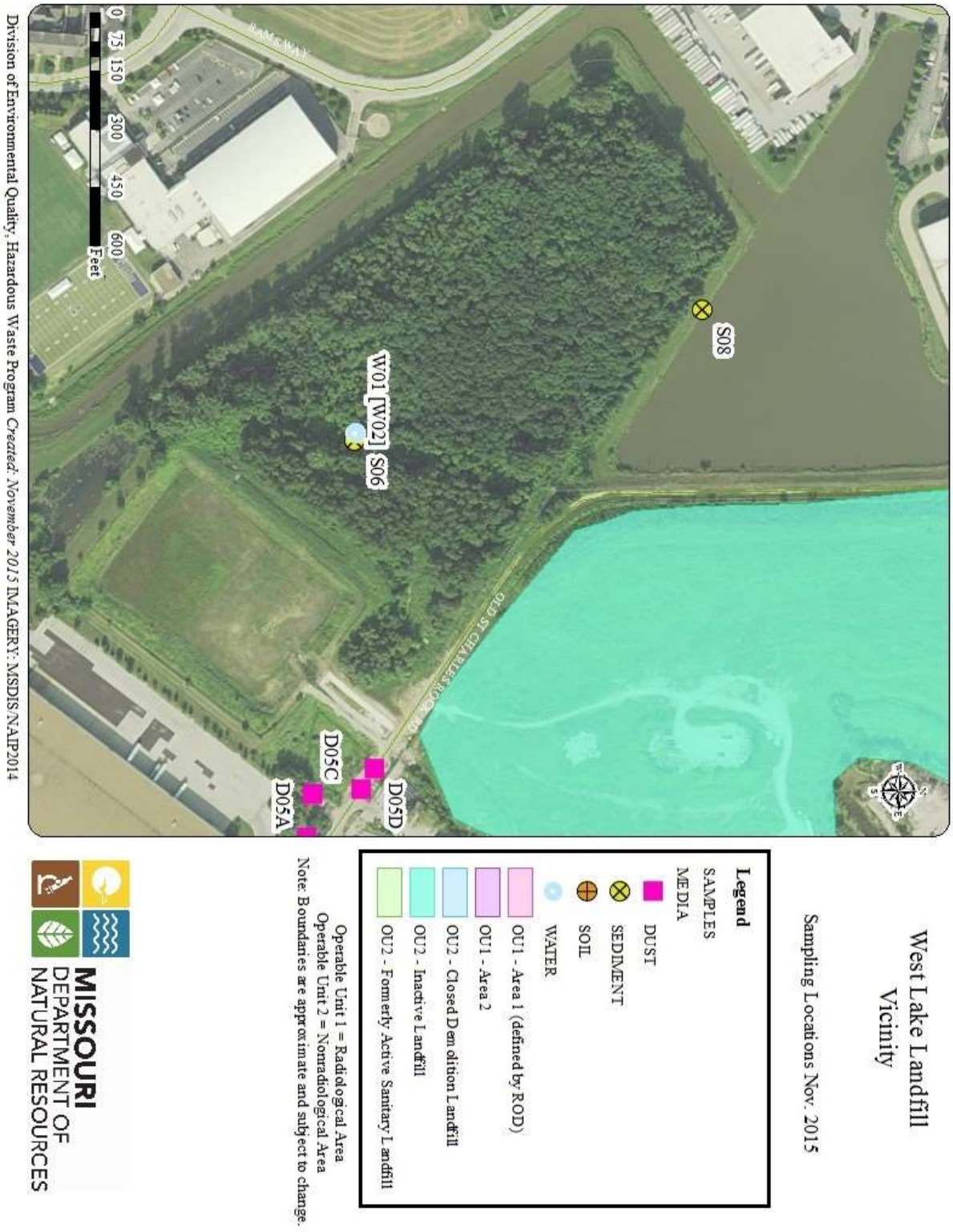


Figure 6: Sampling Location in Wooded Area South of West Lake Landfill

Appendix C: Photograph Log

Photograph 1: EPA Ludlum 2221 with NaI 44-20 detector and directional shield attachment (EPA Equipment Y)

Photograph 2: Gamma walkover survey conducted at Spanish Village Park

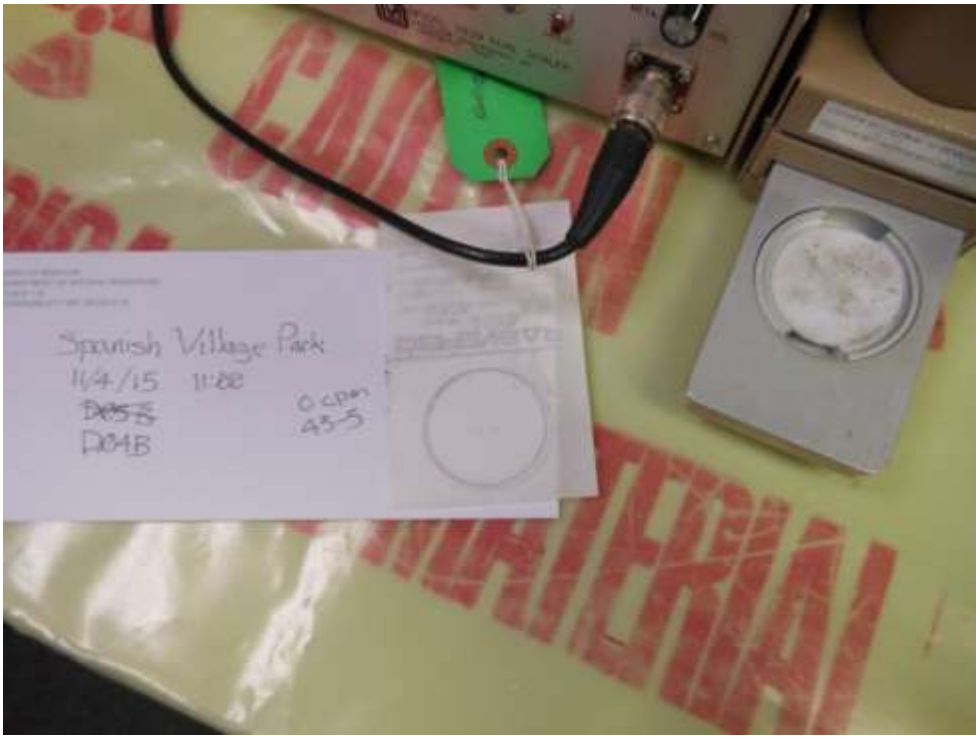
Photograph 3: One minute count being conducted on equipment B following gamma survey of immediate area. These locations are flagged in preparation of final soil sample location S09

Photograph 4: Soil sampling with Split Spoon sampler

Photograph 5: Soil and sediment samples collected on November 4, 2015 being prepared for shipment

Photograph 6: Surface water samples being prepared for shipment

Photograph 7: Collection of dust swipe sample D02A



Photograph 8: Testing of Dust Swipe Sample D04B with Equipment E

Appendix D: Chain of Custody

Page: 1 of 1
Project #:
Information Added by Laboratory (1):
Work Order Number:
PO Number:

MISSOURI DEPARTMENT OF NATURAL RESOURCES
HAZARDOUS WASTE PROGRAM FEDERAL FACILITIES SECTION
CHAIN-OF-CUSTODY RECORD

SAMPLING EVENT:

LABORATORY CONTACT INFORMATION
Eberline Services
601 Scarboro Road Oak Ridge, Tennessee 37830-7831
Phone: 865-481-0683
Fax: 865-483-4621

Client Name: **Missouri Department of Natural Resources** Phone #: **314-877-3046**
Project/Site Name: **West Lake Landfill** Fax #: **314-877-3254**
Address: **Bridgeton, MO**
Collected by: **Dan Carey, Rita Alexander, & Eric Gilstrap** Send Results To: **rita.alexander@dnr.mo.gov**

