DEPARTMENT OF THE AIR FORCE

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HOLLOMAN AIR FORCE BASE, NEW MEXICO

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MEMORANDUM FOR NEW MEXICO ENVIRONMENT DEPARTMENT
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Hazardous and Radioactive Materials Bureau
2044 Galisteo
P.O. Box 26110
Santa Fe NM 87502

FROM: 49 CES/CEVR
550 Tabosa Avenue
Holloman AFB NM 88330-8458

SUBJECT: Submittal of Third Quarter 1998 Monitoring Report, 20,000 Pound Open Detonation Unit (ODU) and Quality Assurance/Quality Control Results

1. Attached are the 20,000 pound ODU *Third Quarter 1998 Monitoring Report* and the *Third Quarter 1998 Monitoring Report Quality Assurance/Quality Control Results* (Atchs 1 and 2, respectively). These reports are submitted requirements per New Mexico Environment Department (NMED) RCRA Permit for Open Detonation Treatment Unit, EPA Number NM6572124422. The quarterly monitoring report contains the results of soil sampling following a detonation. These results were then compared to background levels and site specific risk-based screening levels. Results from the analysis show that the ODU is effectively treating material and residual soil contaminants are below risk-based action levels.

2. The detonation event corresponding to *The Third Quarter 1998 Monitoring Report* was performed on 16 Sep 98. The soil sampling for the quarterly monitoring report occurred on 18 Sep 98, within 72-hours of the detonation event. All permit conditions related to the soil sampling and analysis were met for the quarterly monitoring report.

3. If you have any questions or require additional information, please contact Debbie Hartell at (505) 475-3931.

HOWARD E. MOFFITT
Deputy Base Civil Engineer

Attachments:
1. First Quarter 1998 Monitoring Report 20,000-Pound Open Detonation Unit
2. First Quarter 1998 Monitoring Report Quality Assurance/Quality Control Results

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Headquarters, Air Combat Command
Langley Air Force Base,
Virginia

Final

Third Quarter 1998 Monitoring Report
20,000-Pound Open Detonation Unit

February 1999

49th FIGHTER WING

49 CES/CEV
Holloman Air Force Base,
New Mexico

Part III—Third Quarter 1998 Monitoring Report

20,000-Pound Open Detonation Unit
Background Study and Quarterly Monitoring Program

Final

Prepared for:

Holloman Air Force Base
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February 1999

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LIST OF ACRONYMS

EOD ..... explosive ordnance disposal

HAFB ..... Holloman Air Force Base

NCP ..... National Contingency Plan

OD ..... open detonation

QA ..... quality assurance

QAPP ..... quality assurance project plan

QA/QC ..... quality assurance/quality control

QC ..... quality control

UTL ..... upper tolerance limit

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Executive Summary

During the third quarter of 1998, Holloman Air Force Base (HAFB) performed the third quarterly sampling event at the 20,000-Pound Open Detonation (OD) Unit in accordance with Attachment J of the operating permit. Twelve locations were sampled for metals and explosives. The analytical results were initially compared to the decision criteria outlined on page 33 in Attachment J of the operating permit. None of the sample results exceeded the decision criteria. Detailed results are presented in Section 2.2.

No changes to operations at the 20,000-Pound OD Unit are recommended.

This report summarizes the field activities, results, and conclusions of the third quarter 1998 sampling event.

1.0 Field Operations

Field sampling was conducted on 18 September 1998. The sampling was performed within 72 hours of the detonation event that occurred on 16 September 1998. A total of 12 soil samples were obtained from three different strata within the boundaries of the 20,000-Pound OD Unit. Samples, including quality assurance/ quality control (QA/QC) samples, were collected following the procedures outlined in the *20,000-Pound Open Detonation Unit Background Study and Quarterly Monitoring Work Plan* (Radian, 1997) and summarized in *Part I: Program Overview*. Samples were analyzed for metals and explosives as specified in the Quality Assurance Project Plan (QAPP) of the *Work Plan*.

During the field operations, the dimensions of each strata were measured and recorded. A grid was then developed based on these measurements. Random sampling locations were determined following the guidelines established in the *Work Plan*. Sampling locations are listed in Table 1-1.

Samples were labeled according to the following numbering sequence: HOL20K-Qx-yzs, where:

- x = **Quarter number**;
- y = **Sample type**—The number 0 indicates a normal sample, 1 indicates a duplicate, and 2 indicates an equipment blank;
- z = **Sample number**—these numbers correspond to those numbers listed in Table 1-2; and,
- s = **Stratum (A, B, or C)**.

The area sampled was based on wind data recorded for the detonation that had occurred on 16 September 1998. The wind data for the detonation is listed in Table 1-3. It was assumed that any small particles from the detonation event would fall out downwind of the detonation location. By determining the area for sampling based on the prevalent wind direction for the detonation, the quarterly sampling data reasonably reflect constituent concentrations in the soil. Figure 1-1 illustrates the strata dimensions, grid layout, and sample locations.

2.0 Analytical Results

This section presents a QA/QC evaluation of the analyses and a discussion of the analytical results of the third quarter 1998 sampling event.

2.1 Quality Assurance/Quality Control Summary

Quality control data were reviewed to determine the usability and defensibility of the analytical measurement data. The review focused on field and laboratory blanks, duplicate field samples, matrix spikes, surrogate recoveries, and laboratory control samples. Overall, QC data associated with this program indicate that the measurement data are acceptable and defensible. The data indicate that the QC mechanisms were effective in ensuring measurement data reliability within the expected limits of sampling and analytical error.

Table 1-1
Third Quarter Sample Locations

Stratum: A
Number of Samples: 4
Number of Potential Sampling Locations (n): 21
Scale Factor (n-1): 20

Sample Number	Random Number	Scaled Random Number[a]	Grid Node to Sample[b]
1	0.1349	2.70	A3
2	0.5478	10.96	A11
3	0.6177	12.35	A12
4	0.6903	13.81	A14

Stratum: B
Number of Samples: 4
Number of Potential Sampling Locations (n): 24
Scale Factor (n-1): 23

Sample Number	Random Number	Scaled Random Number[a]	Grid Node to Sample[b]
1	0.0941	2.16	B2
2	0.2783	6.40	B6
3	0.3414	7.85	B8
4	0.9507	21.87	B22

Stratum: C
Number of Samples: 4
Number of Potential Sampling Locations (n): 31
Scale Factor (n-1): 30

Sample Number	Random Number	Scaled Random Number[a]	Grid Node to Sample[b]
1	0.2108	6.32	C6
2	0.3132	9.40	C9
3	0.7254	21.76	C22
4	0.8124	24.37	C24

[a] Scaled Random Number = Random Number * Scale Factor
[b] Grid Node = Scaled Random Number rounded to the nearest integer

Table 1-2
Sample Node and Corresponding Sample Number

Strata	Node Number	Sample Number
A	3	1
	11	2
	12	3
	14	4
B	2	1
	6	2
	8	3
	22	4
C	6	1
	9	2
	22	3
	24	4

Table 1-3.
Wind Direction and Wind Speed During Days of Open Detonation Activities (direction/speed)[1]

Time	Date of Detonation 16 Nov 1998
1300	vrb/7[2]
1330	136/6
1400	202/1
1430	**292/5**[3]
1500	**256/11**
1530	**261/14**
1600	**243/10**

[1] Wind direction is the direction from which the wind is blowing, wind direction is in degrees, wind speed is in knots.
[2] "vrb" represents variable wind direction.
[3] Data in bold type indicate hours during which open detonation events occurred.

