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3. Number

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4. Rev No.

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7. Abstract

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Wade, C. D. and M. A. Wendling, 1994, *618-11 Burial Ground USRADS Radiological Surveys*, WHC-SD-EN-RPT-011, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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Rev. 0

618-11 BURIAL GROUND USRADS RADIOLOGICAL SURVEYS

AUTHOR

MARC WENDLING

**Plant Engineer
WHC\ERHP\Site Investigative Surveys**

REVIEWED BY

C.D. WADE

**Manager
WHC\ERHP\Site Investigative Surveys**

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INITIAL RADIOLOGICAL CHARACTERIZATION SURVEY OF THE 618-11 BURIAL GROUND

SCOPE

This report summarizes and documents the results of the radiological surveys conducted from February 4 through February 10, 1993 over the 618-11 Burial Ground, Hanford Site, Richland, Washington. In addition, this report explains the survey methodology using the Ultrasonic Ranging and Data System (USRADS).

The 618-11 Burial Ground radiological survey field task consisted of two activities: characterization of the specific background conditions and the radiological survey of the area.

The radiological survey of the 618-11 Burial Ground, along with the background study, were conducted by Site Investigative Surveys Environmental Restoration Health Physics Organization of the Westinghouse Hanford Company. The survey methodology was based on utilization of the Ultrasonic Ranging and Data System (USRADS) for automated recording of the gross gamma radiation levels at or near six (6) inches and at three (3) feet from the surface soil.

PURPOSE

The purpose of the survey was to perform an initial radiological survey of the 618-11 area, providing data to assist in the development of an Environmental Restoration Work Plan.

PROCEDURE

The radiological surveys were conducted following the procedures contained in the Health Physics Procedures Manual, (WHC-IP-0692.A); in particular; Section 11.20.02, Ultrasonic Ranging and Data System (USRADS): Connecting the Equipment, Rev. 0; Section 11.20.01, Ultrasonic Ranging and Data System (USRADS): Equipment Setup, Rev. 0; Section 1.25.13, Ultrasonic Ranging and Data System (USRADS): System Calibration, Rev. 0; Section 11.20.03, Ultrasonic Ranging and Data System (USRADS): Performing the Survey, Rev. 0; and Section 11.01.01, Background Determination for Environmental Surveys, Rev. 0.

The radiological surveys were conducted using both a digital count rate meter with a sodium iodide detector reporting in counts per minute (CPM) and a dose rate meter reporting micro Roentgen per hour (uR). The count rate meter was set for gross counting, i.e., window "out". The window setting allows detection of low, intermediate and high energy photons.

These instruments were connected to a CHEMRAD Tennessee Corp. Series 2000 USRADS. The USRADS equipment is used to record the detector readings versus the location of the readings, generate a map of the survey area and save the data on computer storage media.

Rev. 0

618-11 SITE

Introduction

Approximately 9.7 acres of 618-11 Burial Ground was surveyed with the USRADS equipment. Within this area a total of 34,321 data points were collected. Each of these data points represents two gross gamma radiation readings, counts per minute with a NaI detector at six inches and a dose rate with a micro-R meter at three feet, along with the physical coordinates of the readings. A total of 10 individual surveys were conducted in order to complete the area.

Location

Prior to initiating the radiological survey of the 618-11 Burial Ground, a grid system was established so that the individual surveys could be controlled and tied together. Using burial ground markers as control points, Site Investigative Surveys placed stakes in a 200' grid within the burial ground proper. Each grid block was given a numeric designator. (Fig. 1).

Instrumentation

Gamma Detection Instrumentation:

Ludlum Model 4 Count Rate Meter, Serial No. 81500
Ludlum Model 4 Count Rate Meter, Serial No. 81518
Ludlum Model 2221 Digital Scaler/Rate Meter, PNL No. 5580
All CRM's outfitted w/ Ludlum 44-10 2" X 2" NaI Detectors
Ludlum Model 19 microR Meter, PNL No. 5028

These instruments are maintained and calibrated by Pacific Northwest Laboratory.

Radiation survey instruments were checked at the beginning of each day for the proper instrument response. This was accomplished by placing a Cs-137 or U-Nat Check Source next to the detector and observing the instrument's response to the source. Local background radiation checks were also performed by taking three one minute counts.

Discussion

USRADS METHODOLOGY

Each survey entailed setting up the USRADS equipment in a grid block; connecting the radiation survey meters to the USRADS Data Pack; calibrating the USRADS equipment and performing the survey. Calibration of the USRADS is performed prior to starting a survey. The purpose of the calibration sequence is to reestablish the positioning instrumentation after the equipment is moved to a new location.