Sample Analysis Requested (5) (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hh:mm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Radioactive	TSCA Regulated	Total number of containers	Isotopic Uranium	Isotopic Thorium	Radium 226	Radium 228	Gross Alpha	Gross Beta	Lead 210				<-- Preservative Type (6) / Comments: Note: extra sample is required for sample specific QC
						Should this sample be considered:													
WLL20151104S05	11/4/2015	11:10	G	N	SO			1	1	1	1	1	1	1	1				
WLL20151104S01	11/4/2015	13:15	G	N	SO			1	1	1	1	1	1	1	1				
WLL20151104S02	11/4/2015	14:08	G	N	SO			1	1	1	1	1	1	1	1				
WLL20151104S02B	11/4/2015	16:13	G	N	SO			1	1	1	1	1	1	1	1				
WLL20151104S02C	11/4/2015	16:18	FD	N	SO			1	1	1	1	1	1	1	1				
WLL20151104S10	11/4/2015	17:30	G	N	SO			1	1	1	1	1	1	1	1				
WLL20151105S04	11/5/2015	10:40	G	N	SO			1	1	1	1	1	1	1	1				
WLL20151105S09	11/5/2015	12:30	G	N	SO			1	1	1	1	1	1	1	1				
WLL20151105S03	11/5/2015	13:45	G	N	SD			1	1	1	1	1	1	1	1				
WLL20151105S06	11/5/2015	16:05	G	N	SD			1	1	1	1	1	1	1	1				

TAT Requested (circle one): Normal / 2 Week / 1 Week / Other Email Results: Yes / No Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / Level 4

Remarks: *Are there any known hazards applicable to these samples? If so, please list the hazards*

Sample Collection Time Zone: Eastern, Pacific, Central, Mountain, Other _____

Chain of Custody Signatures

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1 Rita Alexander	11/6/15	12:18	1 UPS		
2 UPS			2		
3			3		

Sample Shipping and Delivery Details

LAB PM:
Method of Shipment: Date Shipped:
Airbill #
Airbill #

1.) Work Order and PO numbers are added to this form by the laboratory upon receipt.
2.) QC Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite
3.) Field Filtered: For liquid matrices, indicate with a - Y - for yes the sample was field filtered or - N - for sample was not field filtered.
4.) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, ML=Misc Liquid, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F=Filter, P=Wipe, U=Urine, F=Fecal, N=
5.) Sample Analysis Requested: Analytical method requested (i.e. 8260B, 601B/7470A) and number of containers provided for each (i.e. 8260B - 3, 601B/7470A - 1).
6.) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, HX = Hexane, ST = Sodium Thiosulfate, If no preservative is added = leave field blank

For Lab Receiving Use Only
Custody Seal Intact? YES NO
Cooler Temp: C

Page: 1 of 1
Project #:
Information Added by Laboratory (1):
Work Order Number:
PO Number:

MISSOURI DEPARTMENT OF NATURAL RESOURCES
HAZARDOUS WASTE PROGRAM FEDERAL FACILITIES SECTION
CHAIN-OF-CUSTODY RECORD

SAMPLING EVENT:

LABORATORY CONTACT INFORMATION
Eberline Services
601 Scarboro Road Oak Ridge, Tennessee 37830-7831
Phone: 865-481-0683
Fax: 865-483-4621

Client Name: **Missouri Department of Natural Resources** Phone #: **314-877-3046**

Project/Site Name: **West Lake Landfill** Fax #: **314-877-3254**

Address: **Bridgeton, MO**

Collected by: **Eric Gilstrap & Rita Alexander** Send Results To: **rita.alexander@dnr.mo.gov**

Sample Analysis Requested (5) (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Radioactive	TSCA Regulated	Total number of containers	Isotopic Uranium	Isotopic Thorium	Radium 226	Radium 228	Gross Alpha	Gross Beta	Lead 210					<-- Preservative Type (6)
WLL20151106S08	11/6/2015	15:45	G	N	SO			1	1	1	1	1	1	1	1					

Comments
Note: extra sample is required for sample specific QC

TAT Requested (circle one): Normal / 2 Week / 1 Week / Other

Email Results: Yes / No

Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / Level 4

Remarks: *Are there any known hazards applicable to these samples? If so, please list the hazards*

Sample Collection Time Zone
Eastern Pacific
Central Other _____
Mountain

Chain of Custody Signatures

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1 Rita Alexander	11/6/15	1800	1 UPS		
2 UPS			2		
3			3		

Sample Shipping and Delivery Details

LAB PM:
Method of Shipment: Date Shipped:
Airbill #:
Airbill #:

1.) Work Order and PO numbers are added to this form by the laboratory upon receipt.
2.) QC Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite
3.) Field Filtered: For liquid matrices, indicate with a - Y - for yes the sample was field filtered or - N - for sample was not field filtered.
4.) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, ML=Misc Liquid, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F=Filter, P=Wipe, U=Urine, F=Fecal, N=N
5.) Sample Analysis Requested: Analytical method requested (i.e. 8260B, 6010B/7470A) and number of containers provided for each (i.e. 8260B - 3, 6010B/7470A - 1).
6.) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, HX = Hexane, ST = Sodium Thiosulfate, If no preservative is added = leave field blank

For Lab Receiving Use Only
Custody Seal Intact? *YES* *NO*
Cooler Temp: *C*

Page: 1 of 1
Project #:
Information Added by Laboratory (1):
Work Order Number:
PO Number:

MISSOURI DEPARTMENT OF NATURAL RESOURCES
HAZARDOUS WASTE PROGRAM FEDERAL FACILITIES SECTION
CHAIN-OF-CUSTODY RECORD

SAMPLING EVENT:

LABORATORY CONTACT INFORMATION
Eberline Services
601 Scarsboro Road Oak Ridge, Tennessee 37830-7831
Phone: 865-481-0683
Fax: 865-483-4621

Client Name: **Missouri Department of Natural Resources** Phone #: **314-877-3046**
Project/Site Name: **West Lake Landfill** Fax #: **314-877-3254**
Address: **Bridgeton, MO**
Collected by: **Eric Gilstrap & Rita Alexander** Send Results To: **rita.alexander@dnr.mo.gov**

Sample Analysis Requested (8) (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Radioactive	TSCA Regulated	Total number of containers	Total Uranium	Radium 226	Radium 228	Gross Alpha	Gross Beta						<-- Preservative Type (6)	Comments Note: extra sample is required for sample specific QC
						Should this sample be considered:														
WLL20151105W01	11/5/2015	17:00	G	N	SW			1	1	1	1	1	1							Possible Leachate
WLL20151105W02	11/5/2015	17:00	FD	N	SW			1	1	1	1	1	1							Possible Leachate

TAT Requested (circle one): Normal / 2 Week / 1 Week / Other
Email Results: Yes / No
Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / Level 4

Remarks: *Are there any known hazards applicable to these samples? If so, please list the hazards*

Sample Collection Time Zone
Eastern Pacific
Central Other _____
Mountain

Chain of Custody Signatures

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1 Rita Alexander	11/6/15	14:00	1 UPS		
2 UPS			2		
3			3		

Sample Shipping and Delivery Details

LAB PM:
Method of Shipment: Date Shipped:
Airbill #:
Airbill #:

1.) Work Order and PO numbers are added to this form by the laboratory upon receipt.
2.) QC Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite
3.) Field Filtered: For liquid matrices, indicate with a - Y - for yes the sample was field filtered or - N - for sample was not field filtered.
4.) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, ML=Misc Liquid, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F=Filter, P=Wipe, U=Urine, R=Fecal, N=N
5.) Sample Analysis Requested: Analytical method requested (i.e. 8260B, 6010B/7470A) and number of containers provided for each (i.e. 8260B - 3, 6010B/7470A - 1).
6.) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, HX = Hexane, ST = Sodium Thiosulfate, If no preservative is added = leave field blank

For Lab Receiving Use Only
Custody Seal Intact? *YES* *NO*
Cooler Temp: C

Page: 1 of 1
Project #:
Information Added by Laboratory (1):
Work Order Number:
PO Number:

MISSOURI DEPARTMENT OF NATURAL RESOURCES
HAZARDOUS WASTE PROGRAM FEDERAL FACILITIES SECTION
CHAIN-OF-CUSTODY RECORD

SAMPLING EVENT:

LABORATORY CONTACT INFORMATION
Eberline Services
601 Scarboro Road Oak Ridge, Tennessee 37830-7821
Phone: 865-481-0683
Fax: 865-483-4621

Client Name: Missouri Department of Natural Resources — Phone #: 314-877-3046
Project/Site Name: West Lake Landfill — Fax #: 314-877-3254
Address: 917 N. Hwy 67 Suite 104 Florissant, MO 63031
Collected by: Eric Gilstrap/Rita Alexander — Send Results To: rita.alexander@dnr.mo.gov

Sample Analysis Requested (5) (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)	Date Collected (mm-dd-yy)	Time Collected (Military) (Hours)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Radioactive	Should this sample be considered: TSCA Regulated	Total number of containers	Isotopic Uranium	Isotopic Thorium	Radium 226	Radium 228	Gross Alpha	Gross Beta	Lead 210				<-- Preservative Type (6)	Comments Note: extra sample is required for sample specific QC
WLL20151104D05A	11/4/2015	13:00	G	N	Dust			1	X	X	X	X	X	X	X					MSD Control Panel
WLL20151104D07A	11/4/2015	17:30	G	N	Dust			1	X	X	X	X	X	X	X					AAA Tracking/Sign on Fence