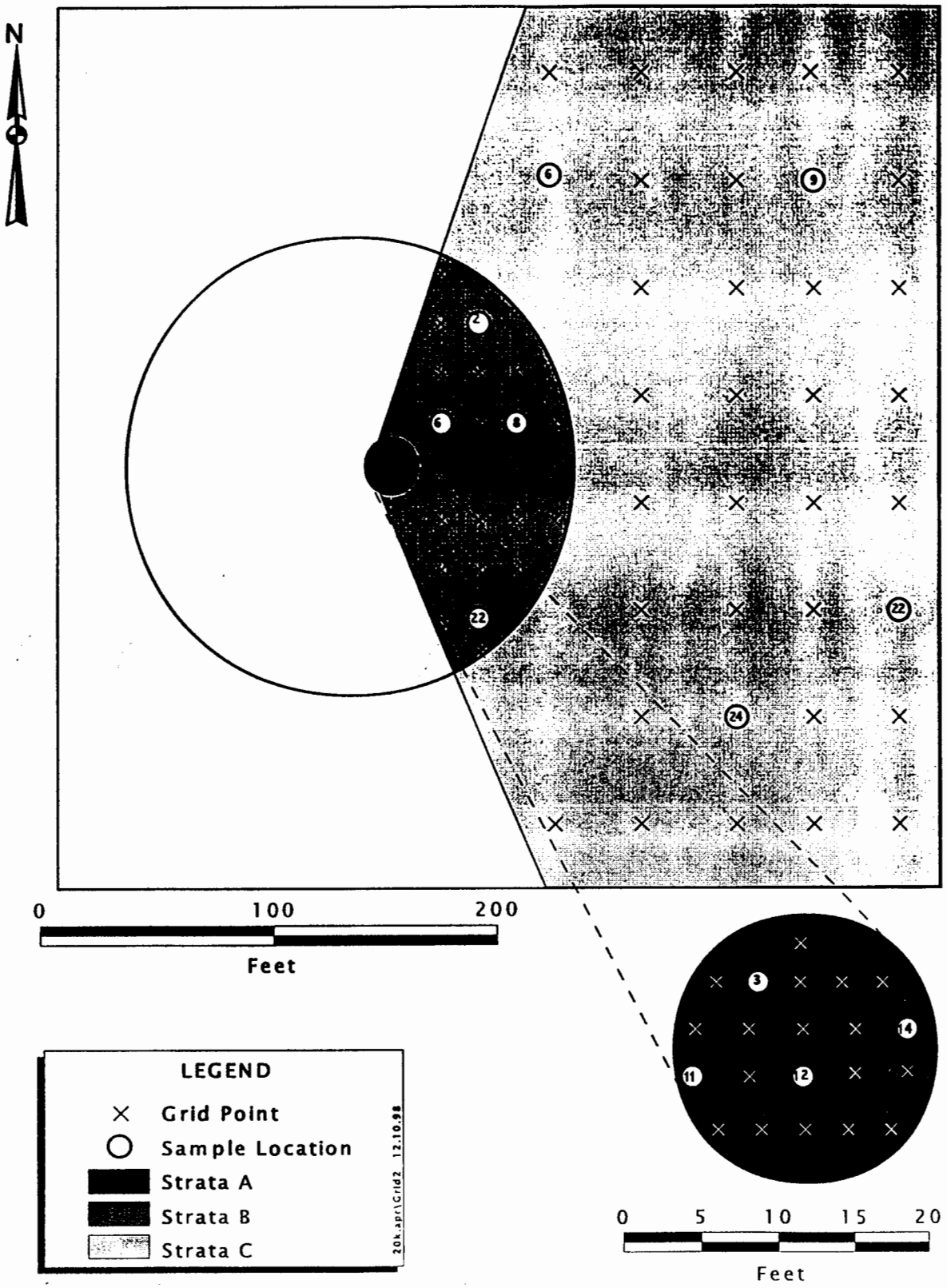

Figure 1-1. Grid Layout and Sample Locations

The data reported for this monitoring event were censored at different levels. The reported data for explosives analyses (SW-846 Methods 8330 and 8332) were censored at the sample detection limit. A "J" flag was assigned to concentrations that were less than the quantitation limit but greater than the detection limit.

The data reported for metals were uncensored results. Traditionally, analytical chemistry data have been censored at a concentration (e.g., method detection limit, practical quantitation limit). The reported metals results are uncensored; all instrument response measurements (including instrument responses that correspond to negative values) are reported as measured concentrations. A "J" flag was assigned to concentrations that were less than the sample-specific detection limit. Measurement variability increases, due to analytical system limitations, as measured concentrations approach (or go below) the detection limit. The "J" flag indicates that there is less confidence in the reported concentration (i.e., estimated quantitation).

2.2 Results Summary

Samples were collected and analyzed for several key analytical parameters as specified in the operating permit and outlined in Table 2-1. Complete analytical results are provided in Appendix A. This section provides a summary of these results and a comparison of the samples from the site to background values.

2.2.1 Organic Results

Only one organic constituent was detected at the site, 2,4-dinitrotoluene. 2,4-dinitrotoluene was detected in one sample within Strata B (Sample I.D. 03B). Because no background values exist for 2,4-dinitrotoluene, this was carried forward to the risk evaluation. The risk evaluation is described in Section 3.0 of this report.

2.2.2 Metals Results

Table 2-1 lists the metal constituents for which the samples were analyzed. These constituents were included in the analyses to determine if metal concentrations exceed naturally occurring concentrations. The analytical results were compared to the site-specific background upper tolerance limits (UTLs). A list of the background UTLs can be found in *Part II: Background Study* (December, 1997). The first quarter 1998 sampling results that exceeded background UTLs are flagged in Appendix A of this report and were carried forward to the risk calculation.

3.0 Evaluation of Potential Risk

Constituents that exceeded background UTLs were further evaluated to determine if the levels present at the site pose a potential risk to human health. Based on the risk assessment, none of the constituents exceeded the decision criteria specified in Attachment J of the operating permit. This section describes the methodology that was used for this evaluation, as well as the results of the comparison.

3.1 Methodology

The 20,000-Pound OD Unit is located in an isolated area of the HAFB. Access to the area is restricted to authorized explosive ordnance disposal (EOD) personnel working at the site during a detonation. The evaluation of potential risk was based upon a realistic, but conservative, exposure scenario for these personnel. Unauthorized entry to the site is prevented by security fences and continuous surveillance in addition to warning signs.

Table 2-1
Analytical Parameters and Methods

SW6010 Metals	SW8330 Explosives
Antimony	1,3,5-Trinitrobenzene
Arsenic	1,3-Dinitrobenzene
Barium	2,4,6-Trinitrotoluene
Beryllium	2,4-Dinitrotoluene
Cadmium	2,6-Dinitrotoluene
Chromium (total)	2-Nitrotoluene
Copper	3-Nitrotoluene
Lead	4-Nitrotoluene
Nickel	HMX
Selenium	Nitrobenzene
Silver	RDX
	TETRYL
SW7471 Mercury	**SW8332 Nitroamine Explosives**
Mercury	Nitroglycerin
	PETN

The exposure scenario for the risk evaluation of the 20,000-Pound OD Unit is based on the frequency of detonations, the amount of time spent at the 20,000-Pound OD Unit for each detonation, and the length of time that the same person would be assigned to this duty. It is assumed that a maximum of ten detonations would be conducted in one year. This is a conservative estimate as the actual number of detonations per year is approximately seven.

It is also assumed that EOD personnel are at the 20,000-Pound OD Unit for two days during each detonation. Typically, the site is inspected on the day after the detonation so personnel are at the site for two days per detonation. However, this is still a very conservative assumption as personnel are there for only a fraction of each day. Finally, the exposure scenario assumes that the same personnel attend every detonation for five years. Five years is a conservative estimate as military personnel are frequently reassigned to different units or duties and no civilian employees are employed at the EOD office. The exposure scenario is further defined in the Risk Evaluation Calculation Sheet in Appendix B.

All inorganic constituents that exceeded background UTLs were included in the evaluation to address the potential for cumulative effects. The maximum detected concentration for each constituent was used to calculate risk. This assumes that the personnel are exposed to this maximum concentration throughout the length of the exposure scenario described above. This is also a conservative assumption. Table 3-1 presents the constituents and their maximum detected concentrations.

3.2 Results of Risk Evaluation

Table 3-2 presents the calculated hazard index and cancer risk estimate for each of the constituents, as well as the cumulative hazard index. The risk range goal in the National Contingency Plan (NCP) is a hazard index less than 1.0 and a cancer risk estimate less than 1E-06. These are levels below which no adverse effects are anticipated. The levels calculated for the 20,000-Pound OD Unit are 2.17E-02 for the total hazard index and 1.81E-08 for the cancer risk estimate. These are well within the NCP goals indicating that no adverse effects are anticipated from exposure to the OD Unit.

4.0 Conclusions

Comparison of the third quarter 1998 monitoring data with the decision criteria indicates that treatment operations at the 20,000-Pound OD Unit are effective. It is recommended that monitoring continue for the next scheduled detonation event.

Table 3-1
Maximum Concentrations of Constituents Exceeding Background UTLs

Constituent	Maximum Detected Concentration (mg/kg)
Arsenic	2.41
Beryllium	0.663
Copper	10.4
Lead	8.54
Nickel	6.68

Notes:
mg/kg = milligrams per kilogram
UTL = Upper Tolerance Limit

Table 3-2
Site Specific Risk Evaluation

Constituent	Maximum Concentration (mg/kg)	Oral RfD (mg/kg/d)	Slope Factor (risk per mg/kg/d)	Hazard Quotient (mg/kg)	Cancer Risk
Arsenic	2.41	3.0E-04	1.50	3.14E-04	1.01E-08
Beryllium	0.663	5.0E-03	4.30	5.19E-06	7.97E-09
Copper	10.4	4.0E-02	NA	1.02E-05	NA
Lead	8.54	NA[a]	NA	2.14E-02[b]	NA
Nickel	6.68	2.00E-02	NA	1.31E-05	NA
2,4 Dinitrotoluene	6.40E-04	2.00E-03	NA	1.25E-08	NA
Total Hazard Quotient and Cancer Risk				**2.17E-02**	**1.81E-08**

[a] Lead does not have an oral RfD; however, the U.S. Environmental Protection Agency (EPA) has determined that a lead concentration of 400 parts per million (ppm) or less does not pose an unacceptable health risk.
[b] The hazard quotient for lead was calculated by dividing the maximum lead concentration by 400 ppm.

mg/kg = milligrams per kilogram
mg/kg/d = milligrams per kilogram per day
NA = Not Applicable

5.0 References

1. Radian International , 1997. *20,000-Pound Open Detonation Unit Background Study and Quarterly Monitoring Work Plan.*

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APPENDIX A
Analytical Results

Table A-1 Third Quarter Analytical Results
Inorganic Constituents

Sample ID	HOL20K-Q3-01A				HOL20K-Q3-01B				HOL20K-Q3-01C				HOL20K-Q3-02A			
Date and Time Sampled	18-SEP-98 @ 1538				18-SEP-98 @ 1442				18-SEP-98 @ 1420				18-SEP-98 @ 1542			
Sample Depth (ft)	0-1				0-2				0-0.3				0-1			
PARAMETER																
SW6010 – Metals (mg/kg)																
Antimony	-0.367	J	(0.361)	[1]	-0.217	J	(0.279)	[1]	0.662		(0.233)	[1]	0.292	J	(0.325)	[1]
Arsenic	0.680		(0.248)	[1]	0.667		(0.191)	[1]	2.30	*	(0.160)	[1]	0.860		(0.223)	[1]
Barium	31.7		(0.0275)	[1]	34.5		(0.0213)	[1]	65.7		(0.0178)	[1]	34.8		(0.0248)	[1]
Beryllium	0.317	B	(0.0153)	[1]	0.254	B	(0.0118)	[1]	0.576	*B	(0.00987)	[1]	0.297	B	(0.0138)	[1]
Cadmium	0.0479	B	(0.0306)	[1]	0.0402	B	(0.0236)	[1]	0.278		(0.0197)	[1]	0.222		(0.0275)	[1]
Chromium	3.18		(0.0540)	[1]	2.73		(0.0417)	[1]	8.53		(0.0349)	[1]	4.21		(0.0486)	[1]
Copper	3.24		(0.132)	[1]	2.59		(0.102)	[1]	7.84		(0.0856)	[1]	6.84		(0.119)	[1]
Lead	1.67		(0.204)	[1]	2.43		(0.158)	[1]	7.27		(0.132)	[1]	2.68		(0.183)	[1]
Nickel	1.84		(0.0825)	[1]	2.05		(0.0638)	[1]	6.04		(0.0533)	[1]	2.20		(0.0743)	[1]
Selenium	-0.213	J	(0.197)	[1]	0.126	J	(0.152)	[1]	-0.000658	J	(0.127)	[1]	0.0514	J	(0.177)	[1]
Silver	0.0947	B	(0.0367)	[1]	-0.0165	BJ	(0.0284)	[1]	-0.0118	BJ	(0.0237)	[1]	-0.0688	BJ	(0.0330)	[1]
SW7471 – Mercury (mg/kg)																
Mercury	-0.00359	J	(0.00512)	[1]	-0.00602	J	(0.00686)	[1]	0.0141		(0.00423)	[1]	-0.00192	J	(0.00548)	[1]

