UAV-Based Radiological Surveys of the St. Anthony Mine Pit-1 Sidewalls

Cibola County, New Mexico

Prepared for:

INTERA Geoscience and Engineering Solutions
6000 Uptown Blvd NE Suite 220
Albuquerque, NM 87110

Prepared by:

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Albuquerque, NM 87113
505-298-4224

October 21, 2021

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1 INTRODUCTION

1.1 *Purpose*

The St. Anthony Mine Site (Site) is a former uranium mine located on the Cebolleta Land Grant, approximately 4.6 mile southeast of Seboyeta, New Mexico. While Site surface soils had been previously radiologically characterized (AVM, 2018) the mine pit sidewalls (sidewalls) had not. This unmanned aerial vehicle (UAV)-based radiological survey was performed to measure gamma count rates associated with sidewalls of Mine Pit 1 (Pit 1). The results of the survey, in conjunction with photo documentation of the sidewalls, may help evaluate reclamation objectives within Pit 1. Figure 1 below identifies various features within Pit-1.

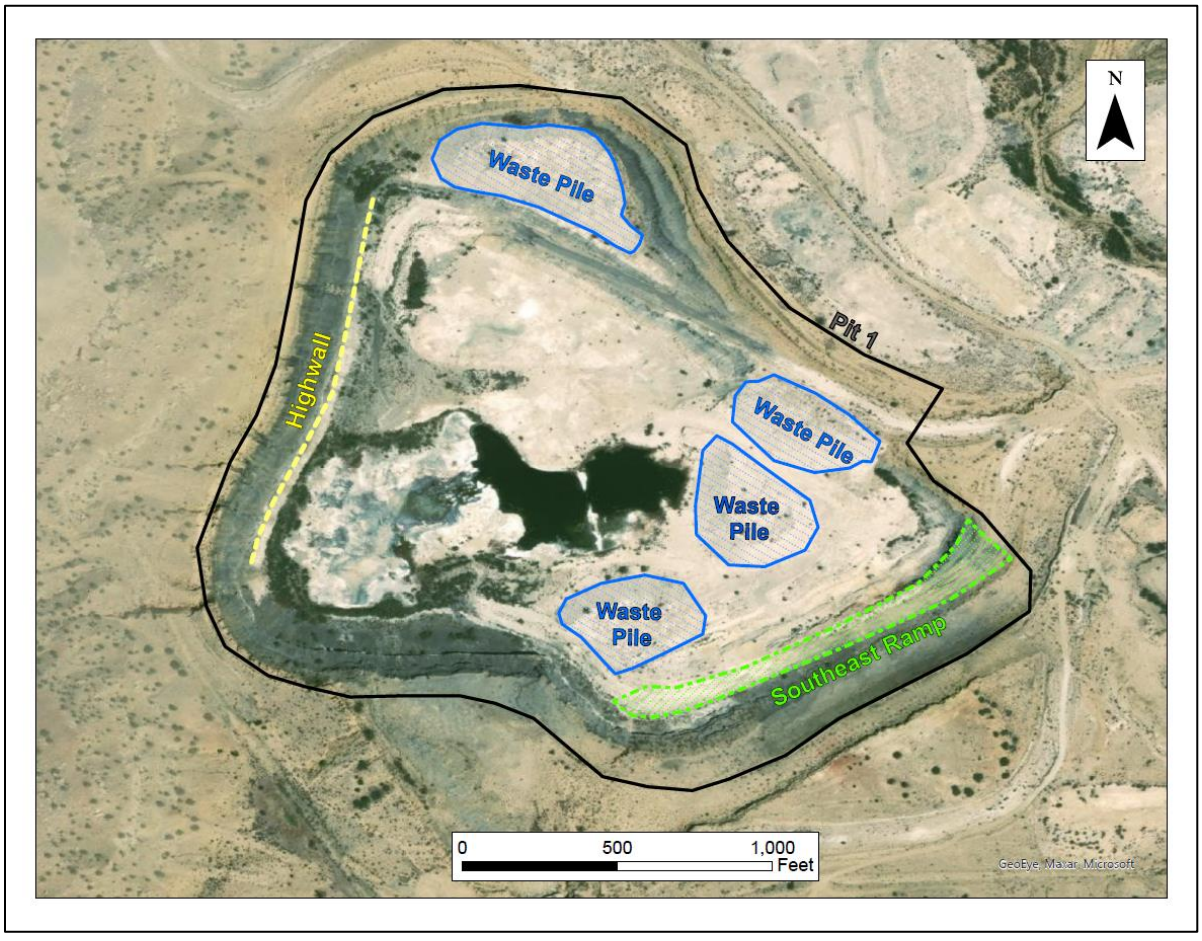

Figure 1: Site Feature Map

1.2 *Setting*

The Site was operated by United Nuclear Corporation (UNC) from 1975 to 1981. The Site comprises underground workings, two open pits, seven large piles of non-economical mine materials with some revegetation, numerous smaller piles of non-economical mine materials, and three topsoil piles. Pit 1 is

currently an open pit where the Jackpile sandstone, Dakota sandstone, and Mancos Shale are exposed. The pit contains an area of expressed groundwater, as well as numerous waste rock and stockpiles, each containing natural sources of radium. Depending on their respective geometry and radium levels, these features contribute various levels of gamma emissions to the sidewall survey measurements. This additional gamma count rate contribution from other sources is often referred to as "gamma shine". The techniques used are designed to adjust the survey and measurements to account for the gamma shine are discussed below.