TAT Requested (circle one): Normal / 2 Week / 1 Week / Other — Email Results: Yes / No — Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / Level 4

Remarks: *Are there any known hazards applicable to these samples? If so, please list the hazards*

Sample Collection Time Zone: Eastern / Pacific / Central / Other _____ / Mountain

Chain of Custody Signatures

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
Rita Alexander	11/4/15	17:00	1		
2			2		
3			3		

Sample Shipping and Delivery Details

LAB PM:
Method of Shipment: — Date Shipped:
Airbill #:
Airbill #:

1.) Work Order and PO numbers are added to this form by the laboratory upon receipt.
2.) QC Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite
3.) Field Filtered: For liquid matrices, indicate with a - Y - for yes the sample was field filtered or - N - for sample was not field filtered.
4.) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, ML=Misc Liquid, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F=Filter, P=Wipe, D=Grass, P=Fecal, N=N
5.) Sample Analysis Requested: Analytical method requested (i.e. 8260B, 6010B/7470A) and number of containers provided for each (i.e. 8260B - 3, 6010B/7470A - 1).
6.) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, HX = Hexane, ST = Sodium Thiosulfate, If no preservative is added = leave field blank.

For Lab Receiving Use Only
Custody Seal Intact? YES NO
Cooler Temp: C

Appendix E: Level IV Data Packets

Level IV data packets are available upon request

Appendix F: Radiological Field Equipment

Equipment A: Ludlum model 2221 with 43-5 ZnS Scintillator detector - The meter has both digital and analog scales, is able to provide both instantaneous rates and accumulative counts over a user set time, and has field adjustable voltage settings to give the user some flexibility in selection of probes and focusing on feedback at different energy levels to help evaluate readings. The 43-5 ZnS detector is an alpha radiation detector that requires very close proximity to the surface of the object being surveyed.

Equipment B: Ludlum model 2221 with 44-10 NaI Gamma Scintillator detector - The meter has both digital and analog scales, and is able to provide both instantaneous rates and cumulative counts over a user set time. The meter also has field adjustable voltage settings to give the user some flexibility in selection of probes and focusing on feedback at different energy levels to help evaluate readings. The 44-10 detector is a Sodium Iodide (NaI) gamma radiation detector that combines high sensitivity and fast response.

Equipment D: Ludlum model 19A µR meter - This meter with built-in detector has a fixed logarithmic analog scale and can merely give feedback as a rate in units of micro-roentgen per hour (µR/hr). It is meant to give fast and easy dose estimates in areas of low activity levels and to provide an alarm as activity begins to approach a preset action level. The instrument needle is constantly moving in response to activity such that visual precision is several µR/hr. Results are most easily presented as a range.

Equipment E: Ludlum model 2929 with 43-10-1 swipe counter - This is a bench top meter and probe designed for counting swipe samples. These samples are small cloth patches used to retrieve dust. Readings are in total counts for alpha and combined beta gamma so readings need to be divided by the duration of the count in minutes for a CPM value.

EPA Equipment Y: Ludlum model 2221 with 44-20 NaI Gamma Scintillator detector – The 44-20 detector has higher detection sensitivity than Equipment B, making it well suited for survey applications (Photograph 1.)

EPA Equipment Z: Ludlum model 3030 with ZnS (Ag) Scintillator detector and shielded 2-inch sample tray – This was utilized as a bench top meter and probe used for simultaneous alpha and beta sample counting. Readings are in CPM for alpha and combined beta gamma.

Appendix G: Previous Investigations

Historic sampling and surveying efforts identified in the SAP that were considered for the current investigation:

- Late 1980's Department of Energy (DOE) Haul Road Sampling, 28 intersections (1994 DOE Remedial Investigation)
- 2005 DNR Formerly Utilized Sites Remedial Action Program (FUSRAP) haul road sampling St. Charles Rock Road, Taussig, Boenker
- March 2013 EPA ASPECT Gamma and Infrared Survey
- May 2013 DNR Radiological Survey, Alpha, Beta, Gamma survey/screening
- June 2013 DHSS Air Sampling, Alpha/Beta particulates, Ambient Gamma
- May 2014 EPA BMAC radiation survey and sampling
- 2014 EPA Community Air Monitoring, Gamma, Alpha/Beta Particulates, Radon
- April 2015 MO University of Science and Technology Phyto forensics
- May 2015 Respondents Air Monitoring, VOCs, Gamma, Alpha/Beta Particulates, Radon

Appendix H: Field Data Logs

D04

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015 **Arrival Time:** 9:50 **Departure Time:** 11:30

Team members/responsibilities:

Ryan Seabaugh + Eric Gilstrap

Weather (Description)	Temperature: 65 F	Humidity: 77 %	Wind: (Direction and Speed)
Partly Cloudy			S (from) @ 3 mph

Radiation detection equipment used: model/serial number/calibration:

☐ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**

Time:							
Reading:							

☑ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:	11/4/15	11:00					11/5/15
Reading:	0 CPM w/ SPORADIC OCCURANCES OF SINGLE 1 CPM (SLIDE)						0 CPM SWIPES

☑ **Ludlum Model 19A/ 201916/June 25, 2015**

Range of Readings: 8-10 μR/hr

Sample Collection Log Information

Sample location description:

SPANISH VILLAGE PARK

Odors Present: Yes or (No) **If Yes Please Describe:**

Collection equipment:

DUST SWIPE, EXTENSION POLE

Sampler's name(s):

See Team Members

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	UTM (m) GPS Coord. 15s	Analytes Requested & Preservative if used
WLL20151104D04A	11/4/15 10:30	GRAB	DUST	PAVILLION RAFTER	0721881 4292870 T	Count α, β+γ w/ 2929
WLL20151104D04B	11/4/15 11:00	↓	↓	JUNGLE GYM	0721902 4292866 T	↓
WLL20151104D04C	11/4/15 11:10	↓	↓	R.R AIR INTAKE	0721891 4292819 T	↓

D05

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015 **Arrival Time:** 12:50 **Departure Time:** ~~13:28~~ 13:26

Team members/responsibilities:

Ryan Seabaugh + Eric Gilstrap

Weather (Description)	Temperature: 70 F	Humidity: 66 %	Wind: (Direction and Speed)
Partly Cloudy			from S @ 2.7 mph

Radiation detection equipment used: model/serial number/calibration:

☐ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**

Time:							
Reading:							

☑ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:	11/5/15						
Reading:	0 CPM SWIPES						

☑ **Ludlum Model 19A/ 201916/June 25, 2015**

Range of Readings: 5-10 uR/hr

Sample Collection Log Information

Sample location description:

MSD LIFT STATION + LEVEE GATE

Odors Present: (Yes) or No **If Yes Please Describe:** MODERATE

Collection equipment:

DUST SWIPE, EXTENSION POLE

Sampler's name(s):

See Team Members

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	UTM (m) GPS Coord. 15S	Analytes Requested & Preservative if used
WLL20151104D05A	11/4/15 13:00	GRAB	DUST	MSD CONTROL PANEL	0721820 4293604G	COUNT α, β+γ w/ 2929
WLL20151104D05B	11/4/15 13:15	↓	↓	EER AIR SAMPLER	0721854 4293600G	↓
WLL20151104D05C	11/4/15 13:20	↓	↓	ROAD	~~0721800 4293653~~	0721816 4293643G ↓
WLL20151104D05D	11/4/15 13:25	↓	↓	LEVEE GATE	0721800 4293653G	

D03

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015 **Arrival Time:** 13:28 **Departure Time:** 13:45

Team members/responsibilities:

Ryan Seabaugh + Eric Gilstrap

Weather (Description)	Temperature: 71 F	Humidity: 64 %	Wind: (Direction and Speed)
Partly Cloudy			from S @ 3 mph

Radiation detection equipment used: model/serial number/calibration:

☐ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**

Time:							
Reading:							

☑ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015** (SWIPES)

Time:	11/5/15						
Reading:	0 CPM	each					

☑ **Ludlum Model 19A/ 201916/June 25, 2015**

Range of Readings: 7-13 μR/hr

Sample Collection Log Information

Sample location description:

HOUSE ON THE HILL

Odors Present: Yes or (No) **If Yes Please Describe:**

Collection equipment:

