DEPARTMENT OF THE ARMY
INSTALLATION MANAGEMENT AGENCY
HEADQUARTERS, UNITED STATES ARMY GARRISON-ROCK ISLAND ARSENAL
1 ROCK ISLAND ARSENAL
ROCK ISLAND, ILLINOIS 61299-5000

REPLY TO
ATTENTION OF:

October 3, 2006

Office of the Garrison Manager

Dr. Thomas McLaughlin
Materials Decommissioning Branch
Division of Waste Management and Environmental Protection
Office of Nuclear Materials Safety and Safeguards
Nuclear Regulatory Commission
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738

Dear Dr. McLaughlin:

In accordance with the U.S. Army's Jefferson Proving Ground License SUB-1435 requirements, enclosed are electronic and hard copies of the Final, Radiation Monitoring Report for License SUB-1435 Jefferson Proving Ground, Summary of Results for April 10-13, 2006 Sampling Effort.

Please contact Mr. Paul Cloud at (410) 436-2381, e-mail address: paul.d.cloud@us.army.mil or Mr. John J. Welling at (309) 782-8433, e-mail address: john.j.welling@us.army.mil if you have any questions.

Sincerely,

Alan G. Wilson
Garrison Manager

Enclosure

cc:
Paul Cloud
Brooks Evens

RADIATION MONITORING REPORT
FOR LICENSE SUB-1435
JEFFERSON PROVING GROUND

Summary of Results for
April 10-13, 2006 Sampling Event

FINAL

Submitted to:

U.S. Department of Army
Installation Support Management Agency
Aberdeen Proving Ground, Maryland

Prepared by:

Science Applications International Corporation
Reston, Virginia

October 2006

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	Micrograms per Liter
µR/hr	Micro-Roentgens/Hour
ASTM	American Society for Testing and Materials
CHPPM	U.S. Army Center for Health Promotion and Preventative Medicine
CFR	Code of Federal Regulations
DO	Dissolved Oxygen
DQO	Data Quality Objective
DU	Depleted Uranium
ERM	Environmental Radiation Monitoring
I.D.	Identification
JPG	Jefferson Proving Ground
LCL	Lower Control Limit
MDC	Maximum Detectable Concentration
NRC	Nuclear Regulatory Commission
SOP	Standard Operating Procedure
pCi/g	PicoCuries per Gram
pCi/L	PicoCuries per Liter
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAIC	Science Applications International Corporation
UCL	Upper Control Limit

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1. INTRODUCTION

Environmental monitoring activities are conducted at Jefferson Proving Ground (JPG), Madison, Indiana, to ensure that depleted uranium (DU), present within the DU Impact Area as a result of the Army's past DU testing program, does not pose a threat to human health and the environment through inadvertent or unanticipated release or migration. The Environmental Radiation Monitoring (ERM) Program, described in the standard operating procedure (SOP) in Appendix A (CHPPM 2000), is designed to meet the requirements of applicable Federal and state regulations, including Nuclear Regulatory Commission (NRC) regulations and requirements under License SUB-1435 (NRC 1988).

The overall goals of JPG's ERM Program are to provide:

- A historical and current perspective of DU levels in various media
- A timely indication of the magnitude and extent of any DU release or migration from past operations.

This report summarizes the methodology, results, and conclusions of the April 2006 sampling event, which is the first of two sampling events in 2006 for this biannual program. The sampling requirements and methodology are presented in Section 2. The results of the multimedia sampling event are presented and discussed in Section 3. Historical data from the ERM Program are discussed in Section 4. Conclusions and recommendations are summarized in Section 5. References cited are identified in Section 6. The appendices of this report include the SOP (Appendix A), field logbook (Appendix B), and data validation summary (Appendix C). All tables and figures are presented at the end of their respective sections.

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2. SAMPLING REQUIREMENTS AND APPROACH

The SOP, provided in Appendix A, specifies the Army's (i.e., the U.S. Army Center for Health Promotion and Preventative Medicine's [CHPPM's]) protocol for the collection and analysis of 11 groundwater, 8 surface water, 8 sediment, and 4 soil samples (with appropriate duplicates) in the DU Impact Area. Science Applications International Corporation (SAIC) implemented this procedure to fulfill the Army's responsibilities for monitoring under NRC License SUB-1435.

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3. RESULTS

The two-person SAIC field crew prepared for and conducted field sampling at JPG from April 10 through 13, 2006. Appendix B contains the field logbook documenting field activities during this sampling event. No unusual or abnormal conditions (e.g., soil or water discoloration, odd odors, or elevated radiation levels) were observed during the sampling effort.

The sample locations for the groundwater, surface water, sediment, and soil samples are depicted in Figure 3-1. Sections 3.1 through 3.4 summarize the sampling results for each medium, respectively. The results of the data validation are presented in Appendix C. All data were determined to meet data quality objectives (DQOs) and criteria presented in the SOP (see Appendix A).

3.1 GROUNDWATER

Concentrations of isotopic uranium in groundwater at the 11 monitoring wells plus 1 duplicate sample are indicated in Table 3-1. Water quality parameter measurements (pH, conductivity, dissolved oxygen [DO], and exposure readings) are noted in Table 3-2. Total uranium concentrations ranged from 0.2 picocuries per liter (pCi/L) (nondetect) to 3.85 pCi/L, with an average concentration of 1.38 pCi/L. In addition to the isotopic concentrations, Table 3-1 presents the U-238/U-234 ratios for each sample, which ranged from 0.47 to 1.26. A U-238/U-234 ratio of 2 or less is representative of natural uranium, whereas higher ratios are potentially indicative of DU (U.S. Army 2002). For the purposes of this report, samples with U-238/U-234 ratios in excess of 3 will be investigated further to validate if the sample is representative of DU or natural uranium. As revealed by the relatively low U-238/U-234 ratios, there is no indication of the presence of DU.

3.2 SURFACE WATER

Concentrations of total dissolved uranium in surface water at the eight sampling locations and one duplicate sample are indicated in Table 3-3. Water quality parameter measurements (pH, conductivity, DO, and exposure readings) are noted in Table 3-4. Total dissolved uranium concentrations ranged from 0.04 pCi/L (nondetect) to 0.62 pCi/L, with an average concentration of 0.25 pCi/L. The U-238/U-234 ratio for each sample ranged from 1.10 to 3.75. Two samples (SWS02 and SWS08) exhibited ratios in excess of 3 and warrant further investigation.

Sample SWS02 exhibited a U238/U234 ratio of 3.75. Further investigation revealed that the U-234 result was flagged with a data validation code of "J" and a reason code of "37," which indicate that the radionuclide was detected, but that the analytical error was in excess of 50 percent of the reported result. This raises doubt as to the accuracy of the U-234 result. Additional inspection shows that the error was high because the result was very low; in fact it was only 9 percent above the minimum detectable concentration (the U-238 result was nearly 300 percent above the minimum detectable concentration and was in itself a very low concentration). The total error for both the U-238 and U-234 results was propagated through the U238/U234 calculation, revealing a ratio of 3.75 ± 3.7. Based upon the very low concentrations of both U-238 and U-234, the high error in the U-234 measurement, and the great uncertainty in the estimate of the ratio, DU is not indicated in this sample.

Sample SWS08 exhibited a U238/U234 ratio of 3.08. The U-234 result was flagged with a data validation code of "J" and a reason code of "37." The result was close to the minimum detectable concentration. Propagation of the total error for the calculation of the ratio reveals a value of 3.08 ± 2.2. Again, based upon the very low concentrations of both U-238 and U-234, the high error in the U-234 measurement, and the great uncertainty in the estimate of the ratio, DU in not indicated in this sample.

3.3 SEDIMENT

Table 3-5 notes the concentrations of isotopic and total uranium in sediment for eight samples and one duplicate sample. Sediment samples were collected at the same locations as surface water samples, as indicated in Figure 3-1. Total uranium concentrations ranged from 0.52 to 1.53 picocuries per gram (pCi/g), with an average of 1.05 pCi/g. In addition, Table 3-5 presents the U-238/U-234 ratios for each sample, which ranged from 0.64 to 1.22. As revealed by the relatively low U-238/U-234 ratios, there is no indication of the presence of DU.

3.4 SOIL

Concentrations of isotopic and total uranium in soil at the four surface soil sample locations and one duplicate sample are specified in Table 3-6. Total uranium concentrations ranged from 1.36 to 1.97 pCi/g, with an average of 1.66 pCi/g. The U-238/U-234 ratios ranged from 0.88 to 1.28. Therefore, as revealed by the low U 238/U 234 ratio, there is no indication of the presence of DU.

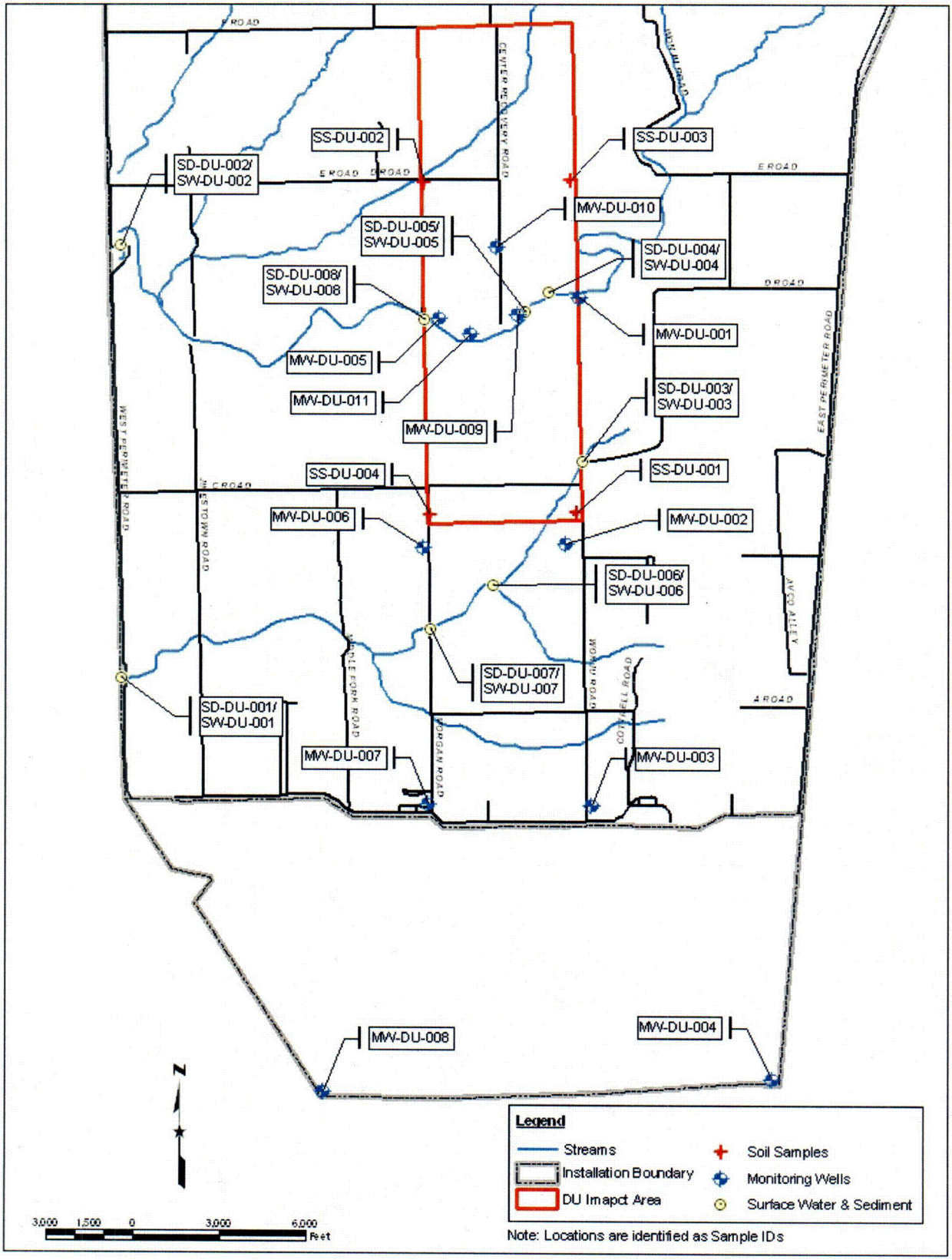

Figure 3-1. Sampling Locations for the JPG ERM Program

Table 3-1. Isotopic Uranium in Groundwater
Jefferson Proving Ground, Indiana

JPG Sample Designation[a]	Sample I.D.	Analyte	Result (pCi/L)
MW01	MW-DU-001	U-234	0.38 J
MW01	MW-DU-001	U-235	-0.02 U
MW01	MW-DU-001	U-238	0.02 U
		Total Uranium	**0.4**
		U-238/U-234 Ratio[b]	**ND**
MW02	MW-DU-002	U-234	0.86
MW02	MW-DU-002	U-235	0.02 U
MW02	MW-DU-002	U-238	0.51 J
		Total Uranium	**1.4**
		U-238/U-234 Ratio[b]	**0.59**
MW03	MW-DU-003	U-234	0.69 J
MW03	MW-DU-003	U-235	0.05 U
MW03	MW-DU-003	U-238	0.47 J
		Total Uranium	**1.2**
		U-238/U-234 Ratio[b]	**0.68**
MW03	MW-DU-003D	U-234	0.72
MW03	MW-DU-003D	U-235	0.03 U
MW03	MW-DU-003D	U-238	0.91
		Total Uranium	**1.7**
		U-238/U-234 Ratio[b]	**1.26**
MW04	MW-DU-004	U-234	0.54 J
MW04	MW-DU-004	U-235	0.07 U
MW04	MW-DU-004	U-238	0.15 U
		Total Uranium	**0.8**
		U-238/U-234 Ratio[b]	**ND**
MW05	MW-DU-005	U-234	0.3 U
MW05	MW-DU-005	U-235	0.04 U
MW05	MW-DU-005	U-238	0.22 U
		Total Uranium	**0.6**
		U-238/U-234 Ratio[b]	**ND**
MW06	MW-DU-006	U-234	2.55
MW06	MW-DU-006	U-235	0.02 U
MW06	MW-DU-006	U-238	1.28
		Total Uranium	**3.9**
		U-238/U-234 Ratio[b]	**0.50**
MW07	MW-DU-007	U-234	1.32
MW07	MW-DU-007	U-235	0.05 U
MW07	MW-DU-007	U-238	0.91
		Total Uranium	**2.3**
		U-238/U-234 Ratio[b]	**0.69**

Table 3-1. Isotopic Uranium in Groundwater Jefferson Proving Ground, Indiana (Continued)

JPG Sample Designation[a]	Sample I.D.	Analyte	Result (pCi/L)
MW08	MW-DU-008	U-234	0.27 J
MW08	MW-DU-008	U-235	0.08 U
MW08	MW-DU-008	U-238	0.23 J
		Total Uranium	**0.6**
		U-238/U-234 Ratio[b]	**0.85**
MW09	MW-DU-009	U-234	1.15
MW09	MW-DU-009	U-235	0.1 U
MW09	MW-DU-009	U-238	-0.01 U
		Total Uranium	**1.2**
		U-238/U-234 Ratio[b]	**ND**
MW010	MW-DU-010	U-234	1.68
MW010	MW-DU-010	U-235	-0.04 U
MW010	MW-DU-010	U-238	0.79
		Total Uranium	**2.4**
		U-238/U-234 Ratio[b]	**0.47**
MW011	MW-DU-011	U-234	0.03 U
MW011	MW-DU-011	U-235	0.04 U
MW011	MW-DU-011	U-238	0.13 U
		Total Uranium	**0.20**
		U-238/U-234 Ratio[b]	**ND**

[a] Represents sample designation developed in previous sampling programs.
[b] Unitless.
J – Indicates that the radionuclide was positively identified; the associated numerical value is the approximate concentration of the radionuclide in the sample.
ND – Indicates that one or more isotopes were not detected; therefore, the calculation was not conducted.
U – Indicates that the data met all QA/QC requirements and the radionuclide was analyzed for but was not detected above the reported sample quantitation limit.

Table 3-2. Groundwater Water Quality Parameters and Exposure Readings Jefferson Proving Ground, Indiana

JPG Designation*	Sample I.D.	pH	Temp (°C)	Conductivity (microSiemens/cm)	Dissolved Oxygen (mg/L)	Rad (µR/hr)
MW01	MW-DU-001	7.53	12.2	0.343	11.51	4
MW02	MW-DU-002	7.28	12.5	0.490	12.19	6
MW03	MW-DU-003	7.09	11.9	0.550	12.21	4
MW04	MW-DU-004	7.27	16.3	0.490	11.74	5
MW05	MW-DU-005	7.45	13.5	1.160	11.04	5
MW06	MW-DU-006	7.48	14.7	0.600	10.70	5
MW07	MW-DU-007	7.35	14.6	0.578	11.58	3
MW08	MW-DU-008	7.36	15.7	0.410	12.76	6
MW09	MW-DU-009	7.56	16.2	7.040	10.60	4
MW10	MW-DU-0010	7.42	14.1	0.572	11.93	4
MW11	MW-DU-0011	8.15	12.8	0.232	12.63	4

* Represents sample designation developed in previous sampling programs.

Table 3-3. Isotopic Uranium in Surface Water
Jefferson Proving Ground, Indiana

JPG Sample Designation[a]	Sample I.D.	Analyte	Result (pCi/g)
SWS01	SW-DU-001	U-234	0.098 U
SWS01	SW-DU-001	U-235	0.036 U
SWS01	SW-DU-001	U-238	0.046 U
		Total Uranium	**0.2**
		U-238/U-234 Ratio[b]	**ND**
SWS02	SW-DU-002	U-234	0.072 J
SWS02	SW-DU-002	U-235	0.01 U
SWS02	SW-DU-002	U-238	0.27
		Total Uranium	**0.4**
		U-238/U-234 Ratio[b]	**3.75**
SWS03	SW-DU-003	U-234	-0.001 U
SWS03	SW-DU-003	U-235	0.01 U
SWS03	SW-DU-003	U-238	0.035 U
		Total Uranium	**0.04**
		U-238/U 234 Ratio[b]	**ND**
SWS04	SW-DU-004	U-234	0.123 J
SWS04	SW-DU-004	U-235	0.017 U
SWS04	SW-DU-004	U-238	0.099 U
		Total Uranium	**0.24**
		U-238/U-234 Ratio[b]	**ND**
SWS05	SW-DU-005	U-234	0.2 J
SWS05	SW-DU-005	U-235	-0.017 U
SWS05	SW-DU-005	U-238	0.22
		Total Uranium	**0.40**
		U-238/U-234 Ratio[b]	**1.10**
SWS05	SW-DU-005D	U-234	0.104 U
SWS05	SW-DU-005D	U-235	-0.022 U
SWS05	SW-DU-005D	U-238	0.088 U
		Total Uranium	**0.2**
		U-238/U-234 Ratio[b]	**ND**
SWS06	SW-DU-006	U-234	0.067 U
SWS06	SW-DU-006	U-235	0.001 U
SWS06	SW-DU-006	U-238	0.066 U
		Total Uranium	**0.13**
		U-238/U-234 Ratio[b]	**ND**
SWS07	SW-DU-007	U-234	0.021 U
SWS07	SW-DU-007	U-235	0.01 U
SWS07	SW-DU-007	U-238	0.086 J
		Total Uranium	**0.1**
		U-238/U-234 Ratio[b]	**ND**
SWS08	SW-DU-008	U-234	0.143 J
SWS08	SW-DU-008	U-235	0.038 U
SWS08	SW-DU-008	U-238	0.44
		Total Uranium	**0.6**
		U-238/U-234 Ratio[b]	**3.08**

[a] Represents sample designation developed in previous sampling programs.
[b] Unitless.

J – Indicates that the radionuclide was positively identified; the associated numerical value is the approximate concentration of the radionuclide in the sample.
ND – Indicates that one or more isotopes were not detected; therefore, the calculation was not conducted.
U – Indicates that the data met all QA/QC requirements and the radionuclide was analyzed for but was not detected above the reported sample quantitation limit.

Table 3-4. Surface Water Quality Parameters and Exposure Readings Jefferson Proving Ground, Indiana

JPG Sample Designation[a]	Sample I.D.	pH	Temp (°C)	Conductivity (microSiemens/cm)	Dissolved Oxygen (mg/L)	Rad (µR/hr)
SWS01	SW-DU-001	8.62	17.1	0.177	12.33	4.5
SWS02	SW-DU-002	8.55	14.7	0.156	11.64	5
SWS03	SW-DU-003	7.79	13.0	0.093	7.19	4
SWS04	SW-DU-004	8.17	14.2	0.181	8.28	5
SWS05	SW-DU-005	8.87	18.1	0.186	10.49	5
SWS06	SW-DU-006	8.13	13.5	0.093	9.27	5
SWS07	SW-DU-007	7.92	13.4	0.001	10.32	4
SWS08	SW-DU-008	8.37	15.9	0.180	10.68	5

[a] Represents sample designation developed in previous sampling programs.

Table 3-5. Isotopic Uranium in Sediment Jefferson Proving Ground, Indiana

JPG Sample Designation[a]	Sample I.D.	Analyte	Result (pCi/g)
SES01	SD-DU-001	U-234	0.77
SES01	SD-DU-001	U-235	0.12 J
SES01	SD-DU-001	U-238	0.6
		Total Uranium	**1.5**
		U-238/U-234 Ratio[b]	**0.78**
SES02	SD-DU-002	U-234	0.55
SES02	SD-DU-002	U-235	0.028 U
SES02	SD-DU-002	U-238	0.67
		Total Uranium	**1.2**
		U-238/U-234 Ratio[b]	**1.22**
SES03	SD-DU-003	U-234	0.66
SES03	SD-DU-003	U-235	0.015 U
SES03	SD-DU-003	U-238	0.57
		Total Uranium	**1.2**
		U-238/U-234 Ratio[b]	**0.86**
SES04	SD-DU-004	U-234	0.38
SES04	SD-DU-004	U-235	0 U
SES04	SD-DU-004	U-238	0.36
		Total Uranium	**0.7**
		U-238/U-234 Ratio[b]	**0.95**
SES04	SD-DU-004D	U-234	0.44
SES04	SD-DU-004D	U-235	0.017 U
SES04	SD-DU-004D	U-238	0.42
		Total Uranium	**0.9**
		U-238/U-234 Ratio[b]	**0.95**
SES05	SD-DU-005	U-234	0.28 J
SES05	SD-DU-005	U-235	-0.004 U
SES05	SD-DU-005	U-238	0.24 J
		Total Uranium	**0.5**
		U-238/U-234 Ratio[b]	**0.86**

Table 3-5. Isotopic Uranium in Sediment
Jefferson Proving Ground, Indiana (Continued)

JPG Sample Designation[a]	Sample I.D.	Analyte	Result (pCi/g)
SES06	SD-DU-006	U-234	0.46
SES06	SD-DU-006	U-235	0.05 U
SES06	SD-DU-006	U-238	0.5
		Total Uranium	**1.0**
		U-238/U-234 Ratio[b]	**1.09**
SES07	SD-DU-007	U-234	0.45
SES07	SD-DU-007	U-235	0.046 U
SES07	SD-DU-007	U-238	0.29 J
		Total Uranium	**0.8**
		U-238/U-234 Ratio[b]	**0.64**
SES08	SD-DU-008	U-234	0.71
SES08	SD-DU-008	U-235	0.053 U
SES08	SD-DU-008	U-238	0.77
		Total Uranium	**1.5**
		U-238/U-234 Ratio[b]	**1.08**

[a] Represents sample designation developed in previous sampling programs.
[b] Unitless.
J – Indicates that the radionuclide was positively identified; the associated numerical value is the approximate concentration of the radionuclide in the sample.
ND – Indicates that one or more isotopes were not detected; therefore, the calculation was not conducted.
U – Indicates that the data met all QA/QC requirements and the radionuclide was analyzed for but was not detected above the reported sample quantitation limit.

Table 3-6. Isotopic Uranium in Surface Soil
Jefferson Proving Ground, Indiana

JPG Designation[a]	Sample I.D.	Analyte	Result (pCi/g)
SOS01	SS-DU-001	U-234	0.87
SOS01	SS-DU-001	U-235	0.037 U
SOS01	SS-DU-001	U-238	1.06
		Total Uranium	**2.0**
		U-238/U-234 Ratio[b]	**1.22**
SOS02	SS-DU-002	U-234	0.76
SOS02	SS-DU-002	U-235	0.054 U
SOS02	SS-DU-002	U-238	0.86
		Total Uranium	**1.7**
		U-238/U-234 Ratio[b]	**1.13**
SOS02	SS-DU-002D	U-234	0.84
SOS02	SS-DU-002D	U-235	0.01 U
SOS02	SS-DU-002D	U-238	0.81
		Total Uranium	**1.7**
		U-238/U-234 Ratio[b]	**0.96**
SOS03	SS-DU-003	U-234	0.58
SOS03	SS-DU-003	U-235	0.042 U
SOS03	SS-DU-003	U-238	0.74
		Total Uranium	**1.4**
		U-238/U-234 Ratio[b]	**1.28**
SOS04	SS-DU-004	U-234	0.83
SOS04	SS-DU-004	U-235	0.063 U
SOS04	SS-DU-004	U-238	0.73
		Total Uranium	**1.6**
		U-238/U-234 Ratio[b]	**0.88**

[a] Represents sample designation developed in previous sampling programs.
[b] Unitless.
J – Indicates that the radionuclide was positively identified; the associated numerical value is the approximate concentration of the radionuclide in the sample.
ND – Indicates that one or more isotopes were not detected; therefore, the calculation was not conducted.
U – Indicates that the data met all QA/QC requirements and the radionuclide was analyzed for but was not detected above the reported sample quantitation limit.

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4. HISTORICAL DATA ASSESSMENT AND TREND ANALYSIS

Historical data from the ERM Program are reviewed and discussed in this section, in the context of existing action levels and corrective actions for environmental media as provided in the SOP for the ERM monitoring and repeated in Table 4-1.