1.3 *Description of Work*

This survey was designed to determine the nature and extent of exposed Jackpile formation and associated radioactivity. Of special interest were areas of the Jackpile formation beneath overhangs, where secondary mineralized zones (e.g., efflorescent minerals) were visually observed, and the transition zone between the Jackpile formation to Morrison formation.

Two separate UAV surveys were flown in the collection of gamma survey data. The first was flown with the radiological detector at 4 meters (m) away from the face of the sidewalls. The second was flown with the radiological detector at 15 m away from the face of the sidewalls. The purpose of this second survey was to estimate gamma shine contribution to the 4-m survey data (i.e., contribution to the 4-m survey data from sources other than the immediate sidewall). These net 4-m gamma count rates are more appropriate for use in estimating the gamma contribution from the immediate sidewall surface. The process of calculating net 4-m gamma survey count rates is discussed in greater detail in Section 2 below.

2 UAV GAMMA RADIATION SURVEY OF THE MINE SIDEWALLS

2.1 *Equipment*

The radiological survey instruments used in the characterization were:

- UAV equipped with a Ludlum Model 44-10 2-inch by 2-inch sodium-iodide high-energy gamma detector paired with a Ludlum Model 3000 scaler for making gamma radiation measurements. Used in performing UAV-based gamma surveys.

The ERG UAV was equipped with a Model 44-10, 2-inch by 2-inch, sodium iodide gamma detector coupled to a Model 3000 scaler, which in turn was connected to an onboard logging system for coupling the radiological data to the UAV positional data. The Model 3000 was operated in scaler mode. The Model 3000 was coupled to an onboard computer that recorded the one-second integrated radiological count and corresponding GPS coordinate to an onboard Secure Digital (SD) card. The data were also transmitted to a remote computer at the UAV control station to provide real-time radiological updates to the technician. The log files were downloaded from the SD card and stored in a project database at the end of each day.

Table 1 lists the radiological instruments by model and serial number used in the investigation.

Table 1. Survey Instruments

Description	Model	Serial Number
UAV Meter	Ludlum Model 3000	25020100
UAV Detector	Ludlum Model 44-10	PR295016

2.2 *Results of the Gamma Survey*

Results for the UAV gamma survey of the sidewalls showing data from different vantage points are provided as figures in Attachment A. Summary statistics for the net 4-m gamma count rates data set are presented in Table 2 below. The negative minimum net 4-m gamma count rate is indicative of high gamma shine in an area.

Table 2. Summary Descriptive Statistics of Gamma Count Rates Logged

Summary Statistics Collected Data (n = 8,120)						
Parameter	**Mean**	**Median**	**Mode**	**Standard Deviation**	**Minimum**	**Maximum**
Net 4-m Gamma Count Rate (cps)	51.7	21.5	13.1	236.0	-759.6	3,348.0

The process of calculating the net 4-m net gamma count rates was as follows:

- UAV gamma survey data was collected at 4-m and 15-m distances from the Pit-1 sidewalls.
    - The 4-m gamma survey was performed to collect gamma survey data in close proximity to the sidewall.
    - The 15-m gamma survey was performed to collect data for use in approximating the background and gamma shine contribution to the 4-m gamma survey data.
- Due to inconsistent levels of gamma shine throughout Pit-1, the 15-m gamma survey data was grouped into multiple 20-meter-wide zones. Each zone was identified by visually observing gamma survey data trends and, using professional judgement, selecting 15-m gamma survey count rates having a near-normal distribution.
- The gamma count rate mean, and standard deviation were calculated for all 15-m gamma survey data located within each zone.
- The 4-m net gamma count rates were then calculated by subtracting the 15-m gamma survey count rate mean, less two standard deviations (95%), from the 4-m gamma count rates located within the same zone.
- The 15-m gamma survey mean count, less two standard deviations, was determined to be the best approach to approximate background and gamma shine for each zone. Where gamma shine was not a factor the subtraction of two standard deviations results in the lower 5% of background subtracted from each 4-m gamma count rate in the same area. Thus, the derived data points are likely inclusive of some background and therefore are considered conservative (overestimated) for the data presented.

Figure A1 shows the net 4-m gamma survey results for the observed 1-second scalar counts (cps) for the sidewalls for the top-down view. The mean gamma count rate of the sidewalls at 4-m is 51.7 cps. The median gamma count rate of the sidewalls at 4-m is 21.5 cps. The minimum value is -759.6 cps. The maximum value is 3,348 cps, with 95% of the net 4-m gamma count rates below 524 cps.

