



REPLY TO  
ATTENTION OF

**DEPARTMENT OF THE ARMY**  
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS  
696 VIRGINIA ROAD  
CONCORD, MASSACHUSETTS 01742-2751

June 14, 2000

RECEIVED  
REGION 1

2000 JUN 20 PM 4:28

Civil/Military Project Management Branch

Ms. Marie Miller  
US Nuclear Regulatory Commission  
Region 1  
475 Allendale Road  
King of Prussia, Pennsylvania 19406-1415

SUBJECT: Watertown, Massachusetts GSA Property

Dear Ms. Miller:

We are transmitting Addendum 2 to the Radiological Characterization and Final Survey Report for your record. Copies of this addendum were also provided at our meeting on May 9, 2000 and include information on:

1. Background uranium concentration on the site
2. Total activity of the uranium at the site

Please call me at 978-318-8607, or Ellen Iorio at 978-318-8174, if you have any questions.

Sincerely,

Dennis J. Waskiewicz  
Project Manager

Enclosure  
As stated

Copy Furnished w/attachment:  
Craig Durrett, MADEP  
Thomas O'Connell, MADPH  
Michael Stroebel, GSA  
Michael Driscoll, Town Manager  
Mike Borisky, ARL  
Samantha Overton, MDC  
Reference Department, Watertown Free Library  
Hans Honerlah, CENAB-EN-H (w/o attachment)

DLB  
**NMSS/RGN MATERIALS-002**

**General Services Administration (GSA) Site  
Watertown, Massachusetts**

**Radiological Characterization and  
Final Survey Report**

**Addendum 2**

Prepared by:

GTS Duratek  
628 Gallaher Road  
Kingston, Tennessee 37763

Morrison Knudsen  
Morrison Knudsen Plaza  
P.O. Box 73  
Boise, Idaho 83729

Prepared by: John P. Andrews  
John P. Andrews  
Principal Radiological Engineer

Date: 11-13-97

Reviewed by: David M. Hall  
David M. Hall  
Manager  
Commercial Projects

Date: 11-20-97

Approved by: Harvey F. Story  
Harvey F. Story  
Director  
Radiological Engineering & Decommissioning Services

Date: 11-20-97

**For: U.S. Army Corps of Engineers, General Administration Site  
Contract No: DACW45-90-D-0029**

**NOVEMBER 1997**

**TABLE OF CONTENTS**

<b>1.0</b>	<b>INTRODUCTION AND SCOPE .....</b>	<b>1</b>
<b>2.0</b>	<b>BACKGROUND FOR NATURAL URANIUM ON THE SITE .....</b>	<b>1</b>
<b>3.0</b>	<b>TOTAL URANIUM CONTAMINATION ON THE GSA SITE .....</b>	<b>2</b>
<b>4.0</b>	<b>POTENTIAL GROUND WATER WASTE CONTAMINATION ESTIMATE .....</b>	<b>3</b>
<b>5.0</b>	<b>SUMMARY .....</b>	<b>3</b>
<b>6.0</b>	<b>REFERENCES .....</b>	<b>4</b>
<b>7.0</b>	<b>ATTACHMENTS .....</b>	<b>4</b>

## 1.0 INTRODUCTION AND SCOPE

On August 21, 1997, the Corps met with representatives of NRC, the State of Massachusetts, their contractor (ABB and SEG (now GTS Duratek)) and the Facilities Manager at the Army Research Laboratory facility in Watertown, Massachusetts, to discuss the current status of the GSA site. During their wide ranging discussion, two items came up that were needed to further evaluate the depleted uranium contamination on the site. These are:

1. What is the background uranium concentration on the site; and
2. What is the total activity of the uranium on the site.

Following the meeting, Dennis J. Waskiewicz requested GTS Duratek to provide these values.

This report provides these calculations and also provides an estimate of the upper bound for water contamination by uranium.

## 2.0 BACKGROUND FOR NATURAL URANIUM ON THE SITE

The background for the GSA site is described in detail in Section 3.2.1 (Page 3-6). Table 3-2 presents summary statistics for Ra-226, Ac-228, Th-234. These nuclides represent the principal nuclides of concern for this site. In particular, the Th-234 concentration is in equilibrium with its parent, U-238. Measuring the Th-234, therefore, provides a measurement of U-238, but not the activity associated with U-234 and U-235.

The calculations of natural uranium in the fill at GSA is shown in Appendix A, Background for Natural Uranium, a spreadsheet prepared to do these calculations.

The estimate of the background concentration of a natural uranium in the fill soil is  $2.12 \pm 0.64$  pCi/gram as natural uranium.

The mass of natural uranium on the site in the top 1-foot layer is estimated at 55.1 kilograms. The mass of natural uranium in the estimated 7-foot layer of fill on the site is about 380 kg.

This calculation is just for the unpaved area of the site. The total uranium on the site in the total fill may be somewhat higher if we also consider the area under the buildings and the asphalt paving. However, the depth of the fill is unknown in these areas.

### 3.0 TOTAL URANIUM CONTAMINATION ON THE GSA SITE

The total uranium for both background uranium and from the contamination by DU is estimated based on the in situ measurements of the site using the 264 gamma spectrum measurements which were evaluated as either uranium plus daughters or as DU. The natural uranium on the site has daughters associated with it whereas the depleted uranium does not.

Based on the evaluation of each measurement, the activity as uranium was calculated in pCi/gram. (The original data in the report is in units of fraction-of-limit with the limit for DU as 35 pCi/g and the limit for U+d as 10 pCi/g.) These concentrations in pCi/g were averaged to obtain the average for the entire site. This value is 3.45 pCi/gram.

In order to estimate the total activity of the site, the average is integrated over the mass of contaminated soil.