DUST SWIPE

Sampler's name(s):

See Team Members

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	UTM (m) GPS Coord. 15S	Analytes Requested & Preservative if used
WLL20151104D03A	11/4/15 13:30	GRAB	DUST	PICNIC BENCH	0722364 4293420	COUNT α, β+γ w/ 2929
WLL20151104D03B	11/4/15 13:42	↓	↓	PIANO TOP	0722333 4293407	↓

DØ2

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015 **Arrival Time:** 13:50 **Departure Time:** 14:30

Team members/responsibilities:

Ryan Seabaugh + Eric Gilstrap

Weather (Description)	Temperature: 72 F	Humidity: 65 %	Wind: (Direction and Speed)
Partly Cloudy			from S @ 3.7 mph

Radiation detection equipment used: model/serial number/calibration:

☐ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**

Time:							
Reading:							

☑ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:	11/5/15			11/4/15			
Reading:	0CPM SWIPES			0CPM W/	SPORADIC	SINGLE	COUNTS 1CPM

☑ **Ludlum Model 19A/ 201916/June 25, 2015** (TRASH BARREL)

Range of Readings: 7-15 μR/hr

Sample Collection Log Information

Sample location description:

St Charles Rock Road Abandoned Gas Station

Odors Present: (Yes) or No **If Yes Please Describe:** MILD

Collection equipment:

DUST SWIPE EXTENSION POLE

Sampler's name(s):

See Team Members

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	UTM (m) GPS Coord. 15S	Analytes Requested & Preservative if used
WLL20151104D02A-1	11/4/15 14:05	GRAB	DUST	DOWN-SPOUT	0722830 4293574 G	Count α, β+γ w/ 2929
WLL20151104D02A-2	11/4/15 14:15	↓	↓	DOWN-SPOUT	~~SAME~~	0722832 4293564 M ↓
WLL20151104D02B	11/4/15 14:25	↓	↓	TRASH BARREL	~~0722854 4293~~	0722854 4293595 M ↓

D01

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015 **Arrival Time:** 14:40 **Departure Time:** 16:00

Team members/responsibilities:

Ryan Seabaugh + Eric Gilstrap

Weather (Description)	Temperature: 70 F	Humidity: 67 %	Wind: (Direction and Speed)
Partly Cloudy			S @ 3.8 mph

Radiation detection equipment used: model/serial number/calibration:

☐ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**

Time:							
Reading:							

☑ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:	11/5/15		11/4/15				
Reading:	0 CPM (SWIPES)		0 CPM w/ SPORADIC SINGLE (INTERIOR)			COUNTS	1 CPM

☑ **Ludlum Model 19A/ 201916/June 25, 2015**

Range of Readings: NA

Sample Collection Log Information

Sample location description:

EER TRAILER

Odors Present: Yes or (No) **If Yes Please Describe:**

Collection equipment:

DUST SWIPE, EXTENSION POLE

Sampler's name(s):

See Team Members

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord.	Analytes Requested & Preservative if used
WLL20151104D01A	11/4/15 14:47	GRAB	DUST	TRAILER OVEN HOOD EXHAUST	0722760 4293958 M	Count α, β+γ w/ 2929
WLL20151104D01B	11/4/15 14:50	↓	↓	PRINTER SHELF	0722757 4293961 M	↓
WLL20151104D01C	11/14/15 14:55	↓	↓	FLOOR	0722759 4293961 M	↓
WLL20151104D01D	11/14/15 15:00	↓	↓	AIR INTAKE	0722757 4293958 M	↓
WLL20151104D01E	11/14/15 15:10	↓	↓	ROOF	0722758 4293957 M	

D07

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015 **Arrival Time:** ~~16:10~~ 17:30 **Departure Time:** ~~17:45~~ 17:48

Team members/responsibilities:
Ryan Seabaugh + Eric Gilstrap
← left, then returned (site manager in a meeting)

Weather (Description)	Temperature: 66 F	Humidity: 78 %	Wind: (Direction and Speed)
Partly Cloudy			from SE @ 2.4 mph

Radiation detection equipment used: model/serial number/calibration:

☐ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**

Time:							
Reading:							

☑ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:	11/5/15						
Reading:	0 CPM	(SWIPES)					

☑ **Ludlum Model 19A/ 201916/June 25, 2015**

Range of Readings: 8-15 μR/hr

Sample Collection Log Information

Sample location description: AAA TRAILER LOT - LOCATIONS APPROVED BY OWNER (EAST FENCE LINE)

Odors Present: (Yes) or No **If Yes Please Describe:** MILD

Collection equipment:
DUST SWIPE

Sampler's name(s):
See Team Members

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	UTM (m) GPS Coord. 15S	Analytes Requested & Preservative if used
WLL20151104D07A	11/4/15 17:30	GRAB	DUST	SIGN	0721505 4294509 G	Count α, β+γ w/ 2929

1 Facility manager in meeting. so we left to look @ other locations and then returned.

D08

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015 **Arrival Time:** _____ **Departure Time:** _____

Team members/responsibilities:

Ryan Seabaugh + Eric Gilstrap

Weather (Description)	Temperature:___F	Humidity: _____%	Wind: (Direction and Speed) _____ @ _____mph

Radiation detection equipment used: model/serial number/calibration:

☐ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**

Time:							
Reading:							

☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:							
Reading:							

☐ **Ludlum Model 19A/ 201916/June 25, 2015**

Range of Readings:

Sample Collection Log Information

Sample location description:

NA
Site Access not obtained.

Odors Present: Yes or No	**If Yes Please Describe:**

Collection equipment:

Sampler's name(s):

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord.	Analytes Requested & Preservative if used

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015 **Arrival Time:** 9:53 **Departure Time:** 11:30

Team members/responsibilities:
Eric Gilstrap - 43-5 - Swipes
Dan Carey - 2x2
Ryan Scobaugh - 19A
Rita Alexander - Note, QC
Also present: Tom Meaker, EPA

Weather (Description)	Temperature: 63F	Humidity: 82%	Wind: (Direction and Speed)
Cloudy			N @ 0 mph

Radiation detection equipment used: model/serial number/calibration:

☑ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015** Pave Range (instantaneous) 8000 - 11000 cpm

Time:	9:58	10:07	10:15	10:21	10:28	10:43	
1 Min - Reading: (cpm)	Sewer grate 10,190	Water Fountain 10,148	Water Overflow Drain 10473	Wall Drainpipe 10352	Tree Trunk by Bike Rack 10,293	Entrance Pavilion Bench 9960	

☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:	~~10:22~~ 10:21	11:00	11:10				
Reading:	0 cpm	0 cpm	cpm				

☑ **Ludlum Model 19A/ 201916/June 25, 2015**

Range of Readings: 10-15 μR/hr

Sample Collection Log Information

Sample location description:
Spanish Village Park

Odors Present: (Yes) or No

If Yes Please Describe: very Mild possible sewer odor

Collection equipment: Swipes + extension pole
Shoe hammer, split spoon sampler with sleeve

Sampler's name(s): Eric Gilstrap / Ryan Scobaugh - Swipes
Dan Carey / Rita Alexander - soil sample

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord.	Analytes Requested & Preservative if used
WLL2051104505	11/4/15 11:10	Grab ~~Soil~~	Soil	Brown, No odor		Ra226, Ra228, Isoth. Th. Isoth. U, Gross Alpha Gross Beta None Pb210
~~Rgb~~ ~~WLL~~ D04A	11/4/15 10:21	Grab	swipe	Pavilion Rafters		
D04B	11/4/15 11:00	Grab	"	~~Bathroom Air intake~~ Floor of side Bay under stairs		
D04C	11/4/15 11:10	Grab 11:10	"	Bathroom Air intake		

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015 **Arrival Time:** 12:50 **Departure Time:** 13:30

Team members/responsibilities:
Dan Carey - RRC, sampling
Rita Alexander observations, sampling

Weather (Description)	Temperature: 66 F	Humidity: 74 %	Wind: (Direction and Speed)
Cloudy			SSE @ 3 mph

Radiation detection equipment used: model/serial number/calibration:

☑ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015** 8000- 11000cpm

Time:	12:57	13:00	13:03	1305	13:08	13:10	
Reading:	9589	9637	9729	9817	10287	8546	

☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:							
Reading:							

☐ **Ludlum Model 19A/ 201916/June 25, 2015**

Range of Readings:

Sample Collection Log Information

Sample location description:
Arthur Trucking Back lot - Drainage - South corner

Odors Present: Yes or (No) **If Yes Please Describe:**

Collection equipment: slide hammer
Split spoon sampler w/ sleeve

Sampler's name(s): Dan Carey, Rita Alexander

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord.	Analytes Requested & Preservative if used
WLL20151104 - S01	11/4/15 13:15	Grab	Soil	Dark Brown No odor		Ra226, Ra228, Isotl, Isotn Th, Gross Alpha, Gross Beta, Pb210 - 25 grams.