Figure A2 shows the results of the net 4-m gamma survey for the observed 1-second scalar counts (cps) for the sidewalls in a three-dimensional view. The maximum gamma count rates are located below the Pit 1 southeast ramp. There is observable mineralization within the Jackpile sandstone on the sidewall in this area and there are mine waste piles nearby. Additionally, elevated gamma count rates were found around the waste pile on the northernmost portion of the Pit 1. Two small locations of elevated gamma count rate were also located on the western portion of the highwall, nearest to the mine pit floor. Other small areas of elevated gamma count rate were identified below the northeast ramp and on the southern highwall at the "notch" above the southeast ramp, about 10 to 15 meters above the mine pit floor.

Figure A3 shows the results of the net 4-m gamma survey for the observed 1-second scalar counts (cps) for the Pit 1 southeastern ramp, and the location of maximum recorded gamma count rate; recorded near the sidewall below the Pit 1 southeastern ramp. The elevated gamma count rates correspond to an area of yellowish-brownish discoloration in the sidewall visible in the figure.

3 RADIOLOGICAL SURVEY INSTRUMENTATION QUALITY ASSURANCE

All radiological survey instrumentation was calibrated within 12-months prior to use. The calibration certificates are attached. Instrument function checks and a test strip in a background area were completed before and after each day's survey. The results of the function checks are included in Attachment B. No issues were identified within the function checks or the test strip data, and instrument stationarity was maintained throughout the project duration.

4 FIELD CHALLENGES

Various challenges were encountered during the performance of this survey.

- The uneven vertical surface of the sidewalls, and inconsistent vegetation growth, made for complications in achieving full survey coverage.
- The presence gamma shine from mine waste piles required taking the approach of performing both a 4-m and 15-m gamma survey to account for gamma influence from sources other than the highwall.
- A Ra-226 concentration in soil correlation previously conducted at the site (AVM, 2018) could not be reliably applied to the sidewall gamma survey data due to the differences in detector geometry and source media. Conducting a new correlation of the sidewalls was determined to be impractical and unsafe due to the terrain and accessibility.

5 SUMMARY AND CONCLUSIONS

As identified in Section **4** above there were multiple challenges in collecting gamma survey data. As a result, the data presented should be considered qualitative and used for general information purposes only.

Gamma radiation count rate data was collected from the sidewalls using a UAV-based gamma survey system. The method of subtracting the mean 15-m gamma survey count rate, less two standard deviations, from the 4-m gamma survey count rates to calculate net 4-m gamma survey count rates was necessary to account for potential gamma shine contribution from mine waste piles not present where the initial correlation data were collected outside of Pit 1.The results are considered approximate, due to the sidewall area radiological survey conditions, including uneven sidewall surfaces and uneven gamma shine, as well as gamma shine from waste rock present in Pit 1.

The mean gamma count rate observed in the net 4-m survey data is 51.7 cps. The highest gamma count rate observed in the survey is 3,348 cps and was recorded just below the Pit 1 southeastern ramp. Of note at this location was a visible yellowish-brownish discoloration of the mine sidewall material.

6 REFERENCES

AVM Environmental. AVM. 2018. Supplemental Radiologic Characterization St. Anthony Mine Site Seboyeta, New Mexico. August 13th, 2018.

Environmental Restoration Group Inc. ERG. 2020. Work Plan for Mine Highwall UAV Surveys at the St. Anthony Mine. August 31st, 2020.

MWH. 2007. Materials Characterization Report St. Anthony Mine Site. October 26th, 2007.

United States Environmental Protection Agency. EPA. 2000. EPA 402-R-97-016. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1. August 2000.