To determine the soil mass, the unpaved area was estimated from the scale drawing of the site by counting squares. Each square is 15 meters by 15 meters or 225 square meters. The area estimate for unpaved area is 37,350 square meters.

The depth of contamination is unknown. Measurements of chips in the scraped areas indicated contamination to 9 inches in the burn pit area. Other areas may or may not have been disturbed by surface soil mixing by heavy equipment. However, because the work of burning DU took place after the majority of the fill was in place, we believe that DU is generally on the surface and not mixed to significant depth in the fill. The depth assumed for this calculation of 1-foot or 0.30 meters. The total volume of soil that is assumed to be contaminated is, therefore, 11,384 cubic meters. Assuming that the density of soil is 1.6 g/cc we calculate 18,000,000 kilograms of soil. The total uranium activity in the soil is:

$$18,000,000 \text{ kg} \times 3.45 \frac{\text{pCi}}{\text{g}} \times \frac{10^3 \text{ g}}{\text{kg}} \times \frac{10^{-12} \text{ Ci}}{\text{pCi}} = 0.0629 \text{ Ci total uranium}$$

This includes background. The same calculation for the background uranium gives 0.0387 Ci of uranium.

The net activity of the site above background is  $0.0629 - 0.0387 = 0.0242$  Ci of uranium.

We assume that all the contaminating uranium is DU, so we can calculate the mass of uranium in a manner similar to that used for the background except we use the approved ratios for the nuclides in DU (Reference 7.13, Technical Basis Document, AMTL-ADM-D-210, *Limit for U-238 in Soil Based on the Limit for Depleted Uranium*) to obtain the value. The total mass of DU of the site is estimated to be 49 kg.

#### 4.0 POTENTIAL GROUND WATER WASTE CONTAMINATION ESTIMATE

The potential for ground water contamination is a concern of the NRC expressed at the meeting. The upper boundary for this contamination is estimated based on the net uranium activity and the total water estimated to be present in the fill. Ground water percentages were measured for the in situ measurements and found to be about 9.4%. If we assume that the water table is one foot below the surface and the depth of fill is seven feet, then the total water on the site in the fill is about 6,400 cubic meters. If all the uranium from contamination is dissolved in the water (unlikely) then the concentration would be about  $4 \times 10^{-6} \mu\text{Ci/ml}$ . (The limiting concentration of effluents in 10CFR 20, Appendix B, Table 2, Column 2 for effluent water for uranium is  $3 \times 10^{-7} \mu\text{Ci/ml}$ .)

#### 5.0 SUMMARY

To summarize:

1. The average concentration of total uranium on the site is 3.45 pCi/g based on in situ gamma spectrometry.
2. The average background for uranium in soil in the Watertown area is 2.12 pCi/gram.
3. The mass of contaminated soil on the GSA site is approximately 11,000 cubic meters over an area of 37,000 square meters. The contamination is assumed to be 0.30 meters deep and the depth of the fill is assumed to be 2.1 meters (7 ft.).
4. The activity of the total uranium including background is estimated at 0.062 Ci. The background for total uranium is estimated at 0.039 Ci for uranium plus daughters, and the net uranium is 0.024 Ci as DU.
5. The total mass of DU contamination is estimated at 49 kg. The total mass of background uranium in the fill is estimated at 400 kg.

6. The maximum water concentration that could occur is estimated at  $3.8 \times 10^{-6} \mu\text{Ci/ml}$ . This would occur if all the DU promptly dissolved in the ground water contained in the fill on the site.

## **6.0 REFERENCES**

- 6.1 Chemical Rubber Company, "CRC Handbook of Chemistry and Physics", CRC Press
- 6.2 Shleien, B., "The Health Physics and Radiological Health Handbook," Revised Scinta, Inc., Silver Springs, MD, 1992

## **7.0 ATTACHMENTS**

- 7.1 Calculation of Total Activity of Uranium on the Site
- 7.2 Calculation of Affected Soil Area of GSA Site
- 7.3 Variable Names and Block Addresses
- 7.4 In Situ Measurement Data for GSA Site
- 7.5 Frequency Distribution of Uranium Concentration

**ATTACHMENT 7.1  
Spreadsheet GSA95 & 94.WBZ  
Calculation of Total Activity of Uranium on the Site**

**Spreadsheet to calculate total uranium on the GSA site.**

To calculate the total activity of uranium on the site we do the following:

1. Estimate the area of the contaminated site. This includes all unpaved areas. The paving and buildings are not contaminated with uranium and the soil below these areas is assumed to be not contaminated with uranium.
2. Use the survey data and sample data as appropriate to estimate the concentration of the activity on the site.
3. Estimate the depth of contamination.
4. Multiply the contaminated area by the estimated depth, concentration, and density to obtain the total activity.

Area x depth = volume

Volume x density = mass

Mass x concentration = Total activity

To estimate the area of the site that is contaminated, the number of affected 15m x 15m blocks on the site were counted.

The total affected area is estimated as 37350 sq m.

The estimated depth of the contamination is unknown, however, based on the mechanics of deposition during the handling of DU chips while preparing the material for burning, and subsequent soil movement, we assume that the material is in the top layer of the soil over the entire site. The depth of the material is assumed to be 1 foot.

The density of the soil is assumed to be 1.6 g/cc.

The concentration in the report is listed in units of fraction of limit. This is useful for remediation, but is not useful for the calculation of total activity on the site. To calculate total activity, each reading is converted from fraction of limit to pCi/gram by multiplying DU fraction of limit by 35 and U+d fraction of limit by 10.

Based on the average activity for all in situ measurements, the activity on the site is approximately 3.45 pCi/gram as uranium.

This includes background uranium at 2.12 pCi/g.

Therefore, the net uranium is 1.33 pCi/g above background.