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015 **Arrival Time:** 13:33 **Departure Time:** 14:25

Team members/responsibilities:

Dan Carey: Rad. sampler
Rita Alexander: observations, sampler

Weather (Description)	Temperature: 68 F	Humidity: 69 %	Wind: (Direction and Speed)
Sunny, Pt. Cloudy			SSE @ 5 mph

Radiation detection equipment used: model/serial number/calibration:

☑ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015** Range:

Time:	1 13:36	2 13:38	3 13:40	4 13:45/13:51	~~13:48~~	5 13:55	6 13:50
Reading:	9748	10360	10749	Corner (fence) 14437 13:33	~~11249~~	corner fence 14158	12228

☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:							
Reading:							

☐ **Ludlum Model 19A/ 201916/June 25, 2015**

Range of Readings:

Sample Collection Log Information

Sample location description:

East corner of Antenna Training lot
Misc Parking lot / construction Debris in low area outside of Parking lot
4, 5 & 6 - Tall Grass Depressed Area E of Pl. 7 - 8kcpm
Pic: 5 4 6
8-10kcpm on debris Pile
13:48 ? Not Marked but Adjacent to 6
11249 in corner close to Area 2 fence

Odors Present: (Yes) or No

If Yes Please Describe: Very faint - Possible transfer sta. odor - Bridgeton LF

Collection equipment: Shale hammer
~~Soil~~ Split spoon sampler with sleeve

Sampler's name(s): Dan Carey
Rita Alexander

Top sample = 1min scan - 8476
Bottom sample = 8452

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord.	Analytes Requested & Preservative if used
WLL20151104 - S02	11/4/15 13:08	Grab	Soil	Typical Brown soil / Red Brick frags.		Ra 224, Ra 228, Th 230 U, Iso Th, Gross Alpha, Gross Beta, Pb 210 No Preserv

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015 **Arrival Time:** 15:56 **Departure Time:** 16:30

Team members/responsibilities:

Dan Carey - 202, sampler
Rita Alexander, sampler, observations

Weather (Description)	Temperature: 69 F	Humidity: 67%	Wind: (Direction and Speed)
Pt. Cloudy			SE @ 12 mph

Radiation detection equipment used: model/serial number/calibration:

✓ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**							
Time:	16:10						
Reading:	10577						
☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**							
Time:							
Reading:							
☐ **Ludlum Model 19A/ 201916/June 25, 2015**							
Range of Readings:							

Sample Collection Log Information

Sample location description:

After trenching PL e corner - 2nd sample + Dup.

Odors Present: Yes or No | **If Yes Please Describe:**

Collection equipment: Slide hammer
split spoon sampler with sleeve

Sampler's name(s):

Dan Carey
Rita Alexander

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord.	Analytes Requested & Preservative if used
WLL20151104 S02B	11/4/15 16:13	G	soil	OK Brn soil some gravel		Ra226, Ra228, Iso U, Iso Th, Gamma Spec, Gross Beta, Pb210 no preserv
WLL20151104 S02C	11/4/15 16:18	Duplicate	soil	OK. Brn soil		"

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015 **Arrival Time:** 17:00 **Departure Time:** 18:00

Team members/responsibilities:
Soil { Dan Carey, Rxr, Sampler / Rita Alexander, Sampler Observer } Eric Gilstrap, Ryan Seabaugh { Swipe Sampling 19A & 43-5

Weather (Description)	Temperature: 69 F	Humidity: 67 %	Wind: (Direction and Speed)
cloudy going back			SE @ 12 mph

Radiation detection equipment used: model/serial number/calibration:

☑ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015** East side Pkng lot 12000-15000 7-8K along South Road (PL)

Time:	17:06	17:09	17:13	17:15	1718	1720	1722
Reading:	7006	7785	10865	12482	12943	13303	13716

☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:							
Reading:							

☑ **Ludlum Model 19A/ 201916/June 25, 2015**

Range of Readings: ~15 MR/hr

Sample Collection Log Information

Sample location description:
AAA Trucking – East side Back PK lot.

Odors Present: (Yes) or No **If Yes Please Describe:** Faint Landfill ODOR - Transfer - Budgeon

Collection equipment:
Swipe sampling equip.
Slide hammer split spoon samplers with sleeve

Sampler's name(s): Dan Carey / Rita Alexander
Eric Gilstrap / Ryan Seabaugh - Swipe samples

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord.	Analytes Requested & Preservative if used
WLL20151104-S10	11/4/15 1017:30	Grab	Soil	DK Brn		Radium, Rad 228, Isotopic U, Isotopic Thy, Gross Alpha, Gross Beta, Pb 210

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 5, 2015 **Arrival Time:** 10:05 **Departure Time:** 10:50

Team members/responsibilities:
Dan Carey 2x2, sample
Rita Alexander observation, sample
Tom Mehler, EPA joined during sampling.

Weather (Description)	Temperature: 64 F	Humidity: 77 %	Wind: (Direction and Speed)
Cloudy lt. Rain			SE @ 7 mph

Radiation detection equipment used: model/serial number/calibration:

☑ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015** 8K-11K

Time:	1018	1020	1022	1030	1033		
Reading:	10084	10436	11812	8604	8488		

☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:							
Reading:							

☑ **Ludlum Model 19A/ 201916/June 25, 2015** 5-10 uR/hr

Range of Readings:

Sample Collection Log Information

Sample location description:
S04 VirRec

Odors Present: Yes or No **If Yes Please Describe:** Very mild Transfer station odor

Collection equipment: Slide hammer & spoon sampler with sleeve

Sampler's name(s): Dan Carey
Rita Alexander

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord.	Analytes Requested & Preservative if used
WLL20151105 S04	11/5/15 10:40	Grab	Soil	OK soil survey		Ra 226, Ra 228, Isotopic Th, Gross Alpha Beta Pb 210

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 5, 2015 **Arrival Time:** 11:05 **Departure Time:** 11:25

Team members/responsibilities:
DAC (Dan Carey) TM, EPA - 3x3 shield @ SØ2 S- cpm { 12k cpm General area / 16 k cpm - sample location
RJA (Ruth Alexander) > observe
Tom Mohler

Weather (Description)	Temperature: 68 F	Humidity: 67 %	Wind: (Direction and Speed)
Cloudy lt. Rain			S @ 13 mph

Radiation detection equipment used: model/serial number/calibration:

☐ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**

Time:							
Reading:							

☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:							
Reading:							

☐ **Ludlum Model 19A/ 201916/June 25, 2015**

Range of Readings:

Sample Collection Log Information

Sample location description:
SØ2 Revisit w EPA & 3x3 (with shielded) Checked Sample SØ2 - No shield Nothing elev - Not enough vol
TM Perform Directional counts in area of SØ2 Gen Area 25K Found elev. Readings near SØ2 N30% elev.

Odors Present: Yes or (No) **If Yes Please Describe:**

Collection equipment: NA: MoEPA: Discussion & observations only

Sampler's name(s):
NA

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord.	Analytes Requested & Preservative if used
None						

Sample Event Log Information							
Project : West Lake Landfill Vicinity Sampling Event							
Sampling & Analysis Plan: West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015							
Purpose: Sample and Data Collection							
Date: November 5, 2015 **Arrival Time:** 1130 **Departure Time:** 1205							
Team members/responsibilities: Don Carey, Rita Alexander, Tom Mahler EPA							
Weather (Description) lt Rain cloudy	Temperature: 68F		Humidity: 69 %		Wind: (Direction and Speed) S @ 13 mph		
Radiation detection equipment used: model/serial number/calibration:							
☐ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**							
Time:							
Reading:							
☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**							
Time:							
Reading:							
☐ **Ludlum Model 19A/ 201916/June 25, 2015**							
Range of Readings:							
Sample Collection Log Information							
Sample location description: EPA unshielded Readings - 3x3 Gravel - 18K cpm; Revisit: AMA S10; 30-31K cpm; S10 loc sample 36-37K cpm; 33-34K cpm (E side of PL)							
Odors Present: Yes or No	**If Yes Please Describe:**						
Collection equipment: NA EPA observation & Discussion only; Photos taken							
Sampler's name(s): NA							
ID Number	**Sample Date/Time**	**Sample Type**	**Sample Matrix**	**Sample Descript.**	**GPS Coord.**	**Analytes Requested & Preservative if used**	
None							

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 5, 2015 **Arrival Time:** 12:10 **Departure Time:** 12:55

Team members/responsibilities:

Dan Carey 202 sample
Rita Alexander sample observe

Weather (Description)	Temperature: 69 F	Humidity: 69 %	Wind: (Direction and Speed)
lt. Rain			5 @ 13 mph

Radiation detection equipment used: model/serial number/calibration:

☑ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**							
Time:	1220	1223	1225	1227			
Reading:	10957	11600	10988	10805			
☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**							
Time:							
Reading:							
☒ **Ludlum Model 19A/ 201916/June 25, 2015**							
Range of Readings:							

Sample Collection Log Information

Sample location description:

SP9 SW corner of AAA PL

Sample taken in low area near NW corner of area w ~~[illegible]~~ Rgt & Base of ~~[illegible]~~ Kent Rd.