(Detection Limit) [Dilution Factor]

B – Indicates that concentration is within 5 times the method blank concentration

J – Indicates that concentration is less than the specified detection limit

* - Indicates that concentration is greater than site-specific Upper Tolerance Limit (UTL)

Table A-1 (Cont.) Third Quarter Analytical Results
Inorganic Constituents

Sample ID	HOL20K-Q3-02B				HOL20K-Q3-02C				HOL20K-Q3-03A				HOL20K-Q3-03B			
Date and Time Sampled	18-SEP-98 @ 1447				18-SEP-98 @ 1452				18-SEP-98 @ 1547				18-SEP-98 @ 1452			
Sample Depth (ft)	0-2				0-0.3				0-1				0-2			
PARAMETER																
SW6010 – Metals (mg/kg)																
Antimony	-0.111	J	(0.317)	[1]	0.134	J	(0.307)	[1]	0.753		(0.337)	[1]	-0.181	J	(0.368)	[1]
Arsenic	0.609		(0.218)	[1]	2.41	*	(0.211)	[1]	1.06		(0.231)	[1]	0.489		(0.252)	[1]
Barium	31.5		(0.0242)	[1]	71.5		(0.0234)	[1]	35.7		(0.0257)	[1]	28.1		(0.0280)	[1]
Beryllium	0.283	B	(0.0135)	[1]	0.663	*	(0.0130)	[1]	0.319	B	(0.0143)	[1]	0.287	B	(0.0156)	[1]
Cadmium	0.0359	B	(0.0269)	[1]	0.150		(0.0260)	[1]	0.105		(0.0258)	[1]	0.0395	B	(0.0311)	[1]
Chromium	2.83		(0.0475)	[1]	9.90		(0.0460)	[1]	3.24		(0.0504)	[1]	2.27		(0.0550)	[1]
Copper	3.30		(0.117)	[1]	8.06		(0.113)	[1]	5.17		(0.124)	[1]	2.35		(0.135)	[1]
Lead	1.14		(0.179)	[1]	6.74		(0.173)	[1]	1.43		(0.190)	[1]	0.726		(0.208)	[1]
Nickel	2.04		(0.0726)	[1]	6.68	*	(0.0702)	[1]	1.99		(0.0770)	[1]	1.86		(0.0841)	[1]
Selenium	-0.0771	J	(0.173)	[1]	-0.308	J	(0.167)	[1]	-0.000950	J	(0.184)	[1]	-0.281	J	(0.200)	[1]
Silver	-0.0942	BJ	(0.0323)	[1]	0.0434	B	(0.0312)	[1]	-0.131	BJ	(0.0342)	[1]	-0.163	BJ	(0.0374)	[1]
SW7471 – Mercury (mg/kg)																
Mercury	-0.00599	J	(0.00569)	[1]	0.0127		(0.00601)	[1]	-0.00464	J	(0.00529)	[1]	-0.00598	J	(0.00568)	[1]

(Detection Limit) [Dilution Factor]

B – Indicates that concentration is within 5 times the method blank concentration

J – Indicates that concentration is less than the specified detection limit

* - Indicates that concentration is greater than site-specific Upper Tolerance Limit (UTL)

Table A-1 (Cont.) Third Quarter Analytical Results
Inorganic Constituents

Sample ID	HOL20K-Q3-03C				HOL20K-Q3-04A				HOL20K-Q3-04A-11				HOL20K-Q3-04B			
Date and Time Sampled	18-SEP-98 @ 1429				18-SEP-98 @ 1550				18-SEP-98 @ 1550				18-SEP-98 @ 1457			
Sample Depth (ft)	0-0.3				0-1				0-0.3				0-2			
PARAMETER																
SW6010 – Metals (mg/kg)																
Antimony	0.312		(0.299)	[1]	0.135		(0.297)	[1]	-0.562	J	(0.363)	[1]	-0.165	J	(0.399)	[1]
Arsenic	2.11	*	(0.205)	[1]	1.57		(0.204)	[1]	0.479		(0.249)	[1]	0.993		(0.274)	[1]
Barium	72.4		(0.0228)	[1]	28.9		(0.0227)	[1]	29.2		(0.0277)	[1]	28.8		(0.0304)	[1]
Beryllium	0.585	*B	(0.0127)	[1]	0.306	B	(0.0126)	[1]	0.334	B	(0.0154)	[1]	0.418	B	(0.0169)	[1]
Cadmium	0.311		(0.0253)	[1]	0.141		(0.0252)	[1]	-0.00308	BJ	(0.0308)	[1]	0.111		(0.0338)	[1]
Chromium	9.37		(0.0448)	[1]	2.90		(0.0445)	[1]	2.35		(0.0543)	[1]	2.63		(0.0598)	[1]
Copper	10.4	*	(0.110)	[1]	3.50		(0.109)	[1]	2.80		(0.133)	[1]	1.90		(0.147)	[1]
Lead	8.54	*	(0.169)	[1]	1.42		(0.168)	[1]	0.749		(0.205)	[1]	0.466		(0.226)	[1]
Nickel	6.24		(0.0684)	[1]	2.13		(0.0680)	[1]	1.62		(0.0830)	[1]	2.00		(0.0913)	[1]
Selenium	-0.0879	J	(0.163)	[1]	0.0453	J	(0.162)	[1]	0.189	J	(0.198)	[1]	0.0214	J	(0.218)	[1]
Silver	0.106	B	(0.0304)	[1]	0.0638	B	(0.0302)	[1]	0.0625	B	(0.0369)	[1]	0.124	B	(0.0406)	[1]
SW7471 – Mercury (mg/kg)																
Mercury	0.00692		(0.00493)	[1]	-0.00458	J	(0.00653)	[1]	-0.00260	J	(0.00494)	[1]	-0.00659	J	(0.00752)	[1]

(Detection Limit) [Dilution Factor]

B – Indicates that concentration is within 5 times the method blank concentration

J – Indicates that concentration is less than the specified detection limit

* - Indicates that concentration is greater than site-specific Upper Tolerance Limit (UTL)

Table A-1 (Cont.) Third Quarter Analytical Results
Inorganic Constituents

Sample ID	HOL20K-Q3-04C			
Date and Time Sampled	18-SEP-98 @ 1433			
Sample Depth (ft)	0-0.3			
PARAMETER				
SW6010 – Metals (mg/kg)				
Antimony	0.0574	J	(0.290)	[1]
Arsenic	1.12	*	(0.199)	[1]
Barium	48.2		(0.0221)	[1]
Beryllium	0.390	B	(0.0123)	[1]
Cadmium	0.177		(0.0246)	[1]
Chromium	5.64		(0.0435)	[1]
Copper	5.16		(0.107)	[1]
Lead	5.05		(0.164)	[1]
Nickel	3.67		(0.0664)	[1]
Selenium	-0.240	J	(0.158)	[1]
Silver	0.0148	BJ	(0.0295)	[1]
SW7471 – Mercury (mg/kg)				
Mercury	0.00175	J	(0.00499)	[1]

(Detection Limit) [Dilution Factor]
B – Indicates that concentration is within 5 times the method blank concentration
J – Indicates that concentration is less than the specified detection limit
* - Indicates that concentration is greater than site-specific Upper Tolerance Limit (UTL)