**Total Mass of Affected Soil**

Total area of affected site is 37,350 m<sup>2</sup> based on counting affected grids. See the Grids page for the number of affected and unaffected grids and a check estimate of the area of the site based on those values.

There are 0.3048 m/ft

If the activity is distributed to 1 foot, or 0.3048 m depth, the volume of contaminated soil is estimated to be

Volume = 11,384 cubic meters for the top layer of affected soil.

The mass of this soil is given by volume \* density. Density of soil is assumed to be 1.6 g/cc or 1,600,000 g/m<sup>3</sup>.

AffectedSoilVol \* g/m<sup>3</sup> = mass

Mass = 1.8E+10 grams, or 18,214,848 kilograms

To obtain the total activity of the soil, we multiply the average concentration times the estimated total mass of soil.

AvgConcentration \* soilgrams \* 1E-12 = Ci uranium

6.3E-02 Ci or 6.3E+01 mCi of uranium, total.

To obtain the net activity above background in the soil, we do the same calculation for the background natural uranium, then subtract the background from the total activity in the soil.

Bkg = 3.9E-02 Ci or 3.9E+01 mCi of uranium background.

Net U = 2.4E-02 Ci or 2.4E+01 mCi, net uranium on the site.

The specific activity of natural uranium and of the DU on the GSA site are somewhat different. The specific activity of the DU is based on a ratio of 1.47 for DU/Th-234 approved by the NRC for this project. (Footnote in Section 3.2.1, Page 3-6)

If we divide the net U number by 0.00, we have the U-238 activity.

U-238 = 1.6E-02 Ci, as U-238.

Assume U-238 is 3.35E-07 Ci/gram (Rad Health Handbook), then the total mass of DU (U-238) is given by the activity divided by the specific activity, or  
Total mass = Ci as U-238 / 3.35E-07 Ci/g = 49,150 g, or  
= 49 kg.

This value is the net mass of DU on the site excluding the background uranium in the soil.

## BACKGROUND FOR URANIUM IN SOIL

Table 3-2 in the report cites the AMTL background concentrations for nuclides

significant to the GSA site. The uranium on the site due solely to background contamination of soil materials deposited on the site as fill is assumed to be the same as the natural uranium in the surrounding areas. The Th-234 activity found in the background survey for the AMTL site is given as 1.0 pCi/g.

The total uranium as natural uranium must assume that U-234 and U-235 are present. The weight percent and activity percents of the nuclides are (ibid):

NUCLIDE	% BY WEIGHT	ACTIVITY %
U-238	99.2739	47.1
U-235	0.7204	2.3
U-234	0.0057	50.6
Totals	100	100

Th-234 is assumed to be in equilibrium with the parent, U-238, therefore, the activity of U-238 is also 0.0 pCi/g in the background soil.

The total activity due to natural uranium is based on the relative abundance of the activity of each of the nuclides relative to that of U-238.

NUCLIDE	% BY WEIGHT	ACTIVITY %	pCi/g	S
U-238	99.2739	47.1	1.00	0.30
U-235	0.7204	2.3	0.05	0.01
U-234	0.0057	50.6	1.07	0.32
Total			2.12	0.64

as natural uranium.

The average concentration of total uranium found from the in situ measurements is 2.1 pCi/g. So the net average concentration is 1.3 pCi/g.

Because the background uranium is significant, we will calculate it also.

The total activity due to background uranium in the top layer of soil is the same calculation as for the DU activity, using the background activity number from the background study. Note, however, that the soil background activity includes all the fill, not just the top layer. (The fill is approximately 7 feet deep.)

$$\begin{aligned}
 \text{Total background uranium as U-238} &= \text{Th234 pCi/g} \times \text{soilgrams} \\
 &= 18214848000 \text{ pCi} \\
 &= 18215 \text{ uCi, or} \\
 &= 18 \text{ mCi as U-238}
 \end{aligned}$$

Thus the total uranium is calculated as 5.5E+07 mg background uranium  
or as kg in the top layer: 55 kg uranium in top layer  
of affected soil;

Because the fill is about 0.0 feet deep, the total uranium in the fill material is ERR kg of total uranium in the fill to the full depth of the fill on the site.

---

Note: The burn pit itself is a tiny contribution to the total uranium on the site. The concentrations are slightly above the limit, but the area is so small compared to the remainder of the site that this is not explicitly included

in the calculation.

Note: The in situ measurements are not completely independent. There is some overlap between readings at the intersections of the grid lines and the readings at the center of the grids. This tends to overestimate the average concentration because the center grids are collected only in areas suspected of higher levels of contamination. In addition, the points are not all collected at grid intersections. This makes the readings biased. However, there are so many readings over almost all the unpaved area of the site, that we believe that the average of the readings is a valid measure of the average concentration on the site.

Note: The uranium in the fill at GSA is all assumed to come from local soil placed as fill. In fact, much of the debris used to fill the site contain refractory materials that contain elevated quantities of uranium and thorium as natural radioactive components of the clays used to make the refractory materials. These have not been quantified. The natural uranium in the refractory material is not included in this calculation.

### GROUND WATER CONCENTRATION ESTIMATE

If we estimate the total water content of the fill material (disregarding the bulk) materials and assuming the percent water is as found for the in situ measurements, the total ground water on the site under the affected area to a depth of 7 feet or 1.8 meters when we set the water level 1 foot below the surface. Assuming the water percent is 9.4 percent or 0.094 fraction, the total water under the affected area is 6421 m<sup>3</sup>, or 6.4E+09 ml of ground water on site.