The assessment of historical trends was limited to the available sampling data for groundwater, surface water, sediment, and soil media since 1998. Quality assurance/quality control (QA/QC) records for data collected prior to 1998 were not available to support trend analyses. Moreover, there were changes to analytical methods implemented beginning in December 2004.[1] In addition, water results for the April 2004 sampling effort are not trended, as the results were provided in units of micrograms per liter (µg/L) rather than picocuries per liter (pCi/L).

4.1 GROUNDWATER

For 163 discrete samples available from 11 monitoring wells (MW01 to MW11) during the period of 1998 through 2006, the average total uranium activity was 0.79 pCi/L, the standard deviation was 1.07 pCi/L, and the maximum detected concentration was 5.27 pCi/L. As shown in Figures 4-1 through 4-11, all of these activities are well below the 150 pCi/L action level for groundwater in each well.

Data for each monitoring well are summarized in Figures 4-1 through 4-11. The figures display data that were obtained by two different organizations using two different analytical techniques. Data collected starting in December 2004 were analyzed for isotopic uranium and achieved minimum detectable concentrations (MDCs) that were generally much lower than the method used prior to December 2004 (i.e., a less sensitive technique was used). The large number of zero values and the large potential error values associated with the analytical results were the primary reasons trend analyses were not performed on these data. These data are included in this analysis for completeness even though they were not used to support conclusions regarding historical trends.

Isotopic uranium data are displayed with associated error bars. These are expressed at 1.96 standard deviations and represent a 95 percent confidence interval. It is important to note that of 298 individual radionuclide measurements, only 79 (or approximately 27 percent) qualified sample detects. This result occurs because the radionuclides are present at environmental levels (i.e., very low concentrations) that also are close to the MDC for the analysis technique applied.

Where trend lines are provided, the associated coefficient of correlation is provided as well (the R^2 value listed on each figure). A R^2 value that approaches 1.0 suggests a strong relationship between the sample results and the sampling dates.

Inspection of the figures for all 11 individual monitoring wells reveals no significant indications or trends. There has been a clear improvement in the MDC values with the selection of the new analytical technique. One might look at a string of zero values prior to December 2004 (e.g., MW-DU-01 Total U Figure 4-1) and infer that the overall monitoring well concentrations have risen; however, this would be an incorrect conclusion. These zero values are below the MDC and the true value is unknown. MW-DU-006 and MW-DU-007 indicate a slight increase in the total uranium concentrations as compared to data prior to December 2004. These increases could be attributed to changes in laboratory protocol (e.g., sampling handling and processing) analysis technique or other factors. These wells should be monitored closely for potential increasing trends in subsequent reports.

In addition to the run charts already presented, individual variable control charts were created for each monitoring well, with the upper control limit (UCL) and the lower control limit (LCL) set at 3

[1] Total uranium is now analyzed by alpha spectroscopy using American Society for Testing and Materials (ASTM) Method D3972-90M rather than the fluorometry and gamma spectroscopy methods applied previously.

standard deviations above or below the mean. The control charts were created and assessed to determine if any single sample result warranted further examination; none did. An example individual control chart is provided in Figure 4-12.

The 11 monitoring wells also were examined in aggregate to see if some wells or particular sampling events were distinctive. A simple individual control chart was created, using the pooled data for all monitoring wells and all data collected after December 2004 (Figure 4-13).

Figure 4-13 indicates that four points lie above the UCL. All four points are for MW-DU-006. Clearly, this well exhibits total uranium results in excess of the other wells. The boring logs for this well indicate that this well was not screened in bedrock. The U-238:U-234 ratio for these samples were all less than 2.0; however, this well will be closely monitored, and the cause for the higher overall concentration will be investigated further and documented in the next ERM report.

Poor correlation was observed between sampling results and the times of year for total uranium in groundwater, for the limited data available (spring and fall only). The average monthly precipitation values at JPG are very nearly equal for all 12 months; therefore, a correlation between precipitation and sample results was not completed. Once additional hydrogeological data are available from the stream and creek gauging activities, data will be assessed statistically to determine if any relationships exist with groundwater (or surface water) uranium results.

4.2 SURFACE WATER

For 139 discrete samples available from 8 primary surface water sampling locations (SW01 to SW8) during the period 1998 through 2006, the average total uranium activity was 0.75 pCi/L, the standard deviation was 3.16 pCi/L, and the maximum detected concentration was 29.0 pCi/L. As shown in Figures 4-14 through 4-21, all of these activities are well below the 150 pCi/L action level for surface water.

Data for each surface water sampling location are summarized in Figures 4-14 through 4-21. Data are presented similar to the approach presented in Section 4.1. It is important to note that of 220 individual radionuclide measurements, only 37 (or approximately 17 percent) qualified as sample detects. R^2 values ranged from 0.0008 to 0.1064 in the eight samples, indicating poor correlation between the sampling results and the sampling dates.

Inspection of the figures for all eight individual surface water sampling locations indicates no significant indications or trends. There has been a clear improvement in the MDC values. Sample SW-DU-005 exhibited a large spike in total uranium result in October 1999. Data on the U-238:U-234 ratio are unavailable, as the sample was analyzed by gamma spectroscopy for U-238. The sample was not investigated at the time, since the value is well within the action level of 150 pCi/L. The sampling result for this time at a downstream location (SW-DU-008) was normal. The sediment samples at SD-DU-005 and SD-DU-008 also were normal. This high concentration has not been repeated. The cause of the spike is unknown and cannot be resolved even though, as noted below, a penetrator was found in the vicinity of this sample location. The exact location is unknown, so no conclusions are drawn regarding the impact of this finding on this single event.

The April 2000 ERM Report indicated that a 10-inch piece of DU penetrator was found on the ground in the creek near bridge 22. This appears to be the general location of sample points SW-DU-005 and SD-DU-005. The October 2000 ERM Report notes that the 10-inch piece of DU penetrator was placed into a plastic bag and that the site management staff was notified. Individual variable control charts were not created for each surface water sampling location, given their limited value.

The eight surface water sampling locations also were examined in aggregate to see if some locations or particular sampling events were distinctive. A simple individual control chart was created,

using the pooled data for all surface waster sampling points and all data collected after December 2004 (Figure 4-22).

Figure 4-22 indicates a single point (SW-DU-005, 2.95 pCi/L, October 2005) is above the UCL. This is the sample location that showed an elevated detection in 1999 at 29 pCi/L. The data were reviewed and the U-238:U-234 ratio was calculated. The result is 0.73 ± 0.5. This ratio is less than 2.0 and the sample can be attributed to natural uranium. No further investigation is warranted; however, this sampling location should be closely monitored.

Poor correlation was observed between sampling results and the times of year for total uranium in surface water, for the limited data available (spring and fall only). The average monthly precipitation values at JPG are very nearly equal for all 12 months; therefore, a correlation between precipitation and sample results was not completed. Once additional hydrogeological data are available from the stream and creek gauging activities, data will be assessed statistically to determine if any relationships exist with surface water (or groundwater) uranium results.

4.3 SEDIMENT

For 135 discrete samples available from 8 sediment sampling locations (SD01 to SD08) during the period 1998 through 2006, the average total uranium activity was 1.13 pCi/g, the standard deviation was 0.83 pCi/g, and the maximum detected concentration was 4.0 pCi/g. As shown in Figures 4-23 through 4-30, all of these activities are well below the lowest action level of 35 pCi/g.

Data for each sediment sampling location are summarized in Figures 4-23 through 4-30. Data are presented similar to the approach presented in Section 4.1. It is important to note that of 227 individual radionuclide measurements, only 81 (or approximately 36 percent) qualified as sample detects. R^2 values ranged from 0.007 to 0.7415. At one location (SD-DU-002), there is an indication of a slight upward trend based on the R^2 value of 0.7415; however, the total uranium concentration of all data at this location is below the action level of 35 pCi/g. All other data indicate poor correlation between the sample results and sampling dates for the years specified.

Inspection of the figures for all eight individual sediment sampling locations reveals a potential increasing trend at SD-DU-002. The last four sampling points were all increasing and all well above the MDC. The correlation coefficient for the trend line is 0.745 and significant. The actual values for the results are all similar to that found in other sediment sampling locations and are reasonable values for soils or sediments (soils range from 0.88 to approximately 3.0 pCi/g on average in the United States). The U-238:U-234 ratio for the October 2005 sample was calculated at 0.94 ± 0.3, which is indicative of the presence of natural uranium. A value of 2.0 or more would warrant further investigation.

A clear improvement in the MDC values has occurred. Individual variable control charts were not created for each sediment sampling location, as they would have limited value in this application.

The eight sediment sampling locations also were examined in aggregate to determine if some locations or particular sampling events were distinctive. A simple individual control chart (Figure 4-31) was created, using the pooled data for all sediment sampling points and all data collected after December 2004.

As noted in the earlier discussion, a single point (SD-DU-007, 2.80 pCi/g, April 2004) is above the UCL. The data were reviewed and the U-238:U-234 ratio was calculated. The result is 0.88 ± 0.3. This ratio is less than 2.0 and the sample is attributed to natural uranium. No further investigation is warranted.

A qualitative review of these limited data indicates no trends in total uranium in sediment from season to season (spring versus fall). The ongoing site investigation should provide a better data set to

indicate these trends stream when the gauges are installed and the monitoring network is redefined to support a more complete and representative data set.

4.4 SOILS

For 81 discrete samples available from four soil sampling locations (SS01 to SS04) during the period 1998 through 2006, the average total uranium activity was 10.19 pCi/g, the standard deviation was 27.16 pCi/g, and the maximum detected concentration was 140.0 pCi/g. As shown in Figures 4-32 through 4-35, the average is well below the action level of 100 pCi/g.

One sample (SS-DU-004, Figure 4-35) exceeded the action level with a value of 140 pCi/g in 1998. This sample was collected in October 1998 from an area along C-Road in the DU Impact Area. Penetrators were visible in the surface soils in the area of the sample. The gamma exposure rate was 18 to 20 micro-Roentgens per hour (μR/hr) at 1 meter above the sampling location. This value is well in excess of background and clearly indicated the presence of DU. Isotopic analysis of the soil samples was not initiated, so DU could not be confirmed. Five additional soil samples were collected in a 1 m^2 area around SS-DU-004 during the next routine sampling event, and reported in the April 1999 ERM Report in accordance with the ERM protocol. A copy of the April 1999 report was not available at the time of this trend report, so the results of the SS-DU-004 follow-up sampling is unknown at this time. The average of these samples is presumed to be less than 100 pCi/g, since there is no indication of any additional investigation of SS-DU-004 in later reports and all of the sampling data for soils in April 1999 were less than 100 pCi/g.

As noted above, there are four primary sampling points for surface soils: SS-DU-001 to SS-DU-004. These points now lie at the approximate corners of the DU Impact Area, although the locations varied greatly during and prior to October 1998.

The numbering of any additional samples, used in averaging as mentioned for SS-DU-004 above, can lead to some confusion. Surface soil samples collected as part of an averaging effort were assigned sample identification numbers of the same series (i.e., SS-DU-005 to SS-DU-012). These samples were not collected routinely from the same physical location each time. In addition, in some cases, sample duplicates were assigned the next sequential number in the series, rather than using the same number with a "D" suffix, as noted in later reports. One must carefully read the associated sampling report to understand where and why a sample with an SS-DU series number in excess of 004 was collected.

For the remaining 67 discrete samples from 4 soil sampling locations (SS01 to SS04) during the period 1999 through 2006, the average total uranium activity was 1.49 pCi/g, the standard deviation was 0.77 pCi/g, and the maximum detected concentration was 5.0 pCi/g. As shown in Figures 4-32 through 4-35, all values are well below the lowest level of 35 pCi/g.

Data for each soil sampling location are summarized in Figures 4-32 through 4-35. Data are presented similar to the approach presented in Section 4.1. It is important to note that of 131 individual radionuclide measurements, only 53 (or approximately 40 percent) qualified as sample detects. R^2 values ranged from 0.0172 to 0.4899, indicating poor correlation between the sampling results and sampling dates.

A review of the figures for all four individual surface soil sampling locations wells indicates no significant indications or trends. The correlation coefficients for SS-DU-001 and SS-DU-002 are less than 0.5 and the error bars all overlap, indicating that the true values all could actually be equal to each other.

There has been a clear improvement in the MDC values. Individual variable control charts were not created for each surface soil sampling location, given their limited value.

The four surface soil sampling locations also were examined in aggregate to see if some locations or particular sampling events were distinctive. A simple individual control chart (Figure 4-36) was created, using the pooled data for all surface soil sampling points and all data collected after December 2004.

One can see that a single point (SS-DU-001D, 2.25 pCi/g, May 2005) lies above the UCL. This sample is actually a duplicate count of the original SS-DU-001 sample, in which the total uranium result was 1.77, which falls below the UCL. The data for SS-DU-001D were reviewed and the U-238:U-234 ratio was calculated. The result is 1.07 ± 0.5. This ratio is less than 2.0 and the sample is attributed to natural uranium. No further investigation is warranted.

One point (SS-DU-003, 1.0 pCi/g, October 2005) is below the LCL. The data for SS-DU-003 were assessed and the U-238:U-234 ratio was calculated. The result is 1.33 ± 0.5. This ratio is less than 2.0 and the sample is attributed to natural uranium. The laboratory data validation package was reviewed and there is no reason to suspect a low bias in the laboratory analysis. No further investigation is warranted. A qualitative review of this limited data indicates no trends in total uranium in soil from season to season (spring versus fall). The ongoing site investigation should provide a better data set to indicate these trends seasonally for soil.

Table 4-1. Action Levels and Corrective Actions for Total Uranium in Environmental Media Jefferson Proving Ground, Indiana

Medium	Total Uranium Action Level	Corrective Action
Groundwater and Surface Water	≥ 150 pCi/L*	Resample. If activity verified, notify NRC and assess results. The findings and recommended corrective actions will be documented for the Army's Radiation Control Committee. The Committee will provide recommendations to the Commander based on its evaluation.
	Less than 150 pCi/L	No action.
Soil and Sediment:		
Perimeter and Background Samples	≥ 35 pCi/g	Collect five additional samples in a 1-meter grid. If average activity exceeds 35 pCi/g, decontaminate to 35 pCi/g.
	Less than 35 pCi/g	No corrective action.
Samples Along the Firing Line	100 – 300 pCi/g	Collect five additional samples in a 1-meter grid. If average activity exceeds 100 pCi/g, investigate and determine reason for high level. If > 300 pCi/g verified, investigate to determine cause and contact NRC.
	Less than 100 pCi/g	No corrective action.

*Effluent concentration limit for uranium is 300 pCi/L in 10 CFR 20, Appendix B, Table 2, Column 2.
Source: Appendix A, pages A-6 and A-7.

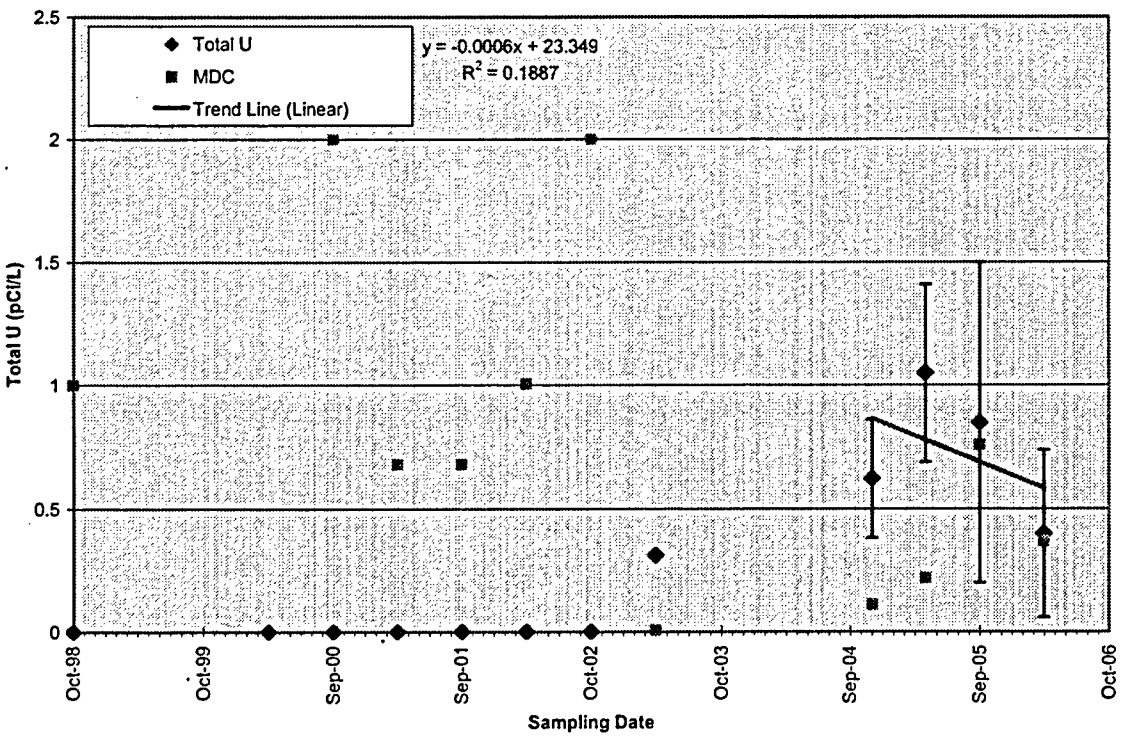

Figure 4-1. Total Uranium in MW-DU-001 (1998-2006)

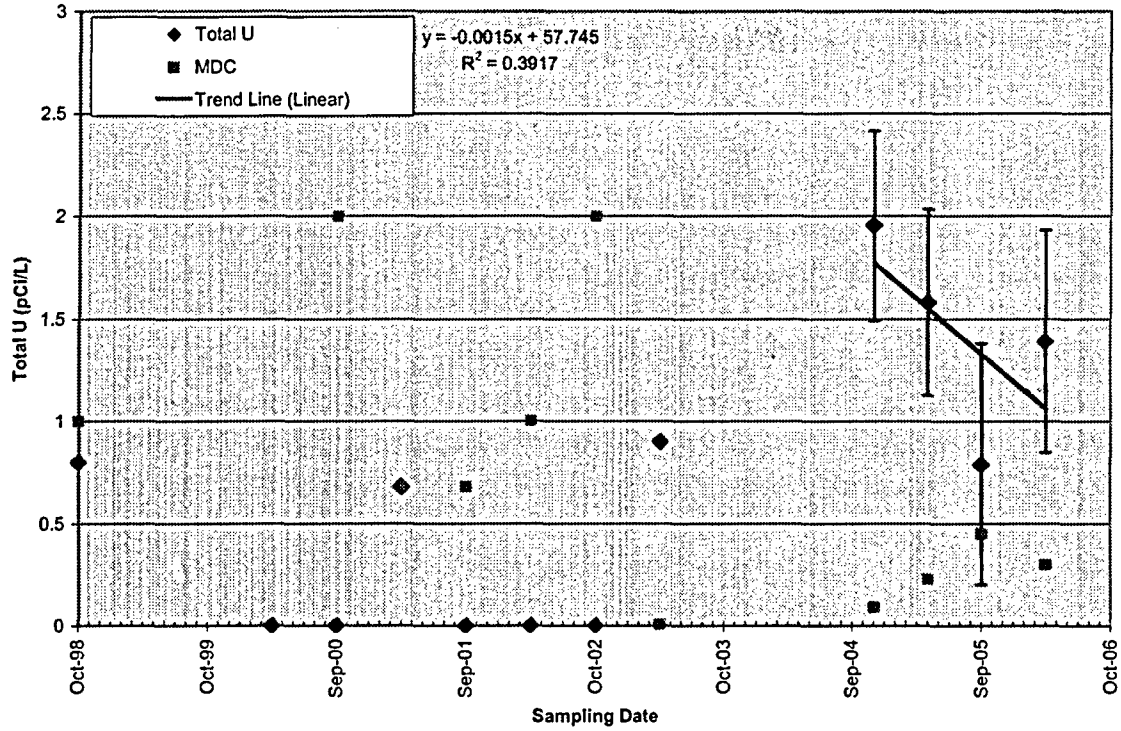

Figure 4-2. Total Uranium in MW-DU-002 (1998-2006)

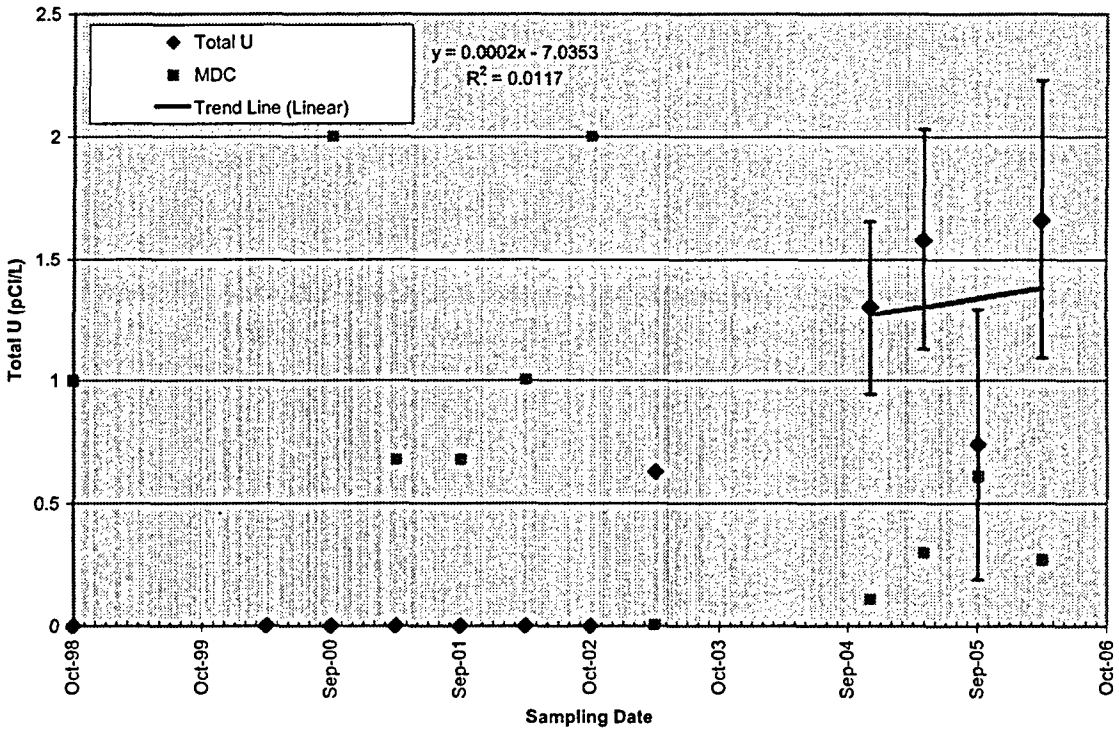

Figure 4-3. Total Uranium in MW-DU-003 (1998-2006)

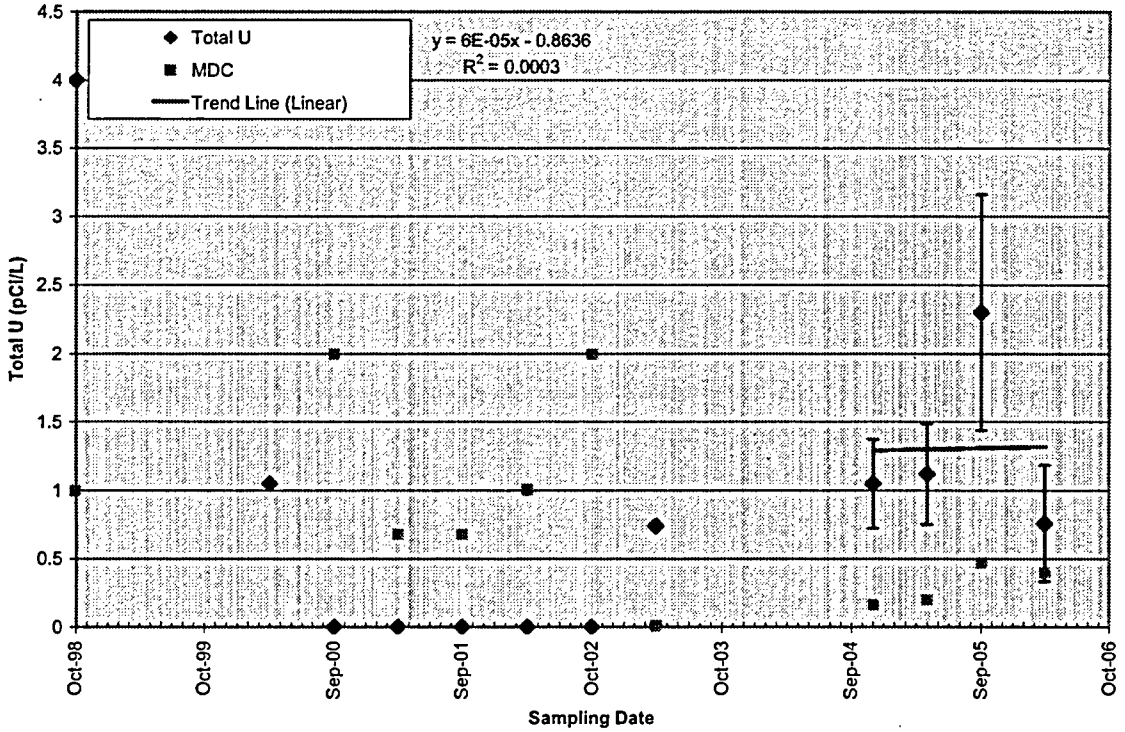

Figure 4-4. Total Uranium in MW-DU-004 (1998-2006)