Table A-2 Third Quarter Analytical Results
Organic Constituents

Sample ID	HOL20K-Q3-01A			HOL20K-Q3-01B			HOL20K-Q3-01C			HOL20K-Q3-02A		
Date and Time Sampled	18-SEP-98 @ 1538			18-SEP-98 @ 1442			18-SEP-98 @ 1420			18-SEP-98 @ 1542		
Sample Depth (ft)	0-1			0-2			0-0.3			0-1		
PARAMETER												
Percent moisture	22.7	( )	[1]	18.6	( )	[1]	10.1	( )	[1]	17.4	( )	[1]
SW8330 – Explosives (µg/g)												
1,3,5-Trinitrobenzene	ND	(0.0970)	[1]	ND	(0.0970)	[1]	ND	(0.0970)	[1]	ND	(0.0970)	[1]
1,3-Dinitrobenzene	ND	(0.0626)	[1]	ND	(0.0626)	[1]	ND	(0.0626)	[1]	ND	(0.0626)	[1]
2,4,6-Trinitrotoluene	ND	(0.133)	[1]	ND	(0.133)	[1]	ND	(0.133)	[1]	ND	(0.133)	[1]
2,4-Dinitrotoluene	ND	(0.0721)	[1]	ND	(0.0721)	[1]	ND	(0.0721)	[1]	ND	(0.0721)	[1]
2,6-Dinitrotoluene	ND	(0.130)	[1]	ND	(0.130)	[1]	ND	(0.130)	[1]	ND	(0.130)	[1]
2-Nitrotoluene	ND	(0.209)	[1]	ND	(0.209)	[1]	ND	(0.209)	[1]	ND	(0.209)	[1]
3-Nitrotoluene	ND	(0.253)	[1]	ND	(0.253)	[1]	ND	(0.253)	[1]	ND	(0.253)	[1]
4-Nitrotoluene	ND	(0.191)	[1]	ND	(0.191)	[1]	ND	(0.191)	[1]	ND	(0.191)	[1]
HMX	ND	(0.0830)	[1]	ND	(0.0830)	[1]	ND	(0.0830)	[1]	ND	(0.0830)	[1]
Nitrobenzene	ND	(0.0584)	[1]	ND	(0.0584)	[1]	ND	(0.0584)	[1]	ND	(0.0584)	[1]
RDX	ND	(0.133)	[1]	ND	(0.133)	[1]	ND	(0.133)	[1]	ND	(0.133)	[1]
TETRYL	ND	(0.145)	[1]	ND	(0.145)	[1]	ND	(0.145)	[1]	ND	(0.145)	[1]
SW8332 – Nitroamine Explosives (µg/g)												
Nitroglycerin	ND	(0.0293)	[1]	ND	(0.0293)	[1]	ND	(0.0293)	[1]	ND	(0.0293)	[1]
PETN	ND	(0.0232)	[1]	ND	(0.0232)	[1]	ND	(0.0232)	[1]	ND	(0.0232)	[1]

(Detection Limit) [Dilution Factor]
B – Indicates that concentration is within 5 times the method blank concentration
J – Indicates that concentration is less than the specified detection limit
* - Indicates that concentration is greater than site-specific Upper Tolerance Limit (UTL)

Table A-2 (Cont.) Third Quarter Analytical Results
Organic Constituents

Sample ID	HOL20K-Q3-02B			HOL20K-Q3-02C			HOL20K-Q3-03A			HOL20K-Q3-03B		
Date and Time Sampled	18-SEP-98 @ 1447			18-SEP-98 @ 1452			18-SEP-98 @ 1547			18-SEP-98 @ 1452		
Sample Depth (ft)	0-2			0-0.3			0-1			0-2		
PARAMETER												
Percent moisture	19.2	( )	[1]	10.6	( )	[1]	14.5	( )	[1]	20.4	( )	[1]
SW8330 – Explosives (µg/g)												
1,3,5-Trinitrobenzene	ND	(0.0970)	[1]	ND	(0.0970)	[1]	ND	(0.0970)	[1]	ND	(0.0970)	[1]
1,3-Dinitrobenzene	ND	(0.0626)	[1]	ND	(0.0626)	[1]	ND	(0.0626)	[1]	ND	(0.0626)	[1]
2,4,6-Trinitrotoluene	ND	(0.133)	[1]	ND	(0.133)	[1]	ND	(0.133)	[1]	ND	(0.133)	[1]
2,4-Dinitrotoluene	ND	(0.0721)	[1]	ND	(0.0721)	[1]	ND	(0.0721)	[1]	0.610	(0.0721)	[1]
2,6-Dinitrotoluene	ND	(0.130)	[1]	ND	(0.130)	[1]	ND	(0.130)	[1]	ND	(0.130)	[1]
2-Nitrotoluene	ND	(0.209)	[1]	ND	(0.209)	[1]	ND	(0.209)	[1]	ND	(0.209)	[1]
3-Nitrotoluene	ND	(0.253)	[1]	ND	(0.253)	[1]	ND	(0.253)	[1]	ND	(0.253)	[1]
4-Nitrotoluene	ND	(0.191)	[1]	ND	(0.191)	[1]	ND	(0.191)	[1]	ND	(0.191)	[1]
HMX	ND	(0.0830)	[1]	ND	(0.0830)	[1]	ND	(0.0830)	[1]	ND	(0.0830)	[1]
Nitrobenzene	ND	(0.0584)	[1]	ND	(0.0584)	[1]	ND	(0.0584)	[1]	ND	(0.0584)	[1]
RDX	ND	(0.133)	[1]	ND	(0.133)	[1]	ND	(0.133)	[1]	ND	(0.133)	[1]
TETRYL	ND	(0.145)	[1]	ND	(0.145)	[1]	ND	(0.145)	[1]	ND	(0.145)	[1]
SW8332 – Nitroamine Explosives (µg/g)												
Nitroglycerin	ND	(0.0293)	[1]	ND	(0.0293)	[1]	ND	(0.0293)	[1]	ND	(0.0293)	[1]
PETN	ND	(0.0232)	[1]	ND	(0.0232)	[1]	ND	(0.0232)	[1]	ND	(0.0232)	[1]

(Detection Limit) [Dilution Factor]
B – Indicates that concentration is within 5 times the method blank concentration
J – Indicates that concentration is less than the specified detection limit
* - Indicates that concentration is greater than site-specific Upper Tolerance Limit (UTL)

Table A-2 (Cont.) Third Quarter Analytical Results
Organic Constituents

Sample ID	HOL20K-Q3-03C			HOL20K-Q3-04A			HOL20K-Q3-04A-11			HOL20K-Q3-04B		
Date and Time Sampled	18-SEP-98 @ 1429			18-SEP-98 @ 1550			18-SEP-98 @ 1550			18-SEP-98 @ 1457		
Sample Depth (ft)	0-0.3			0-1			0-0.3			0-2		
PARAMETER												
Percent moisture	9.65	( )	[1]	22.1	( )	[1]	18.7	( )	[1]	32.3	( )	[1]
SW8330 – Explosives (µg/g)												
1,3,5-Trinitrobenzene	ND	(0.0970)	[1]	ND	(0.0970)	[1]	ND	(0.0970)	[1]	ND	(0.0970)	[1]
1,3-Dinitrobenzene	ND	(0.0626)	[1]	ND	(0.0626)	[1]	ND	(0.0626)	[1]	ND	(0.0626)	[1]
2,4,6-Trinitrotoluene	ND	(0.133)	[1]	ND	(0.133)	[1]	ND	(0.133)	[1]	ND	(0.133)	[1]
2,4-Dinitrotoluene	ND	(0.0721)	[1]	ND	(0.0721)	[1]	ND	(0.0721)	[1]	ND	(0.0721)	[1]
2,6-Dinitrotoluene	ND	(0.130)	[1]	ND	(0.130)	[1]	ND	(0.130)	[1]	ND	(0.130)	[1]
2-Nitrotoluene	ND	(0.209)	[1]	ND	(0.209)	[1]	ND	(0.209)	[1]	ND	(0.209)	[1]
3-Nitrotoluene	ND	(0.253)	[1]	ND	(0.253)	[1]	ND	(0.253)	[1]	ND	(0.253)	[1]
4-Nitrotoluene	ND	(0.191)	[1]	ND	(0.191)	[1]	ND	(0.191)	[1]	ND	(0.191)	[1]
HMX	ND	(0.0830)	[1]	ND	(0.0830)	[1]	ND	(0.0830)	[1]	ND	(0.0830)	[1]
Nitrobenzene	ND	(0.0584)	[1]	ND	(0.0584)	[1]	ND	(0.0584)	[1]	ND	(0.0584)	[1]
RDX	ND	(0.133)	[1]	ND	(0.133)	[1]	ND	(0.133)	[1]	ND	(0.133)	[1]
TETRYL	ND	(0.145)	[1]	ND	(0.145)	[1]	ND	(0.145)	[1]	ND	(0.145)	[1]
SW8332 – Nitroamine Explosives (µg/g)												
Nitroglycerin	ND	(0.0293)	[1]	ND	(0.0293)	[1]	ND	(0.0293)	[1]	ND	(0.0293)	[1]
PETN	ND	(0.0232)	[1]	ND	(0.0232)	[1]	ND	(0.0232)	[1]	ND	(0.0232)	[1]

(Detection Limit) [Dilution Factor]
B – Indicates that concentration is within 5 times the method blank concentration
J – Indicates that concentration is less than the specified detection limit
* - Indicates that concentration is greater than site-specific Upper Tolerance Limit (UTL)

Table A-2 (Cont.) Third Quarter Analytical Results
Organic Constituents

Sample ID	HOL20K-Q3-04C		
Date and Time Sampled	18-SEP-98 @ 1433		
Sample Depth (ft)	0-0.3		
PARAMETER			
Percent moisture	13.5	( )	[1]
SW8330 – Explosives (µg/g)			
1,3,5-Trinitrobenzene	ND	(0.0970)	[1]
1,3-Dinitrobenzene	ND	(0.0626)	[1]
2,4,6-Trinitrotoluene	ND	(0.133)	[1]
2,4-Dinitrotoluene	ND	(0.0721)	[1]
2,6-Dinitrotoluene	ND	(0.130)	[1]
2-Nitrotoluene	ND	(0.209)	[1]
3-Nitrotoluene	ND	(0.253)	[1]
4-Nitrotoluene	ND	(0.191)	[1]
HMX	ND	(0.0830)	[1]
Nitrobenzene	ND	(0.0584)	[1]
RDX	ND	(0.133)	[1]
TETRYL	ND	(0.145)	[1]
SW8332 – Nitroamine Explosives (µg/g)			
Nitroglycerin	ND	(0.0293)	[1]
PETN	ND	(0.0232)	[1]

(Detection Limit) [Dilution Factor]
B – Indicates that concentration is within 5 times the method blank concentration
J – Indicates that concentration is less than the specified detection limit
* - Indicates that concentration is greater than site-specific Upper Tolerance Limit (UTL)

APPENDIX B
Risk Evaluation Calculation Sheet

RADIAN INTERNATIONAL LLC

CALCULATION SHEET

PROJECT NUMBER	DATE	PROJECT
630258	12-1-98	20,000-Pound OD Unit

EOD Exposure Scenario

Noncarcinogenic

$$HQ\frac{mg}{kg} = \frac{C \cdot EF \cdot ED \cdot \frac{IRS_a}{10^6} \cdot FC}{RfD_o \cdot BW_a \cdot AT}$$