Every attempt was made to traverse each grid block on an approximately 10 foot cross hatched pattern, however, due to the roughness of the terrain and varying vegetation growth this was not always possible. Speed of survey was approximately 2 feet/sec. The gamma detector was maintained about six inches from the soil surface by suspending the detector from a boom attached to the surveyors backpack. The dose rate meter

REV. 0

was mounted to this boom three feet from the soil surface. In this manner detector geometry remained relatively constant throughout the entire survey.

USRADS SURVEY RESULTS

No statistically elevated radiation/contamination readings were observed in any of the surveys conducted. Survey statistics are summarized in Table 1.

Figure 2 is a composite survey track map of the entire area surveyed. Figure 3 is a radiological contour of the area. Figures 4 and 5 are three dimensional graphical interpretations of the CPM and dose rate data collected.

Due to a software limitation on the number of data points that may be represented on a contour or 3-D interpretation it was necessary to filter the data set. The CPM set was limited to data points > 8,000 cpm and > 3' apart and the dose rate set to data points > 8 uR/Hr and > 3' apart.

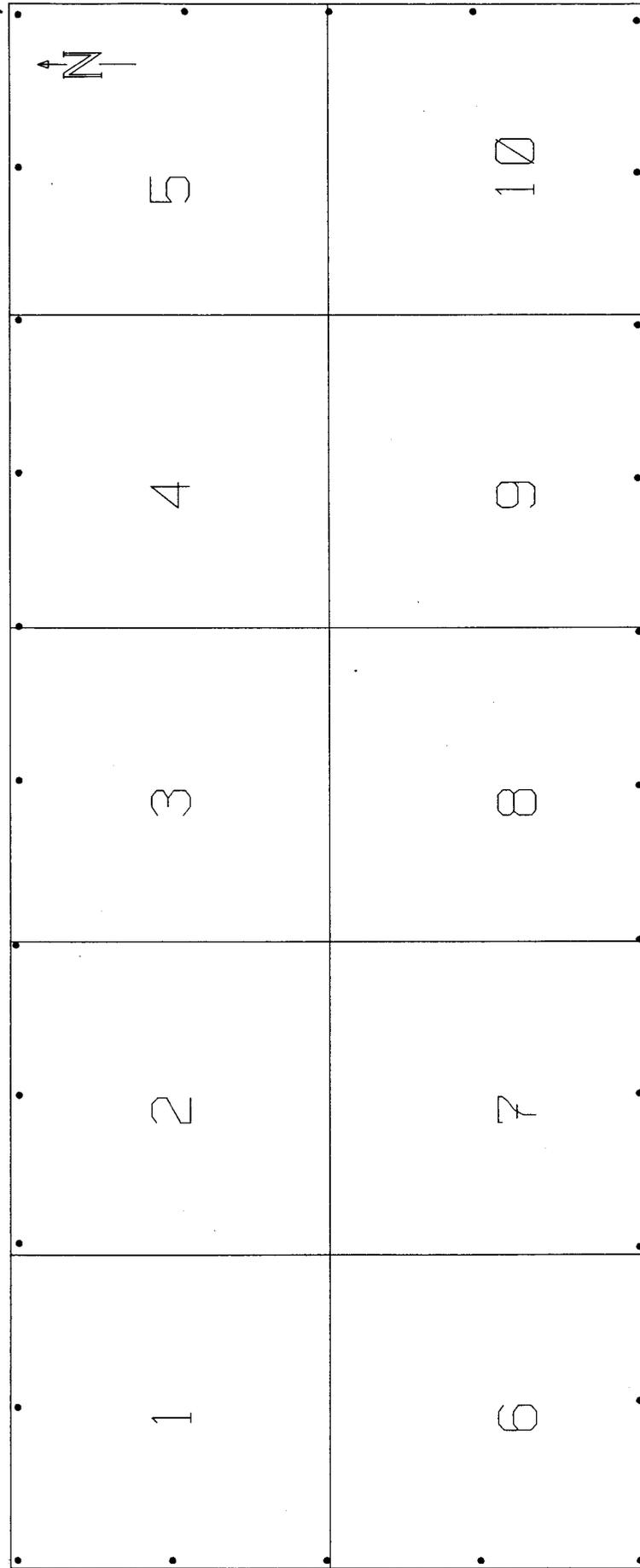
While no individual data point exceeded the minimum detectable count rate at a 95% confidence level over background, Figures 3,4, and 5 give an indication of where the highest elevated count and dose rate are located in the 618-11 area.