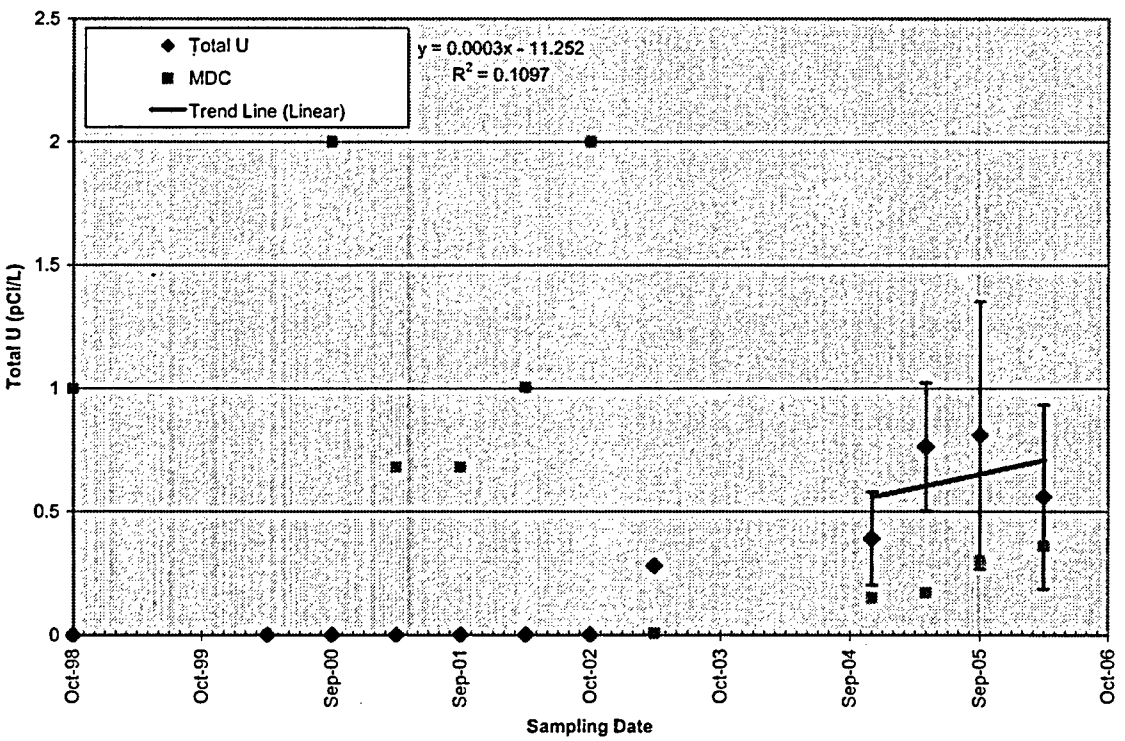

Figure 4-5. Total Uranium in MW-DU-005 (1998-2006)

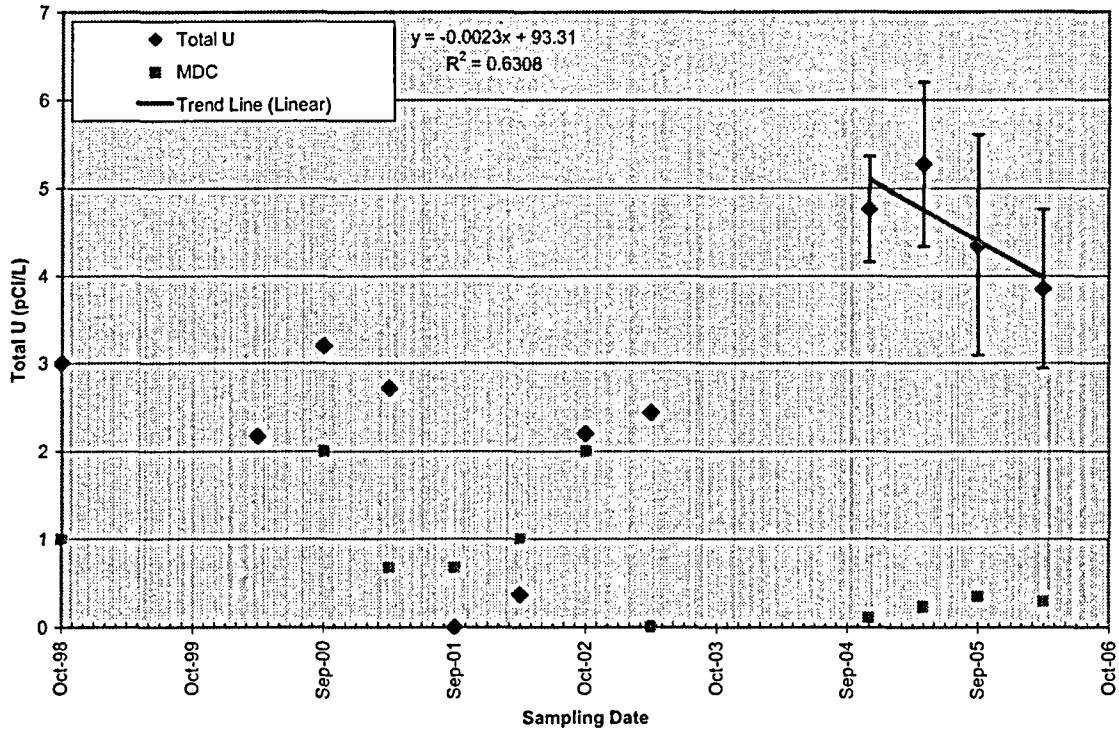

Figure 4-6. Total Uranium in MW-DU-006 (1998-2006)

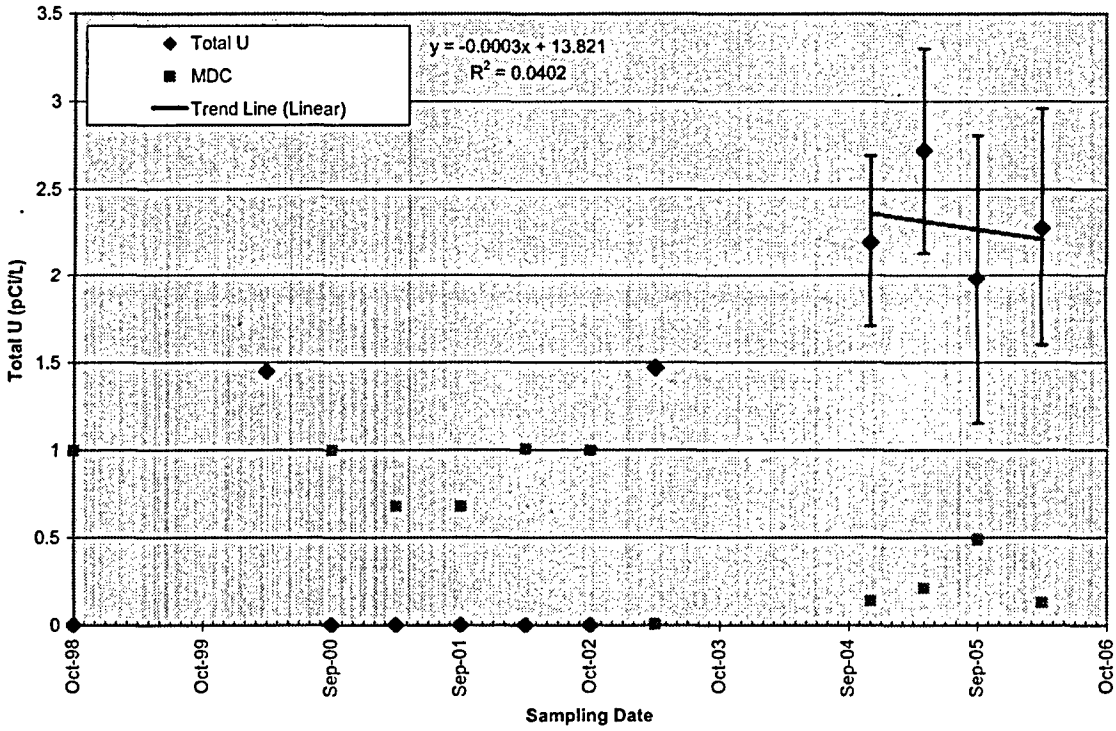

Figure 4-7. Total Uranium in MW-DU-007 (1998-2006)

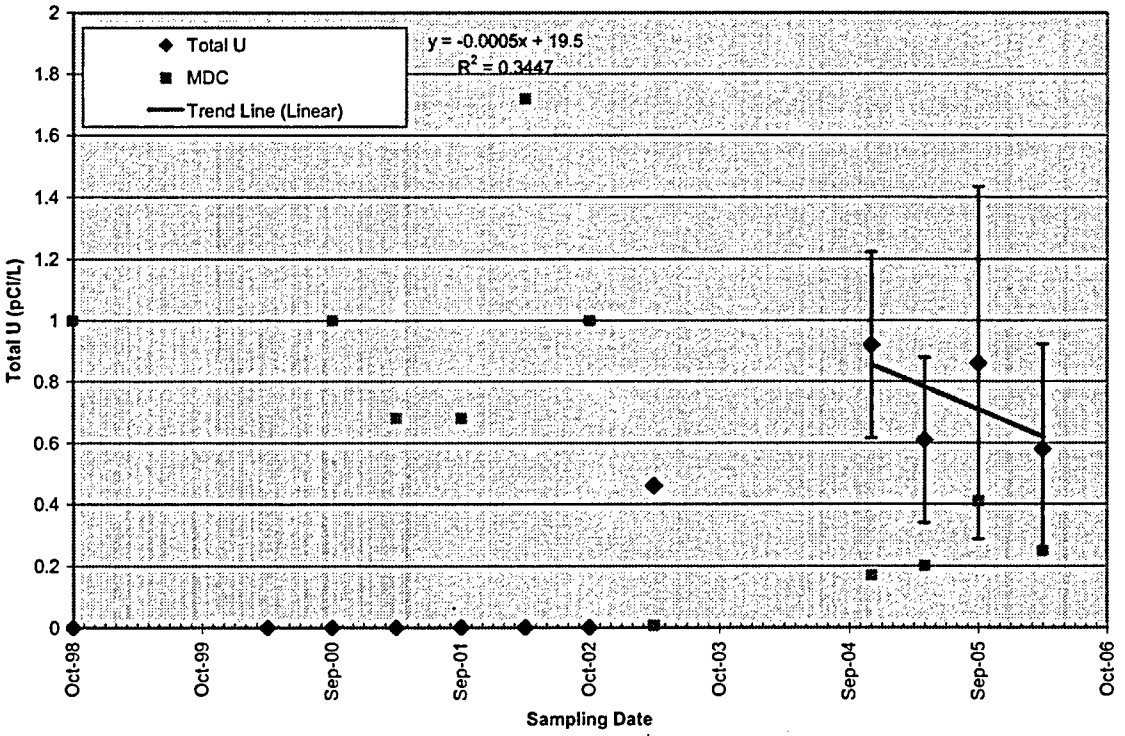

Figure 4-8. Total Uranium in MW-DU-008 (1998-2006)

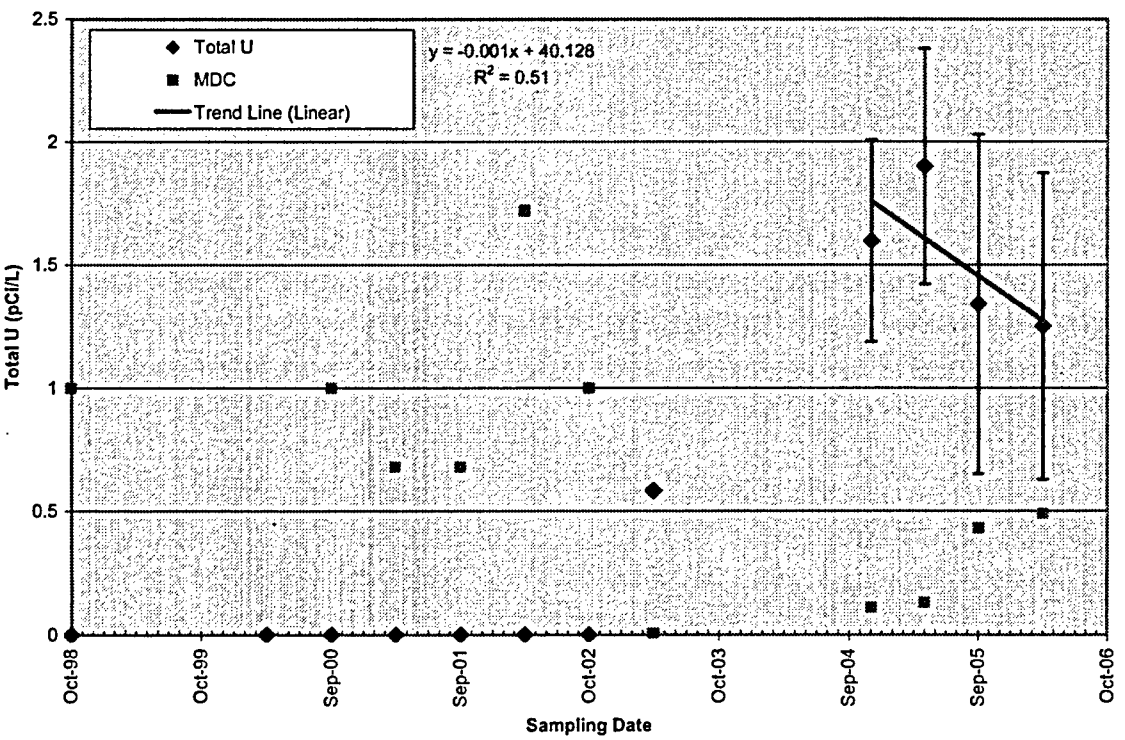

Figure 4-9. Total Uranium in MW-DU-009 (1998-2006)

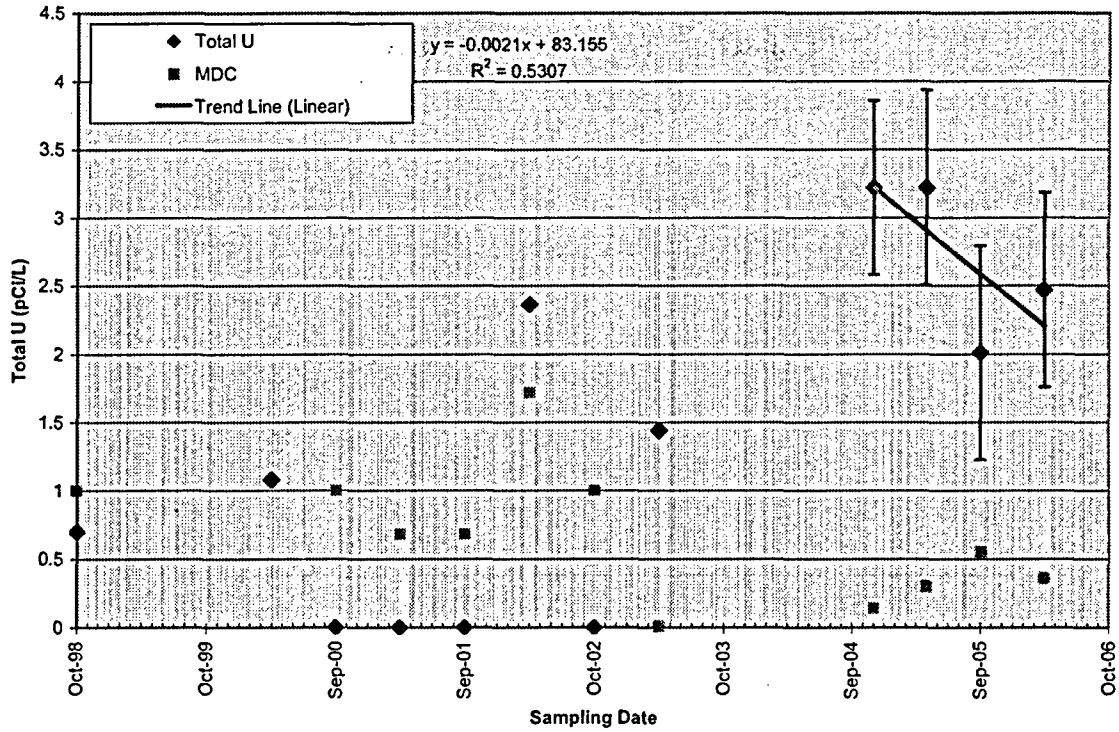

Figure 4-10. Total Uranium in MW-DU-010 (1998-2006)

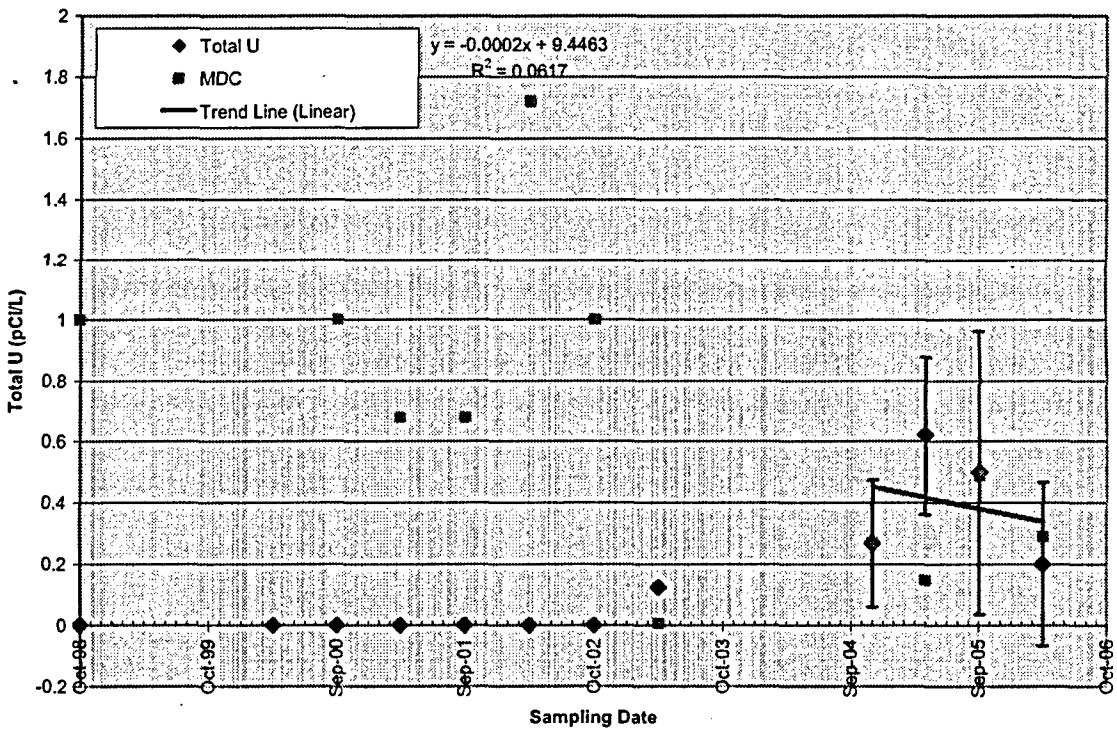

Figure 4-11. Total Uranium in MW-DU-011 (1998-2006)

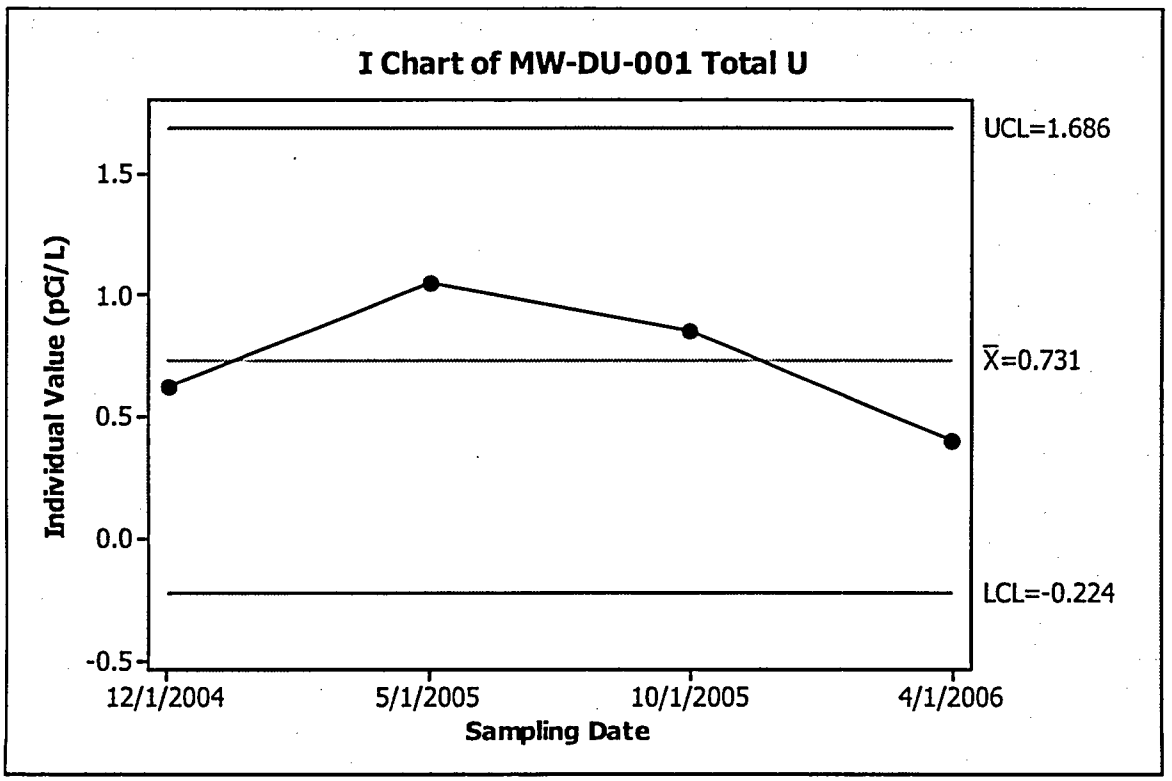

Figure 4-12. Variable Control Chart for Total Uranium in MW-DU-001 (2004-2006)

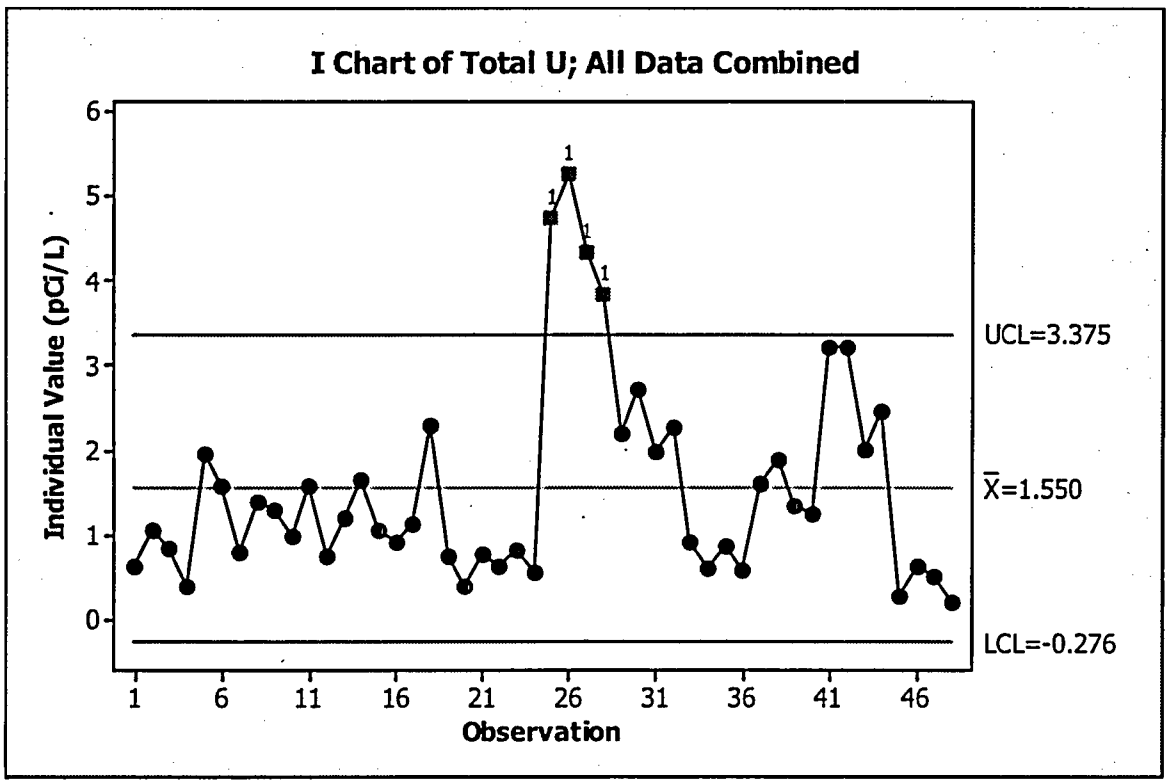

Figure 4-13. Control Chart for All Monitoring Well Data (2004-2006)

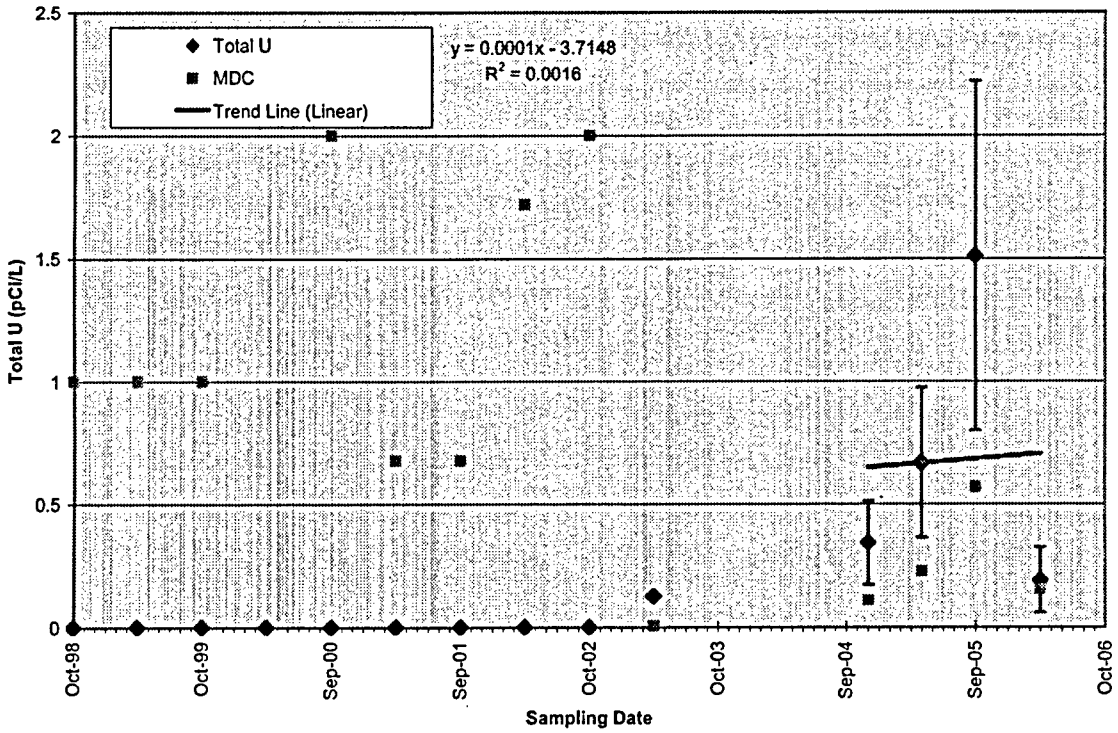

Figure 4-14. Total Uranium in SW-DU-001 (1998-2006)