Dividing the net U uCi as calculated above by total ml gives 3.8E-06 uCi/ml. This is an upper level boundary condition for activity in water above background. This value exceeds the concentration in 10 CFR 20 Appendix B, Table 2, Column 2, "Effluent Water," 3E-07, by a factor of 13. This assumes that the material is completely soluble, which it is not, as no uranium has been observed in the water. Uranium in most oxide forms and as metal is insoluble in water.  
Ref: CRC Handbook of Chemistry and Physics, CRC Press

### CONCLUSIONS

The background uranium U-238 concentration on the site is: 1.0 pCi/g.

Background natural uranium concentration on the site is: 2.1 pCi/g.

The total curies of uranium on the site is estimated at: 6.3E-02 Curies.  
This is assumed to be in the top layer of soil. This layer is: 1 ft.

The total uranium on the site from contamination as uranium is 49 kg as net U corrected for background U-238 in the top layer of soil.

The total uranium from background uranium in the fill added to the site in just the affected areas is ERR kg of natural uranium.

The maximum groundwater concentration possible for the site is 3.8E-06 uCi/ml.

However, uranium as found on the site is insoluble and should not be a significant source of ground water contamination.

---

Note: Uranium is used to refer to DU and/or natural uranium or both. Because these materials are mixed on the site, it is impossible to distinguish between them when doing averages. When referring to DU this is stated. When referring to the isotopes of uranium, they are named. When referring to natural uranium, the fact that it is natural is also stated in context. In general for calculating the mass of uranium on the site, the nuclide used is the U-238 present equally in DU and in natural uranium on a weight basis.

---

---

Notes on this spreadsheet: The calculated fields in this sheet are coded as yellow fields. The input parameters are coded as blue fields. All the fields have been named. The field names are on the spreadsheet page named Blocks.

---

---

D:\GSA\FINAL\GSA\FIGS\GSA95&94.WB2

---

**ATTACHMENT 7.2  
Spreadsheet GSA95 & 94.WBZ  
Calculation of Affected Soil Area of GSA Site**

**Calculation of affected soil area of GSA site.**

Basis for calculation is counting 15 meter grids off of drawing "Plan of Samples at The Watertown GSA Site, Watertown, Massachusetts" Bryant Associates, Inc., 9304-100\GSA.DWG, Revised January 31, 1995.

The grids were counted to provide the total number of grids in each row, and the number of "unaffected" grids in each row. Unaffected grids are those covered by asphalt or buildings. Grids inside the perimeter fence are included.

Row Letter	Total Grids	Unaffected Grids	Affected Grids
A	19	4	15
B	27	6	21
C	28	7	21
D	29	7	22
E	29	6	23
F	27	6	21
G	22	9	13
H	16	3	13
I	9		9
J	5		5
K	2		2
L	1		1
Totals	214	48	166

Grid area = 15 meters x 15 meters = 225 m2

Total affected area = 37350 m2

---

D:\GSA\FINAL\GSA\FIGS\GSA95&94.WB2:Grids

**ATTACHMENT 7.3  
Spreadsheet GSA95 & 94.WBZ  
Variable Names and Block Addresses**

**Variable names and Block addresses.**

<b>Block Name</b>	<b>Block Address</b>
AffectedSoilVol	Total Activity:C62
area	Total Activity:D53
AvgConcentration	Data:G267
AvgFracOfLim	Data:C267
bkgU-238mci	Total Activity:D143
BkgUCi	Total Activity:B82
BkgUmCi	Total Activity:D82
CiOfU	Total Activity:B76
DU/Th234	Total Activity:F87
fraction	Data:C2..C265
g/cc	Total Activity:C65
g/m3	Total Activity:E65
kgBkgUranium	Total Activity:D146
kgNatUranium	Total Activity:A151
kgU238	Total Activity:E97
LayerDepth	Total Activity:D59
LayerDepthM	Total Activity:F59
LimitConc	Calcs:D16
m/ft	Total Activity:C57
mCiDU	Calcs:C19
mgUranium	Total Activity:D145
mpcW	Total Activity:A188
natUbkg	Total Activity:D128
NetUCi	Total Activity:B84
pCiDU	Calcs:C17
PercentH2O	Total Activity:D181
radius	Calcs:D1
ReadingArea	Calcs:C3
SoilDepth	Total Activity:F138
soilgrams	Total Activity:B69
spaU-238	Total Activity:C94
Th234pCi/g	Total Activity:F108
TotalAffectedArea	Grids:C30
TotalBkgU238	Total Activity:D141
TotalBkgU238mCi	Total Activity:D143
TotalBkgU238uCi	Total Activity:D142
TotalUmCi	Total Activity:D76
TotalWater	Total Activity:D182
TotalWaterml	Total Activity:D183
U234Act%	Total Activity:C115
U235Act%	Total Activity:C114
U238Act%	Total Activity:C113
U-238Ci	Total Activity:B92
U238fraction	Calcs:F25
U238mg	Total Activity:E96
U238wtPercent	Total Activity:B113
uCi/ml	Total Activity:F185

# Calculation of Total DU on GSA Site

uCiDU	Calcs:C18
WaterDepthFraction	Total Activity:F181
WaterDepthM2	Total Activity:B180
WaterFraction	Total Activity:F181