Attachment A
Survey Figures

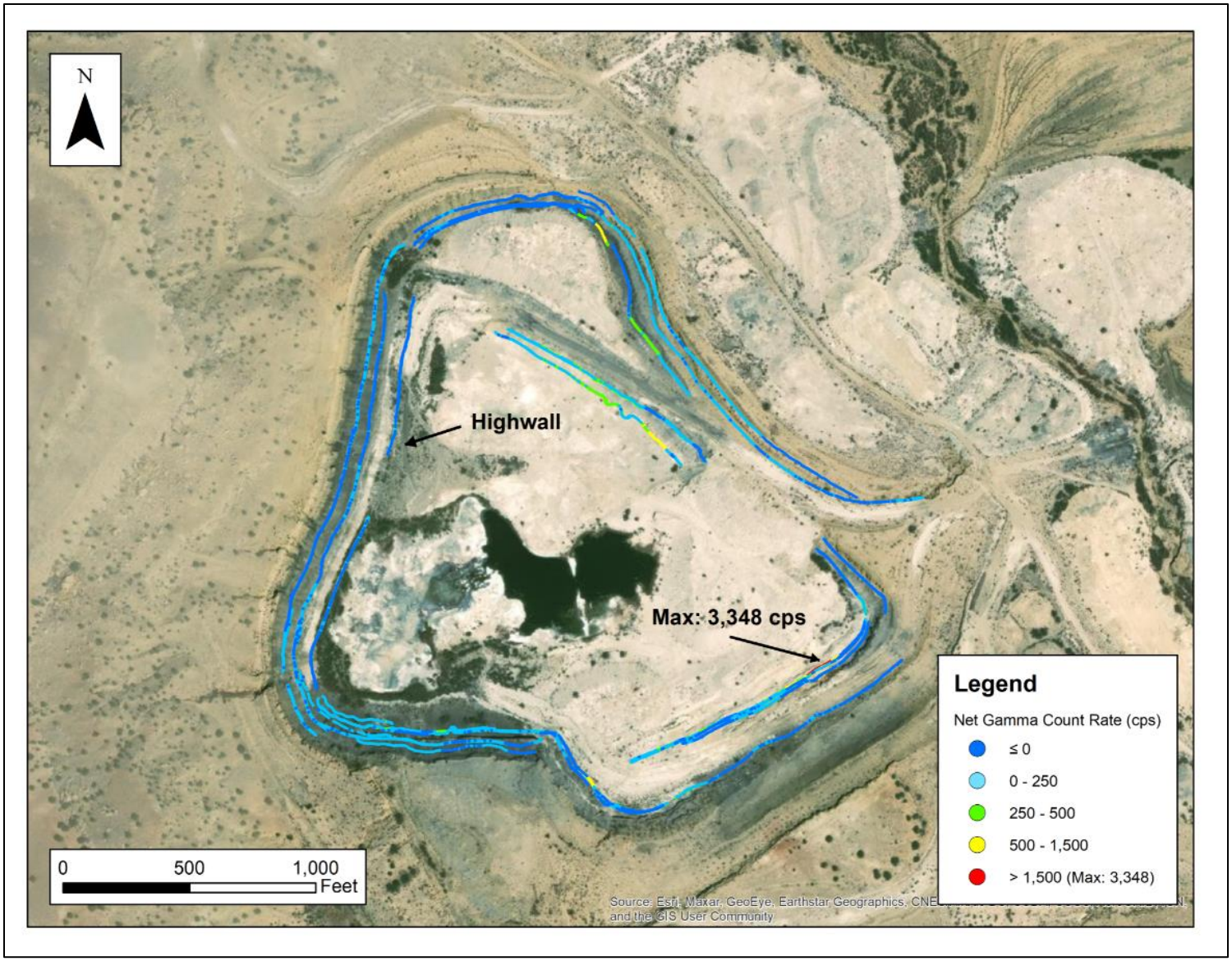

Figure A1: Top-down view of Pit 1 with the observed count rate data overlaid on the map