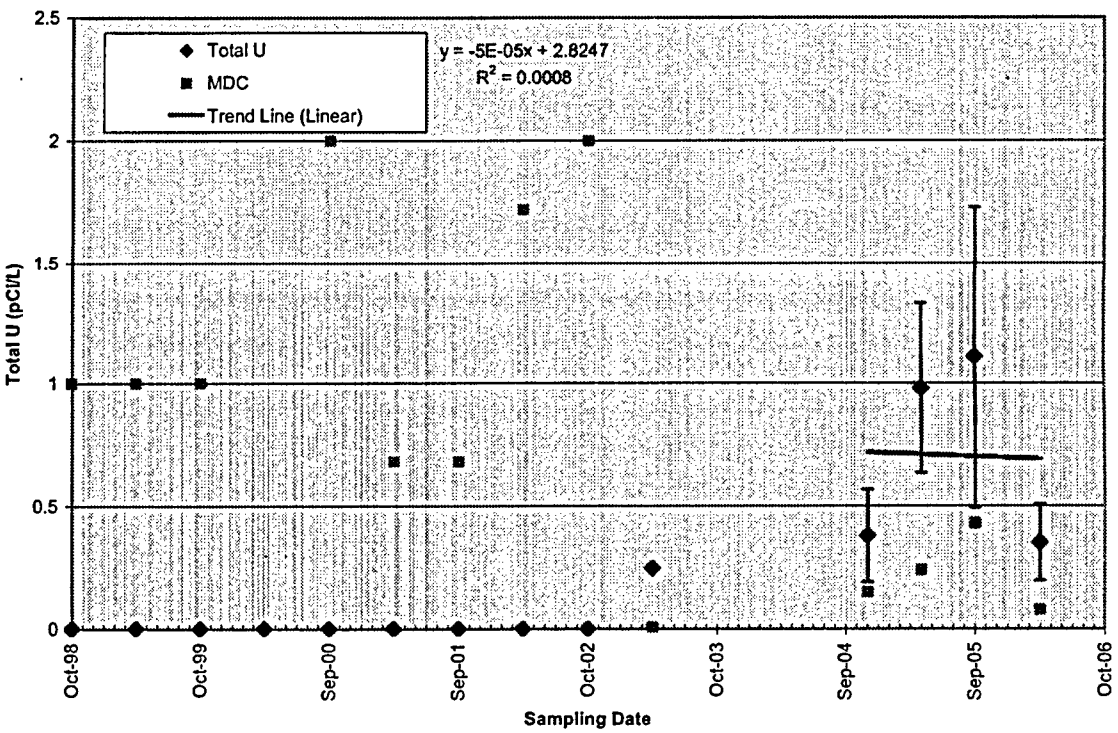

Figure 4-15. Total Uranium in SW-DU-002 (1998-2006)

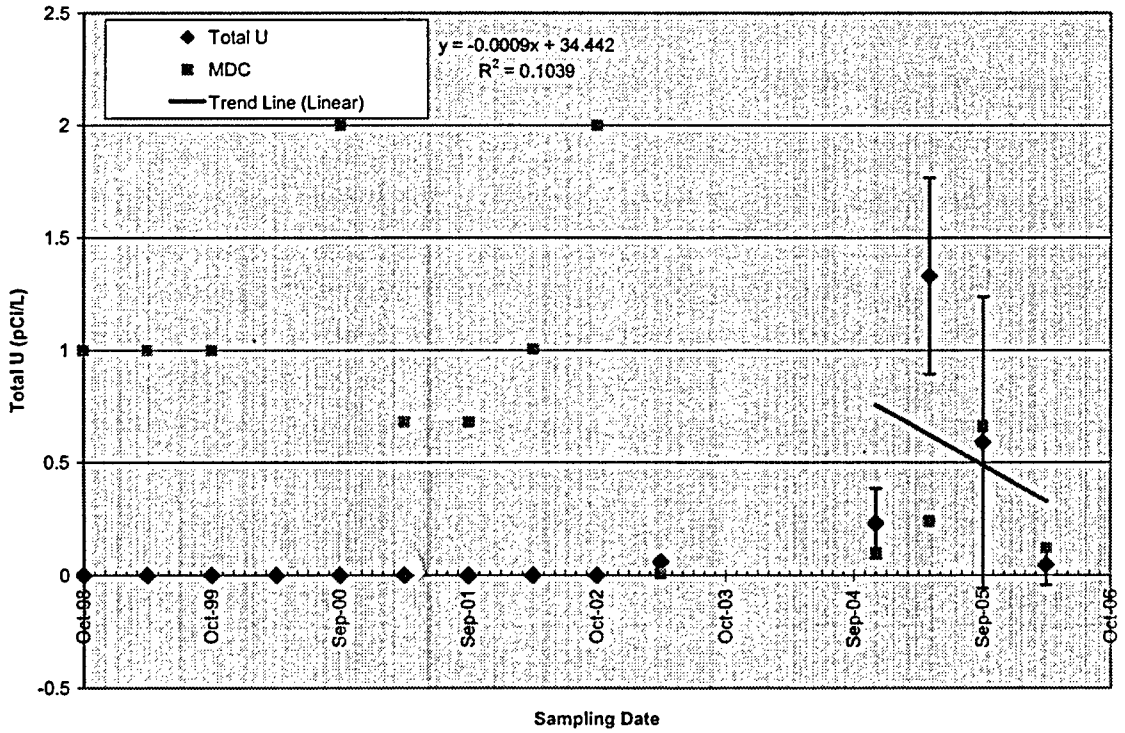

Figure 4-16. Total Uranium in SW-DU-003 (1998-2006)

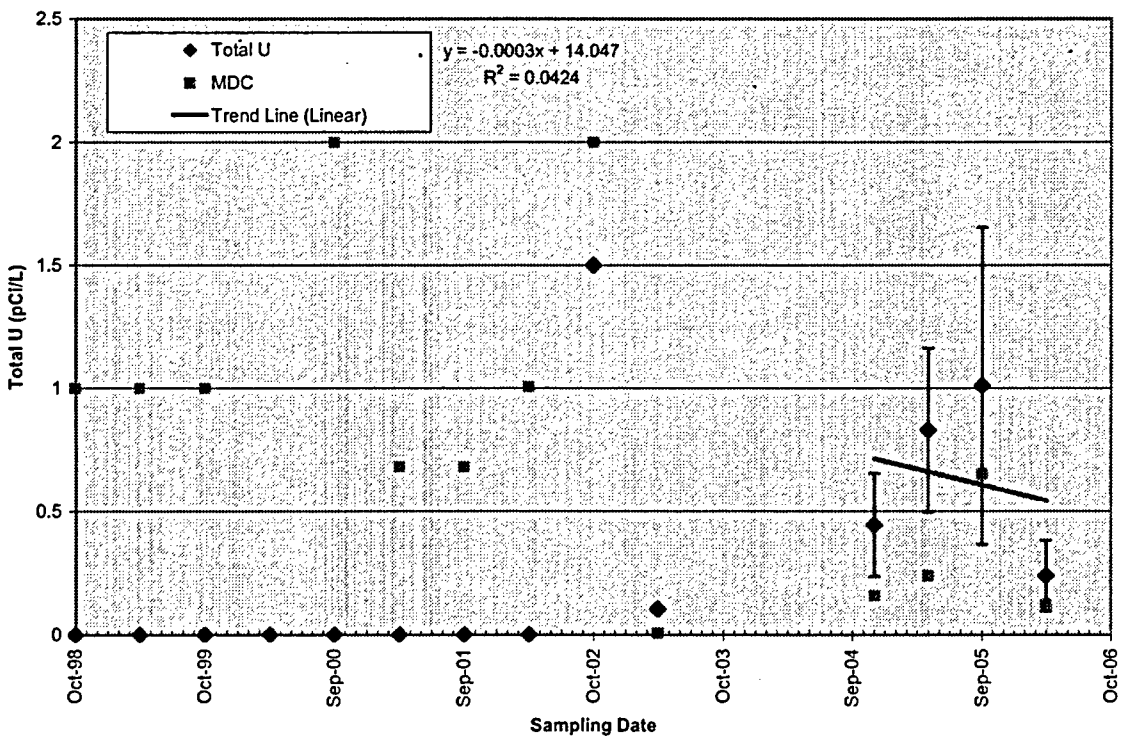

Figure 4-17. Total Uranium in SW-DU-004 (1998-2006)

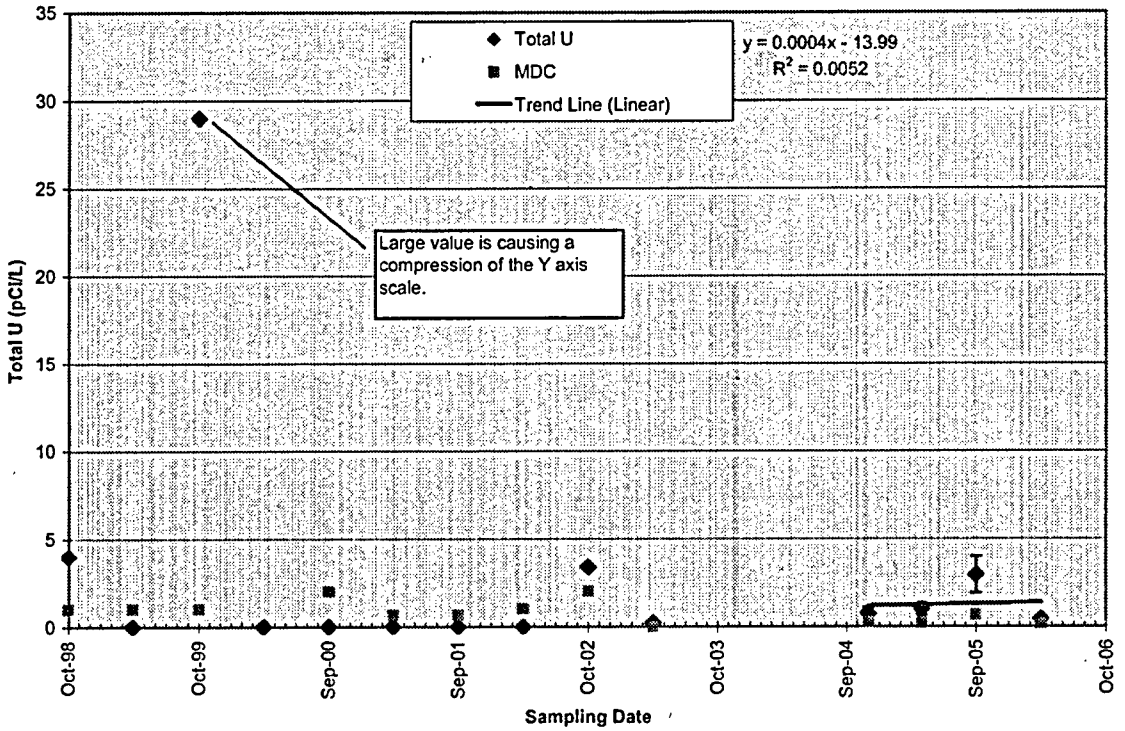

Figure 4-18. Total Uranium in SW-DU-005 (1998-2006)

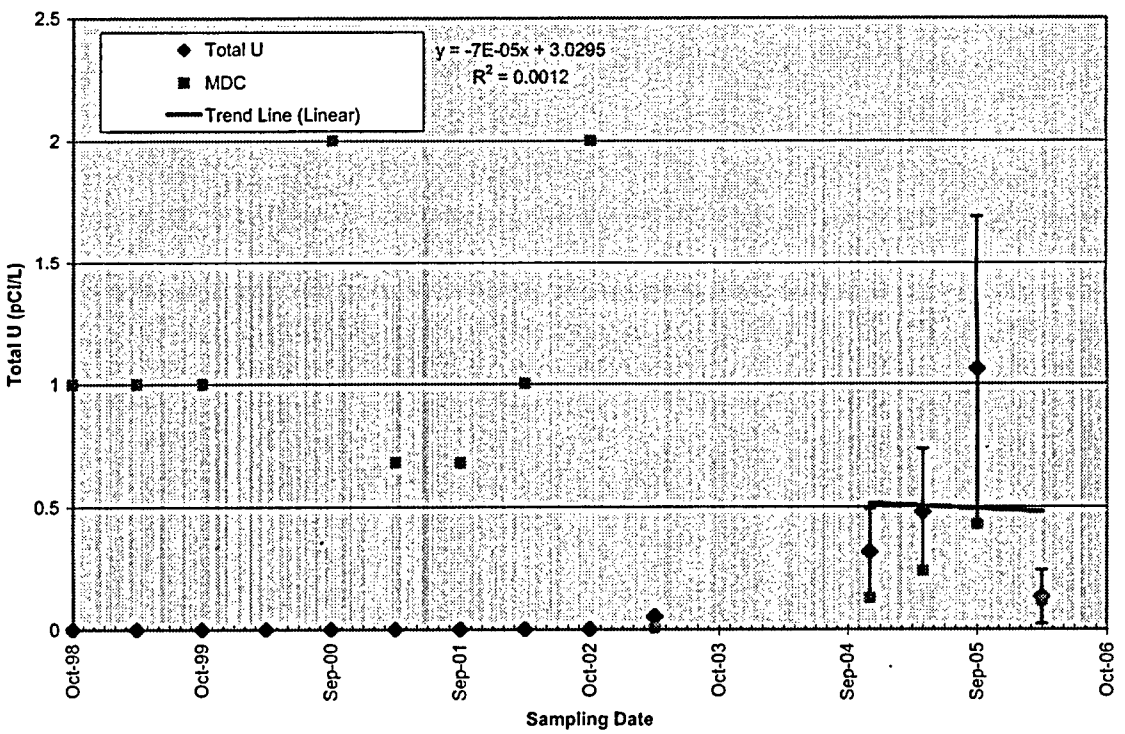

Figure 4-19. Total Uranium in SW-DU-006 (1998-2006)

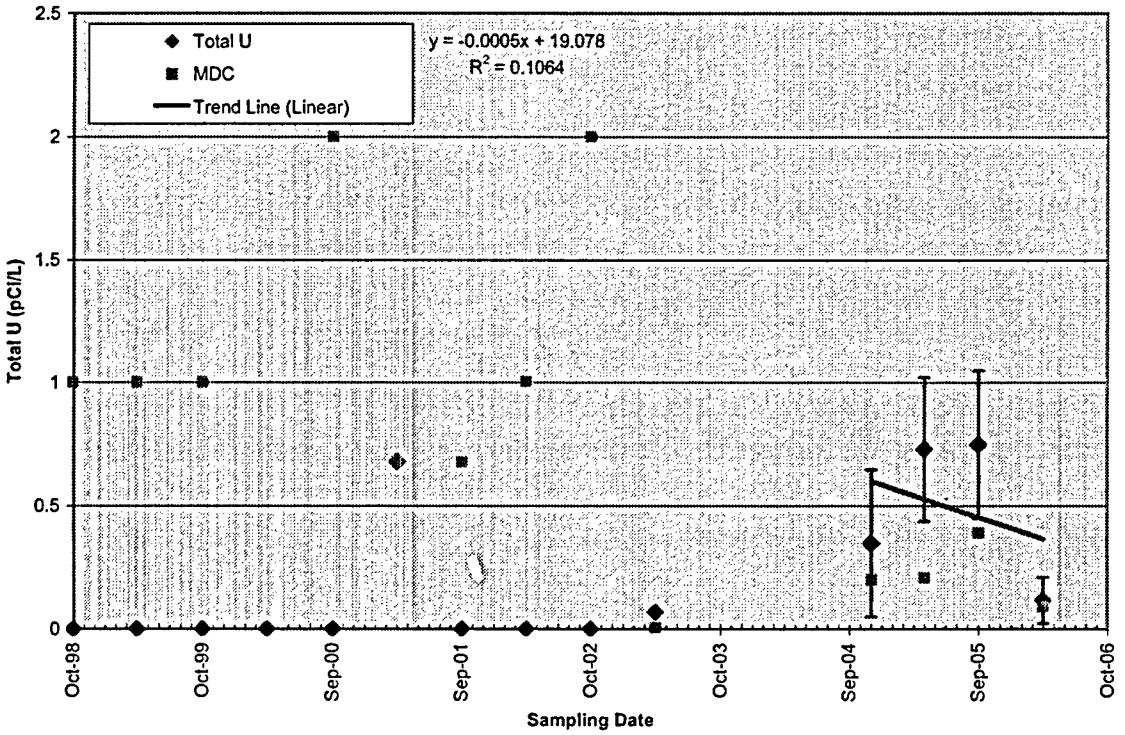

Figure 4-20. Total Uranium in SW-DU-007 (1998-2006)

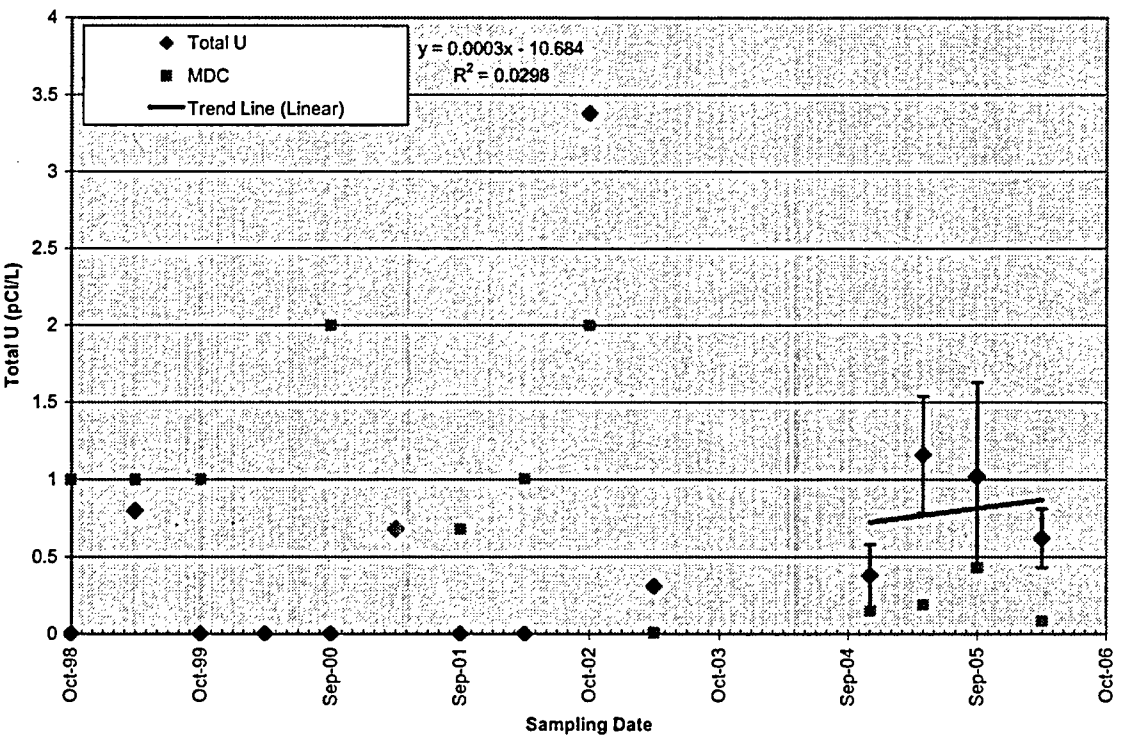

Figure 4-21. Total Uranium in SW-DU-008 (1998-2006)

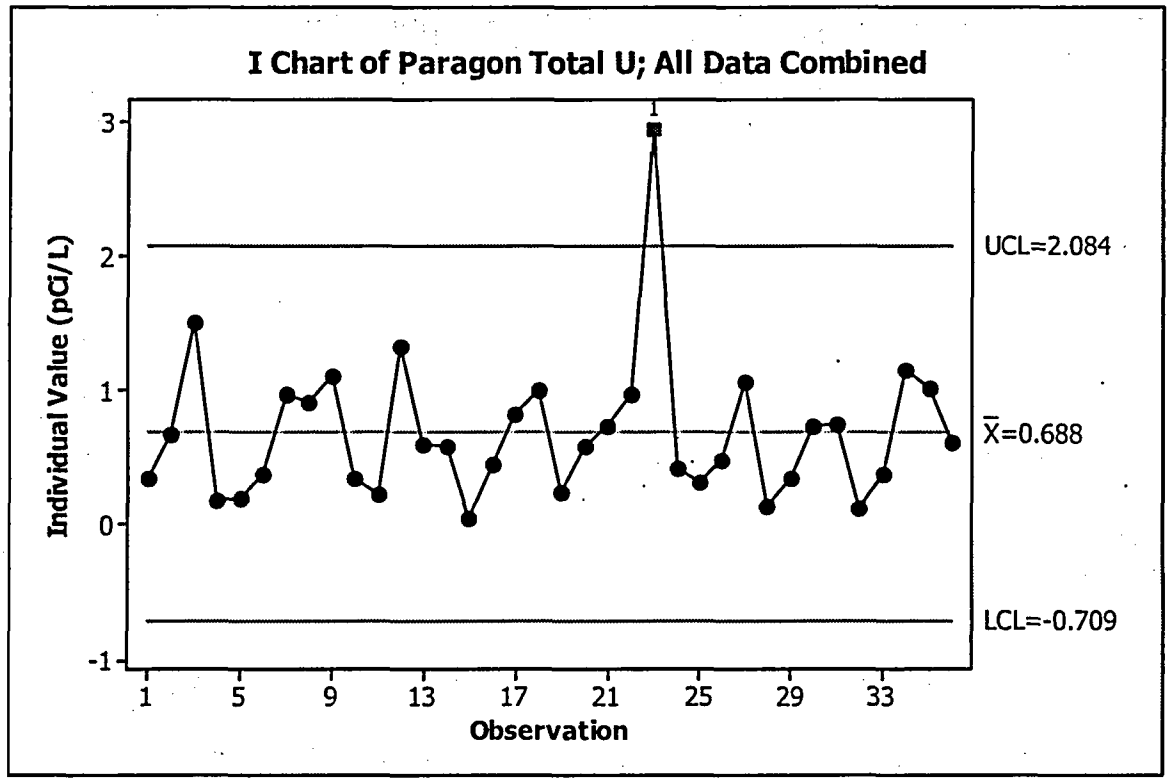

Figure 4-22. Control Chart for All Surface Water Data (2004-2006)

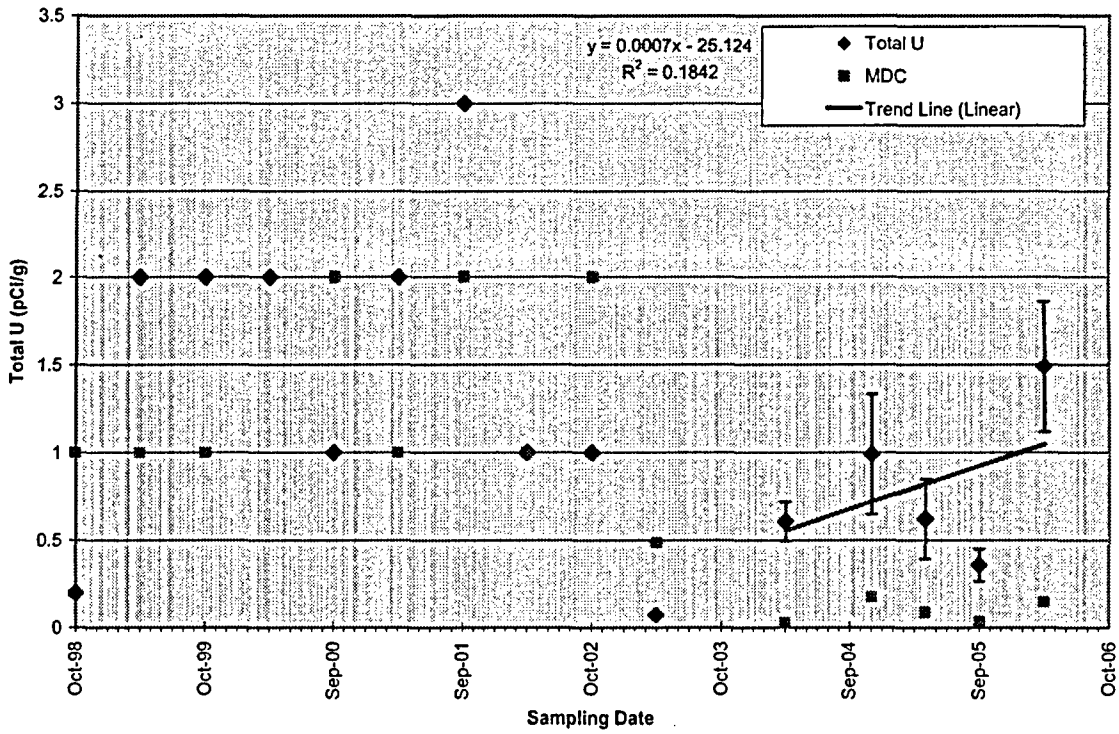

Figure 4-23. Total Uranium in SD-DU-001 (1998-2006)