---

D:\GSA\FINAL\GSA\FIGS\GSA95&94.WB2:Blocks

**ATTACHMENT 7.4  
Spreadsheet GSA95 & 94.WBZ  
In Situ Measurement Data for GSA Site**

Calculation of Total DU on GSA Site

Location	Material	Fraction of Limit	File	Northing	Easting	pCi/g
B-20	DU	0.104	gsv00130	947.90	1020.00	3.65
B-21	DU	0.000	gsv00128	984.40	1053.00	0.00
C-16	U+d	0.327	gsv00120	834.80	851.60	3.27
C-16-C1	U+d	0.513	gsv00119	836.55	886.35	5.13
C-17	U+d	0.485	gsv00111	871.30	884.60	4.85
C-17-C1	U+d	0.514	gsv00110	873.08	919.35	5.14
C-18	U+d	0.490	gsv00108	907.80	917.60	4.90
C-18-C1	U+d	0.280	gsv00109	909.63	952.32	2.80
C-19	U+d	0.196	gsv00100	944.40	950.50	1.96
C-19-C1	DU	0.000	gsv00099	946.15	985.28	0.00
C-19-C1	DU	0.000	gsv00101	946.15	985.28	0.00
C-20	U+d	0.167	gsv00102	980.90	983.50	1.67
C-20-C1	DU	0.113	gsv00126	982.65	1018.25	3.97
C-20-C2	DU	0.188	gsv00129	978.00	1024.00	6.57
C-21	U+d	0.250	gsv00094	1017.40	1016.50	2.50
C-21-C1	DU	0.074	gsv00127	1019.15	1051.25	2.57
C-22	U+d	0.210	gsv00097	1053.90	1049.50	2.10
C-23	DU	0.000	gsv00135	1090.40	1082.50	0.00
C-23-C1	DU	0.000	gsv00132	1092.18	1117.25	0.00
C-24	U+d	0.159	gsv00138	1126.90	1115.50	1.59
C-24-C1	U+d	0.336	gsv00139	1128.72	1150.25	3.36
C-25	DU	0.037	gsv00156	1163.50	1148.50	1.29
C-25-C1	DU	0.000	gsv00157	1165.25	1183.25	0.00
C-25-C2	DU	0.178	gsv00158	1184.00	1200.00	6.22
C-26	DU	0.452	gsv00160	1200.00	1181.50	15.84
C-26-C1	DU	0.231	gsv00159	1201.75	1216.22	8.08
C-30	DU	0.051	gsv00029	1346.00	1313.40	1.78
C-30-C1	U+d	0.193	gsv00030	1347.82	1348.15	1.93
C-31	DU	0.000	gsv00032	1382.60	1346.40	0.00
C-31-C1	U+d	0.343	gsv00033	1384.35	1381.15	3.43
C-32	DU	0.009	gsv00034	1419.10	1379.40	0.30
C-32-C1	DU	0.090	gsv00049	1420.85	1414.15	3.13
C-33	U+d	0.829	gsv00048	1455.60	1412.40	8.29
D-15	U+d	0.386	gsv00123	831.30	782.10	3.86
D-16	U+d	0.288	gsv00122	867.80	815.10	2.88
D-16	U+d	0.440	gsv00115	867.80	815.10	4.40
D-16-C1	U+d	0.371	gsv00114	869.55	849.82	3.71
D-16-C1	U+d	0.257	gsv00121	869.55	849.82	2.57
D-17	U+d	0.308	gsv00113	904.30	848.00	3.08
D-17-C1	U+d	0.444	gsv00112	906.05	882.80	4.44
D-18	U+d	0.362	gsv00107	940.80	881.00	3.62
D-18-C1	DU	0.000	gsv00106	942.60	915.78	0.00
D-19	DU	0.000	gsv00103	977.40	914.00	0.00
D-20	U+d	0.172	gsv00104	1013.90	947.00	1.72
D-20-C1	U+d	0.475	gsv00095	1015.65	981.75	4.75
D-21	U+d	0.191	gsv00096	1050.40	980.00	1.91
D-21-C1	U+d	0.200	gsv00093	1052.15	1014.75	2.00
D-22	U+d	0.594	gsv00086	1086.90	1013.00	5.94
D-22-C1	U+d	0.545	gsv00134	1088.65	1047.75	5.45
D-23	U+d	0.176	gsv00136	1123.40	1046.00	1.76
D-23-C1	DU	0.000	gsv00137	1125.15	1080.75	0.00