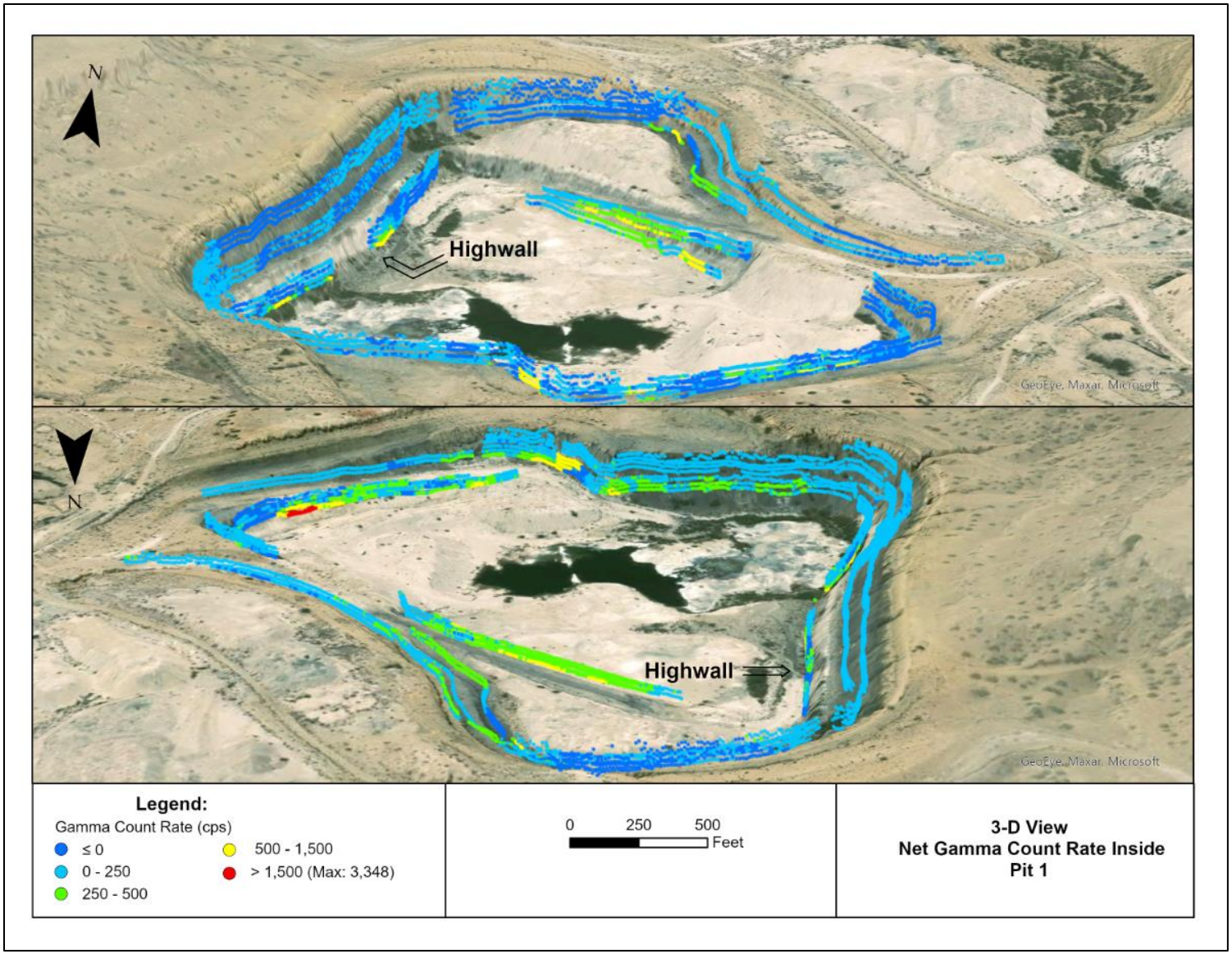

Figure A2: Three-dimensional view of the observed count rates (cps)

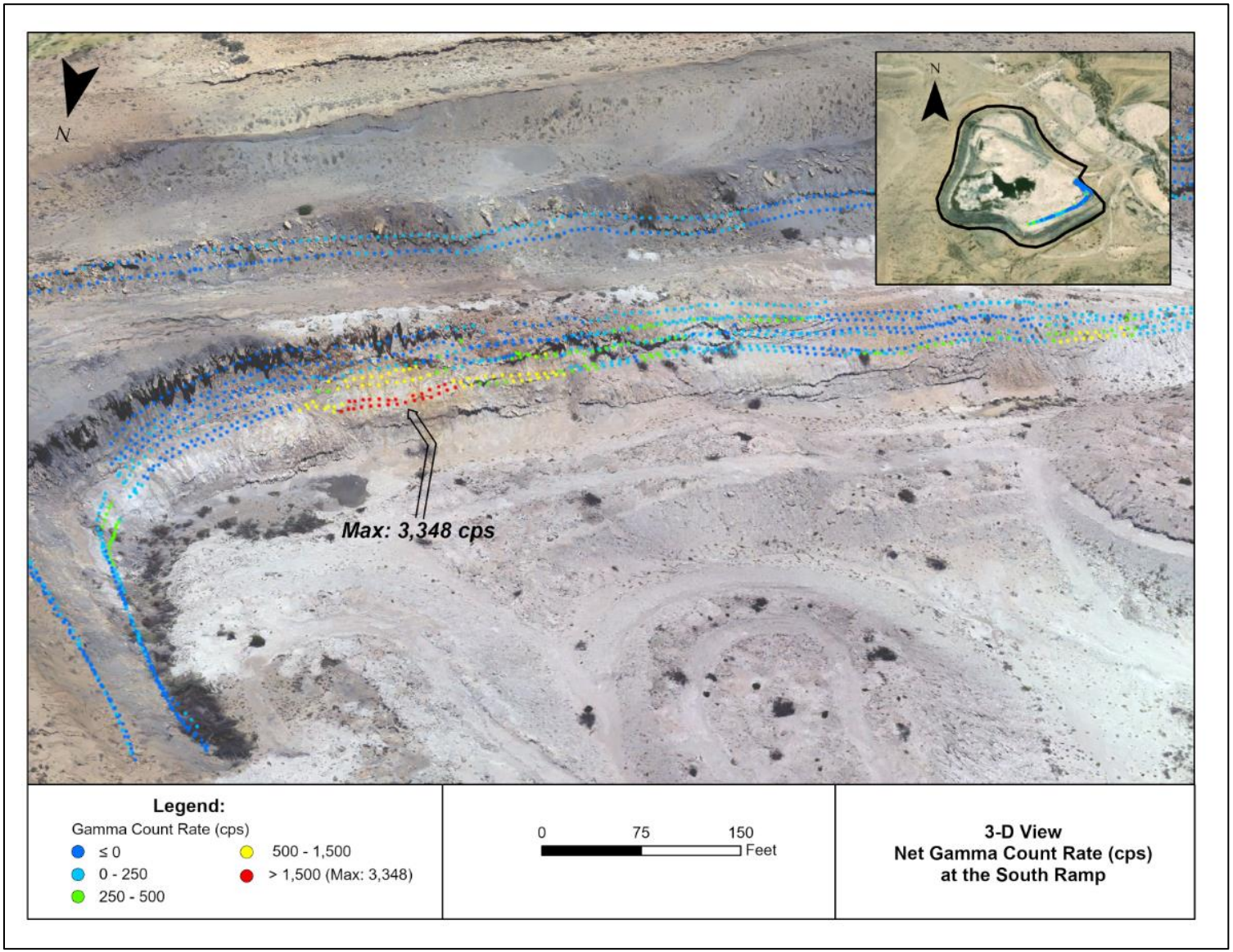

Figure A3: Three-dimensional view of the Pit 1 Southeastern Ramp observed count rates (cps)