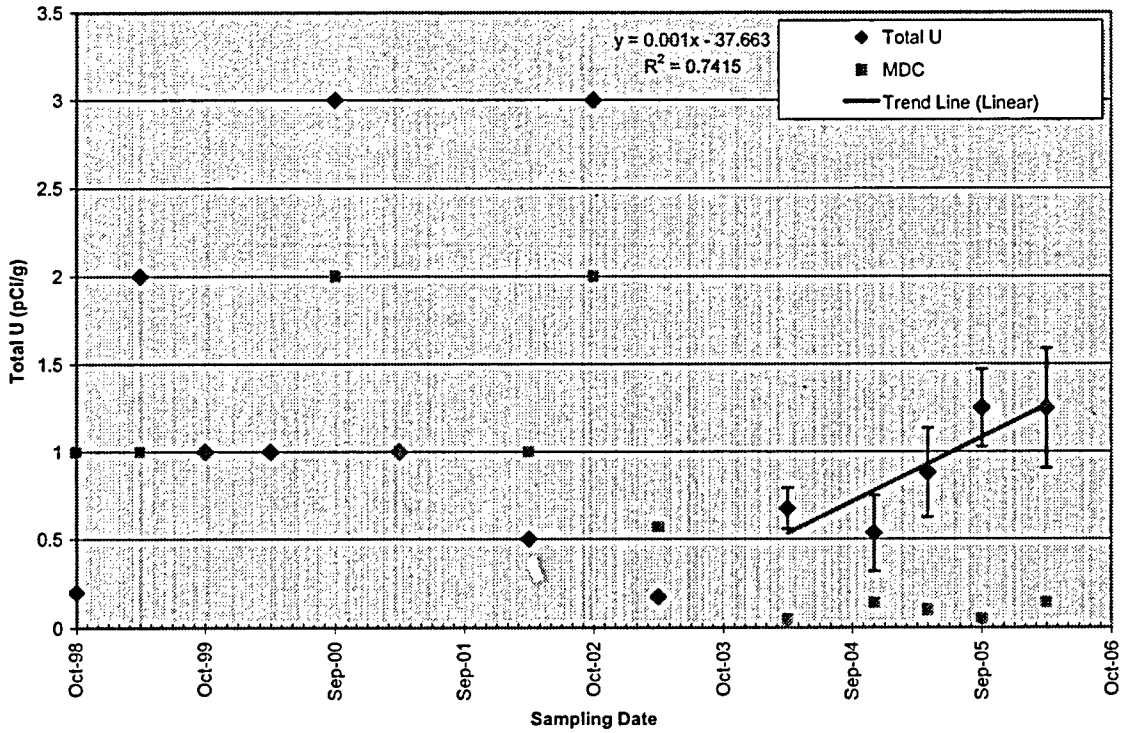

Figure 4-24. Total Uranium in SD-DU-002 (1998-2006)

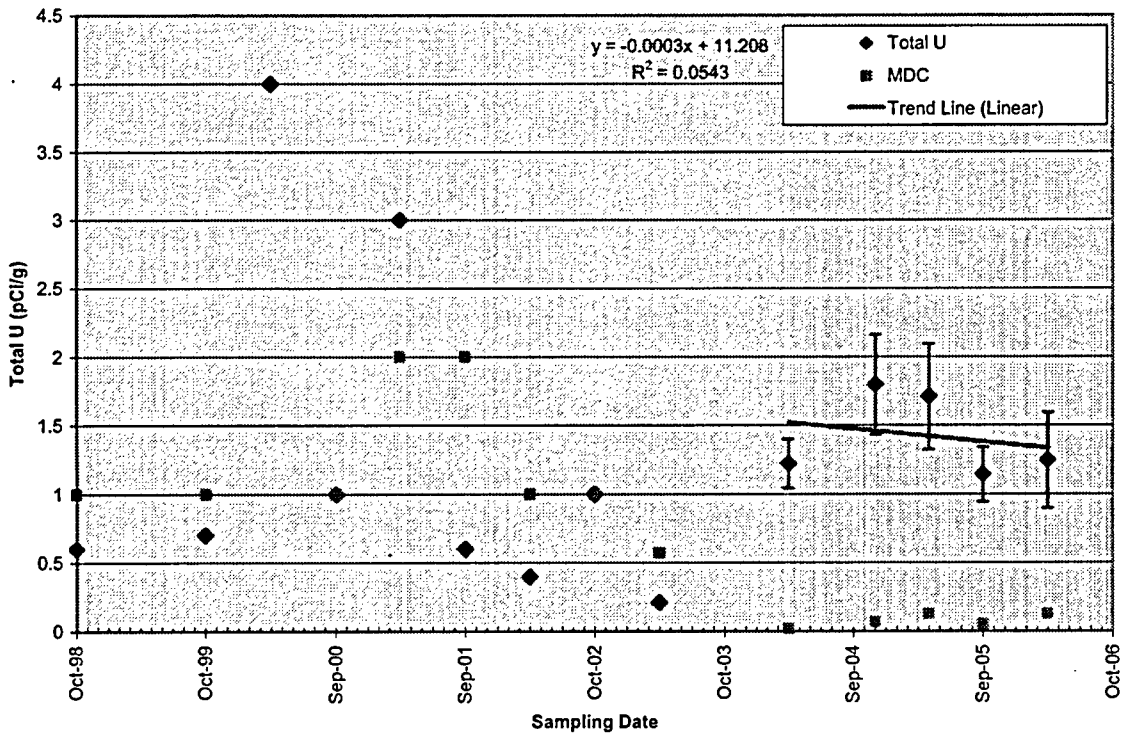

Figure 4-25. Total Uranium in SD-DU-003 (1998-2006)

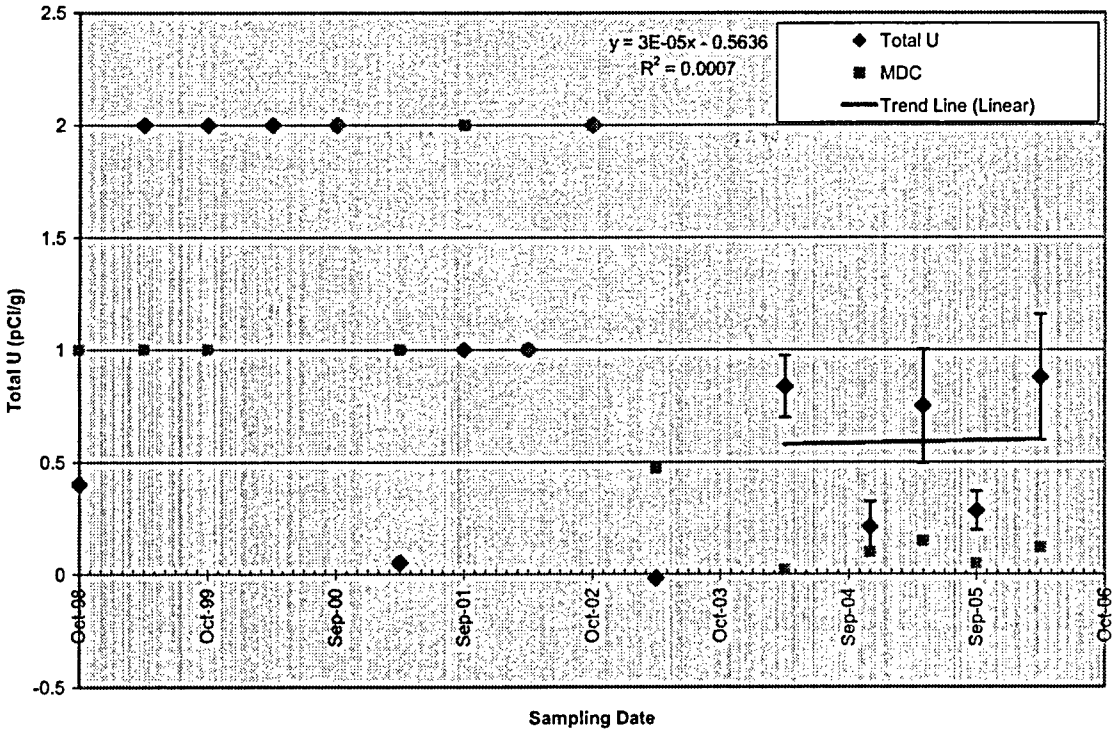

Figure 4-26. Total Uranium in SD-DU-004 (1998-2006)

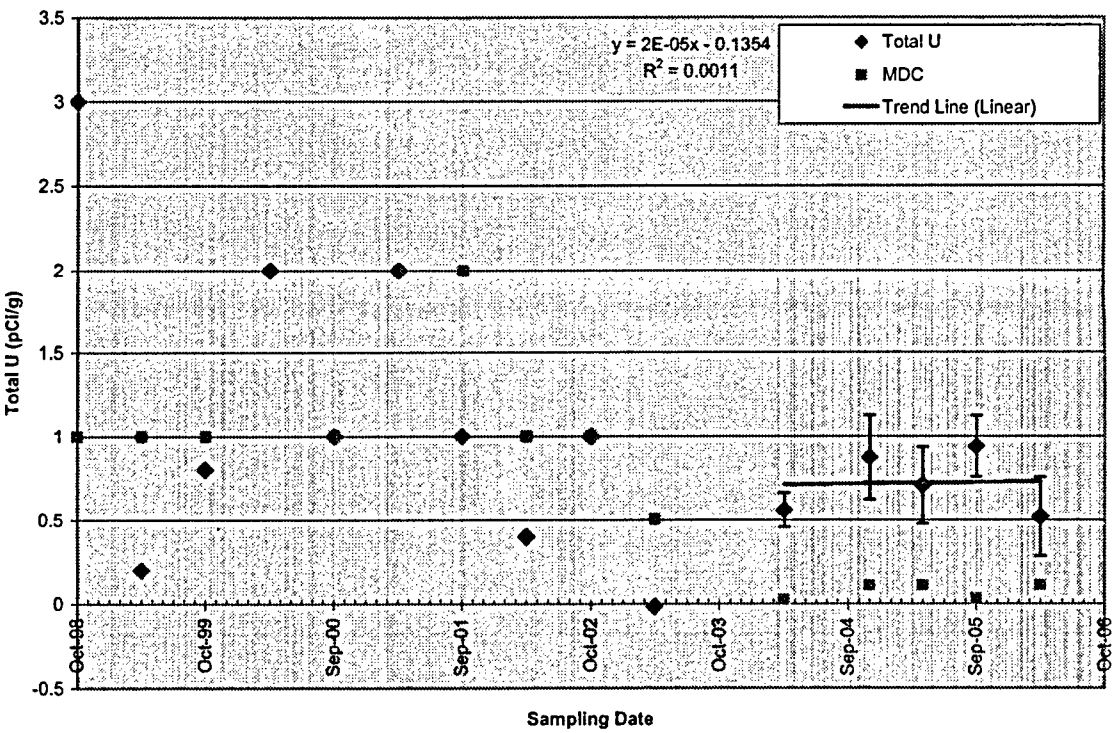

Figure 4-27. Total Uranium in SD-DU-005 (1998-2006)

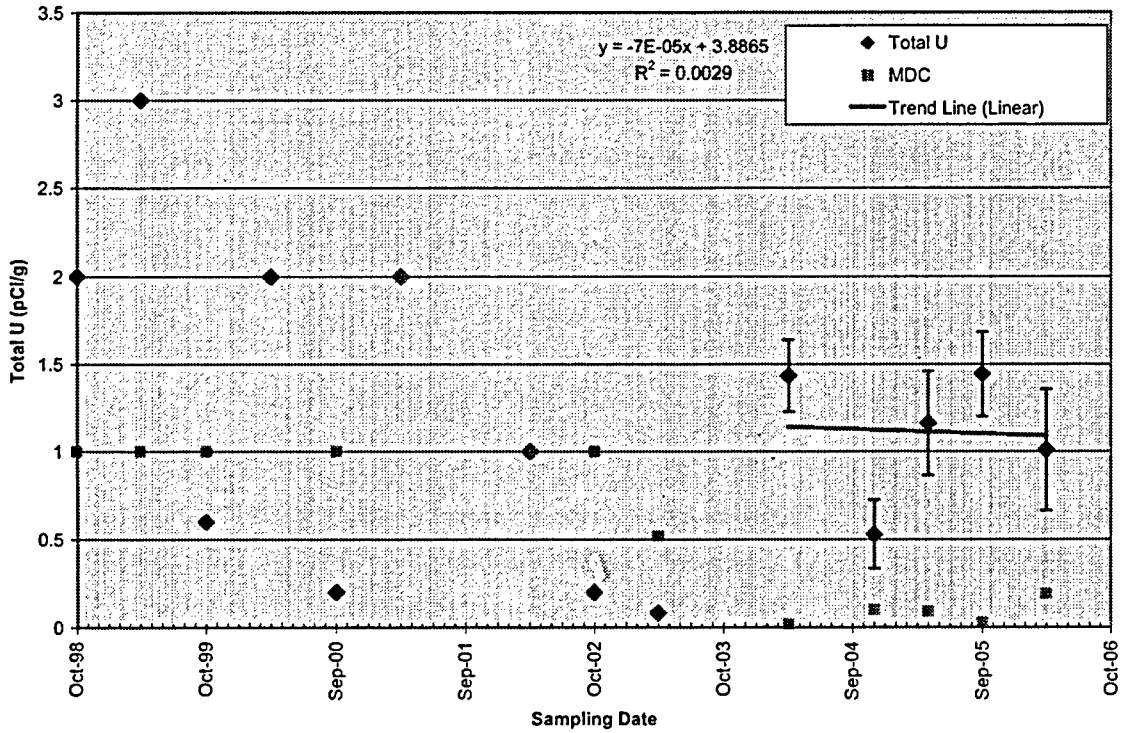

Figure 4-28. Total Uranium in SD-DU-006 (1998-2006)

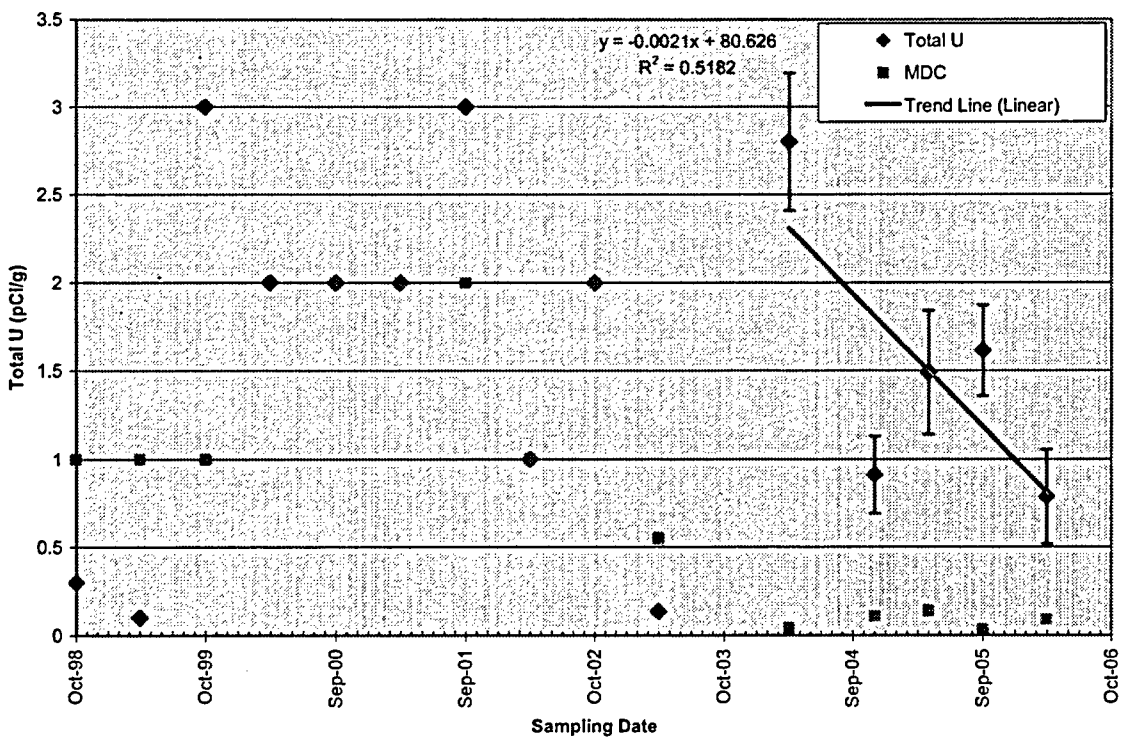

Figure 4-29. Total Uranium in SD-DU-007 (1998-2006)

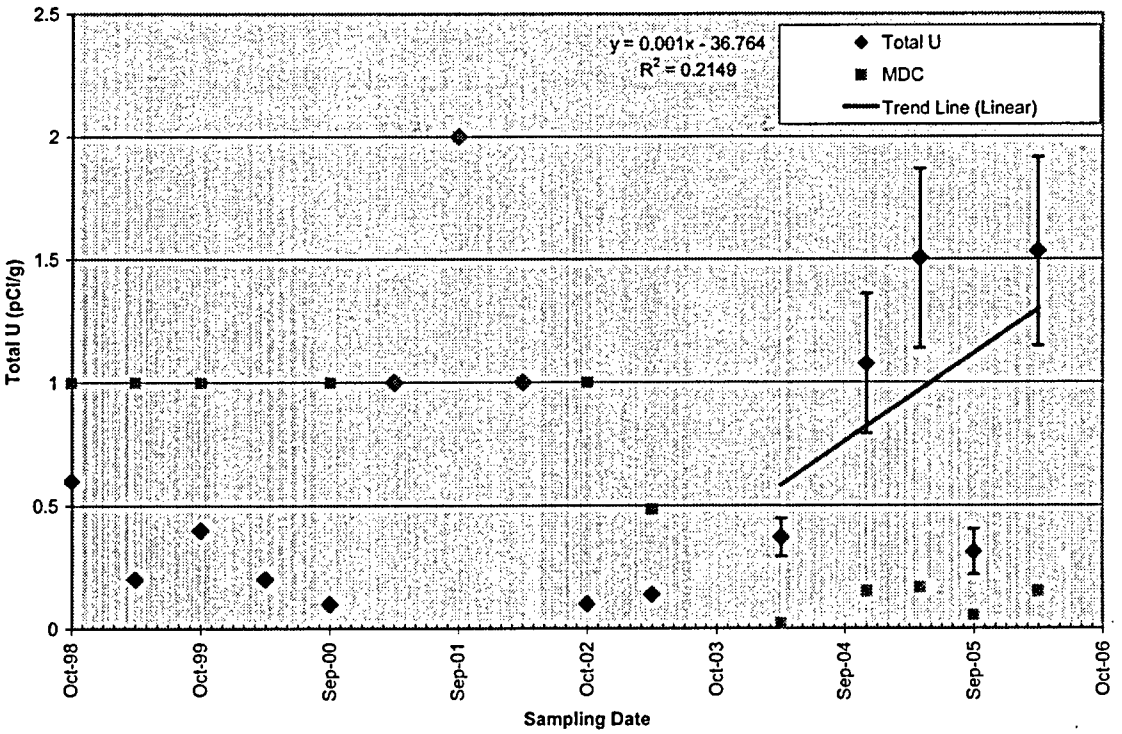

Figure 4-30. Total Uranium in SD-DU-008 (1998-2006)

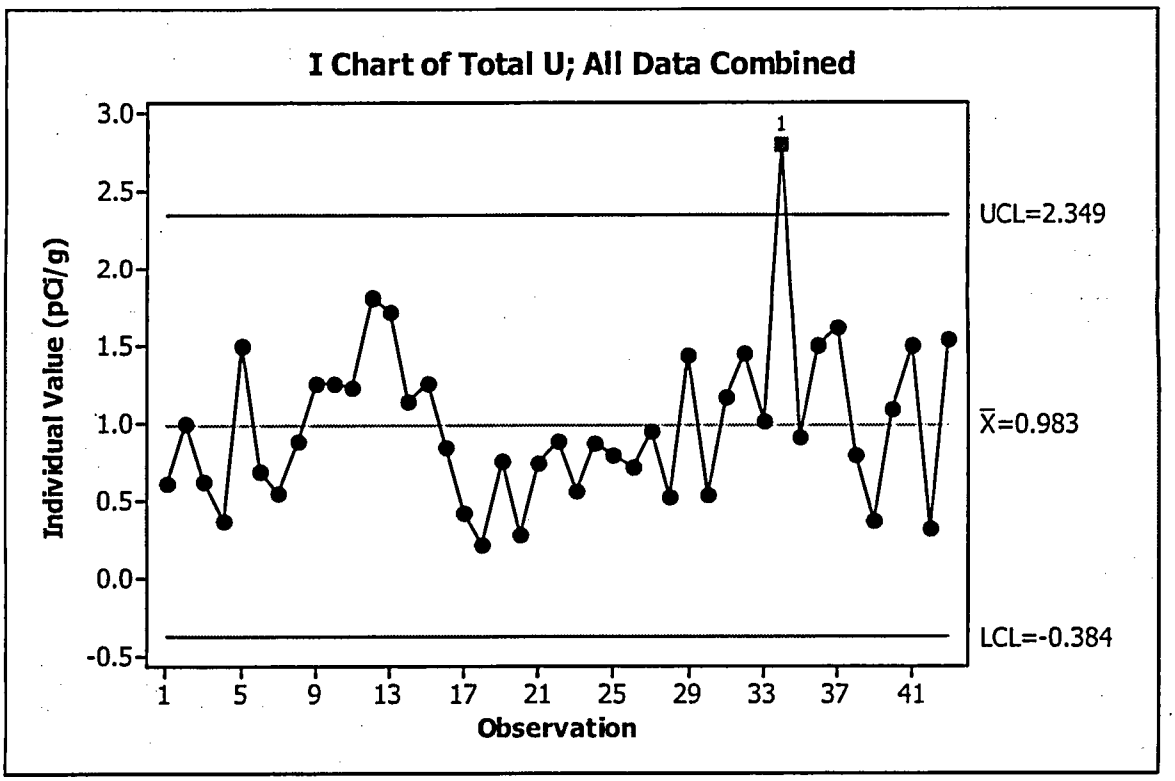

Figure 4-31. Control Chart for All Sediment Data (2004-2006)

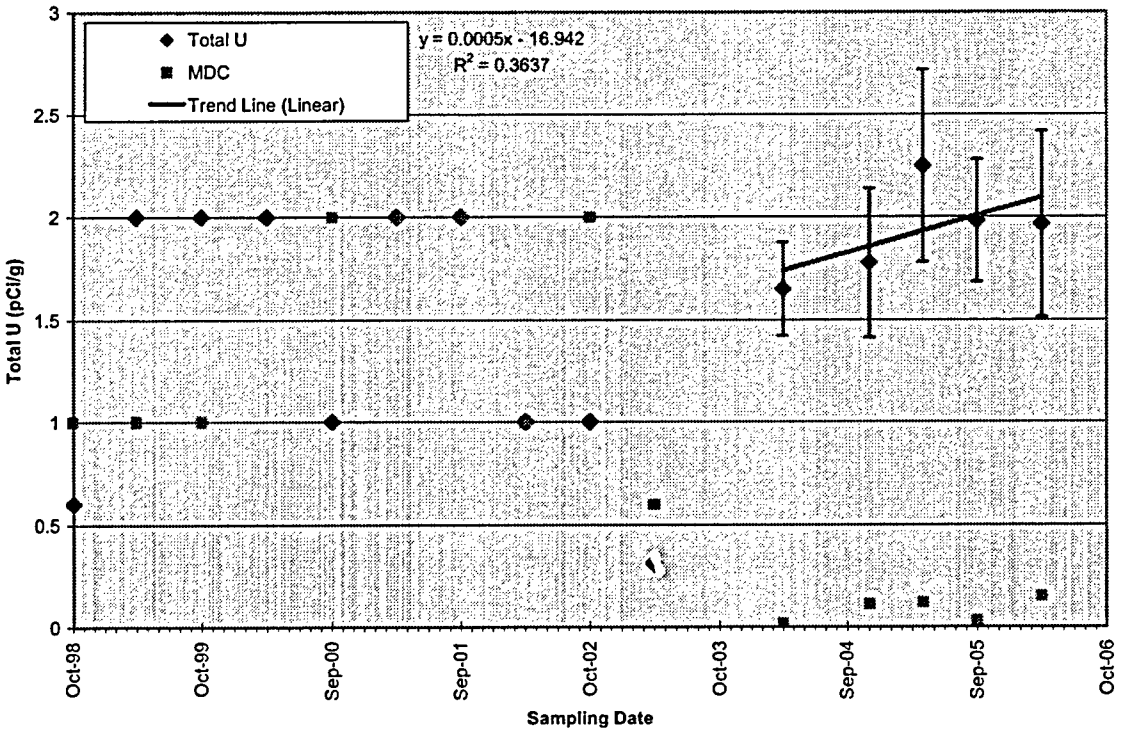

Figure 4-32. Total Uranium in SS-DU-001 (1998-2006)