Calculation of Total DU on GSA Site

D-24	DU	0.113	gsv00141	1159.90	1079.00	3.95
D-24-C1	DU	0.079	gsv00140	1161.68	1113.75	2.76
D-25	U+d	1.047	gsv00154	1196.40	1112.00	10.47
D-25-C1	DU	0.251	gsv00155	1198.22	1146.72	8.78
D-26	U+d	1.975	gsv00162	1233.00	1144.90	19.75
D-26-C1	DU	0.358	gsv00163	1234.75	1179.67	12.53
D-27	DU	0.412	gsv00164	1269.50	1177.90	14.41
D-27-C1	DU	0.318	gsv00166	1271.25	1212.65	11.14
D-29	DU	0.060	gsv00026	1342.50	1243.90	2.10
D-29-C1	U+d	0.254	gsv00027	1344.25	1278.65	2.54
D-30	U+d	0.170	gsv00028	1379.00	1276.90	1.70
D-30-C1	DU	0.000	gsv00031	1380.78	1311.65	0.00
D-31	DU	0.058	gsv00036	1415.50	1309.90	2.05
D-31-C1	DU	0.029	gsv00035	1417.32	1344.65	1.02
D-32	U+d	0.252	gsv00037	1452.10	1342.90	2.52
D-32-C1	U+d	0.284	gsv00047	1453.85	1377.65	2.84
D-33	U+d	0.610	gsv00046	1488.60	1375.90	6.10
D-33-C1	U+d	1.692	gsv00050	1490.35	1410.63	16.92
E-14	DU	0.065	gsv00085	827.80	712.60	2.27
E-15	U+d	0.154	gsv00080	864.30	745.60	1.54
E-15-C1	U+d	0.147	gsv00124	866.05	780.32	1.47
E-16	U+d	0.439	gsv00078	900.80	778.50	4.39
E-16-C1	U+d	0.399	gsv00116	902.55	813.28	3.99
E-17	U+d	0.454	gsv00077	937.30	811.50	4.54
E-17-C1	U+d	0.265	gsv00117	939.05	846.25	2.65
E-18	U+d	0.650	gsv00074	973.80	844.50	6.50
E-18-C1	U+d	0.166	gsv00118	975.58	879.25	1.66
E-19	U+d	0.410	gsv00072	1010.30	877.50	4.10
E-19-C1	DU	0.068	gsv00105	1012.13	912.25	2.39
E-20	U+d	0.880	gsv00092	1046.90	910.50	8.80
E-20-C1	DU	0.000	gsv00098	1048.65	945.25	0.00
E-21	DU	0.000	gsv00090	1083.40	943.50	0.00
E-21-C1	U+d	0.205	gsv00087	1085.15	978.25	2.05
E-22-C1	U+d	0.113	gsv00145	1121.65	1011.25	1.13
E-23	DU	0.025	gsv00179	1156.40	1009.50	0.88
E-23-C1	DU	0.000	gsv00144	1158.15	1044.22	0.00
E-24	DU	0.000	gsv00143	1192.90	1042.40	0.00
E-24-C1	DU	0.110	gsv00142	1194.65	1077.20	3.83
E-25	U+d	0.959	gsv00175	1229.40	1075.40	9.59
E-25-C1	DU	0.266	gsv00161	1231.20	1110.17	9.32
E-26	DU	0.376	gsv00173	1266.00	1108.40	13.16
E-26-C1	DU	0.681	gsv00165	1267.75	1143.15	23.82
E-27-C1	DU	0.345	gsv00167	1304.25	1176.15	12.09
E-27-C2	DU	0.171	gsv00168	1310.00	1146.00	5.98
E-28	DU	0.220	gsv00023	1339.00	1174.40	7.70
E-28-C1	DU	0.125	gsv00024	1340.75	1209.15	4.37
E-29	U+d	0.222	gsv00025	1375.50	1207.40	2.22
E-29-C1	DU	0.000	gsv00055	1377.25	1242.15	0.00
E-30	U+d	0.584	gsv00054	1412.00	1240.40	5.84
E-30-C1	DU	0.000	gsv00052	1413.75	1275.15	0.00
E-31	DU	0.000	gsv00039	1448.50	1273.40	0.00
E-31-C1	DU	0.089	gsv00038	1450.28	1308.15	3.13

Calculation of Total DU on GSA Site

E-32	DU	0.000	gsv00040	1485.00	1306.40	0.00
E-32-C1	U+d	0.185	gsv00045	1486.82	1341.13	1.85
E-33	DU	0.000	gsv00051	1521.60	1339.30	0.00
F-13	DU	0.000	gsv00183	824.20	643.10	0.00
F-13-C1	U+d	0.186	gsv00084	825.97	677.85	1.86
F-14	DU	0.036	gsv00083	860.70	676.10	1.25
F-14-C1	DU	0.000	gsv00082	862.53	710.82	0.00
F-15	DU	0.000	gsv00056	897.30	709.00	0.00
F-15-C1	DU	0.000	gsv00079	899.05	743.78	0.00
F-16	DU	0.000	gsv00059	933.80	742.00	0.00
F-16-C1	U+d	0.398	gsv00076	935.55	776.75	3.98
F-17	U+d	0.368	gsv00061	970.30	775.00	3.68
F-17-C1	U+d	1.036	gsv00075	972.05	809.75	10.36
F-18	U+d	0.175	gsv00063	1006.80	808.00	1.75
F-18-C1	DU	0.000	gsv00073	1008.55	842.75	0.00
F-19	DU	0.000	gsv00065	1043.30	841.00	0.00
F-19-C1	U+d	0.157	gsv00071	1045.08	875.75	1.57
F-20	DU	0.023	gsv00067	1079.80	874.00	0.82
F-20-C1	U+d	0.218	gsv00091	1081.63	908.75	2.18
F-21	DU	0.040	gsv00069	1116.40	907.00	1.39
F-21-C1	U+d	0.699	gsv00088	1118.15	941.75	6.99
F-22	U+d	0.301	gsv00089	1152.90	940.00	3.01
F-22-C1	DU	0.000	gsv00180	1154.65	974.72	0.00
F-23	DU	0.107	gsv00151	1189.40	972.90	3.76
F-23-C1	DU	0.000	gsv00178	1191.15	1007.67	0.00
F-24-C1	DU	0.095	gsv00177	1227.65	1040.65	3.32
F-25	DU	0.110	gsv00149	1262.40	1038.90	3.85
F-25-C1	DU	0.000	gsv00176	1264.18	1073.65	0.00
F-26	U+d	0.781	gsv00171	1298.90	1071.90	7.81
F-26-C1	DU	0.414	gsv00170	1300.72	1106.65	14.49
F-26-C2	DU	0.950	gsv00172	1318.00	1089.00	33.26
F-27	DU	0.133	gsv00018	1335.50	1104.90	4.65
F-27-C1	DU	0.180	gsv00169	1337.25	1139.65	6.29
F-28	DU	0.101	gsv00019	1372.00	1137.90	3.54
F-28-C1	U+d	0.735	gsv00022	1373.75	1172.65	7.35
F-29	U+d	0.325	gsv00020	1408.50	1170.90	3.25
F-29-C1	U+d	0.308	gsv00021	1410.25	1205.65	3.08
F-30	U+d	0.302	gsv00043	1445.00	1203.90	3.02
F-30-C1	DU	0.090	gsv00044	1446.75	1238.63	3.16
FS-2	U+d	2.449	gsv00001	1460.00	1416.00	24.49
FS-26	DU	1.390	gsv00182	1030.00	1014.00	48.66
G-14-C1	DU	0.000	gsv00081	895.50	674.28	0.00
G-15	U+d	0.171	gsv00058	930.30	672.50	1.71
G-15-C1	DU	0.000	gsv00057	932.05	707.25	0.00
G-16	DU	0.000	gsv00133	966.80	705.50	0.00
G-16-C1	DU	0.000	gsv00060	968.55	740.25	0.00
G-17	U+d	0.179	gsv00011	1003.30	738.50	1.79
G-17-C1	U+d	0.244	gsv00062	1005.05	773.25	2.44
G-18	DU	0.007	gsv00010	1039.80	771.50	0.26
G-18-C1	DU	0.000	gsv00064	1041.55	806.25	0.00
G-19	DU	0.000	gsv00009	1076.30	804.50	0.00
G-19-C1	DU	0.080	gsv00066	1078.05	839.25	2.79