Attachment B
Calibration and Function Check Forms

www.ludlums.com

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

ILAC-MRA ACCREDITED
CERT # 4084.01

Customer ENVIRONMENTAL RESTORATION GRP ORDER NO. 20376651/492556

M Ludlum Measurements, Inc. Model 3000 Serial No. 25020100

Mfg. Ludlum Measurements, Inc. Model 44-10 Serial No. PR295016

Cal. Date 15-Apr-20 Cal Due Date 15-Apr-21 Cal. Interval 1 Year Meterface 44-10 R

Check mark applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 25 % Alt 710.0 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

☑ Mechanical ck. ☐ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☐ Window Operation ☐ Geotropism
☑ Audio ck. ☑ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 4.4 VDC
☑ Calibrated in accordance with LMI SOP 14.8 ☑ Calibrated in accordance with LMI SOP 14.9

Instrument Volt Set 1100 V Input Sens. 10 mV Det. Oper. 1100 V at 10 mV Threshold Dial Ratio = mV

☑ HV Readout (2 points) Ref./Inst. 600 / 601 V Ref./Inst. 1300 / 1322 V

COMMENTS:

Deadtime: 8 µSec
Calibration Constant: 549 e+8
Primary Units: R/hr
Primary Units Alarm: 500 µR/hr
Secondary Units: cpm
Secondary Units Alarm: 5 kcpm
Firmware: 49835N30

Unable to take as found readings on range due to setup change.
Overload checked but not set.
Pulser calibration RATEMETER READOUT performed without deadtime.
Pulser calibration SCALER READOUT reflects 6 second count.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING	RANGE MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING
Digital	5 mR/hr	N/A	4.98 mR/hr				
Digital	1 mR/hr		1.00				
	800 µR/hr		803 µR/hr				
	200 µR/hr		194				

Range(s) Calibrated Electronically

Multimeter uncertainty within 1.3% of reading, Gamma uncertainty within 5.0% of reading, Neutron uncertainty within 7.0% of reading, Count rate uncertainty within 5.4% of reading

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING		REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING
Digital Readout	800K cpm	800 kcpm	800 kcpm	Scaler	800K cpm	80.0K	80.0K
	200K cpm	200	200		200K cpm	20.0K	20.0K
	80K cpm	80.0	80.0		80K cpm	8.00K	8.00K
	20K cpm	20.0	20.0		20K cpm	2.00K	2.00K
	8K cpm	8.00	8.00		8K cpm	801	801
	2K cpm	2.00	2.00		2K cpm	200	200
	800 cpm	799 cpm	799 cpm		800 cpm	80	80
	200 cpm	201	201		200 cpm	20	20

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.
All pass/fail determinations are based on the manufacturer's specifications without considering uncertainty factors.
Measurement results represent expanded uncertainties expressed at approximately the 95% level of confidence, using a coverage factor of k=2.
The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323AB-2013

ISO/IEC 17025:2017(E)
State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 S/N: ☐ 059 ☐ 2171CP ☐ 2261CP ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 1909 ☐ 1916CP ☐ 2324/2521
☐ 5717CO ☐ 5719CO ☐ 60646 ☐ 70897 ☐ 73410 ☐ E552 ☐ G112 ☑ 2168CP ☐ S-394 ☐ S-1054 ☐ T10081 ☐ T10082 Neutron Am-241 Be ☐ T-304 Ra-226 ☐ Y982
☐ E551 ☐ 5105 ☐ CSV280

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241(~0.66µCi)

☑ m 500 S/N 251106 ☐ Oscilloscope S/N ☑ Multimeter S/N 15060230

Calibrator James McBeth James McBeth Title Calibrator Date 15APR20

QC'd By Title Final QC Date 15Apr20

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed.

Ludlum Device Parameters

Product: Model 3000
Serial Number: 25020100
4/15/2020 8:05:02 AM

Device

Device Firmware	49835C-N30.3838
Device Model	Model 3000
Device Serial Number	25020100
Device Real Time Clock Day	15
Device Real Time Clock Hour	8
Device Real Time Clock Minutes	4
Device Real Time Clock Month	4
Device Real Time Clock Seconds	55
Device Real Time Clock Year	2020
Device Real Time Clock Day of the Week	1
Device Backlight Threshold	2
Device Sleep	0
Device Dual Level Audio Setting	0
Device R to Sv Ratio	0.0106
Device Log Button	0
Device Backlight Threshold Low Turn On	40
Device Backlight Threshold Low Turn Off	120
Device Backlight Threshold High Turn On	17
Device Backlight Threshold High Turn Off	100
Device Backlight On	0
Device Count Display Mode	0
Device Count Audio Mode	0
Device Rate Reset Button	0
Device Setup Protect	Normal
Device Auxiliary Enabled	1
Device Auxiliary Mode	0
Device Auxiliary Auto Power Down	1
Device Auxiliary Write Protect	1
Device Auxiliary Encryption Enabled	1
Device Area Monitor enabled	0
Device Auxiliary Enabled	0
Device Auxiliary 375-Ethernet-Mode Port	0
Device Auxiliary AutoMode Interval	0