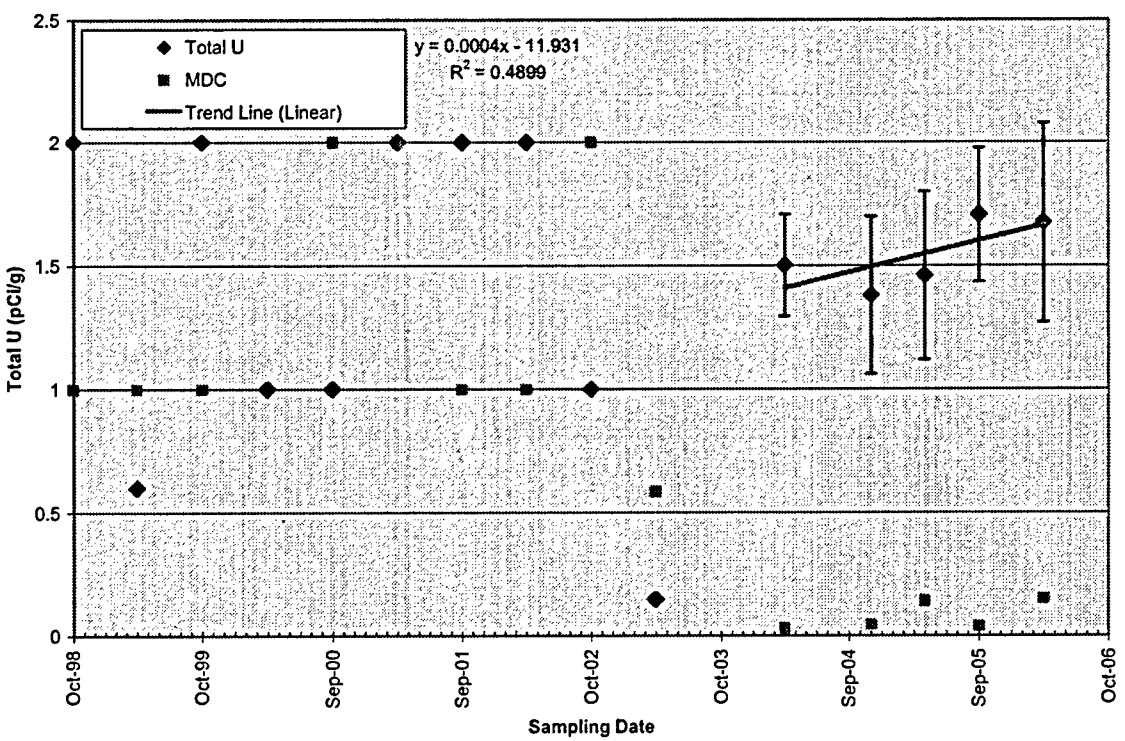

Figure 4-33. Total Uranium in SS-DU-002 (1998-2006)

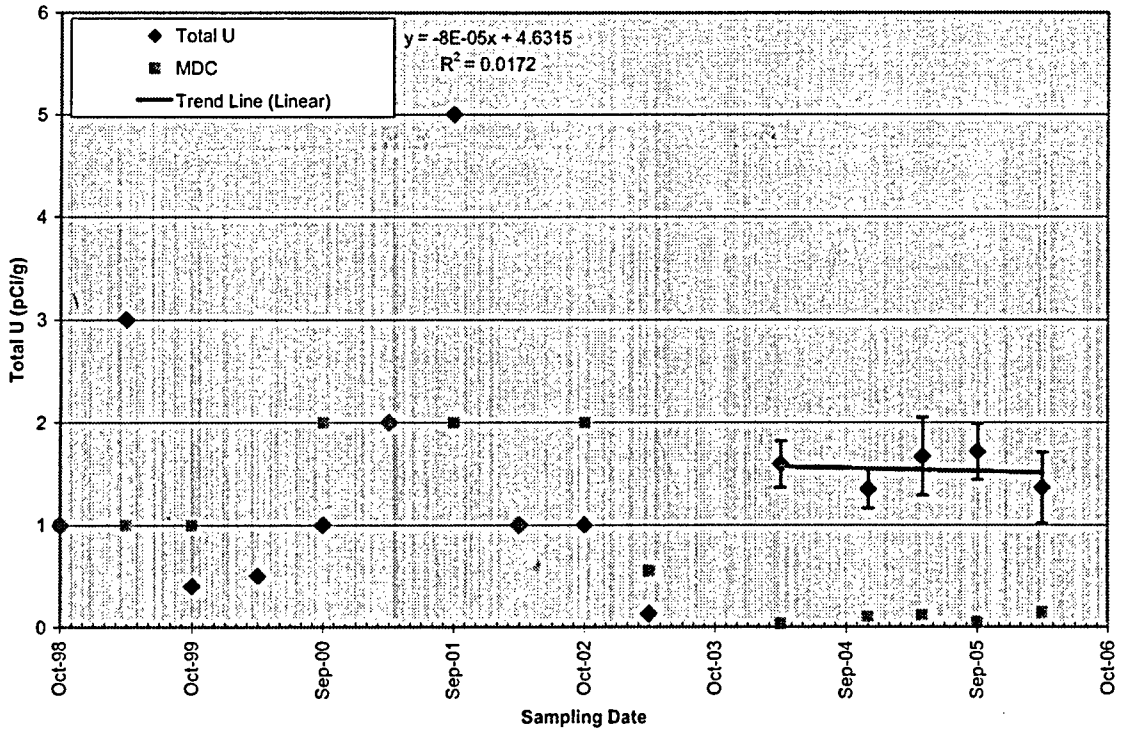

Figure 4-34. Total Uranium in SS-DU-003 (1998-2006)

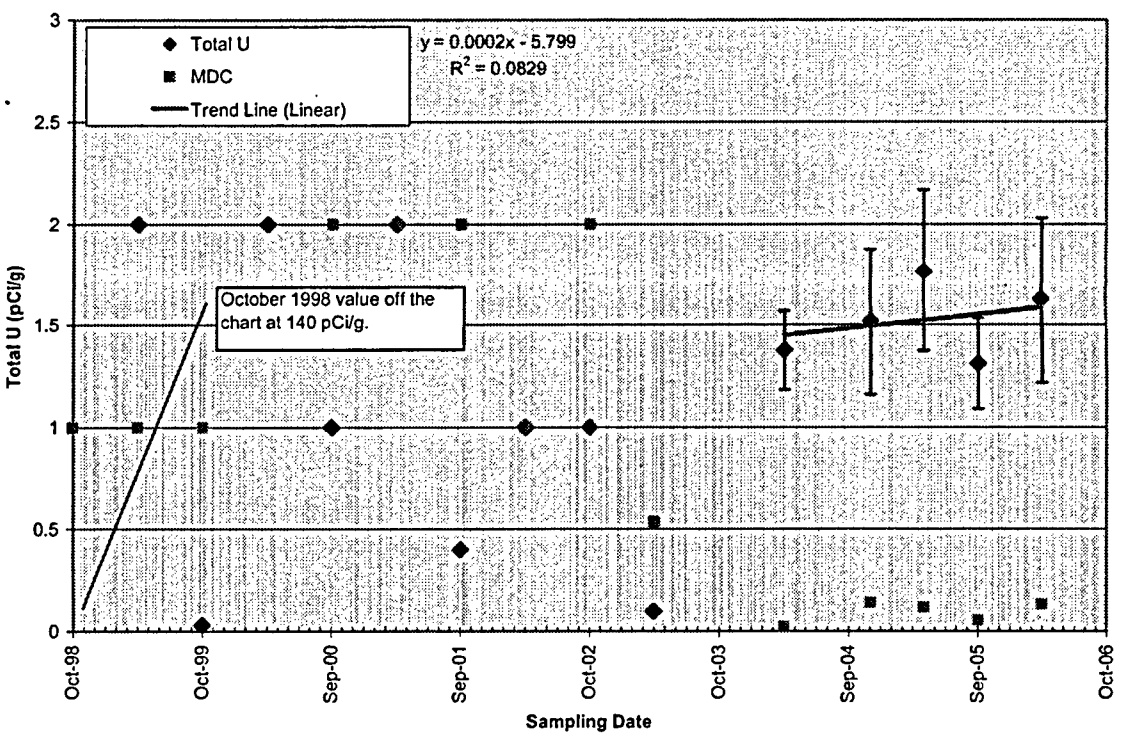

Figure 4-35. Total Uranium in SS-DU-004 (1998-2006)

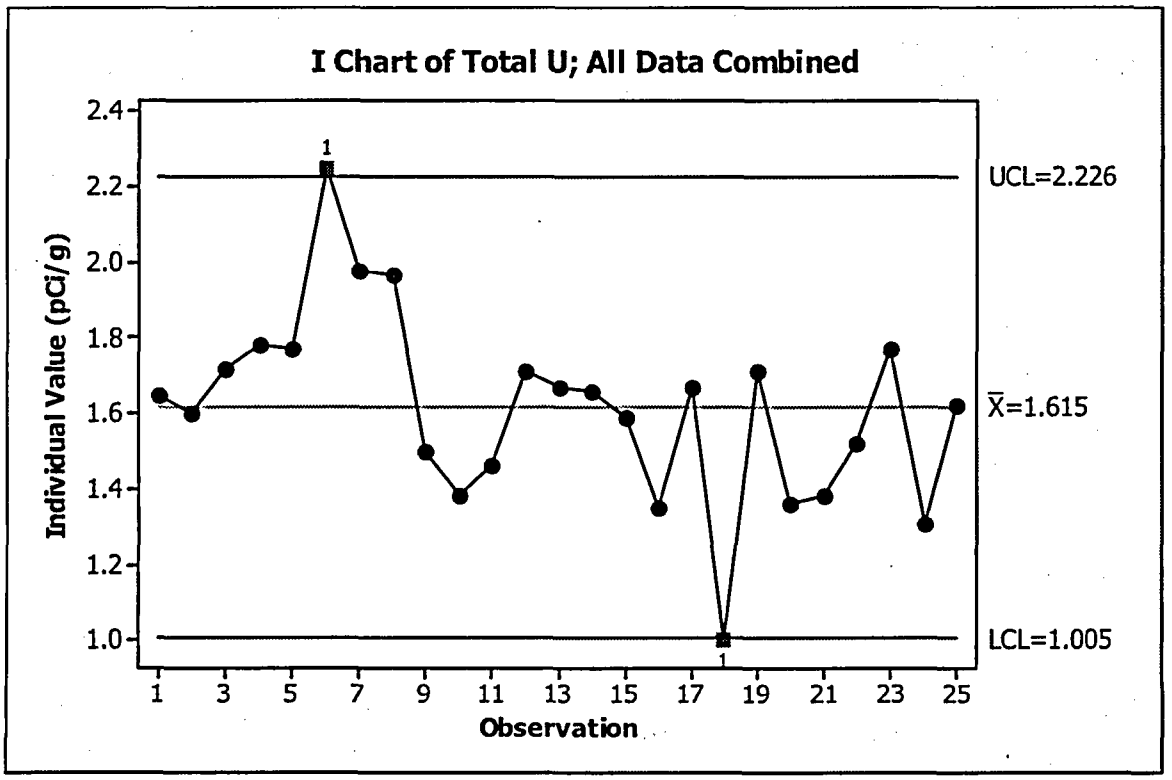

Figure 4-36. Control Chart for All Surface Soil Data (2004-2006)

5. CONCLUSIONS AND RECOMMENDATIONS

The April 2006 sampling event was conducted in accordance with the SOP (CHPPM 2000), and all data were determined to comply with the requirements of the Quality Assurance Project Plan (QAPP) (see Appendix A). None of the environmental media samples exceeded or even approached the action levels (see Table 4-1) established in the SOP. There was no indication of DU in any of the environmental media sampled and the trend analysis completed did not provide evidence of any increasing or decreasing trends in the environmental media sampled. Future environmental monitoring will continue to be completed in accordance with the SOP until it is superseded by a revised ERM Program Plan.

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6. REFERENCES

CHPPM (U.S. Army Center for Health Promotion and Preventative Medicine). 2000. *Standard Operating Procedure, Depleted Uranium Sampling Program, Environmental Radiation Monitoring Program.* SOP No. OHP 40-2. March 10.

CFR (Code of Federal Regulations). 2004. 10 CFR 40.4. Energy. Nuclear Regulatory Commission. Domestic Licensing of Source Material. Definitions.

CFR. 2004. 10 CFR 20. Energy. Nuclear Regulatory Commission. Standards for Protection Against Radiation.

NRC (Nuclear Regulatory Commission). 1988. License Number SUB-1435 and Subsequent Amendments, Jefferson Proving Ground, Madison, Indiana. U.S. Army, TECOM, Aberdeen . Proving Ground, Maryland. May 8.

U.S. Army. 2002. Decommissioning Plan for License SUB-1435. Jefferson Proving Ground, Madison, Indiana. Prepared for the U.S. Army SBCCOM by SAIC. June.

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APPENDIX A
STANDARD OPERATING PROCEDURE

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SOP No. OHP 40-2

Effective Date 10 Mar 00
Date Removed from Service _____

STANDING OPERATING PROCEDURE

Depleted Uranium Sampling Program
Environmental Radiation Monitoring Program
Jefferson Proving Ground, Madison, IN

This SOP supersedes, in its entirety, the SOP of the same name dated April 1998.

1. **Purpose.** This Standing Operating Procedure (SOP) prescribes policies, responsibilities, and procedures for administration and execution of the Health Physics Program (HPP), USACHPPM support of the Soldier and Biological Chemical Command (SBCCOM) biannual Environmental Radiation Monitoring (ERM) Program conducted at the Jefferson Proving Ground, Madison, Indiana.

2. **Authority.**

a. US Nuclear Regulatory Commission License No. SUB-1435.

b. Program Services Meeting, 14 September 1999, between SBCCOM and HPP, USACHPPM.

3. **Scope.** This SOP applies to Health Physics Program personnel performing the collection of environmental samples in support of the ERM.

4. **Definitions, Abbreviations.** A list of terms and abbreviations used in this SOP can be found in Annex A.

5. **Forms, Labels, and Worksheets.** A sample of all forms, sample labels, and sample collection worksheets can be found in Annex B.

6. **Point(s) of Contact for Program Coordination:**

a. **Soldier and Biological Chemical Command**
Ms. Joyce Kuykendall, SBCCOM Health Physicist
Comm: 410-436-7118
DSN : 584-7118
email: joyce.kuykendall@sbccom.apgea.army.mil

b. **US Army Center for Health Promotion and Preventive Medicine**
Health Physics Program (Pgm 26)
Comm: 410-436-3502
DSN : 584-3502
fax : 410-436-8261/8263

Radiologic, Classic and Clinical Chemistry Division (RCCCD)
Comm: 410-436-3983/8235
DSN: 584-8235

c. **Jefferson Proving Ground**
Mr. Ken Knouf, Site Manager
Mr. Phil Mann
Ms. Yvette Hayes
Comm: 812-273-2551/2522/6075

7. **Survey Coordination.**

a. Pre-Survey Coordination: 60 days prior to scheduled sample date.

1) Initial Coordination: - made through the SBCCOM Health Physicist. Close coordination with the site management team at JPG will be required to ensure support will be onsite at the time of sampling.

2) USACHPPM HPP Program Assistant, (410) 436-1303, (if call from the Edgewood Arsenal: 5-1303) will be contacted to initiate travel orders. Due to the nature of the sampling program, a four-wheel drive vehicle is required to perform this project. The project and associated report number will be 26-MA-8260-R#-YY. The R# will be a "1" for the October and "2" for the April survey, and the YY will be the current fiscal year.

3) Prepare CHPPM Form 330-R-E (Request for Laboratory Services. (See Annex B) This form can be found on the USACHPPM Web Site or through intranet FormFlow program. Current DLS Test Codes being used are as follows:

Evaluations for Uranium in Soils for the soil and sediment samples, DLS Test Code: 803; STD Method: G-002.

Evaluations for Uranium in Water for the ground and surface water samples, DLS Test Code: 586; STD Method: U-002.

Note: Sample containers for all medium except soils, are provided by SBCCOM and will be onsite however sample labels should be requested from the lab.

Ensure that sample bags, labels and coolers are shipped to the following address:

US Army Jefferson Proving Ground
1661 West J.P.G. Niblo Road (Bldg. 125)
Madison, IN 47250
(812) 273-2551

4) Request for instrumentation to support the sampling program should be made no later than 30 days prior to the scheduled departure date.

Radiation detection instrumentation and soil sampling tools will be coordinated through the HPP Instrumentation Coordinator, ext. 8228. Electronic message will be used for coordination.

Water Quality Instrumentation (pH meter, temperature, and conductivity) will be coordinated through the Surface Water and Waste Water Program (Pgm 32) at extension 3310/4211.

5) Final coordination for project should be completed no later than 14 days prior to departure date.

Contact the site management personnel at JPG and schedule dates for purging of wells prior to arrival. Purging should be accomplished no later than the Friday preceding and no earlier than 14 days prior to the scheduled start date of the sampling visit.

b. Field instrument quality control. Upon receipt of field instruments from the HPP Instrument Coordinator and the Surface Water and Waste Water Program, appropriate instrument quality control checks will be conducted to ensure proper operation prior to departure.

1) Radiation detection instrumentation will be checked for response against a radiation check source. This check source should also be shipped to the survey site for instrument verification on

site. The radiation check source used need not be a calibrated source as instrument response is the parameter being evaluated.

2) Water quality instruments should also be verified using guidance provided by water program personnel. At a minimum, verify the accuracy of the pH meter using the certified pH solution packets.

8. **Sample Collection.** Four separate sample matrixes will be collected in support of the ERM. Methodologies for sampling can be found in US Army Environmental Hygiene Agency (the predecessor to USACHPPM) Technical Guide 155, Environmental Sampling Guide, February 1993.

a. Ground Water Samples. A total of 11 monitoring wells have been established to be used for the Environmental Monitoring Program. Wells are indicated on the ground water sample map (figure 1, Anne C) using an alphanumeric code containing the letters MW and a two digit sample number (01-11).

1) Sample will be collected using a new hand bailer for each sample. Care will be taken when lowering the bailer into the well to prevent unnecessary aeration or contamination of the sample.

2) A total quantity to be collected will be 1 US gallon.

3) A portion of the first bailer full of water will be placed into a clean beaker, or other suitable container, and an evaluation of radiation level, temperature, pH and conductivity will be conducted and recorded.

4) Sample information will be recorded on the Ground Water Sample Collection Worksheet. (Annex B)

5) Samples will not be filtered or persevered in the field.

b. Soil Samples. A total of 4 soil samples will be collected, one from each corner of the trapezoidal impact area. Sample locations are indicated on the soil sample map (figure 2, Annex C).

1) Sample will be collected using a new or properly cleaned scoop, trowel, or other suitable tool. Sample will be placed in a self sealing (Ziploc®) bag.

2) A sample quantity of approximately 1000 grams will be collected.

3) Radiation dose rate measurements will be taken at 1 meter above the sample location and recorded on the Soil Sample Collection Worksheet (Annex B).

c. Surface Water Samples. A total of 8 sample locations have been identified for the collection of water sample from the two creeks that run through the DU impact area (figure 3, Annex C).

1) Sample will be collected using the grab method. Sample container will be positioned pointing upstream and below the surface of the water.

2) A sample quantity of 1 US gallon will be collected.

3) Radiation dose rate measurements will be taken at 1 meter above the sample location and recorded on the Surface Water Sample Worksheet (Annex B).

4) Water sample will not be filtered or preserved in the field.

d. Sediment Sample. A total of 8 sample locations have been identified for the collection of sediment samples from the two creeks that run through the DU impact area. Sediment samples will be collected at the sites selected for surface water collection (figure 3, Annex C).

1) Sample will be collected using a new or properly cleaned scoop, trowel, or other suitable tool. Sample will be placed in a glass sample jar.

2) Sediment sample will be collected only after the water sample has been collected.

3) While a sediment sample is usually considered a solid sample matrix, a certain amount of water is expected in the sample. The sample should not be drained of water that is collected as part of the sample.

4) Radiation dose rate measurements will be taken at 1 meter above the sample location and recorded on the Sediment Sample Worksheet (Annex B).

9. **Sample Management.** Since sample collected are in support of NRC License commitments, chain-of-custody procedures will be followed.

a. Samples will be secured from unauthorized access during the period of sampling.

b. Prior to shipment of samples to USACHPPM, a properly completed CHPPM Form 235-R-E, Chain of Custody Record (Annex B), will be placed in each shipping container. Survey personnel will maintain a copy of the Chain of Custody Record for verification of sample transport.

c. Water samples must reach RCCCD no later than 4 days from the time of sampling. To ensure this time frame is met and that the laboratory has time to filter and preserve the sample if necessary, water samples should be collected on the first day of the sampling trip and shipped the following day. It is not necessary to ship the water, sediments, and soils together.

10. **Sample Analysis.** Sample analysis of all environmental samples will be performed through the USACHPPM RCCCD.

a. Samples will be analyzed in accordance with RCCCD established protocols and procedures. All environmental samples will be coordinated with the SBCCOM RPO for disposal instructions.

1) Water samples will be analyzed fluorometrically for dissolved total uranium.

2) Soil and sediment samples will be analyzed using gamma spectroscopy, keying on the isotopic peaks of the Thorium-234. The thorium is the daughter of U-238 and is considered to be in equilibrium therefore the activity would be equal.

b. The QC for laboratory instruments will be performed by RCCCD.

c. Reports of analysis will be forwarded to the USACHPPM project officer responsible for requesting the sampling. Electronic as well as hard copy reports will be requested.

11. **Action Levels.** Every effort will be made to maintain radiation exposures and releases of radioactive and non-radioactive toxic metals to unrestricted areas as low as is reasonable achievable (ALARA).

a. The following criteria for the restricted area will be used to limit DU exposure. (Limits were established in the NRC Approved ERM)

SOIL:

- Perimeter and background samples:

  ≤ 35 pCi/g - no corrective action.

  > 35 pCi/g - collect 5 additional samples in a 1 meter square grid. If average > 35 pCi/g is confirmed, recommendation to decontaminate soil to ≤ 35 pCi/g will be made to the SBCCOM RPO.

- Sample locations along the lines of fire:

  < 100 pCi/g - no corrective action

  100-300 pCi/g - collect 5 additional samples in a 1 meter square grid. If average > 100 pCi/g is confirmed, investigate to determine reason for the high level.

  > 300 pCi/g - collect 5 additional samples in a 1 meter square grid. If average > 300 pCi/g is confirmed, investigate to determine reason for the high level and immediately notify the SBCCOM RPO to initiate notification to the NRC.

WATER:

- Uranium limit established in 10 CFR 2, Annex B is 3.0×10^{-1} pCi/ml

  < 1.5×10^{-1} pCi/ml - no corrective action.

  > 1.5×10^{-1} pCi/ml - resample; if results above 1.5×10^{-1} pCi/ml is confirmed, investigate to determine reason for the high level and immediately notify the SBCCOM RPO to initiate notification to the NRC.

b. Basis for Action. If any of the action levels are exceeded, an evaluation of cause will be performed by the SBCCOM RPO. The RPO will provide a report of findings to the RCC. Based on their determination, recommendations to the commander on corrective action will be made.

GARY J. MATCEK
MAJ, MS
Program Manager, Health Physics Program

ANNEX A

DEFINITIONS AND ABBREVIATION

1. **Definitions:**

a. **Action Level:** The numerical value that will cause the decision maker to choose one of the alternative actions. The action level may be a regulatory standard or may be a level set to ensure that corrective action is initiated before regulatory standards are met.

b. **Area:** A general term referring to any portion of a site, up to and including the entire site.

c. **Background Sample:** A sample collected from an area similar to the one being studied, but in an area thought to be free of contaminant of concern.

d. **Calibration:** Comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments.

e. **Chain-of-Custody:** Documentation of the possession and handling of a sample from the time it is collected to the final disposition.

f. **Detection Limit:** The lowest concentration at which given analytical procedures can identify.

e. **Duplicate Samples:** Samples collected simultaneously from the same source, under identical conditions, into separate containers.

g. **Ground Water Sample:** A sample of water taken from an established monitoring well.

h. **Preservation:** Techniques which retard physical and/or chemical changes in a sample after it has been collected.

i. **Quality Assurance:** A monitoring program which ensures the production of quality data and identifies and quantifies all sources of error associated with each step of the sampling and analytical effort.

j. **Sample:** A part or selection from a medium located in a survey area that represents the quality or quantity of a given parameter or nature of the whole area.

k. **Sediment:** A sample of the mineral and/or organic matter deposited by surface waters.

l. **Soil Sample:** A sample of the soil taken from the first 15 centimeters (6 inches) of surface soil.

m. **Split Sample:** A sample, which has been portioned into two or more containers from a single sample container.

n. **Surface Water:** Water found above the surface of the soil, particularly water contained in creeks and streams.

2. **Abbreviations:**

a.	DU	Depleted Uranium
b.	ERM	Environmental Radiation Monitoring Program
c.	g	gram
d.	HPP	Health Physics Program
e.	JPG	Jefferson Proving Ground
f.	ml	milliliter
g.	NRC	Nuclear Regulatory Commission
h.	pCi	pico-Curie

i.	QC	Quality Control
j.	RCCCD	Radiologic, Classic and Clinical Chemistry Division
k.	RPO	Radiation Protection Officer
l.	SBCCOM	Soldier and Biological, Chemical Command
m.	SOP	Standing Operating Procedure
n.	USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine

ANNEX B

FORMS, LABELS AND WORKSHEETS

Request for Laboratory Services

Directorate of Laboratory Sciences
REQUEST FOR LABORATORY SERVICES

PLEASE PRINT OR TYPE ALL REQUESTED INFORMATION

For DLS Use Only
LIMS JOB#
Date Received

PART 1: PROJECT INFORMATION

1. DATE OF REQUEST: 08/03/2000
2. PROJECT #: (CHPPM only) 26 MA 8260 XO#
3. FUND SOURCE: ☐ P84 ☐ DERA ☐ OTHER Supplemental *(Specify)*
4. DIVISION/PROGRAM: Health Physics Program
5. INSTALLATION: Jefferson Proving Ground
6. STATE WHERE SAMPLES TO BE COLLECTED: Indiana
7. NAME OF PROJECT OFFICER(s): Mr. David Collins
   TELEPHONE: (410) 436-3502 FAX# (410) 436-8261
   E-MAIL: david.collins@apg.amedd.army.mil
8. NAME OF SAMPLE COLLECTOR: Mr David Collins
9. PROJECT DESCRIPTION/OBJECTIVE *(Screen, Monitoring, Regulatory or Health Concern, Etc.)*:
   Sampling required as part of the Environmental Radiation Monitoring Plan
10. SAMPLE OR SITE HISTORY (High Toxicity, Etc):
    DU Firing Range
11. PROJECT COORDINATOR/DLS TECHNICAL CONSULTANT - Was project coordinated with DLS? ☒ YES ☐ NO
    Name of Person in DLS: Mr. Gary Wright ext. 8235

PART 2: TURNAROUND TIME REQUESTED

1. DATE RESULTS REQUIRED:
2. INDICATE THE APPROPRIATE SAMPLE OR PROJECT DESIGNATION:
   ☒ STANDARD
   (Note: All samples are routinely processed as Standard Analyses Unless Arrangements Have Been Made with DLS for High-Priority or Top-Priority Analyses.)
   ☐ HIGH-PRIORITY ☐ TOP-PRIORITY
   (Note: High-Priority and Top-Priority Requests should be Coordinated with DLS and are Subject to Cost Surcharges.)