Odors Present: Yes or No | **If Yes Please Describe:**

Collection equipment: Slide hammer & split spoon sampler with sleeve

Sampler's name(s): Dan Carey
Rita Alexander

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord.	Analytes Requested & Preservative if used
WLL2015105 – SP9	11/5/15 12:30	G	Soil	OK Bin Soil		Ra226, Ra228, Th232, U238, Cs137, Alpha Radium, Pb210

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 5, 2015 **Arrival Time:** 13:39 **Departure Time:** 14:10

Team members/responsibilities:
DAC Sampler 2x2, GPS (Dan Carey)
EG Sampler, Photo (Eric Gilstrap)
RA Sampler, observations (Rita Alexander)

Weather (Description)	Temperature: 67F	Humidity: 78 %	Wind: (Direction and Speed)
H. Rain			S @ 10 mph

Radiation detection equipment used: model/serial number/calibration:

☒ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**							
Time:	13:43						
Reading:	9442						
☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**							
Time:							
Reading:							
☐ **Ludlum Model 19A/ 201916/June 25, 2015**							
Range of Readings:							

Sample Collection Log Information

Sample location description: Parked @ SJ
Heavily Veg Ditch adjacent to St. Charles Rock Rd & Area 2
Across from Jimmy Johns
Ditch is Between SCRR & Area 2

DAC EG entered Veg Area @ 13:33 to locate area for 1 min Reading (2x2) & Sample Gamma walkover - Not Pos. Due to heavy Veg

Odors Present: (Yes) or No **If Yes Please Describe:** Mild - Mod - Transfer/Manure odor

Collection equipment:
Slide hammer split spoon sampler with sleeve

Sampler's name(s):
DAC / RJA / EG
DAC sampler, 2x2
EG sampler, Photos
RJA sampler, observations

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord.	Analytes Requested & Preservative if used
WLV20151105 - S03	11/5/15 13:45	Soil Grab	Soil			Ra226, Ra228, Th230, Th232, Gross Alpha, Gross Beta, Pb210

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 5, 2015 **Arrival Time:** 15:03 **Departure Time:** 17:30

Team members/responsibilities:
EG - Sampler
RA - Observations, sampler

Weather (Description)	Temperature: 66 F	Humidity: 83%	Wind: (Direction and Speed)
Lt. Rain			S @ 12 mph

Radiation detection equipment used: model/serial number/calibration:

☒ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**							
Time:		16:00					
Reading:		9800					
☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**							
Time:							
Reading:							
☐ **Ludlum Model 19A/ 201916/June 25, 2015**							
Range of Readings:							

Sample Collection Log Information

Sample location description:
Drainage way in woods S of WLL... S06

Odors Present: ~~Yes~~ or (No) **If Yes Please Describe:**

Collection equipment: Slide hammer + split spoon w/ sleeve

Sampler's name(s):

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord.	Analytes Requested & Preservative if used
WLL2015 1105 - S06	11/5/15 16:05	Grab Soil/e	Soil/ Sed	Dk Brn Soil/ Sed		Ra226, Ra228, Th232, Isotho, Gross Alpha Gross Beta Pb 210
WLL 2015 1105 ~~W06A~~ W01	11/5/15 17:00	Grab	Surface Water	Dk Gray Water		Total U, Ra226, Ra228 Gross Alpha Gross Beta
WLL 2015 1105 ~~W06B~~ W02	11/5/15 17:00	Field Dup	Surface Water	"		Total U, Ra226, Ra228 Gross Alpha, Gross Beta

S08

Sample Event Log Information

Project : West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:

West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 6, 2015 **Arrival Time:** 15:15 **Departure Time:** 16:10

Team members/responsibilities:

Eric Gilstrap

Weather (Description)	Temperature: 60 F	Humidity: 37 %	Wind: (Direction and Speed)
Sunny			~~N~~ NW from @ 4.6 mph

Radiation detection equipment used: model/serial number/calibration:

☐ **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**

Time:							
Reading:							

☐ **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**

Time:							
Reading:							

☐ **Ludlum Model 19A/ 201916/June 25, 2015**

Range of Readings:

Sample Collection Log Information

Sample location description:

Drainage path discharge location from SW wooded area into ~~lake~~ lake bordering Lakefront Drive properties

Odors Present: Yes or (No) **If Yes Please Describe:**

Collection equipment:

Split Spoon

Sampler's name(s):

See Team Members

ID Number	Sample Date/Time	Sample Type	Sample Matrix	Sample Descript.	GPS Coord. UTM 15S	Analytes Requested & Preservative if used
WLL20151106S08	Nov 6, 2015 15:45	GRAB	SED/SOIL		0,721,437 4,293,913	Iso U, Iso Th, Ra-226, Ra-228
						Gross α, Gross β

Appendix I:MDNR Meteorological Data

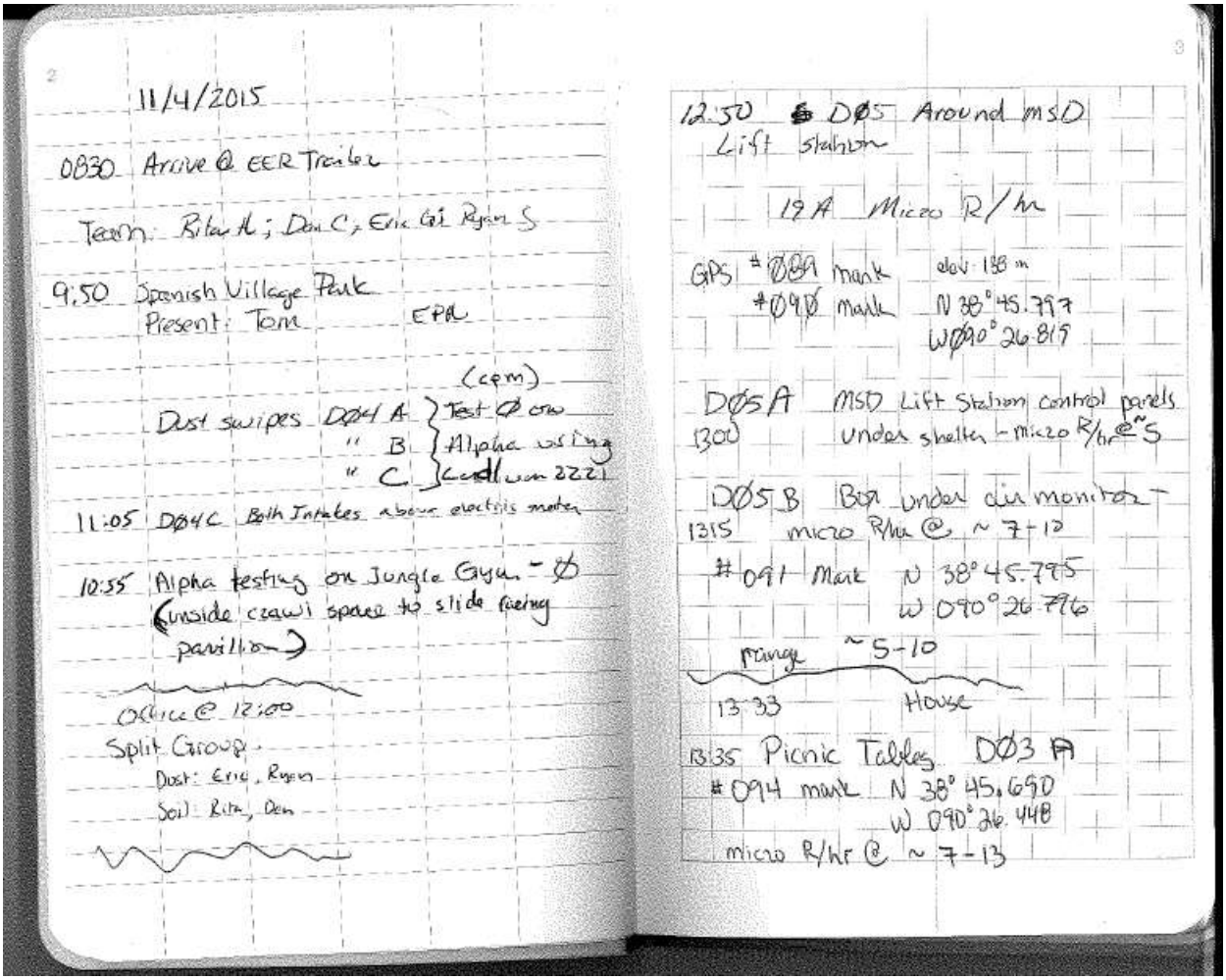
Bridgeton Sanitary Landfill
Hourly Average Meteorological Data