Carcinogenic

$$CR = \frac{C \cdot EF \cdot ED \cdot \frac{IRS_a}{10^6} \cdot FC \cdot CPS_o}{BW_a \cdot AT_c}$$

Exposure Variables	Value	Symbol
Hazard quotient	Calculated	*HQ*
Cancer risk	Calculated	*TR*
Constituent concentration (mg/kg)	Analyte-Specific	*C*
Reference dose oral (mg/kg/d)	Analyte Specific	RfD_o
Slope factor (risk/mg/kg/d)	Analyte Specific	CPS_o
Body weight, adult (kg)	70	BW_a
Averaging time noncarcinogens (d)	ED x 365	*AT*
Averaging time carcinogens (d)	25550	AT_c
Exposure frequency (d/y)	20	*EF*
Exposure duration, total (y)	5	*ED*
Ingestion rate of soil, adult (mg/d)	100	IRS_a
Fraction of soil ingested from contaminated area (unitless)	0.5	FC

APPENDIX C
Chain-of-Custody Forms

9809485-487

RADIAN INTERNATIONAL LLC

Chain of Custody Record

PROJECT: Holloman 20k-Pound

SITE: OD Unit - 3rd Quarter

PREPARED BY (Signature): Gregory W. Woods

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	MS/MSD	NO. OF CONTAINERS	SW 6010 A	SW 7471 A	D 2216	REMARKS
HOL20K-03-01A	Soil	9/18/98 1538		1	X	X	X	
" 02A		1542		1				
" 03A		1547		1				
" 04A		1550		1				
" 01B		1442		1				
" 02B		1447		1				
" 03B		1452		1				
" 04B		1457		1				
" 01C		1420		1				
" 02C		1424		1				

REMARKS: Placed in cooler w/ ice prior to shipment

RELINQUISHED BY:	DATE	TIME
Gregory W. Woods	9/21/98	1700

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP °C	SEAL #	CONDITION
M. Gordon	9/22/98	1030							

REMARKS: ADD# 98-1763

IEG-AI/FH3-96-30337coc.FH5

7804485-487

RADIAN INTERNATIONAL LLC

Chain of Custody Record

PROJECT: Holloman 20k Pond

SITE: OD Unit - 3rd Quarter

PREPARED BY (Signature): [signature]

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	MS/MSD	NO. OF CONTAINERS	SW6010A	SW7471A	D2216									REMARKS
HOL20K-Q3-03C	Soil	9/18/98 1429		1	X	X										
" 04C		1433		1												
" 04A-11		1550		1												
" 04A-21	EB	1605		1												HNO_3 Preserved

ANALYSES

REMARKS

RELINQUISHED BY:	DATE	TIME
[signature]	9/21	1700

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION
M. Gordon	9/22/98	1030							

REMARKS: ADD#98-1763

IEG-AIFH10-96-30337coc.FH5

RADIAN INTERNATIONAL LLC

Chain of Custody Record

PROJECT: Holcomb 20K - Pond

SITE: CD Unit - Quarter 3

PREPARED BY (Signature): [illegible]

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	MS/MSD	NO. OF CONTAINERS	SW8330	SW8330	ANALYSES									REMARKS
HOL 20K - 03 - 01A	Soil	9/18/98		1	X	X										
" 01A				1												
" 03A				1												
" 04A				1												
" 01B				1												
" 02B				1												
" 03B				1												
" 04B				1												
" 01C				1												
" 02C				1												

REMARKS: Placed in cooler w/ ice prior to shipment

RELINQUISHED BY:	DATE	TIME
[illegible]		

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP °C	SEAL #	CONDITION

REMARKS:

EQ-AFRL-98-3337/Doc RH-1

RADIAN INTERNATIONAL LLC

Chain of Custody Record

PROJECT: Holloman PCK - Pond

SITE: OD Unit - Quarter 3

PREPARED BY (Signature): [illegible]

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	MS/MSD	NO. OF CONTAINERS	ANALYSES											REMARKS
HOLPCK-03-03C																
" 04C																
" 04A-11																
" 04A-21																

REMARKS

RELINQUISHED BY:	DATE	TIME
[illegible]	[illegible]	7:00

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP °C	SEAL #	CONDITION

REMARKS:

IEG-AFR1.4-8-30537/coc.FH5

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Headquarters, Air Combat Command
Langley Air Force Base,
Virginia

Final

Third Quarter 1998 Monitoring Report

Quality Assurance/Quality Control Results
20,000-Pound Open Detonation Unit

February 1999

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49 CES/CEV
Holloman Air Force Base,
New Mexico

Third Quarter 1998 Monitoring Report
Quality Assurance/Quality Control Results
20,000-Pound Open Detonation Unit

Final

Prepared for:

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February 1999

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List of Acronyms

AS	Analytical spike
EPA	Environmental Protection Agency
ICPES	Inductively Couples Plasma Emission Spectroscopy
LCS	Laboratory control samples
MS	Matrix spiked
MSD	Matrix spike duplicate
ND	Not distinguishable
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative percent difference

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EXECUTIVE SUMMARY

A Radian Quality Assurance (QA) specialist reviewed the quality control (QC) data for the analytical measurement data. This review was performed to determine the usability and defensibility of the third quarter chemical measurement data for the Holloman 20,000 OD Unit. The review focused on field and laboratory blanks, matrix spikes, surrogate recoveries, and laboratory control samples. Overall, QC data associated with this program indicate that measurement data are acceptable and defensible. The data indicate that the QC mechanisms were effective in ensuring measurement data reliability within the expected limits of sampling and analytical error.

There were some minor concerns identified during QA/QC review that should be noted prior to final interpretation of the analytical results. The concern with the greatest potential impact on the project was blank contamination with low-level metals. The laboratory "B" flag indicates that the analyte was detected in the method blank; however, the relevancy of the method blank concentration was not related to the normal sample results. The "B" flag was reassigned by the QA Specialist to indicate that the sample analyte concentration was within five times the batch associated method blank concentration. These reassigned "B" flagged analytical results are not distinguishable from the blank result and should be considered "ND". All of the copper and silver results in the data set received a "B" flag. Some of the low-level cadmium and beryllium results received "B" flags; however, higher levels were distinguishable from blanks. The "B" flags were removed from all normal sample barium results, since these results were significantly different than the blank values.

Finally, the data user should note that the data reported for this investigation were censored at different levels for reporting. The analytical data for explosives (SW-846 Methods 8330 and 8332) were censored at the sample detection limit. A "J" flag was assigned to concentrations that were less than the quantitation limit but greater than the detection limit.

The data reported for metals were uncensored results. Traditionally, analytical chemistry data have been censored at a concentration (e.g., method detection limit, practical quantitation limit). However, the metals data contained in the analytical reports were not censored. Consequently, low levels (greater than zero but less than sample-specific detection limit) of analytes are reported. A "J" flag was assigned to concentrations that were less than the sample-specific detection limit. The QA/QC review for each method is summarized in this report.

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1.0 SUMMARY OF QA/QC ACTIVITIES

This section presents any potential limitations in the use of the data.

Overall, QA/QC data associated with this program indicate that the measurement data are acceptable and defensible for the Holloman 20,000-pound OD Unit. The QA/QC data indicate the QC mechanisms were effective in ensuring measurement data reliability within the expected limits of sampling and analytical error.

QC data provide information for identifying and defining both qualitative limitations and quantitative bias associated with measurement data. The following key types of QC analysis provide the primary basis for quantitatively evaluating data quality:

- Field and laboratory blank samples;
- Duplicate field samples;
- Matrix and surrogate spiked samples; and
- Laboratory control samples.

1.1 Blank Samples

Blanks are laboratory pure matrices designed to detect the introduction of contamination or other artifacts into the sampling and analytical process. This is an especially important role in measurement programs involving trace-level analyses. Results are presented in the following sections for the analysis of laboratory, equipment rinsate, and trip blanks.

1.1.1 Laboratory Blanks

Laboratory blanks pertain only to the analytical process and are included with each batch of samples analyzed. The laboratory blanks provide an ongoing check of the analytical process for systemic sample contamination. Laboratory method (reagent) blanks are processed through the entire preparation and analytical measurement techniques, in the same manner as the native field samples, and provide an indication of systemic contamination whose root cause may be in the laboratory preparation or measurement systems. Laboratory system blanks are processed only through the analytical measurement systems and provide data to assess potential systemic contamination of the measurement system. When contamination is indicated by blank values above pre-established levels, corrective action is initiated to identify and eliminate the source of contamination. If possible, the affected samples are reanalyzed.

1.1.2 Equipment Blanks

An equipment, or rinsate, blank is an aliquot of analyte-free (i.e., Type II or organic-free) water that is poured over or through the sampling equipment, collected in a sample container, and returned to the laboratory as a sample. Equipment blanks are used to demonstrate whether a nondedicated sampling device has been adequately decontaminated. Equipment blank results reflect the combined effects of sample collection, handling, transportation, storage, and analysis.

1.1.3 Trip Blanks

Trip blanks were not analyzed for this project, since trip blanks accompany samples for volatile organic analyses only.

1.2 Duplicate Field Samples

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate sample results are used to assess precision, including variability associated with both samples, the laboratory analysis, the sample collection process and

sample homogeneity. Sample homogeneity is a major factor in the reproducibility of duplicate field sample results. For example, in soil samples it may be difficult to create a homogeneous sample mixture if the soil is moist or clayey. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. Duplicate water and soil samples were collected and submitted blind to the laboratory at a frequency of 10% for this program.

1.3 Matrix and Surrogate Spikes

Matrix spiked (MS) samples and surrogate spiked samples are part of the QC protocol for the analysis of organic compounds. The QC protocol for the metals analyses includes matrix spikes; however, surrogate spikes are not performed.