PART 3: REPORT DISTRIBUTION OPTIONS

1. REPORT RESULTS BY: *(Indicate Preference)*
   ☒ cc:MAIL/E-MAIL TO ADDRESS: david.collins@apg.amedd.army.mil
   ☐ FAX TO *(Write Fax#)*:
   ☒ MAIL:

REQUESTED BY: Mr. David Collins
PRINT NAME: SIGNATURE:
(Note: Signature Required if Submitted by Hard Copy)

CHPPM Form 330-R-E, 1 May 96, (MCHB-DC-LLI) Replaces AEHA Form 330-R, Jul 93, which is obsolete.

Figure B-1a

PART 4: PROJECT COORDINATION INFORMATION

1. DATE SAMPLES TO ARRIVE AT DLS: 12/04/2000

(Note: Prior Arrangements Must Be Made with SML for Samples That Will Arrive Outside of Routine Duty Hours which are M-F 0730 -1700)

Special Comments: Samples will arrive from the field without preservation or filtration.

2. SPECIAL HANDLING REQUIREMENTS:

- [x] CHAIN-OF-CUSTODY (COC)
- [ ] SAFETY CONSIDERATION/HAZARDOUS MATERIALS (Specify):
- [x] ANALYSES WITH SHORT-HOLDING TIMES (List Specific Analyses):
  Filter water samokes and test for dissolved U-238, No preservative add in the field.
- [ ] OTHER (Specify):

3. SAMPLE COLLECTION KIT:

DATE REQUIRED: 07/04/2000

CHECK PREFERENCE:

- [ ] 1. TO BE PICKED UP AT DLS BY PROJECT OFFICER
- [x] 2. SHIP TO: *(Please include Bldg # and Phone #)*

3 large coc ers and bags for soil samples need to be shipped to site
U.S. Army Hefferson Proving Ground
1661 West J.P.G. Niblo Road (Bldg 125)
Madison, IN 47250
(812) 273-2551

PART 5: SAMPLE ANALYSIS INFORMATION

DLS TEST CODE	PROCEDURE DESCRIPTION	STD METHOD	MATRIX	NUMBER OF SAMPLES	SPECIAL REQUIREMENTS/COMMENTS (REQUESTS FOR EXTRA BLANKS OR
803	Uranium in Soil	G-002	Soil	5	Soil
586	Uranium in Water	U-002	Water	9	Surface Water (1 gal Cubitainer)
803	Uranium in Soil	G-002	Soil	9	Sediment
586	Uranium in Water	U-002	Water	12	Ground Water (1 gal Cubitainer)

Table May Be Continued on Next Page if Additional Space is Required.

Figure B-1b

Sample Labels

Below is an example of a label to placed on each sample container.

PROJECT #:
INSTALLATION:
POC:
SAMPLE #:
DATE COLLECTED:
TIME COLLECTED:
SAMPLE PRESERVED:
ANALYSIS REQUIRED:

Figure B-2

Effective Date _____
Date Removed from Service _____

JEFFERSON PROVING GROUND
DU SAMPLING PROGRAM
PROJECT NUMBER: 26-MA-R_-8260-__

GROUND WATER SAMPLES						
Sample ID	Sample Date	Exposure Reading (µR/hr)	Sample Locations	Comments		
				pH	Temp (°C)	Conductivity (µMHOS)
MW01			Well @ D-Road and Wonju Road (perimeter DU impact area)			
MW02			Well between C-Road & Wonju Road (perimeter DU impact area)			
MW03			Well between A-Road & gate on Wonju Road (perimeter DU impact area)			
MW04			Well on South Perimeter Rd. (Along south border of JPG)			
MW05			Well @ D-Road & Morgan Road (across Bridge No. 13) perimeter DU impact area			
MW06			Well @ C-Road & Morgan Road (perimeter DU impact area)			

Effective Date _____
Date Removed from Service _____

JEFFERSON PROVING GROUND
DU SAMPLING PROGRAM
PROJECT NUMBER: 26-MA-R_-8260-__

GROUND WATER SAMPLES						
Sample ID	Sample Date	Exposure Reading (µR/hr)	Sample Locations	Comments		
				pH	Temp (°C)	Conductivity (µMHOS)
MW07			Well @ Oakdale School House on Morgan Road (perimeter DU impact area)			
MW08			Well @ Southwest Corner of JPG (Along south border of JPG)			
MW09			Well @ D-Road and Bridge No. 22 (inside DU impact area)			
MW10			Well on Center Recovery Road (inside DU impact area)			
MW11			Well on D-Road between Morgan and C Recovery Road (inside impact area)			
MW12			Duplicate or Split Sample _____			

Effective Date _____
Date Removed from Service _____

JEFFERSON PROVING GROUND
DU SAMPLING PROGRAM
PROJECT NUMBER: 26-MA-R_-8260-__

SOIL SAMPLES				
Sample ID	Sample Date	Exposure Reading (µR/hr)	Sample Locations	JPG ID Code
SOS1			Vicinity at intersection of C-Road and Wonju Road)	(S44)
SOS2			Vicinity at intersection of E-Road and Morgan Road	(S48)
SOS3			0.5 miles east of intersection at C-Road & East Recovery Road	(S43)
SOS4			Corner of Morgan Road and C-Road	(S47)
SOS5			Duplicate or Split of	
SOS6			Well on south perimeter road along south border of JPG	B-1
SOS7			West Perimeter Road at Fork Creek	B-3
SOS8			South Perimeter Road of JPG	B-5
SOS9			Well on SW Corner of JPG	B-6

NOTE: Per letter from the NRC dated 7 Sep 99, soil sample locations S6 and S8 that were previously sampled will no longer require sampling. No other changes to the ERM Plan have been approved.

Effective Date _____
Date Removed from Service _____

JEFFERSON PROVING GROUND
DU SAMPLING PROGRAM
PROJECT NUMBER: 26-MA-R_-8260-__

SURFACE WATER SAMPLES				
Sample ID	Sample Date	Exposure Reading (µR/hr)	Sample Locations	JPG ID Code
SWS1			West Perimeter Road Middle Fork Creek (exits JPG property)	SWBS (M1)
SWS2			Big Creek (exits JPG property)	SWBN (M2)
SWS3			Wonju Road Middle Fork Creek (enters DU impact area)	SWSE (M3)
SWS4			Big Creek (enters DU impact area)	SWNE (M4)
SWS5			Bridge No. 22 Big Creek	SWM (M5)
SWS6			Line of Fire Middle Fork Creek	SWS (M6)
SWS7			Bridge No. 12 @ Morgan Road Middle Fork Creek	SWSW (M7)
SWS8			Bridge No. 13 @ Morgan Road Big Creek	SWNW (M8)
SWS9			Duplicate or Split of SWS_	SWNE (M4)

Effective Date _____
Date Removed from Service _____

JEFFERSON PROVING GROUND
DU SAMPLING PROGRAM
PROJECT NUMBER: 26-MA-R_-8260-__

SEDIMENT SAMPLES				
Sample ID	Sample Date	Exposure Reading (µR/hr)	Sample Locations	JPG ID Code
SES1			West Perimeter Road Middle Fork Creek (exits JPG property)	(M1)
SES2			Big Creek (exits JPG property)	(M2)
SES3			Wonju Road Middle Fork Creek (enters DU impact area)	(M3)
SES4			Big Creek (enters DU impact area)	(M4)
SES5			Bridge No. 22 Big Creek	(M5)
SES6			Line of Fire Middle Fork Creek	(M6)
SES7			Bridge No. 12 @ Morgan Road Middle Fork Creek	(M7)
SES8			Bridge No. 13 @ Morgan Road Big Creek	(M8)
SES9			Duplicate or Split of SES_	(M4)

ANNEX C

SAMPLE LOCATION MAPS

Jefferson Proving Ground: DU Sampling
GROUNDWATER MONITORING WELLS

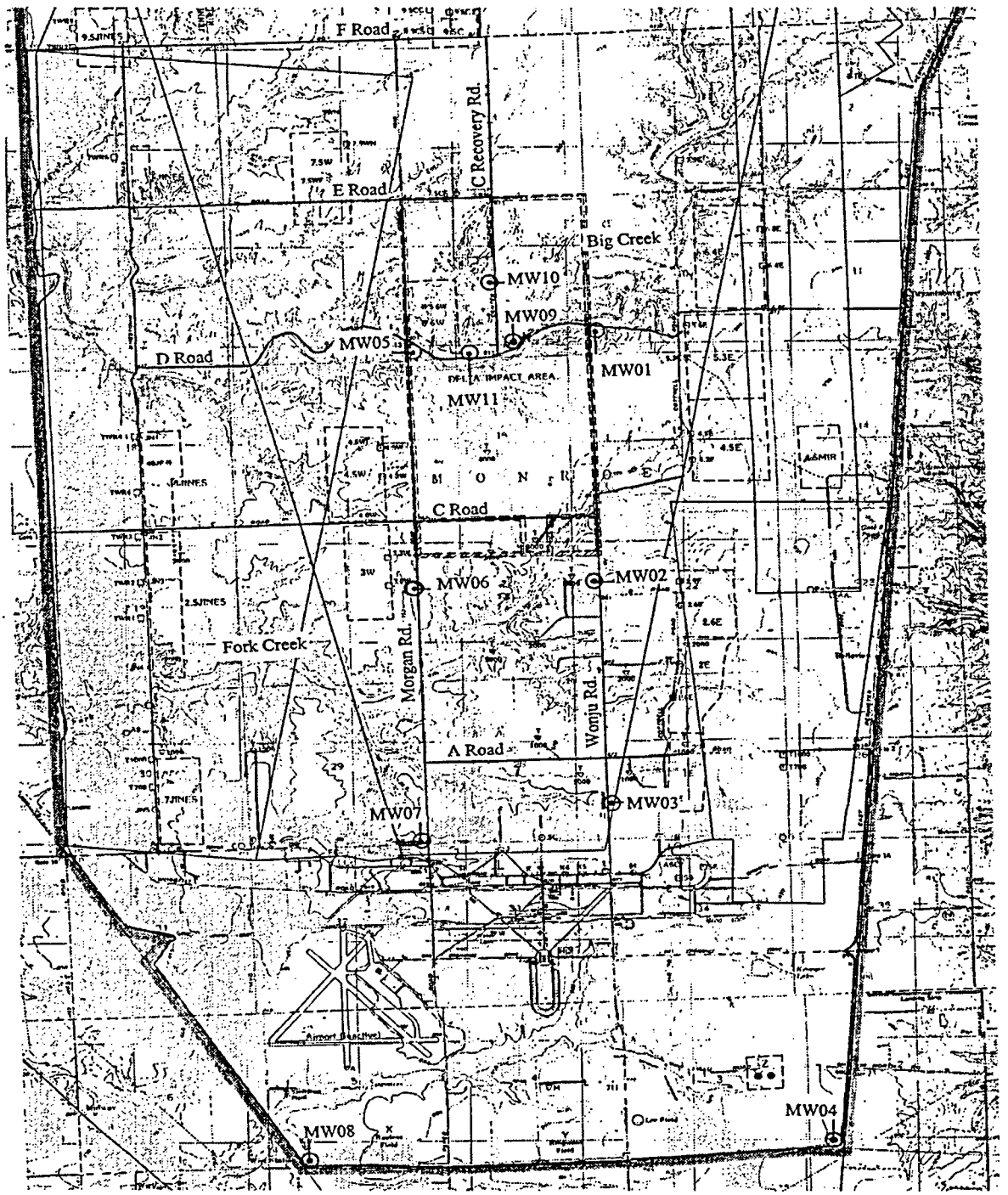

Figure 1: Groundwater samples (Sept. 1997)

Jefferson Proving Ground: DU Sampling
SOIL SAMPLES

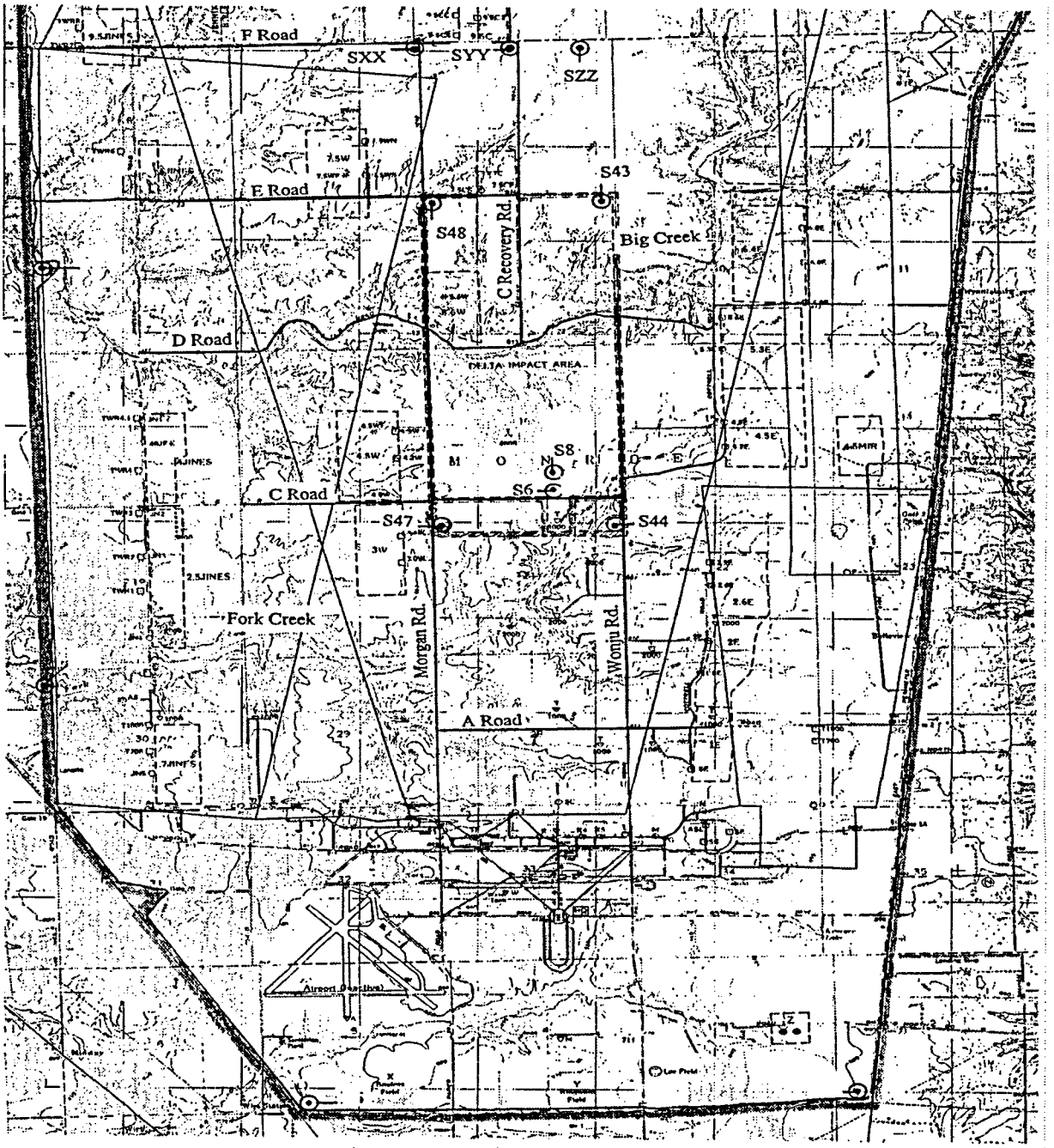

Figure 2: Soil Samples (Sept. 1997)

Jefferson Proving Ground: DU Sampling
SURFACEWATER & SEDIMENT SAMPLES

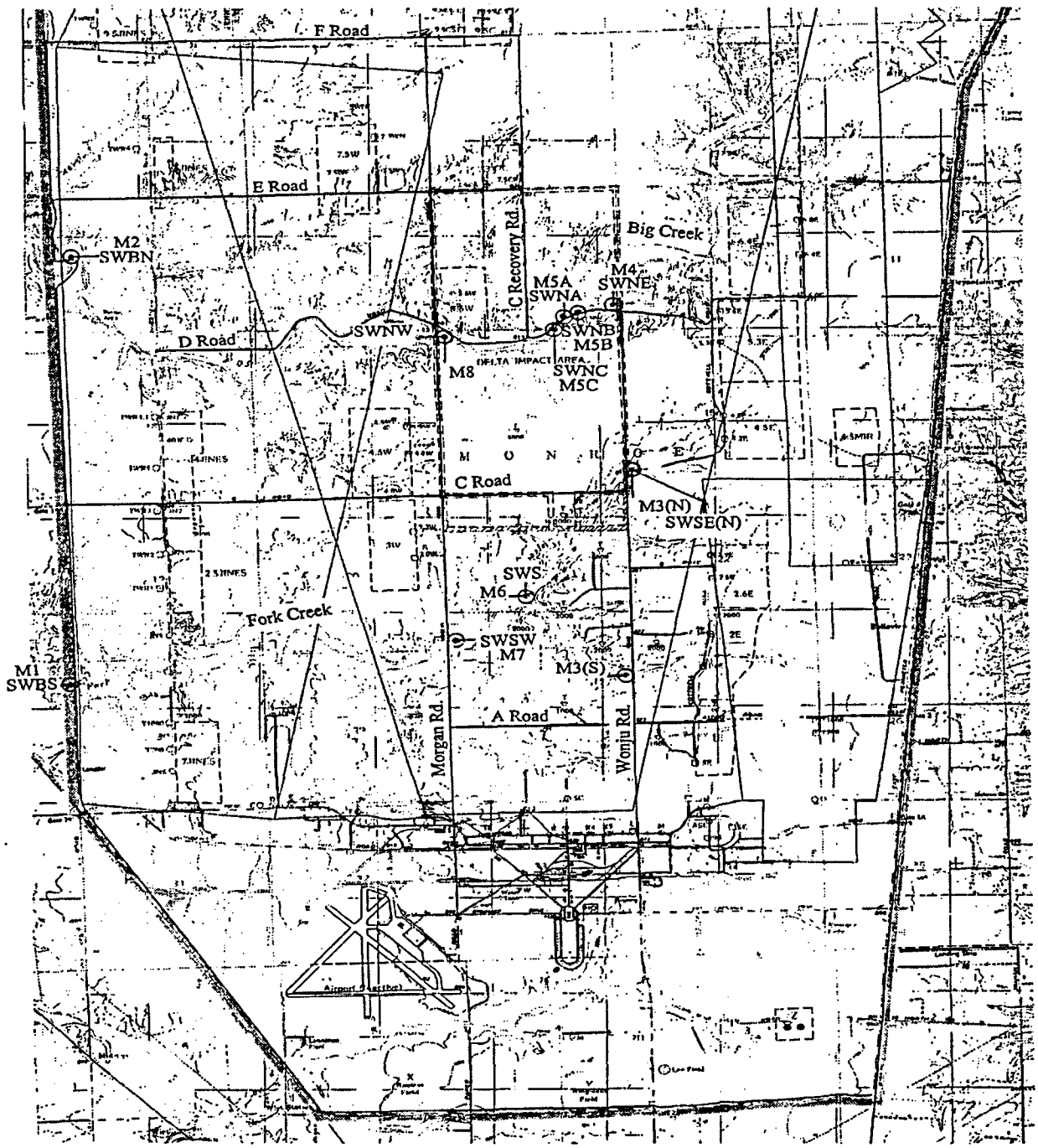

Figure 3: Surfacewater & Sediment Samples (Sept. 1997)

APPENDIX B
FIELD LOGBOOK

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JPG Madison IN 4/10/06
Army Corp Louisville

1400 Arrive at JPG at Army office. Check supply shipment, talk to Phil Mann about schedule & sampling.

1545 Go to hotel to check in.

4/10/06

10.0 4/10/06

JPG Madison IN 4/11/06
Army Corp Louisville

0630 Arrive at field office
Site crew:
Jared Teese - St Louis office
William Wilkinson - Boston office

Conduct Health & Safety tailgate meeting
(See Page 5 & 6 for additional Health Safety discussion)

1. Personnel will be frisked upon exit of each site location
2. Level D PPE, steel toes & safety glasses
3. Do not handle UXO or disturb soil at the surface.
4. Dan low level Rad Source - See Page 5.
5. Obey site speed limits & watch for deer in road
6. Equipment calibrated daily
7. Samples screened w/ Rad instruments after ea. sample.

10.0 4/11/06

B-1

JPG - Madison IN 4/11/06
Army COE - Louisville

0. Continued from last Page
All samples were filtered & cooled to 4°C.
09. Sampling in this Stream Event includes:
4 Sw Samples & Dup
8 Sediment Samples & Dup
11 Gw Samples & Dup
4 Soil Samples (surface) & Duplicate
WW 4/11/06

0730 Calibrate Equipment (next page)
RAD Equipment
Horiba

0830 Get Supplies, Verify & Sample Bottles Ready for Sampling -

0900 Calibrate Horiba -4-10
Cal Solution (SHSC Equipment & Supply)
pH 4.000 0.0 NTU 1.99 mS/cm
Expiration 12/2007 Part 3576
Calibration Completed
pH 3.98
Cond 4.48
WW 4/11/06

JPG - Madison IN 4/11/06
Army COE - Louisville

Rad Instrument Check-in
WW 4/11/06
Meter # 202411
Model # 2360
Detector # 212722
Cal Due 1/05/2007
WW 4/11/06

07:05 Perform initial checkin of instrument.
Alpha Source 1 min count x10
Beta Source 1 min count x10
Beta Background 1 min count x10
Alpha Background 10 min count x10
WW 4/11/06

09:20 Model 19 Serial N. 209715
Micro R Meter 4/11/06
WW

09:52 Daily Checkin on 4389/2360
QC Checks in as acceptable
WW 4/11/06

JPG Madison IN 4/11/06
Army COE - Louisville

10:00 Calibration of Rad Equipment & water quality instrument Complete. Truck Packed for Sampling. Go to Wells DU-MW-003 & 007 to Sample Before Burning takes place

10:15 collect GW sample at MW DU-003. 2 liter Polys collected, preserved with HNO_3. 2 Bottles collected (Sample & Dup). Sample cooled to 4°C

10:35 Go to Well Location MW-DU-006

10:45 Arrive at MW-DU-006 collect W.L (SEE PAGE 66)

10:50 collect MW-DU-006 All samples collected with in line filter & peristaltic Pump Sample, cooled to 4°C 1 liter poly collected

Filter type: High Capacity Polyethersulfone Groundwater filter, model # QF045 Area 607 cm² Pour size .45 micron Max Pres. 60 PSI

2/11/06 W.W.

B-3

JPG Madison IN 4/11/06
Army COE - Louisville

Soil & Sediment Samples

DATE	TIME	LOCATION	SAIC #	RAD MONITORING (uRAD)
4/12/06	7:55	SS-DU-001	05	4
4/12/06	13:50	SS-DU-002	05	5
4/12/06	14:35	SS-DU-003	05	5
4/12/06	11:04	SS-DU-004	05	3
4/12/06	1350	SS-DU-004D	05	5
4/11/06	1345	SD-DU-001	05	4
4/11/06	1415	SD-DU-002	05	5
4/12/06	0905	SD-DU-003	05	4
4/12/06	0850	SDU-DU-004	05	4
4/12/06	0850	SD-DU-004D	05D	4
4/12/06	1445	SD-DU-005	05	5
4/12/06	0930	SD-DU-006	05	4
4/12/06	1715	SD-DU-007	05	4
4/12/06	1310	SD-DU-008	05	4

W.W 4/11/06

SR6 Madison IN 4/11/06
Army COE - Louisville

Groundwater Samples - Water Quality Measurements

DATE	TIME	LOCATION	SPEC #	pH	Cond	Turb	D.O	Temp	Meth
4/12/06	0835	MW-DU-0001	05	7.53	0.345	6.0	11.57	12.2	4
4/12/06	0730	MW-DU-0002	05	7.28	0.490	0.0	2.19	12.5	6
4/11/06	12:15	MW-DU-0003	05	7.09	0.550	0.0	12.21	11.9	4
4/11/06	12:50	MW-DU-0004	05	7.27	0.490	+0	11.74	14.3	5
4/10/06	12:35	MW-DU-0005	06	8.15	0.232	-10	11.64	13.5	5
4/11/06	1050	MW DU-0006	05	7.48	0.60	0.0	10.70	14.7	5
4/11/06	1125	MW-DU-0007	05	7.35	0.578	83	11.58	14.0	3
4/11/06	1310	MW-DU-0008	05	7.36	0.410	0.0	12.76	15.7	6
4/12/06	1500	MW-DU-0009	05	7.56	0.704	-10	10.60	16.2	4
4/12/06	1345	MW-DU-0010	06	7.42	0.872	-10	11.93	14.1	4
4/12/06	1330	MW-DU-0011	05	8.15	0.232	9	12.63	12.8	4
4/11/06	10:15	MW-24-0003	OSD						4

4/11/06 W.O.