Date and Hour	Avg. Temp. (Degrees F)	Avg. Wind From (Directional Degrees)	Avg. Wind From (Cardinal Direction)	Avg. Wind Speed (Miles per Hour)	Avg. Relative Humidity (Percent)
11/4/2015 10:00	64.02	196.00	SSW	2.91	79.97
11/4/2015 11:00	65.77	176.00	S	3.54	75.38
11/4/2015 12:00	68.23	165.00	S	3.63	70.07
11/4/2015 13:00	70.19	152.00	S	2.68	66.48
11/4/2015 14:00	72.33	144.00	SE	3.52	62.31
11/4/2015 15:00	70.32	148.00	S	4.05	67.13
11/4/2015 16:00	68.82	147.00	S	3.72	71.68
11/4/2015 17:00	66.80	142.00	SE	2.44	77.56
11/4/2015 18:00	65.94	146.00	SE	2.45	80.70
11/4/2015 19:00	66.77	156.00	S	4.41	77.52
11/4/2015 20:00	66.45	166.00	S	4.00	76.87
11/4/2015 21:00	67.55	170.00	S	4.13	69.37
11/4/2015 22:00	67.55	174.00	S	5.18	67.88
11/4/2015 23:00	67.38	179.00	S	4.48	65.28
11/5/2015 0:00	66.99	173.00	S	3.49	64.26
11/5/2015 1:00	65.55	160.00	S	1.97	65.86
11/5/2015 2:00	63.53	150.00	S	1.93	70.78
11/5/2015 3:00	65.07	195.00	SSW	4.25	67.72
11/5/2015 4:00	64.12	154.00	S	2.33	70.79
11/5/2015 5:00	61.72	156.00	S	2.00	77.73
11/5/2015 6:00	62.00	155.00	S	2.77	80.12
11/5/2015 7:00	62.84	145.00	SE	2.94	79.93
11/5/2015 8:00	64.70	164.00	S	5.82	76.83
11/5/2015 9:00	66.56	180.00	S	6.79	74.69
11/5/2015 10:00	67.43	172.00	S	5.08	74.17
11/5/2015 11:00	67.53	183.00	S	4.79	76.21
11/5/2015 12:00	65.88	192.00	SSW	5.57	84.84

Bridgeton Sanitary Landfill
Hourly Average Meteorological Data

Date and Hour	Avg. Temp. (Degrees F)	Avg. Wind From (Directional Degrees)	Avg. Wind From (Cardinal Direction)	Avg. Wind Speed (Miles per Hour)	Avg. Relative Humidity (Percent)
11/5/2015 12:00	65.88	192.00	SSW	5.57	84.84
11/5/2015 13:00	65.65	182.00	S	6.23	86.68
11/5/2015 14:00	65.75	176.00	S	5.50	86.92
11/5/2015 15:00	64.99	170.00	S	7.91	89.05
11/5/2015 16:00	64.81	173.00	S	7.19	89.80

Appendix J: Field Book Notes



2

11/4/2015

0830 Arrive @ EER Trailer

Team: Brian A; Don C, Eric G, Ryan S

9:50 Spanish Village Park
Present: Tom EPA

(cpm)
Dust swipes DØ4 A } Test @ ow
" B } Alpha using
" C } Cadium 2221

11:05 DØ4C Both Intakes above electric meter

10:55 Alpha testing on Jungle Gym - Ø
(inside crawl space to slide facing pavilion)

Office @ 12:00
Split Group
Dust: Eric, Ryan
Soil: Rita, Don

3

12:50 DØ5 Around MSD
Lift station

12A Micro R/hr

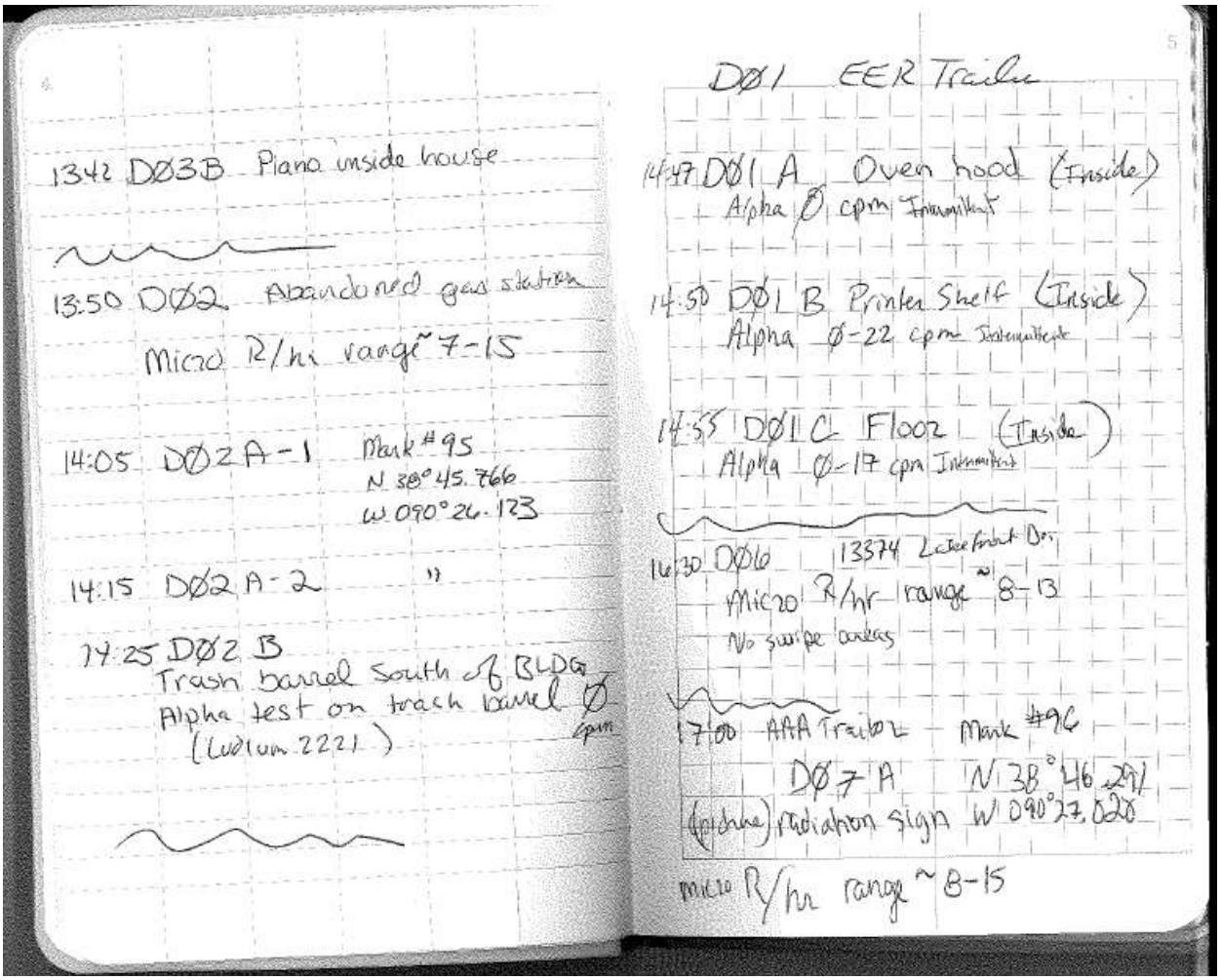
GPS #ØØ9 mark elev. 138 m
#ØØØ mark N 38° 45.797
W090° 26.819