Calculation of Total DU on GSA Site

G-20	DU	0.000	gsv00008	1112.80	837.50	0.00
G-20-C1	DU	0.000	gsv00068	1114.58	872.25	0.00
G-21	U+d	0.221	gsv00007	1149.30	870.50	2.21
G-21-C1	DU	0.000	gsv00070	1151.13	905.22	0.00
G-22	DU	0.000	gsv00006	1185.90	903.40	0.00
G-22-C1	DU	0.000	gsv00153	1187.65	938.17	0.00
G-23	DU	0.000	gsv00005	1222.40	936.40	0.00
G-23-C1	U+d	0.485	gsv00152	1224.15	971.15	4.85
G-24	DU	0.000	gsv00004	1258.90	969.40	0.00
G-24-C1	U+d	0.173	gsv00148	1260.65	1004.15	1.73
G-25	DU	0.000	gsv00003	1295.40	1002.40	0.00
G-25-C1	DU	0.128	gsv00147	1297.15	1037.15	4.48
G-26	U+d	0.429	gsv00002	1331.90	1035.40	4.29
G-26-C1	DU	0.457	gsv00146	1333.68	1070.15	16.01
G-26-C2	DU	1.120	gsv00181	1329.00	1075.00	39.21
H-11	DU	0.000	gsv00184	817.20	504.10	0.00
H-12	U+d	0.195	gsv00017	853.70	537.00	1.95
H-12-C2	U+d	0.223	gsv00016	877.00	580.00	2.23
H-13-C1	DU	0.000	gsv00015	891.95	604.75	0.00
H-15-C1	U+d	0.209	gsv00013	965.03	670.75	2.09
H-16-C1	DU	0.000	gsv00012	1001.55	703.75	0.00
A-27	DU	0.000	ipv00123	1170.50	1287.50	0.00
A-28	DU	0.000	ipv00129	1207.00	1320.50	0.00
A-29	U+d	0.151	ipv00128	1243.60	1353.50	1.51
B-27	U+d	0.867	ipv00120	1203.50	1251.00	8.67
B-27-C1	DU	0.072	ipv00125	1205.25	1285.72	2.53
B-28	DU	0.000	ipv00124	1240.00	1283.90	0.00
B-28-C1	DU	0.000	ipv00127	1241.78	1318.70	0.00
B-29	DU	0.000	ipv00126	1276.50	1316.90	0.00
B-29-C1	DU	0.000	ipv00186	1277.73	1340.10	0.00
C-27	DU	0.442	ipv00133	1236.50	1214.40	15.47
C-27-C1	DU	0.053	ipv00132	1238.25	1249.17	1.86
C-28	DU	0.070	ipv00130	1273.00	1247.40	2.47
C-28-C1	U+d	0.214	ipv00134	1274.75	1282.15	2.14
C-29	U+d	0.540	ipv00135	1309.50	1280.40	5.40
D-28	DU	0.171	ipv00131	1306.00	1210.90	5.97
D-28-C1	U+d	0.440	ipv00136	1307.75	1245.65	4.40
G-28	DU	0.000	ipv00171	1405.00	1101.40	0.00
A-16	DU	0.000	ipv00086	768.80	924.60	0.00
A-17	DU	0.000	ipv00085	805.40	957.60	0.00
A-18	U+d	0.211	ipv00083	841.90	990.60	2.11
A-19	DU	0.000	ipv00087	878.40	1023.60	0.00
A-20	U+d	0.210	ipv00094	914.90	1056.60	2.10
A-21	DU	0.000	ipv00096	951.40	1089.50	0.00
A-22	DU	-0.008	ipv00101	987.90	1122.50	-0.27
A-23	DU	0.000	ipv00104	1024.50	1155.50	0.00
A-24	U+d	0.129	ipv00105	1061.00	1188.50	1.29
A-25	DU	0.102	ipv00113	1097.50	1221.50	3.55
A-26	DU	0.000	ipv00118	1134.00	1254.50	0.00
A-27	DU	0.000	ipv00123	1170.50	1287.50	0.00
A-28	DU	0.000	ipv00129	1207.00	1320.50	0.00
A-28	U+d	0.151	ipv00128	1207.00	1320.50	1.51