MS samples are field samples to which known amounts of the analytes of interest have been added. Both a spiked and an unspiked aliquot are analyzed. The difference between the two aliquots is calculated and compared with the amount of spike added before the extraction or digestion process. Since actual samples are used for the recovery determination, any matrix effects are taken into consideration. Usually expressed as a percentage of the spiked amount, spike recovery can be considered as a measure of the measurement accuracy in the actual sample matrix. For a single sample, this includes the combined effects of bias, or systematic error, and the measurement variability due to imprecision, and thus reflects overall uncertainty in the measurement results.

Surrogate spike samples are similar to MS samples except that an unspiked aliquot is not analyzed. Instead, all samples are spiked with one or more of the surrogate compounds that are chemically similar to the analytes of interest but not expected to be present in the actual field samples. Recovery of these surrogate compounds gives an estimate of the effectiveness of the extraction and analysis for a single sample.

1.4 Laboratory Control Samples

Laboratory control samples (LCSs) are used to assess analytical performance and must be in control for all standard conditions. These are synthetic samples containing some or all of the analytes of interest at known concentrations and prepared independently from calibration standards. LCSs are always analyzed with each analytical batch. LCSs may be used to estimate analytical bias and accuracy by comparing measured results with theoretical concentrations. The estimate of bias would be included if the LCS compounds exhibited high or low recoveries. Although LCSs do not address matrix effects as spiked field samples do, they allow batch-to-batch variability to be considered and are useful in identifying trends.

2.0 MAXIMUM HOLDING TIMES

Maximum holding times are established for each method to prevent possible change in concentration of the compounds of interest over time. Compounds of interest may be lost because of biological degradation or volatilization or degradation due to light and/or heat. The organic analyses are particularly susceptible to these types of losses. Adherence to holding time requirements is reviewed while analytical measurement data are qualitatively evaluated. The hold time requirements for this program are in accordance with the Quality Assurance Project Plan (QAPP) and U.S. Environmental Protection Agency (EPA) guidance.

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3.0 QUALITY CONTROL RESULTS FOR SOIL SAMPLE ANALYSES

QC procedures and activities implemented during this program provide a basis for estimating measurement precision and accuracy. QC procedures associated with investigative soil samples included the analysis of laboratory and field blanks, matrix and surrogate spikes, and LCSs. Results of these analyses are discussed in this section.

3.1 SW-846 Method 8330 Explosives

All sample preparation and analyses were performed within the EPA- and project QAPP specified maximum holding time requirements.

Method Blank Results

The method blank results did not have any explosive compounds reported at or above the stated detection limits. The results of these analyses indicate that no significant contamination occurred from handling, preparation, or analyses in the laboratory. A summary of the blanks analyzed with the field samples is provided in Table 3-1.

Equipment Blank Results

The equipment blank analyzed (Table 3-1) did not have target analytes reported at or above the stated detection limits. Consequently, these analyses indicate that the decontamination process in the field was adequate and did not artificially introduce contaminants to the field samples.

Surrogate Recoveries

Surrogate (3,4-dinitrotoluene) recoveries for the field samples were within the laboratory control limits of 11%-152%. The surrogate recoveries for the field samples, equipment blanks, and batch QC samples are listed in Table 3-2. Overall, the surrogate recoveries indicate the analytical systems were in control at the time of sample analysis.

Matrix Spike Results

The percent recovery for all of the spike compounds was acceptable for both the MS and matrix spike duplicate (MSD) samples, except for one MSD recovery. The compound 1,3,5-trinitrobenzene was recovered above the upper control limit in the MSD sample. Additionally, the relative percent difference (RPD) for 1,3,5-trinitrobenzene was high, due to the MSD recovery. The RPD for the MS/MSD pair demonstrated acceptable method precision. The percent recoveries and RPD for the MS and MSD sample are summarized in Table 3-3.

Laboratory Control Sample Results

The percent recoveries (Table 3-4) for the LCS and LCS duplicate (LCSD) samples were within the laboratory control limits; consequently, the data are acceptable. A review of these data indicates both acceptable method accuracy and no significant bias because of improper calibration of the analytical systems.

Field Duplicate Analysis

One field sample was collected in duplicate and submitted to the laboratory for analysis. There were no target analytes detected at or above the sample detection limits. Consequently, overall sample and analytical precision cannot be estimated from these data. The duplicate pair results are summarized in Table 3-5.

3.2 SW-846 Method 8332 PETN and NG

All sample analyses were performed within the maximum holding time requirement as specified by the EPA and the project QAPP.

Method Blank Sample Results

The method blanks did not have any

target compounds reported as present at or above the stated detection limits. The results of these analyses indicate that no significant contaminant contribution from handling, preparation, or analyses occurred in the laboratory. A summary of the blanks analyzed with the field samples is provided in Table 3-6.

Equipment Blank Results

The equipment blank analyzed (Table 3-6) did not have target analytes reported as present at or above the stated detection limits. Consequently, these analyses indicate that the cleaning process in the field was adequate and did not artificially introduce contaminants to the field samples.

Surrogate Recoveries

Surrogate (1-nitronaphthalene) recoveries for the field samples were within the laboratory control limits of 70%-130%. Surrogate recoveries for the field samples, equipment blanks, and batch QC samples are listed in Table 3-7. Overall, surrogate spike recoveries indicate the analytical systems were in control at the time of sample analysis.

Matrix Spike Results

The percent recovery for all of the spike compounds was acceptable for both the MS and MSD recoveries for the sample. The RPD for the MS/MSD pair demonstrated excellent method precision. The percent recoveries and RPD for the MS and MSD sample are summarized in Table 3-8.

Laboratory Control Sample Results

The percent recoveries (Table 3-9) for the LCS and LCS duplicate samples were within the laboratory control limits; consequently, the data are acceptable. A review of these data indicates both acceptable method accuracy and no significant bias because of improper calibration of the analytical systems.

Field Duplicate Analysis

One field sample was collected in duplicate and submitted to the laboratory for analysis. There were no target analytes detected at or above the sample detection limits. Consequently, overall sample and analytical precision cannot be estimated from these data. The duplicate pair results are summarized in Table 3-10.

3.3 SW-846 Method 6010A ICPES Metals

Soil samples were collected and analyzed for antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, nickel, selenium, and silver by SW-846 Method 6010A using trace inductively coupled plasma emission spectroscopy (ICPES) technology. All sample preparation and analyses were performed within the maximum holding time requirements specified by the EPA and the project QAPP.

Method Blank Results

The measurement values are within the QAPP criteria; consequently, the method blank results were acceptable. Overall, the results (Table 3-11) of these analyses indicate that no significant contaminant contribution from handling, preparation, or analyses occurred in the laboratory. The laboratory "B" flag indicated that the analyte was detected in the method blank; however, the relevancy of the method blank concentration was not related to the normal sample results by the laboratory. The "B" flag was reassigned by the QC Specialist to indicate that the analyte was detected in the batch associated method blank at a concentration within five times of the sample concentration.

Equipment Blank Results

The equipment sample results indicate the cleaning process in the field was adequate and did not artificially introduce contaminants to the field samples. The target analytes reported were

less than the stated detection limits, similar to the method blank analytical measurement results or less than the QAPP quantitation limits (see Table 3-11).

Matrix Spike Results

The sample selected for matrix spike analysis had high MSD recoveries for chromium and copper. The associated MS recovery, analytical spike (AS) and LCS/LCSD recoveries were in control for chromium and copper. Consequently, the MSD results reflect matrix heterogeneity rather than more variability in the measurement process than expected, the data are acceptable. The RPD values were in control, except for chromium and copper where one spike recovery was outside the control limits. The RPD for all analytes were in control for the associated LCS/LCSD pair; consequently, the data are acceptable. The MS and MSD recoveries and calculated RPD values are summarized in Table 3-12.

Laboratory Control Sample Results

All of the target analytes were recovered within the laboratory control limits for the solid LCS and LCSD samples. All the RPD for the LCS/LCSD samples were within the laboratory control limits. The LCS/LCSD recoveries and RPD values are summarized in Table 3-13. A review of these data indicates both acceptable method accuracy and no significant bias because of improper calibration of the analytical systems.

Field Duplicate Analysis

One field sample was collected in duplicate and submitted to the laboratory for ICPES metal analysis. There were several results less than the detection limit, which cannot be reliably used to estimate overall precision. The results for barium, chromium, copper, nickel, and silver indicate acceptable precision of the field collection and analytical measurement systems. The duplicate pair results and RPD are summarized in Table 3-14.

3.4 SW-846 Method 7471A Mercury

Samples were collected and analyzed for mercury by SW-846 Method 7471A. All sample preparation and analyses were performed within the maximum holding time requirements specified by the EPA and the project QAPP.

Method Blank Results

Mercury was not detected in any of the method blanks at levels above the QAPP reporting limits or sample-specific detection limits. The individual measurement results for the method blanks are summarized in Table 3-15.

Equipment Blank Results

The mercury concentrations reported (Table 3-15) were less than the stated detection limits, similar to the method blank analytical measurement results or less than the QAPP acceptance limits. Consequently, these analyses indicate the cleaning process in the field was adequate and did not artificially introduce mercury contamination to the field samples.

Matrix Spike Results

The reported recoveries were within laboratory control limits for both the MS and MSD results. These MS/MSD results demonstrate acceptable method precision. The MS and MSD recoveries and calculated RPD values are summarized in Table 3-16.

Laboratory Control Sample Results

Mercury was recovered within the laboratory control limits for the LCS and LCSD samples. All the RPD values for the LCS and LCSD samples were within the laboratory control limits. A review of these data (see Table 3-17) indicates both acceptable method accuracy and no significant bias because of improper calibration of the analytical systems.

Field Duplicate Analysis

The absolute differences between the normal and field duplicate results indicate acceptable precision of the field collection and analytical measurement systems. The duplicate pair results and RPD are summarized in Table 3-18.