DØ5A MSD Lift Station control panels
1300 under shelter - micro R/hr @ ~5

DØ5B Box under air monitor
1315 micro R/hr @ ~ 7-12
#091 Mark N 38° 45.795
W 090° 26.796
range ~5-10

1333 House

1335 Picnic Tables DØ3 A
#094 mark N 38° 45.690
W 090° 26.448
micro R/hr @ ~ 7-13



4

1342 DØ3B Piano inside house

13:50 DØ2 Abandoned gas station
Micro R/hr range ~ 7-15

14:05 DØ2A-1 Mark #95
N 38°45.766
W 090°26.123

14:15 DØ2A-2 "

14:25 DØ2B
Trash barrel South of BLDG
Alpha test on trash barrel Ø cpm
(Uranium 2221)

5

DØ1 EER Trailer

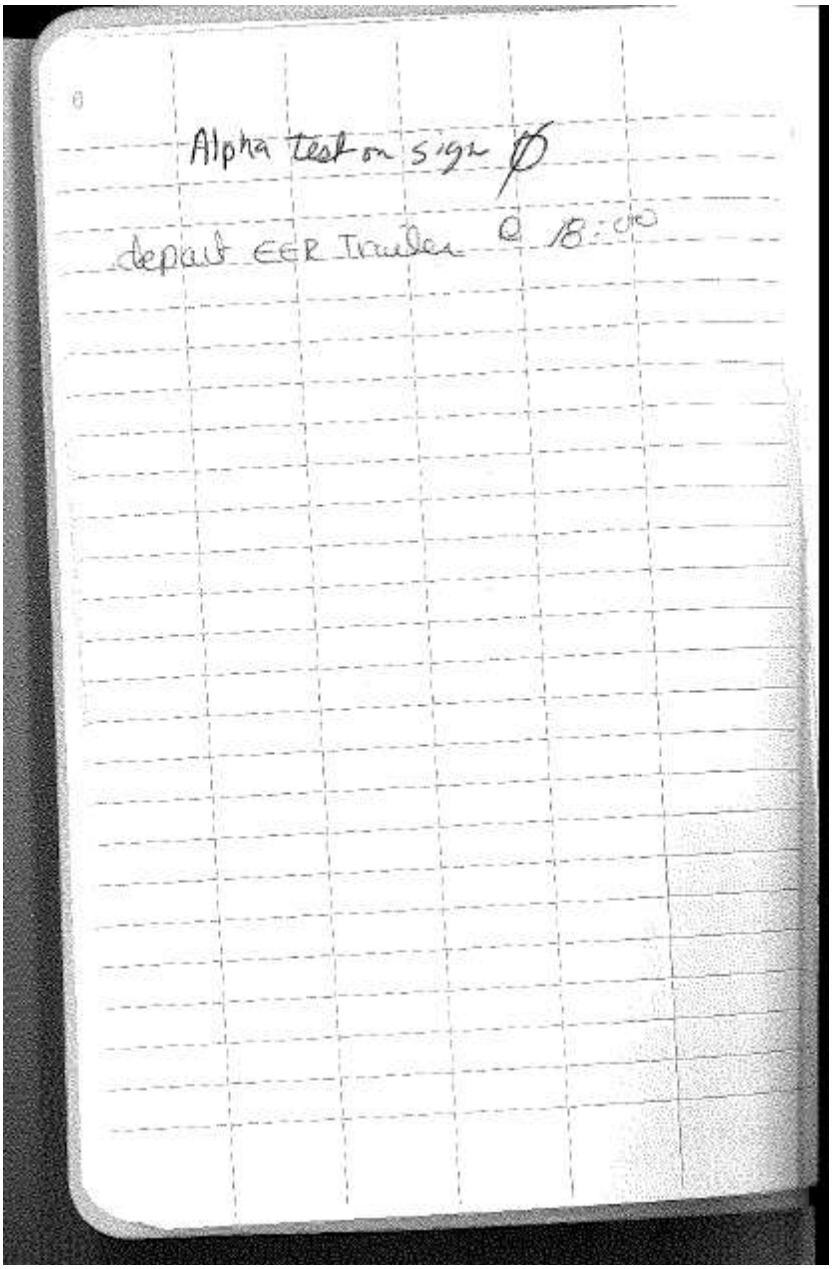
14:47 DØ1A Oven hood (Inside)
Alpha Ø cpm Intermittent

14:50 DØ1B Printer Shelf (Inside)
Alpha Ø-22 cpm Intermittent

14:55 DØ1C Floor (Inside)
Alpha Ø-17 cpm Intermittent

16:30 DØ6 13374 Lakefront Dr.
Micro R/hr range ~ 8-13
No surface contam

17:00 AAA Trailer Mark #96
DØ7A N 38°46.291
(Outside) radiation sign W 090°27.020
Micro R/hr range ~ 8-15



Alpha test on sign Ø

depart EER Trailer @ 18:00

11/4/15 0625 West Lake Landfill Vicinity Sampling
Arrived @ Hussman OSR Trailer w/ Eric Gilstrap
Met with EPA Personnel Adam Ubrano.
EG 2nd & signed off on BHASP.
Weather: cloudy, foggy, 59°F, 93% humid; wind S @ 5 mph
Dates staff arrived @ 7:15
EPA staff present: Tom Mahler 816-604-0546
DNSS: Steve May, Will Brady, Shawn Odom, Mark Jenkerson
Keith Henke: 573-645-5943
Randy Maley, Will Harris Franklin, Cory Jorgensen
Marrison Reynolds, Nick Rensmeyer, Jeremy Wilson
Jonathan Gravette, Brian Campbell
Arrived @ Hussman 2nd time @ 9:30
Met Ryan Seabaugh & Tom Mahler.
Began sample Rx @ 9:45
Broke for lunch @ 14:30 - 1500
Ended day @ approx 18:00 & left area for
Floriant Field Office
We completed - All swipe samples &
Soil samples from locs. S05, S01, S02 &
~~S010~~ S10. All notes kept ~~of~~ on Field logs.
Pictures taken. Ludlum Equipment check were performed
Before & After Sampling Day.
Results kept in equipment log
Book.

11/5/15 West Lake landfill Vicinity Sampling
2nd day WL Vicinity Sampling
Arrived @ Florissant Field office @
8am to prep for sampling.
left Florissant office w Dan Carey
for 1st loc @ ~ 0930.
1st loc S04 @ Virbrec. Met w Berry
Miller @ Virbrec to gain Access.
weather: cloudy, lt. rain, 64°F, 77% humidity
TBM Mauler, wind SE @ 7mph.
EPA joined us while @ Virbrec
& followed us to Areas S02 (Arthur Trucking)
& S010 & S09 - AAA Trucking Parking lots.
~~They~~ we observed our sample loc &
conducted some scans with their
3x3 radiation detection equipment.
Aaron Schmitt & several people with the
AGO & SWMP joined us briefly while @
AAA. and left around 12:00. Dan Carey
& I resumed sampling @ 12:00 with scan &
soil sampling @ S09. Eric Gilstrap joined
us @ 13:15 & assisted in collecting sample
@ S03 in ditch across St. Charles Rock Rd
from Jimmy Johns. 14:15-15:00: we Broke for
lunch. Eric Gilstrap & I continued soil/surface sampling
@ the loc S06, finishing & leaving area @ 17:30.

84 11/16/15

Arrived @ 12:30 EPA Fenton, MO

Met Tom Moller, EPA. Began QC check for Ludlum 3030 equipment with lead shielding

"α" Th230 check source 19,100 dpm 12/1/03

SN#: 5158-03 DNS-4

EPA SN# 0768-5023

"β" Sr90 check source 5,510 dpm 12/2/03

SN #: 5156-03 DNS-14

EPA #: 770-3427

Th230 c.s. 1 min ct = α = 329, cpm = 17% eff.

Sr 90 c.s. 1 min ct = β = 1198 cpm = 22% eff.

Making averages counts in cpm

10 min Bkg count: 0(α) 142(β) cpm

α Alpha β = Beta

Began 10 min cts @ 13:08 of WW Simple samples

DØ4A: α = 0 β = 45 cpm

DØ1D: α = 0 β = 43 cpm

DØ5A: α = 0 β = 43 cpm

DØ7A: α = 1 β = 48 cpm

LI 3030 was calibrated by Ludlum 12/5/14

It is due for recalibration on 12/5/15

Serial # = 191249

Completed counts @ 14:15

Left EPA Fenton office @ 14:30

Rgf