SR6 - Madison IN 4/11/06
Army COE - Louisville

Water Level Measurements

LOCATION	DATE	TIME	Water Level (ft BTOC)
MW-DU-0001	4/12/06	0835	9.96'
MW-DU-0002	4/12/06	0730	9.71'
MW-DU-0003	4/11/06	12:10	7.10'
MW-DU-0004	4/11/06	12:50	3.87'
MW-DU-0005	4/12/06	14:55	33.14'
MW-DU-0006	4/11/06	10:50	33.85'
MW-DU-0007	4/11/06	11:25	8.31'
MW-DU-0008	4/11/06	13:10	23.36'
MW-DU-0009	4/12/06	1500	22.14
MW-DU-0010	4/12/06	13:45	2.12'
MW-DU-0011	4/12/06	13:25	6.98

Ground water Sampling Equipment / Procedure

- YSI Indicator
- Horiba U-10
- Masterflex Environmental Sampler / pump
- silicon tubing .187 x .375 x 100' Lot # 5179
  N Industries 216-526-2300
- Bailer - Preleaned & dedicated
- Cool to 4°C

W.O. 4/11/06

JPG - Madison IN 4/11/06
Army COE - Louisville

Surface Water Samples - Water Quality Measurements

Date	Time	Location	SAIC #	pH	Cond	Turb	DO	Temp	Wkr
4/11/06	1354	SW-DU-001	05	8.62	0.177	999	12.33	11.1	4/5
4/11/06	14:15	SW-DU-002	05	8.55	0.156	-10	11.64	11.7	5
4/12/06	0945	SW-DU-003	05	7.79	0.093	-10	7.09	13.0	4
4/12/06	0850	SW-DU-004	05	8.17	0.151	-10	8.28	14.2	
~~4/10/06~~	~~10:35~~	~~SW-DU-005~~	~~05~~	~~7.47~~	~~0.116~~	~~6~~	~~4.34~~	~~13.1~~	~~WW sampler~~
4/12/06	0930	SW-DU-006	05	8.13	0.693	-10	9.27	13.5	~~WW sampler~~
4/12/06	10:15	SW-DU-007	05	7.92	0.001	-10	10.32	13.4	
4/12/06	13:10	SW-DU-008	05	8.37	0.140	-10	10.68	15.9	
4/11/06	1358	SW-DU-001	DD	-	see above				
4/12/06	1445	SW-DU-005	05	8.87	0.186	-10	10.49	18.1	4
~~SW-DU-005~~									

WW sampler 4/11/06

4/12/06 WW

JPG - Madison IN 4/11/06
Army COE - Louisville

11:10 Finish Sampling MW-DU-006, Go to MW-DU-007

11:20 Arrive at MW-DU-007 & sample well

11:25 MW-DU-007 WL = 8.33' BTOC
Collect water sample with Peristaltic pump, tubing & 0.45 micron filter, Bailer & Top-Samples cooled to 4°C
1 liter poly (HPC) collected

11:40 Go to Lunch

12:20 Back Onsite

12:30 Go to MW-DU-004 to Sample well

12:50 Collect Sample - Groundwater At MW-DU-004. Groundwater is filtered (0.45 micron). Cool Sample to 4°C. Sample collected with bailer, peristaltic pump, tubing and preprocessed 1 liter poly. All Sample material, are dedicated to each well location & disposed off.

1305 Go to MW-DU-008 to collect Groundwater sample

4/11/06 WW

SPG Madison IN 4/11/06
Army COE - Louisville

13:10 Arrive at MW-DU-005
WL = 23.36 feet BTOC
13:20 Collect Water Samples
Water is Filtered (0.45 micron)
Cool to 4°C
13:50 collect Surface water & Sediment
Sample at SW-DU-001,
SD-DU-001 & Duplicate
Samples at SW-DU-001.
Samples Filtered with
0.45 micron filter. Samples
collected with dedicated
tubing & Equipment, Cool to 4°C
14:15 collect SW-DU-002 & SD-DU002
Filter Samples Cool to 4°C
14:45 Back at field office to
unload & Rec Samples.
16:00 OFFSITE for the day

4/11/06

4/12/06 ww

SPG Madison IN 4/12/06
Army COE - Louisville

0630 Arrive at field office
0645 Conduct H/S Tailgate
Meeting (Place Stag)
SAIC STAFF:
William Wilkinson -
Jared Meeske
CALIBRATE HORIBA-U-10
Auto Calibration
pH => 4.000 ✓ OKAY
Cond => 4.49 mS/cm ✓ OKAY
See Page 62 - Cal Info
0710 Pack Equipment for Sampling
Go to MW-DU-002 to Sample
water
0725 Arrive at MW-DU-002
Set up Peristaltic Pump, tubing
bailer & Rope
WL = 9.71' BTOC
0730 Collect GW Sample MW-DU-002
Sampled Filtered (0.45 micron filter)
Cooled to 4°C
0740 Collect Surface Soil Samples
0755 SS-DU-001 (Surface with dedicated
Stainless steel Spoon, Plastic & Bucket
4/12/06 W.W.

JPG Madison IN 4/12/06
Army COE - Louisville

0805 Arrive at SW-DU-0003 to collect SD & SW Sample. Sediment Sample Collected with dedicated Stainless Steel Spoon. Surface water sample filtered, dedicated tubing & Peristaltic pump used to collect sample.

0820 Leave site for next location
mw 4/12/06

0835 Collect SW sample MW-DU-001 Sample Filtered, Cool to 4°C

0845 Go to Sample Location SW-DU-004 to collect SW sample. Sample Filtered, Cool to 4°C. (SD-DU-004)

0930 Collect SW-DU-006. Sample Filtered, Cool to 4°C

1015 Collect SW-DU-007 Sample Filtered, Cool to 4°C. All Samples Preserved w/ HNO3 (SD-DU-007 also collected)

1310 Collect SW-DU-008, Sample Filtered, Cool to 4°C
4/12/06 w.w

JPG Madison IN 4/12/06
Army COE - Louisville

1325 Collect Groundwater Sample MW-DU-010. Filter Sample, Cool to 4°C, All Samples Preserved (HNO3). All Sampling equipment dedicated to each locations.

1345 Collect MW-DU-010. Filter Sample w/ 0.45 Micron filter. Cool to 4°C. Water Quality Measurements on Page 67.

14:25 Collect Surface Soil Sample Dedicated stainless Steel Spoon (decond with Potable water, DI)
Sample I.D SS-DU-0003 (SAMPLE)
Cooled to 4°C

Note: Surface soil samples Also collected SS-DU-0004 (SAMPLE) at 11:04 am & SS-DU-0002 (SAMPLE) & Dup collected at 1350 pm
Procedure same as entry Above.

14:45 Collect SW-DU-005 & SD-DU-005 Filtered, cooled to 4°C, Bottles Preserved w HNO3 (Filter 0.45 micron)
4/12/06 w.w

JPG Madison IN 4/12/06
Army COE - Louisville

1500 Arrive MW 01-009 to Collect GW SAMPLE
Sample collected with disposable, preleaned tether bailer, Tygon tubing, (dedicated) & peristatic pump. All sample supplies are dedicated to Event location & disposed of.
Inline Filter (0.45 micron)
Sample preserved with HNO3
Cooled to 4°C
NOTE: water run through filter for 30 seconds before Groundwater sample collected.
15:20 Vehicle packed with Samples, well lock replaced. Head to OFFICE to prep SAMPLES for Shipment tomorrow.
16:00 Arrive at FIELD OFFICE
16:10 Go to Store for Ice & Supplies. P.
16:25 Pack up equipment for Shipment, denied, Activities for 4/12/06

Location: JPG Madison IN 4/12/06
Project: Army COE - Louisville

16:45 Secure Samples,
17:15 Leave FIELD OFFICE for the day.

WW 4/12/06

WW 4/12/06

JPG Madison IN 4/13/06
Army COE - Louisville

0730 Arrive at FIELD OFFICE
0745 Conduct H/S tailgate Meeting
Activities today:
1. Finish Packing Equipment
2. Bottle count
3. Custody Seal Bottles
4. Bag ICE & Pack
5. Samples in coolers
6. Custody Sign & Tape coolers
7. SHIP SAMPLES VIA Fed-X
11:30 Coolers ready for SHIPMENT
Equipment Packed &
ready for SHIPMENT c/o
Supplier.
11:40 Go to Hotel to check
out & Head to Fed-X
at Airport in Cincinnati
OHIO.
14:00 Arrive at Fed-X at
Cincinnati Airport location
Ship Samples
17:20 Go to Airport.

WIW 4/13/06

B-9

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APPENDIX C
DATA VALIDATION SUMMARY

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C. DATA VALIDATION SUMMARY

C.1 PARAGON ANALYTICS SDGs 06-04-128, 06-04-129, AND 06-04-130

This report contains the results from the data validation technical review for the Jefferson Proving Ground (JPG) samples and analyses that are associated with the above-referenced laboratory and sample delivery group (SDG) numbers. These data points have been selected for data validation, and the sample data summary sheets on the following pages specifically identify the samples and analyses associated with this validation review.

The JPG validation technical review was conducted in accordance with the U.S. Environmental Protection Agency (USEPA) *Contract Laboratory Program* (CLP) *National Functional Guidelines for Inorganic Data Review* (July 2002) and Science Applications International Corporation (SAIC) Quality Assurance Technical Procedure (QATP) No. TP-DM-300-7, *Data Validation* (Revision 0, 2/2004). The validation technical review was based on the information and documentation supplied by the associated laboratory. The analyses were evaluated against criteria established in the related analytical procedures and the JPG data quality requirements.

The attachment to this report provides the sample data summary sheets for the samples associated with the above-referenced SDGs. These summary sheets identify the analytical values and the qualifiers for each sample and parameter. The attachment also outlines the validation qualifiers and reason code used in the validation of the data.

Report Summary	
Total Number of Samples	35
Total Number of Data Points	105
Total Number of Rejected Data Points	0
Percent Completeness (approval to rejection ratio)	100%

C.1.1 ANALYTICAL CATEGORY: RADIOCHEMICAL

- Uranium-234 (U-234), Uranium-235 (U-235), and Uranium-238 (U-238) were determined by alpha spectrometry (American Society for Testing and Materials [ASTM] D3972-90M).
- Groundwater samples were analyzed in SDG 06-04-130, surface water samples were analyzed in SDG 06-04-129, and sediment/soil samples were analyzed in SDG 06-04-128.

1. The following items (as applicable) have been addressed during the validation review:

   - Sample custody, integrity, and preservation
   - Sample handling and preparation
   - Holding times
   - Instrument calibration and performance
   - Dilution factors
   - Detection limits
   - Laboratory background and carry-over
   - Overall assessment of the data
   - Quality control (QC)
     - Calibration checks and background
     - Preparation blanks
     - Laboratory control samples
     - Field blanks (if available)
     - Field duplicates (if available)
     - Chemical yield (tracer recovery).

2. The above items were found to be acceptable, except as follows:

   - ***Overall Assessment of Data***—U-234, U-235, and U-238 sample data with results greater than the minimum detectable concentration(MDC) were qualified as estimated, *J*, reason code 37 in instances where the associated error was greater than 50 percent of the sample result.

3. Additional comments:

   - The case narrative reports that the analytical method quantifies U-235 alpha activity in a specific region of interest corresponding to emission energies between those of U-234 and U-238. A potential limitation of this method is that measurable amounts of U-234 in the sample may cause a small amount of characteristic activity in the U-235 region of interest due to poorly resolved alpha activity at the boundary between the two regions. To minimize the potential for a high bias in the U-235 analytical results, the U-235 region of interest has been narrowed and limited to a lower energy region. An 85.1 percent abundance correction has been made to the final U-235 results. No action was taken during validation.

The attached sample data summary for soil and water samples provides the qualifiers and the appropriate validation code for all samples.

SAMPLE INDEX	
Laboratory: Paragon Analytics	*SDG #:* 06-04-128, 06-04-129, 06-04-130

Client Sample I.D.	Laboratory Sample I.D.	Date Collected	Analyses Performed
SS-DU-001 SAIC05	0604128-1	12-Apr-06	Isotopic Uranium
SS-DU-002 SAIC05	0604128-2	12-Apr-06	Isotopic Uranium
SS-DU-003 SAIC05	0604128-3	12-Apr-06	Isotopic Uranium
SS-DU-004 SAIC05	0604128-4	12-Apr-06	Isotopic Uranium
SS-DU- SAIC05D	0604128-5	12-Apr-06	Isotopic Uranium
SD-DU-001 SAIC05	0604128-6	11-Apr-06	Isotopic Uranium
SD-DU-002 SAIC05	0604128-7	11-Apr-06	Isotopic Uranium
SD-DU-003 SAIC05	0604128-8	12-Apr-06	Isotopic Uranium
SD-DU-004 SAIC05	0604128-9	12-Apr-06	Isotopic Uranium
SD-DU-005 SAIC05	0604128-10	12-Apr-06	Isotopic Uranium
SD-DU-006 SAIC05	0604128-11	12-Apr-06	Isotopic Uranium
SD-DU-007 SAIC05	0604128-12	12-Apr-06	Isotopic Uranium
SD-DU-008 SAIC05	0604128-13	12-Apr-06	Isotopic Uranium
SD-DU-004 SAIC05D	0604128-14	12-Apr-06	Isotopic Uranium
MW-DU-001 SAIC05	0604130-1	12-Apr-06	Isotopic Uranium
MW-DU-002 SAIC05	0604130-2	12-Apr-06	Isotopic Uranium
MW-DU-003 SAIC05	0604130-3	11-Apr-06	Isotopic Uranium
MW-DU-004 SAIC05	0604130-4	11-Apr-06	Isotopic Uranium
MW-DU-005 SAIC05	0604130-5	12-Apr-06	Isotopic Uranium
MW-DU-006 SAIC05	0604130-6	11-Apr-06	Isotopic Uranium
MW-DU-007 SAIC05	0604130-7	11-Apr-06	Isotopic Uranium
MW-DU-008 SAIC05	0604130-8	11-Apr-06	Isotopic Uranium
MW-DU-009 SAIC05	0604130-9	12-Apr-06	Isotopic Uranium
MW-DU-010 SAIC05	0604130-10	12-Apr-06	Isotopic Uranium
MW-DU-011 SAIC05	0604130-11	12-Apr-06	Isotopic Uranium
MW-DU-003 SAIC05D	0604130-12	11-Apr-06	Isotopic Uranium
SW-DU-001 SAIC05	0604129-1	11-Apr-06	Isotopic Uranium
SW-DU-002 SAIC05	0604129-2	11-Apr-06	Isotopic Uranium
SW-DU-003 SAIC05	0604129-3	12-Apr-06	Isotopic Uranium
SW-DU-004 SAIC05	0604129-4	12-Apr-06	Isotopic Uranium
SW-DU-005 SAIC05	0604129-5	12-Apr-06	Isotopic Uranium
SW-DU-006 SAIC05	0604129-6	12-Apr-06	Isotopic Uranium
SW-DU-007 SAIC05	0604129-7	12-Apr-06	Isotopic Uranium
SW-DU-008 SAIC05	0604129-8	12-Apr-06	Isotopic Uranium
SW-DU-001 SAIC05D	0604129-9	12-Apr-06	Isotopic Uranium

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ATTACHMENT

JEFFERSON PROVING GROUND
SAMPLE DATA SUMMARY SHEETS

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SAMPLE DATA SUMMARY – SOILS	
Laboratory: Paragon Analytics	*SDG #:* 06-04-128

Isotopic Uranium ASTM D3972-90M							
Sample I.D.	Analyte	Result	Error	MDC	Units	Qualifier	Reason Code
SS-DU-001 SAIC05	U-234	0.87	0.30	0.15	pCi/g		
SS-DU-001 SAIC05	U-235	0.037	0.079	0.124	pCi/g	U	
SS-DU-001 SAIC05	U-238	1.06	0.33	0.12	pCi/g		
SS-DU-002 SAIC05	U-234	0.76	0.27	0.15	pCi/g		
SS-DU-002 SAIC05	U-235	0.054	0.077	0.134	pCi/g	U	
SS-DU-002 SAIC05	U-238	0.86	0.29	0.13	pCi/g		
SS-DU-003 SAIC05	U-234	0.58	0.22	0.13	pCi/g		
SS-DU-003 SAIC05	U-235	0.042	0.072	0.143	pCi/g	U	
SS-DU-003 SAIC05	U-238	0.74	0.26	0.12	pCi/g		
SS-DU-004 SAIC05	U-234	0.83	.29	0.13	pCi/g		
SS-DU-004 SAIC05	U-235	0.063	0.085	0.132	pCi/g	U	
SS-DU-004 SAIC05	U-238	0.73	0.27	0.11	pCi/g		
SS-DU-002 SAIC05D	U-234	0.84	0.28	0.12	pCi/g		
SS-DU-002 SAIC05D	U-235	0.010	0.075	0.130	pCi/g	U	
SS-DU-002 SAIC05D	U-238	0.81	0.28	0.05	pCi/g		
SD-DU-001 SAIC05	U-234	0.77	0.27	0.13	pCi/g		
SD-DU-001 SAIC05	U-235	0.12	0.11	0.12	pCi/g	J	37
SD-DU-001 SAIC05	U-238	0.60	0.23	0.15	pCi/g		
SD-DU-002 SAIC05	U-234	0.55	0.22	0.13	pCi/g		
SD-DU-002 SAIC05	U-235	0.028	0.076	0.144	pCi/g	U	
SD-DU-002 SAIC05	U-238	0.67	0.25	0.13	pCi/g		
SD-DU-003 SAIC05	U-234	0.66	0.25	0.09	pCi/g		
SD-DU-003 SAIC05	U-235	0.015	0.081	0.127	pCi/g	U	
SD-DU-003 SAIC05	U-238	0.57	0.23	0.13	pCi/g		
SD-DU-004 SAIC05	U-234	0.38	0.18	0.05	pCi/g		
SD-DU-004 SAIC05	U-235	0	0.079	0.06	pCi/g	U	
SD-DU-004 SAIC05	U-238	0.36	0.18	0.05	pCi/g		
SD-DU-005 SAIC05	U-234	0.28	0.16	0.10	pCi/g	J	37
SD-DU-005 SAIC05	U-235	-0.004	0.084	0.112	pCi/g	U	

Isotopic Uranium ASTM D3972-90M							
Sample I.D.	Analyte	Result	Error	MDC	Units	Qualifier	Reason Code
SD-DU-005 SAIC05	U-238	0.24	0.15	0.10	pCi/g	J	37
SD-DU-006 SAIC05	U-234	0.46	0.23	0.19	pCi/g		
SD-DU-006 SAIC05	U-235	0.05	0.10	0.14	pCi/g	U	
SD-DU-006 SAIC05	U-238	0.50	0.24	0.16	pCi/g		
SD-DU-007 SAIC05	U-234	0.45	0.20	0.09	pCi/g		
SD-DU-007 SAIC05	U-235	0.046	0.081	0.062	pCi/g	U	
SD-DU-007 SAIC05	U-238	0.29	0.16	0.09	pCi/g	J	37
SD-DU-008 SAIC05	U-234	0.71	0.26	0.15	pCi/g		
SD-DU-008 SAIC05	U-235	0.053	0.076	0.132	pCi/g	U	
SD-DU-008 SAIC05	U-238	0.77	0.27	0.13	pCi/g		
SD-DU-004 SAIC05D	U-234	0.44	0.19	0.12	pCi/g		
SD-DU-004 SAIC05D	U-235	0.017	0.074	0.099	pCi/g	U	
SD-DU-004 SAIC05D	U-238	0.42	0.19	0.10	pCi/g		

SAMPLE DATA SUMMARY – WATERS	
Laboratory: Paragon Analytics	*SDG #:* 06-04-130, 06-04-129

Isotopic Uranium ASTM D3972-90M							
Sample I.D.	Analyte	Result	Error	MDC	Units	Qualifier	Reason Code
MW-DU-001 SAIC05	U-234	0.38	0.27	0.33	pCi/L	J	37
MW-DU-001 SAIC05	U-235	-0.02	0.16	0.37	pCi/L	U	
MW-DU-001 SAIC05	U-238	0.02	0.13	0.31	pCi/L	U	
MW-DU-002 SAIC05	U-234	0.86	0.41	0.29	pCi/L		
MW-DU-002 SAIC05	U-235	0.02	0.17	0.30	pCi/L	U	
MW-DU-002 SAIC05	U-238	0.51	0.31	0.26	pCi/L	J	37
MW-DU-003 SAIC05	U-234	0.69	0.36	0.30	pCi/L	J	37
MW-DU-003 SAIC05	U-235	0.05	0.17	0.33	pCi/L	U	
MW-DU-003 SAIC05	U-238	0.47	0.28	0.11	pCi/L	J	37
MW-DU-004 SAIC05	U-234	0.54	0.33	0.36	pCi/L	J	37
MW-DU-004 SAIC05	U-235	0.07	0.17	0.30	pCi/L	U	
MW-DU-004 SAIC05	U-238	0.15	0.21	0.40	pCi/L	U	
MW-DU-005 SAIC05	U-234	0.30	0.25	0.33	pCi/L	U	
MW-DU-005 SAIC05	U-235	0.04	0.17	0.36	pCi/L	U	
MW-DU-005 SAIC05	U-238	0.22	0.22	0.33	pCi/L	U	
MW-DU-006 SAIC05	U-234	2.55	0.75	0.20	pCi/L		
MW-DU-006 SAIC05	U-235	0.02	0.16	0.28	pCi/L	U	
MW-DU-006 SAIC05	U-238	1.28	0.49	0.29	pCi/L		
MW-DU-007 SAIC05	U-234	1.32	0.51	0.11	pCi/L		
MW-DU-007 SAIC05	U-235	0.05	0.18	0.13	pCi/L	U	
MW-DU-007 SAIC05	U-238	0.91	0.41	0.11	pCi/L		
MW-DU-008 SAIC05	U-234	0.27	0.22	0.21	pCi/L	J	37
MW-DU-008 SAIC05	U-235	0.08	0.17	0.25	pCi/L	U	
MW-DU-008 SAIC05	U-238	0.23	0.20	0.21	pCi/L	J	37
MW-DU-009 SAIC05	U-234	1.15	0.55	0.49	pCi/L		
MW-DU-009 SAIC05	U-235	0.10	0.22	0.32	pCi/L	U	
MW-DU-009 SAIC05	U-238	-0.01	0.19	0.41	pCi/L	U	
MW-DU-010 SAIC05	U-234	1.68	0.58	0.36	pCi/L		
MW-DU-010 SAIC05	U-235	-0.04	0.16	0.31	pCi/L	U	
MW-DU-010 SAIC05	U-238	0.79	0.38	0.31	pCi/L		
MW-DU-011 SAIC05	U-234	0.03	0.14	0.29	pCi/L	U	
MW-DU-011 SAIC05	U-235	0.04	0.16	0.12	pCi/L	U	

Isotopic Uranium ASTM D3972-90M							
Sample I.D.	Analyte	Result	Error	MDC	Units	Qualifier	Reason Code
MW-DU-011 SAIC05	U-238	0.13	0.16	0.24	pCi/L	U	
MW-DU-003 SAIC05D	U-234	0.72	0.36	0.27	pCi/L		
MW-DU-003 SAIC05D	U-235	0.03	0.16	0.23	pCi/L	U	
MW-DU-003 SAIC05D	U-238	0.91	0.41	0.27	pCi/L		
SW-DU-001 SAIC05	U-234	0.098	0.092	0.155	pCi/L	U	
SW-DU-001 SAIC05	U-235	0.036	0.049	0.071	pCi/L	U	
SW-DU-001 SAIC05	U-238	0.046	0.065	0.123	pCi/L	U	
SW-DU-002 SAIC05	U-234	0.072	0.063	0.066	pCi/L	J	37
SW-DU-002 SAIC05	U-235	0.010	0.054	0.078	pCi/L	U	
SW-DU-002 SAIC05	U-238	0.27	0.13	0.07	pCi/L		
SW-DU-003 SAIC05	U-234	-0.001	0.046	0.119	pCi/L	U	
SW-DU-003 SAIC05	U-235	0.010	0.054	0.078	pCi/L	U	
SW-DU-003 SAIC05	U-238	0.035	0.053	0.098	pCi/L	U	
SW-DU-004 SAIC05	U-234	0.123	0.096	0.122	pCi/L	J	37
SW-DU-004 SAIC05	U-235	0.017	0.062	0.046	pCi/L	U	
SW-DU-004 SAIC05	U-238	0.099	0.086	0.113	pCi/L	U	
SW-DU-005 SAIC05	U-234	0.20	0.12	0.17	pCi/L	J	37
SW-DU-005 SAIC05	U-235	-0.017	0.051	0.110	pCi/L	U	
SW-DU-005 SAIC05	U-238	0.22	0.11	0.09	pCi/L		
SW-DU-006 SAIC05	U-234	0.067	0.071	0.118	pCi/L	U	
SW-DU-006 SAIC05	U-235	0.001	0.051	0.100	pCi/L	U	
SW-DU-006 SAIC05	U-238	0.066	0.066	0.100	pCi/L	U	
SW-DU-007 SAIC05	U-234	0.021	0.043	0.091	pCi/L	U	
SW-DU-007 SAIC05	U-235	0.010	0.050	0.072	pCi/L	U	
SW-DU-007 SAIC05	U-238	0.086	0.068	0.074	pCi/L	J	37
SW-DU-008 SAIC05	U-234	0.143	0.089	0.084	pCi/L	J	37
SW-DU-008 SAIC05	U-235	0.038	0.051	0.073	pCi/L	U	
SW-DU-008 SAIC05	U-238	0.44	0.16	0.08	pCi/L		
SW-DU-001 SAIC05D	U-234	0.104	0.095	0.154	pCi/L	U	
SW-DU-001 SAIC05D	U-235	-0.022	0.052	0.121	pCi/L	U	
SW-DU-001 SAIC05D	U-238	0.088	0.077	0.110	pCi/L	U	

KEY TO THE DATA VALIDATION QUALIFIERS

QUALIFIERS	
U	Indicates that the data met all quality assurance/quality control (QA/QC) requirements, and that the radionuclide was analyzed for but was not detected above the reported sample quantitation limit.
J	Indicates that the radionuclide was positively identified; the associated numerical value is the approximate concentration of the radionuclide in the sample.
UJ	Indicates that the radionuclide was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
N	The analysis indicates the presence of a radionuclide for which there is presumptive evidence to make a "tentative identification."
R	Indicates that the sample results for the radionuclide are rejected or unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the radionuclide cannot be verified.

Data Validation Reason Code

37 Associated error was greater than 50 percent of the sample result.

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