Device Calibration

Device Calibration High Voltage Slope	50
Device Calibration High Voltage Offset	-64
Device Calibration Channel [1] Pulse Threshold Offset	-3

Detector 1

Detector [1] Serial Number	PR295016
Detector [1] Model	44-10
Detector [1] High Voltage	1100
Detector [1] Overload	100
Detector [1] Count Time	60

Detector [1] Operation Mode	0
Detector [1] Auto Response Rate	1
Detector [1] Response Time	0
Detector [1] Audio Sigma	0
Detector [1] Enabled	0
Detector [1] Unit 1 Rate Unit Type	9
Detector [1] Unit 1 Rate Min Range	0
Detector [1] Unit 1 Rate Min Decimal Point	0
Detector [1] Unit 1 Rate Max Value	7
Detector [1] Unit 1 Rate Max Range	1
Detector [1] Unit 1 Rate Max Decimal Point	0
Detector [1] Unit 1 Rate Alarm Value	500
Detector [1] Unit 1 Rate Alarm Range	0
Detector [1] Unit 1 Rate Alarm Decimal Point	0
Detector [1] Unit 1 Scaler Unit Type	3
Detector [1] Unit 1 Scaler Min Range	0
Detector [1] Unit 1 Scaler Min Decimal Point	0
Detector [1] Unit 1 Scaler Alarm Value	0
Detector [1] Unit 1 Scaler Alarm Range	0
Detector [1] Unit 1 Scaler Alarm Decimal Point	0
Detector [1] Unit [2] Rate Unit Type	0
Detector [1] Unit [2] Rate Min Exponet	0
Detector [1] Unit [2] Rate Max Value	0
Detector [1] Unit [2] Scaler Unit Type	0
Detector [1] Unit [2] Scaler Min Exponet	0
Detector [1] Unit 2 Rate Unit Type	5
Detector [1] Unit 2 Rate Min Range	0
Detector [1] Unit 2 Rate Min Decimal Point	0
Detector [1] Unit 2 Rate Max Value	999
Detector [1] Unit 2 Rate Max Range	1
Detector [1] Unit 2 Rate Max Decimal Point	0
Detector [1] Unit 2 Rate Alarm Value	500
Detector [1] Unit 2 Rate Alarm Range	1
Detector [1] Unit 2 Rate Alarm Decimal Point	2
Detector [1] Unit 2 Scaler Unit Type	1
Detector [1] Unit 2 Scaler Min Range	0
Detector [1] Unit 2 Scaler Min Decimal Point	0
Detector [1] Unit 2 Scaler Alarm Value	0
Detector [1] Unit 2 Scaler Alarm Range	0
Detector [1] Unit 2 Scaler Alarm Decimal Point	0
Detector [1] Unit [3] Rate Unit Type	0
Detector [1] Unit [3] Rate Min Exponet	0
Detector [1] Unit [3] Rate Max Value	0
Detector [1] Unit [3] Scaler Unit Type	0
Detector [1] Unit [3] Scaler Min Exponet	0
Detector [1] Channel [1] Pulse Threshold	10
Detector [1] Channel [1] Dead Time Correction	8
Detector [1] Channel [1] Dead Time Correction 2	0
Detector [1] Channel [1] Loss of Count Time	60
Detector [1] Channel [1] Calibration Constant	549
Detector [1] Channel [1] Calibration Constant Exponent	8
Detector [1] Channel [1] Efficiency 4pi	15

Order #: 20376651/492556

Customer: ENVIRONMENTAL RESTORATION GRP

Detector: 44-10 **Serial No.:** PR295016

Instrument: Model 3000 **Serial No.:** 25020100

BKG Time: 6

Distance: Surface

Selected HV: 1100

Date: Wednesday, April 15, 2020

Notes:

Signature: James McBeth

Channel(s)

Name	Threshold
Channel 1	10 mV

Source(s)

Name	ID	Activity	Time	Type
Am241		0.66 µCi	6	γ

High Voltage	Background	Am241
	Reading	Reading
800	475	7,768
850	490	8,693
900	502	9,747
950	520	10,035
1000	540	9,964
1050	507	9,981
- 1100	509	10,063
1150	524	10,168
1200	496	10,472
1,250	559	10,484
1,300	587	10,878
1,350	837	11,168
1,400	1,194	12,647

Nw

Single-Channel Function Check Log

Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

METER	
Manufacturer:	Ludlum
Model:	3000
Serial No.:	250201OO
Cal. Due Date:	15 Apr 21

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR295016
Cal. Due Date:	15 Apr 21

Comments:
UAV 1
DETECTOR MOUNTED ON
UAV DIRECTLY ABOVE
SOURCE.