Calculation of Total DU on GSA Site

B-15	DU	0.058	ipv00080	765.30	855.10	2.05
B-15-C1	U+d	0.264	ipv00089	767.05	889.85	2.64
B-16	U+d	0.407	ipv00081	801.80	888.10	4.07
B-16-C1	DU	0.005	ipv00090	803.58	922.85	0.17
B-17	U+d	0.407	ipv00082	838.30	921.10	4.07
B-17-C1	DU	0.009	ipv00091	840.13	955.85	0.33
B-18	U+d	0.116	ipv00084	874.90	954.10	1.16
B-18-C1	U+d	0.216	ipv00092	876.65	988.85	2.16
B-19	DU	0.000	ipv00093	911.40	987.10	0.00
B-19-C1	DU	0.124	ipv00097	913.15	1021.82	4.34
B-20	U+d	0.405	ipv00095	947.90	1020.00	4.05
B-20-C1	DU	0.119	ipv00098	949.65	1054.78	4.15
B-21	DU	0.000	ipv00111	984.40	1053.00	0.00
B-21-C1	U+d	0.142	ipv00099	986.15	1087.75	1.42
B-22	U+d	0.126	ipv00100	1020.90	1086.00	1.26
B-22-C1	DU	0.000	ipv00106	1022.68	1120.75	0.00
B-23	DU	0.000	ipv00103	1057.40	1119.00	0.00
B-23-C1	DU	0.000	ipv00110	1059.22	1153.75	0.00
B-24	U+d	0.191	ipv00107	1094.00	1152.00	1.91
B-24-C1	DU	0.000	ipv00112	1095.75	1186.75	0.00
B-25	DU	0.000	ipv00114	1130.50	1185.00	0.00
B-25-C1	DU	0.110	ipv00117	1132.25	1219.75	3.85
B-26	U+d	0.995	ipv00116	1167.00	1218.00	9.95
B-26-C1	U+d	0.137	ipv00119	1168.75	1252.75	1.37
B-27	U+d	0.867	ipv00120	1203.50	1251.00	8.67
B-27-C1	DU	0.053	ipv00132	1205.25	1285.72	1.86
B-27-C1	DU	0.072	ipv00125	1205.25	1285.72	2.53
B-28	DU	0.000	ipv00124	1240.00	1283.90	0.00
B-28-C1	DU	0.000	ipv00127	1241.78	1318.70	0.00
B-29	DU	0.000	ipv00126	1276.50	1316.90	0.00
B-29-C1	DU	0.000	ipv00186	1277.73	1340.10	0.00
B-30	DU	0.000	ipv00185	1313.10	1349.90	0.00
B-30-C1	DU	0.000	ipv00184	1331.35	1366.40	0.00
B-31	U+d	0.694	ipv00183	1349.60	1382.90	6.94
B-31-C1	DU	0.000	ipv00181	1367.85	1399.40	0.00
B-32	DU	0.000	ipv00178	1386.10	1415.90	0.00
B-32-C1	U+d	0.176	ipv00179	1404.35	1432.40	1.76
B-33	DU	0.000	ipv00180	1422.60	1448.90	0.00
B-33-C1	U+d	0.773	ipv00190	1440.85	1465.40	7.73
B-34	U+d	0.132	ipv00187	1459.10	1481.90	1.32
B-34-C1	DU	0.000	ipv00191	1477.35	1498.40	0.00
C-27	DU	0.442	ipv00133	1236.50	1214.40	15.47
C-28	DU	0.070	ipv00130	1273.00	1247.40	2.47
C-28-C1	U+d	0.214	ipv00134	1274.75	1282.15	2.14
C-29	U+d	0.540	ipv00135	1309.50	1280.40	5.40
C-33-C1	DU	0.123	ipv00189	1457.35	1447.15	4.29
I-5	DU	0.000	ipv00149	631.10	269.60	0.00
I-6	DU	0.000	ipv00138	667.60	302.60	0.00
I-7	U+d	0.130	ipv00139	704.10	335.60	1.30
I-8	DU	0.000	ipv00140	740.60	368.60	0.00
I-9	U+d	0.144	ipv00143	777.10	401.60	1.44
J-3	DU	0.074	ipv00150	591.00	167.10	2.61

Calculation of Total DU on GSA Site

J-4	DU	0.000	ipv00151	627.50	200.10	0.00
J-5	U+d	0.198	ipv00154	664.10	233.10	1.98
J-6	U+d	0.165	ipv00155	700.60	266.10	1.65
K-3	DU	0.000	ipv00166	624.00	130.60	0.00
K-4	DU	0.000	ipv00170	660.50	163.60	0.00

Average Frac. of Lim.=	0.22	AvgConcentration:	3.45
Std dev =	0.32		5.69
Number of measurements =	264		264
Standard deviation of the mean	0.02		0.35

---

D:\GSA\FINAL\GSA\FIGS\GSA95&94.WB2:Data

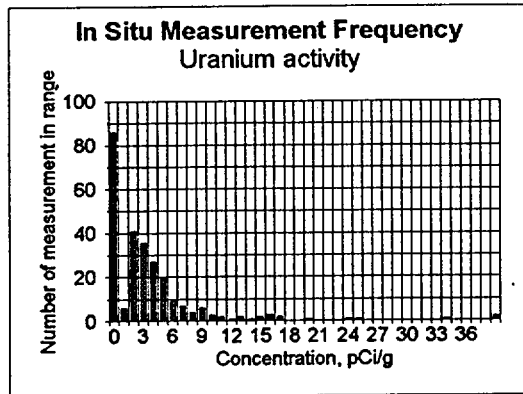
**RADIOLOGICAL CHARACTERIZATION AND  
FINAL SURVEY REPORT**

---

**ATTACHMENT 7.5  
Spreadsheet GSA95 & 94.WBZ  
Frequency Distribution of Uranium Concentration**

Frequency distribution of uranium concentration

0	86
1	6
2	41
3	36
4	27
5	20
6	9
7	7
8	4
9	6
10	3
11	2
12	1
13	2
14	1
15	2
16	3
17	2
18	0
19	0
20	1
21	0
22	0
23	0
24	1
25	1
26	0
27	0
28	0
29	0
30	0
31	0
32	0
33	0
34	1
35	0
36	0
37	0
38	0
	2



Frequency graph includes both DU and U+d

D:\GSA\FINAL\GSA\FIGS\GSA95&94.WB2:Data