Table 3-1
Summary of SW-846 Method 8330 Blank Results

Analytical Batch	Sample Identification[a]	Analyte	Concentration	Detection Limit	Units
G988W030	BL-151794-1	None Detected	--	--	µg/L
G9893004	HOL20K-Q3-04A-21	None Detected	--	--	µg/g

[a] Method blanks have the "BL-" prefix to the sample identification. Equipment Blanks have the "-21" suffix to the sample identification.

Table 3-2
Summary of SW-846 8330 Surrogate Spike Recoveries

Analytical Batch	Sample	3,4-Dinitrotoluene (11-152%)	Accuracy Acceptable?
G988W030	BL-151794-1	90	yes
	QC-151794-1	84	yes
	HOL20K-Q3-02B	90	yes
	HOL20K-Q3-03B	94	yes
	HOL20K-Q3-04B	98	yes
	HOL20K-Q3-01C	92	yes
	HOL20K-Q3-02C	90	yes
	HOL20K-Q3-03C	86	yes
	HOL20K-Q3-04C	90	yes
	HOL20K-Q3-04A-11	90	yes
	QD-151794-1	82	yes
	HOL20K-Q3-01A	82	yes
	HOL20K-Q3-01A	82	yes
	HOL20K-Q3-01A	92	yes
	HOL20K-Q3-02A	90	yes
	HOL20K-Q3-03A	88	yes
	HOL20K-Q3-04A	92	yes
	HOL20K-Q3-01B	92	yes
	HOL20K-Q3-04A-21	85	yes

Table 3-3
Summary of SW-846 8330 Matrix Spike and Matrix Spike Duplicate Results

Sample	Analyte	Accuracy Objective (% Rec[a])	MS (% Rec)	MSD (% Rec)	Accuracy Acceptable	Precision Objective (RPD[b])	RPD	Precision Acceptable
HOL20K-Q3-01A	1,3,5-Trinitrobenzene	71.8-126	99.5	140	yes	7.2	34.1	no
	1,3-Dinitrobenzene	78.2-134	96.6	96.9	yes	6.7	0.3	yes
	2,4,6-Trinitrotoluene	75.1-124	95.5	95.1	yes	8.3	0.4	yes
	2,4-Dinitrotoluene	68.6-126	112	111	yes	8.3	0.9	yes
	2,6-Dinitrotoluene	77.9-127	89.7	89.3	yes	6.6	0.5	yes
	2-Nitrotoluene	78.6-120	95.1	95	yes	6.8	0.1	yes
	3-Nitrotoluene	77.7-119	96.2	96.1	yes	7.2	0.1	yes
	4-Nitrotoluene	79.6-122	95.7	95.6	yes	7.3	0.1	yes
	HMX	71.7-117	95.7	95.2	yes	6.9	0.5	yes
	Nitrobenzene	78.3-120	98.9	98.9	yes	6.8	0	yes
	RDX	65.3-122	99	98.6	yes	8	0.4	yes
	Tetryl	64.5-144	95.9	96.1	yes	8.4	0.2	yes

[a] Percent Recovery (% Rec) = [(Spiked Sample Concentration) - (Non-spiked Sample Concentration)] / (Spike Concentration) X 100.
[b] Relative Percent Difference (RPD) = |Difference] / Mean X 100.

MS = Matrix Spike
MSD = Matrix Spike Duplicate

Table 3-4
Summary of SW-846 Method
Laboratory Control Sample Recoveries

Sample	Analyte	Accuracy Objective (% Rec[a])	LCS (%Rec)	Accuracy Acceptable
QC-151794-1	1,3,5-Trinitrobenzene	31.0-148	101	yes
	1,3-Dinitrobenzene	26.4-155	98.5	yes
	2,4,6-Trinitrotoluene	10.4-136	95.6	yes
	2,4-Dinitrotoluene	26.9-138	113	yes
	2,6-Dinitrotoluene	29.5-148	90.8	yes
	2-Nitrotoluene	25.5-132	96	yes
	3-Nitrotoluene	36.5-126	97.1	yes
	4-Nitrotoluene	36.2-133	96.5	yes
	HMX	33.0-142	97.3	yes
	Nitrobenzene	30.2-125	100	yes
	RDX	26.0-146	101	yes
	TETRYL	0.1-133	95.7	yes
QC-151794-2	1,3,5-Trinitrobenzene	31.0-148	102	yes
	1,3-Dinitrobenzene	26.4-155	97.4	yes
	2,4,6-Trinitrotoluene	10.4-136	94.5	yes
	2,4-Dinitrotoluene	26.9-138	112	yes
	2,6-Dinitrotoluene	29.5-148	89.9	yes

Table 3-4 (Continued)

Sample	Analyte	Accuracy Objective (% Rec[a])	LCS (%Rec)	Accuracy Acceptable
	2-Nitrotoluene	25.5-132	95.2	yes
	3-Nitrotoluene	36.5-126	96	yes
	4-Nitrotoluene	36.2-133	95.4	yes
	HMX	33.0-142	96.4	yes
	Nitrobenzene	30.2-125	99.1	yes
	RDX	26.0-146	100	yes
	TETRYL	0.1-133	94.3	yes

[a] Percent Recovery (% Rec) = (LCS Sample Result) / (Spike Concentration) X 100.
LCS = Laboratory Control Sample

Table 3-5
Summary of SW-846 8330 Field Duplicate Results

Normal Sample/ Field Duplicate	Analyte	Routine (g/g)	Duplicate (g/g)	RPD[a] (%)
HOL20K-Q3-04A HOL20K-Q3-04A-11	None Detected	--	--	NC

[a] Relative Percent Difference (RPD) = |Difference| / Mean X 100.
ND = Not Detected
NC = Not Calculable (calculation not meaningful)

Table 3-6
Summary of SW-846 8330 Blank Results

Analytical Batch	Sample Identification	Analyte	Concentration	Detection Limit	Units
G988Q02L	BL-151798-1	None Detected	--	--	µg/L
G988Q02L	HOL20K-Q3-04A-21	None Detected	--	--	µg/g
G988W02Y	BL-151795-1	None Detected	--	--	µg/g

Table 3-7
Summary of SW-846 8332 Surrogate Spike Recoveries

Analytical Batch	Sample	1-Nitronaphthalene (70-130%)	Accuracy Acceptable?
G988Q02L	BL-151798-1	93.7	yes
	QC-151798-1	96	yes
	QC-151798-2	94.9	yes
	HOL20K-Q3-04A-21	92.6	yes
G988W02Y	BL-151795-1	99.1	yes
	QC-151795-1	99.5	yes
	HOL20K-Q3-02B	94.9	yes
	HOL20K-Q3-03B	97.9	yes
	HOL20K-Q3-04B	99.6	yes
	HOL20K-Q3-01C	100	yes
	HOL20K-Q3-02C	103	yes
	HOL20K-Q3-03C	106	yes
	HOL20K-Q3-04C	100	yes
	HOL20K-Q3-04A-11	100	yes
	QD-151795-1	100	yes
	HOL20K-Q3-01A	97.6	yes
	HOL20K-Q3-01A	97.5	yes
	HOL20K-Q3-01A	97.6	yes
	HOL20K-Q3-02A	99	yes
	HOL20K-Q3-03A	98.6	yes
	HOL20K-Q3-04A	100	yes
	HOL20K-Q3-01B	101	yes

Table 3-8
Summary of SW-846 8332 Matrix Spike and Matrix Spike Duplicate Results

Sample	Analyte	Accuracy Objective (% Rec[a])	MS (% Rec)	MSD (% Rec)	Accuracy Acceptable	Precision Objective (RPD[b])	RPD	Precision Acceptable
HOL20K-Q3-01A	Nitroglycerin	65-135	94.3	93.3	yes	35	1.1	yes
HOL20K-Q3-01A	PETN	65-135	106	105	yes	35	0.9	yes

[a] Percent Recovery (% Rec) = [(Spiked Sample Concentration) - (Non-spiked Sample Concentration)] / (Spike Concentration) X 100.
[b] Relative Percent Difference (RPD) = |Difference| / Mean X 100.

MS = Matrix Spike
MSD = Matrix Spike Duplicate

Table 3-9
Summary of SW-846 8332
Laboratory Control Sample Recoveries

Sample	Analyte	Accuracy Objective (% Rec[a])	LCS (%Rec)	Accuracy Acceptable
QC-151798-1	Nitroglycerin	70-130	102	yes
	PETN	70-130	108	yes
QC-151795-1	Nitroglycerin	70-130	93.5	yes
	PETN	70-130	107	yes

[a] Percent Recovery (% Rec) = (LCS sample result) / (Spike Concentration) X 100.
LCS = Laboratory Control Sample

Table 3-10
Summary of SW-846 8332 Field Duplicate Results

Normal Sample/ Field Duplicate	Analyte	Routine (g/g)	Duplicate (g/g)	RPD[a] (%)
HOL20K-Q3-04A HOL20K-Q3-04A-11	None Detected	--	--	NC

[a] Relative Percent Difference (RPD) = |Difference| / Mean X 100.
ND = Not Detected
NC = Not Calculable (calculation not meaningful)