Source: Cs-137 Activity: 3.24 uCi Source Date: 4/18/16 Distance to Source: 6 inch (below)

Serial No.: 329-94 Emission Rate: NA cpm/emissions

NOTE: For use as needed. Acceptable upper/lower net counts, detector total efficiecy, and detector MDA calculated on ERG Form ITC.201.B .

Acceptable Upper Net Counts: 28,422

Acceptable Lower Net Counts: 18,948

Total Efficiency (E_t): N/A

MDA (dpm/100-cm²): N/A

Date	Time	Battery	High Voltage V	Threshhold mV	Source Counts cpm	BKG Counts cpm	Net Counts cpm	Initials	Note(s):
09/22/20	1253	NA	1100	10	42251	18521	23730	SP	
09/22/20	1736	NA	1100	10	43250	19661	23589	PH	
09/23/20	1030	NA	1100	10	~~44551~~	18160	24246	PH	Source = 42406 CPM
09/23/20	1745	NA	1100	10	43574	19451	24123	SP	
09/24/20	1018	NA	1100	10	44999	19535	25464	SP	
09/24/20	1512	NA	1100	10	44356	18762	25594	SP	
09/25/20	1031	NA	1100	10	44104	20068	24036	PH	
09/25/20	1640	NA	1100	10	44826	20535	24291	PH	
09/28/20	1047	NA	1100	10	45205	21837	23368	SP	
09/28/20	1714	NA	1100	10	42216	21988	20228	SP	
09/29/20	1048	NA	1100	10	46604	22709	23895	SP	
09/29/20	1708	NA	1100	10	46219	23286	22933	SP	

Reviewed by: [signature]

Review Date: 10/30/20

Single-Channel Function Check Log

Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

METER	
Manufacturer:	Ludlum
Model:	3000
Serial No.:	25020100
Cal. Due Date:	15 Apr 21

DETECTOR	
Manufacturer:	Ludlum
Model:	44-10
Serial No.:	PR 295016
Cal. Due Date:	15 Apr 21

Comments:
UAV 1
DETECTOR MOUNTED ON
UAV DIRECTLY ABOVE
SOURCE.

Source: Cs-137 Activity: 3.24 uCi Source Date: 4/18/16 Distance to Source: 6 in (below)

Serial No.: 329-94 Emission Rate: NA cpm/emissions

NOTE: For use as needed. Asccceptable upper/lower net counts, detector total effiiciecy, and detector MDA calculated on ERG Form ITC.201.B .

Acceptable Upper Net Counts: 28,422

Acceptable Lower Net Counts: 18,948

Total Efficiency (E_t): NA

MDA (dpm/100-cm²): NA

Date	Time	Battery	High Voltage V	Threshhold mV	Source Counts cpm	BKG Counts cpm	Net Counts cpm	Initials	Note(s):
09/30/20	1025	NA	1100	10	46946	24498	22448	SP	
09/30/20	1720	NA	1100	10	45616	23022	22594	SP	
10/01/20	1038	NA	1100	10	45906	23007	22899	PH	
10/01/20	1710	NA	1100	10	45212	22894	22318	PH	
10/02/20	1059	NA	1100	10	45678	22907	22771	SP	
10/02/20	1812	NA	1100	10	45281	21977	23304	SP	

Reviewed by: [signature]

Review Date: 10/30/20

	QC Counts, Function Check and Total Efficiency of a Survey Meter	

CT-009 FORM 1 – SINGLE-CHANNEL FUNCTION CHECK RANGE WORKSHEET

METER		DETECTOR			Source
Manufacturer:	Ludlum	Manufacturer:	Ludlum	Upper Limit (cpm):	28,422
Model:	3000	Model:	44-10	Lower Limit (cpm):	18,948
Serial No.:	250201OO	Serial No.:	PR295016		
Calibration Date:	15 Apr 21	Calibration Date:	15 Apr 21		

☐ Alpha: N/A 2-pi Emission Rate: N/A (cpm) Serial Number: N/A

☑ Gamma: Cs-137 Activity: 3.24 (μCi) Date: 4/18/16 Serial Number: 329-294 SP

Source Orientation / Distance between detector: ≈ 6 inch directly above source

Comments: _____

Observation	BKG Counts (cpm - μR/hr)	Gross Source Counts (cpm - μR/hr)	Net Source Counts (cpm - μR/hr)
1	18,057	42,164	24107
2	17,997	41,990	23993
3	18,255	41,832	23577
4	18,073	42,364	24291
5	18,576	41,801	23255
6	18,369	41,484	23115
7	18,469	42,050	23581
8	18,092	42088	23996
9	18,222	41,715	23493
10	18,566	42036	23470
Average Net Count Rate(s)			23685
Upper Net Count Rate (Average + 20%)			28422
Lower Net Count Rate (Average - 20%)			18948

SP

Performed by: Sam Patamiti **Date:** 09/22/2020

Reviewed by: _____ **Date:** 10/30/20