Table 3-11
Summary of SW-846 Method 6010A Blank Results

Analytical Batch	Sample Identification	Analyte	Concentration		Detection Limit	Result Unit
EM61E2809241457	BLK983273	Antimony	-0.0023	J	0.00266	mg/L
		Arsenic	-0.00071	J	0.00173	mg/L
		Barium	-0.00002	J	0.000302	mg/L
		Beryllium	0	J	0.000988	mg/L
		Cadmium	-0.00013	J	0.000362	mg/L
		Chromium	-0.00061	J	0.00061	mg/L
		Cobalt	-0.00058	J	0.000979	mg/L
		Copper	0.00024	J	0.000832	mg/L
		Iron	-0.0214	J	0.0252	mg/L
		Lead	-0.00062	J	0.00136	mg/L
		Manganese	-0.00004	J	0.000498	mg/L
		Nickel	-0.00084	J	0.000927	mg/L
		Selenium	-0.00005	J	0.00149	mg/L
		Silver	0.00006	J	0.000626	mg/L
		Thallium	-0.00094	J	0.00274	mg/L
		Tin	0.00033	J	0.00342	mg/L
		Vanadium	0.00031	J	0.000707	mg/L
		Zinc	-0.00018	J	0.00426	mg/L
EM61E2809241457	HOL20K-Q3-04A-21	Antimony	0.00257	J	0.00266	mg/L
		Arsenic	0.00165	J	0.00173	mg/L
		Barium	0.00036		0.000302	mg/L
		Beryllium	0.00025	J	0.000988	mg/L
		Cadmium	0.00021	J	0.000362	mg/L
		Chromium	0.00058	J	0.00061	mg/L
		Copper	-0.00054	B J	0.000832	mg/L
		Lead	0.00028	J	0.00136	mg/L
		Nickel	0.00035	J	0.000927	mg/L
		Selenium	0.00095	J	0.00149	mg/L
		Silver	-0.0006	B J	0.000626	mg/L
EMJ61E809241239	BLK983274	Antimony	-0.114	J	0.354	mg/kg
		Arsenic	-0.125	J	0.243	mg/kg
		Barium	0.022	J	0.027	mg/kg
		Beryllium	0.119		0.015	mg/kg
		Cadmium	0.015	J	0.03	mg/kg
		Chromium	-0.012	J	0.053	mg/kg
		Copper	-0.05	J	0.13	mg/kg
		Lead	-0.085	J	0.2	mg/kg
		Nickel	-0.078	J	0.081	mg/kg
		Selenium	-0.146	J	0.193	mg/kg
		Silver	0.027	J	0.036	mg/kg

J = Result is less than stated sample-specific detection limit.
B = Sample concentration is within five times the associated method blank concentration.

Table 3-12
Summary of SW-846 6010A Matrix Spike and Matrix Spike Duplicate Results

Sample	Analyte	Accuracy Objective (% Rec[a])	MS/AS (% Rec)	MSD (% Rec)	Accuracy Acceptability	Precision Objective (RPD[b])	RPD	Precision Acceptability
HOL20K-Q3-04A-11	Antimony	80-120	80	91	yes	20	13	yes
	Arsenic	80-120	101	103	yes	20	2	yes
	Barium	80-120	95	94	yes	20	1.1	yes
	Beryllium	80-120	97	97	yes	20	0	yes
	Cadmium	80-120	95	96	yes	20	1	yes
	Chromium	80-120	97	305 Q	no	20	103 Q	no
	Copper	80-120	100	138 Q	no	20	32 Q	no
	Lead	80-120	96	95	yes	20	1	yes
	Nickel	80-120	95	116	yes	20	20	yes
	Selenium	80-120	105	102	yes	20	2.9	yes
	Silver	80-120	106	107	yes	20	0.9	yes
HOL20K-Q3-04A-11 (AS)	Antimony	75-125	75	118	yes			
	Arsenic	75-125	75	105	yes			
	Barium	75-125	75	94	yes			
	Beryllium	75-125	75	100	yes			
	Cadmium	75-125	75	101	yes			
	Chromium	75-125	75	103	yes			
	Copper	75-125	75	98	yes			
	Lead	75-125	75	103	yes			

Table 3-12 (Continued)

Sample	Analyte	Accuracy Objective (% Rec[a])	MS/AS (% Rec)	MSD (% Rec)	Accuracy Acceptability	Precision Objective (RPD[b])	RPD	Precision Acceptability
	Nickel	75-125	75	103	yes			
	Selenium	75-125	75	105	yes			
	Silver	75-125	75	110	yes			

[a] Percent Recovery (% Rec) = [(Spiked Sample Concentration) - (Non-spiked Sample Concentration)] / (Spike Concentration) X 100.
[b] Relative Percent Difference (RPD) = |Difference| / Mean X 100.
MS = Matrix Spike
AS = Analytical Spike
MSD = Matrix Spike Duplicate

Table 3-13
Summary of SW-846 6010A Laboratory Control Sample Recoveries

Sample	Analyte	Accuracy Objective (% Rec[a])	LCS (% Rec)	LCSD (% Rec)	Accuracy Acceptability	Precision Objective (RPD[b])	RPD	Precision Acceptability
EM61E2809241457	LCSD984982	Antimony	94	96	yes	20	2.1	yes
		Arsenic	95	95	yes	20	0	yes
		Barium	97	97	yes	20	0	yes
		Beryllium	101	102	yes	20	1	yes
		Cadmium	94	95	yes	20	1.1	yes
		Chromium	98	98	yes	20	0	yes
		Cobalt	97	97	yes	20	0	yes
		Copper	98	98	yes	20	0	yes
		Iron	97	98	yes	20	1	yes
		Lead	97	97	yes	20	0	yes
		Manganese	98	98	yes	20	0	yes
		Nickel	97	97	yes	20	0	yes
		Selenium	98	98	yes	20	0	yes
		Silver	100	101	yes	20	1	yes
		Thallium	96	97	yes	20	1	yes
		Tin	95	96	yes	20	1	yes
		Vanadium	101	102	yes	20	1	yes
		Zinc	96	97	yes	20	1	yes

Table 3-13 (Continued)

Sample	Analyte	Accuracy Objective (% Rec[a])	LCS (% Rec)	LCSD (% Rec)	Accuracy Acceptability	Precision Objective (RPD[b])	RPD	Precision Acceptability
EMJ61E809241239	LCSD984984	Antimony	98	98	yes	20	0	yes
		Arsenic	94	94	yes	20	0	yes
		Barium	95	96	yes	20	1	yes
		Beryllium	104	99	yes	20	4.9	yes
		Cadmium	95	96	yes	20	1	yes
		Chromium	103	98	yes	20	5	yes
		Copper	104	97	yes	20	7	yes
		Lead	98	95	yes	20	3.1	yes
		Nickel	95	97	yes	20	2.1	yes
		Selenium	101	95	yes	20	6.1	yes
		Silver	106	106	yes	20	0	yes

[a] Percent Recovery (% Rec) = (LCS Sample Result) / (Spike Concentration) X 100.
[b] Relative Percent Difference (RPD) = |Difference| / Mean X 100.
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate

Table 3-14
Summary of SW-846 6010A Field Duplicate Results

Normal Sample/ Field Duplicate	Analyte	Routine (mg/kg)	Duplicate (mg/kg)	RPD[a] (%)
HOL20K-Q3-04A HOL20K-Q3-04A-11	Antimony	1.35 J	-0.562 J	485.3
	Arsenic	1.57	0.479	106.5
	Barium	28.9	29.2	1.0
	Beryllium	0.306 B	0.334 B	8.8
	Cadmium	0.141 B J	-0.00308 B J	208.9
	Chromium	2.9	2.35	21.0
	Copper	3.5	2.8	22.2
	Lead	1.42	0.749	61.9
	Nickel	2.13	1.62	27.2
	Selenium	0.0453 J	0.189 J	122.7
	Silver	0.0638 B	0.0625 B	2.1

[a] Relative Percent Difference (RPD) = |Difference| / Mean X 100.
J = Result is less than stated sample-specific detection limit.
B = Sample concentration is within five times the associated method blank concentration.

Table 3-15
Summary of SW-846 7471A Blank Results

Batch Identification	Sample Identification	Analyte	Concentration	Detection Limit	Result Units
AAZ4__809240847	BLK983275	Mercury	-0.0001 J	0.000057	mg/L
AAZ4__809240847	HOL20K-Q3-04A-21	Mercury	-0.0001 J	0.000057	mg/L
AAZ4__809240847	BLK983276	Mercury	-0.007 J	0.0057	mg/kg

J = Result is less than stated sample-specific detection limit.
B = Sample concentration is within five times the associated method blank concentration.

Table 3-16
Summary of SW-846 7471A Matrix Spike and Matrix Spike Duplicate Results

Sample	Analyte	Accuracy Objective (% Rec[a])	MS/AS (% Rec)	MSD (% Rec)	Accuracy Acceptable	Precision Objective (RPD[b])	RPD	Precision Acceptable
HOL20K-Q3-04C (AS)	Mercury	85-115	106		yes			
HOL20K-Q3-04C	Mercury	80-120	109	110	yes	25	0.9	yes

[a] Percent Recovery (% Rec) = [(Spiked Sample Concentration) - (Non-spiked Sample Concentration)] / (Spike Concentration) X 100.
[b] Relative Percent Difference (RPD) = |Difference| / Mean X 100.
MS=Matrix Spike
AS=Analytical Spike
MSD=Matrix Spike Duplicate

Table 3-17
Summary of SW-846 7471A Laboratory Control Sample Recoveries

Sample	Analyte	Accuracy Objective (% Rec[a])	LCS (% Rec)	LCSD (% Rec)	Accuracy Acceptable	Precision Objective (RPD[b])	RPD	Precision Acceptable
LCSD984986	Mercury	80-120	100	97	yes	13	3	yes
LCSD984988	Mercury	80-120	102	102	yes	13	0	yes

[a] Percent Recovery (% Rec) = (LCS Sample Result) / (Spike Concentration) X 100.
[b] Relative Percent Difference (RPD) = |Difference| / Mean X 100.
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate

Table 3-18
Summary of SW-846 7471A Field Duplicate Results

Normal Sample/ Field Duplicate	Analyte	Routine (mg/kg)	Duplicate (mg/kg)	RPD[a] (%)
HOL20K-Q3-04A HOL20K-Q3-04A-11	Mercury	-0.00458 J	-0.0026 J	55.2

[a] Relative Percent Difference (RPD) = |Difference| / Mean X 100.