Table 1

618-11 Burial Ground USRADS Survey Statistics

SURVEY	DATE	GRID	DATA PTS	MAX CPM	MEAN CPM	SIGMA	MAX uR	MEAN uR	SIGMA
618111A	02/10/93	1	3265	8160	5855.21	607.87	14.72	8.45	1.6
618112A	02/10/93	2	3139	8460	6162.63	614.59	14.42	9.01	1.74
618-11-3A	02/08/93	3	3436	8040	6036.46	602.43	14.12	8.68	1.68
618-11-4A	02/08/93	4	3247	7860	5939.83	601.23	16.52	8.79	1.76
618-11-5A	02/05/93	5	3281	7560	5828.67	594.18	15.32	8.34	1.58
618116A	02/10/93	6	3633	7920	5779.04	614.64	15.02	8.17	1.65
618117A	02/09/93	7	3315	8460	6559.95	652.78	15.02	9.78	1.72
618118A	02/09/93	8	3726	9480	7308.97	672.28	16.52	10.86	1.85
618-11A	02/08/93	9	3646	8160	5746.16	610.76	13.52	8.63	1.65
618-11-6A	02/04/93	10	3633	8040	5815.76	611.29	14.12	8.52	1.64

618-11 USRADS SURVEY GRID LAYOUT



USRADS SURVEYS
ENP/Site Investigative Surveys

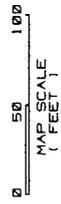
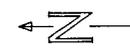
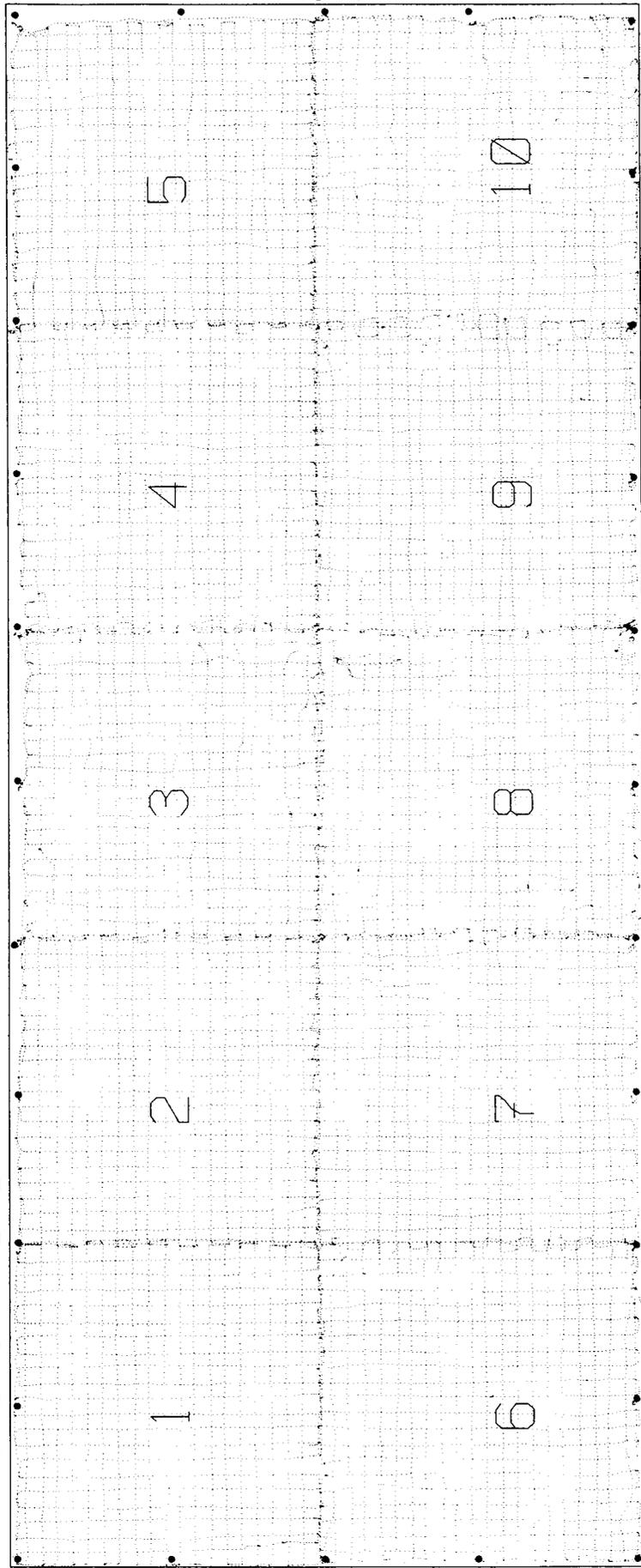


FIGURE 1

618-11 USRADS SURVEY TRACK



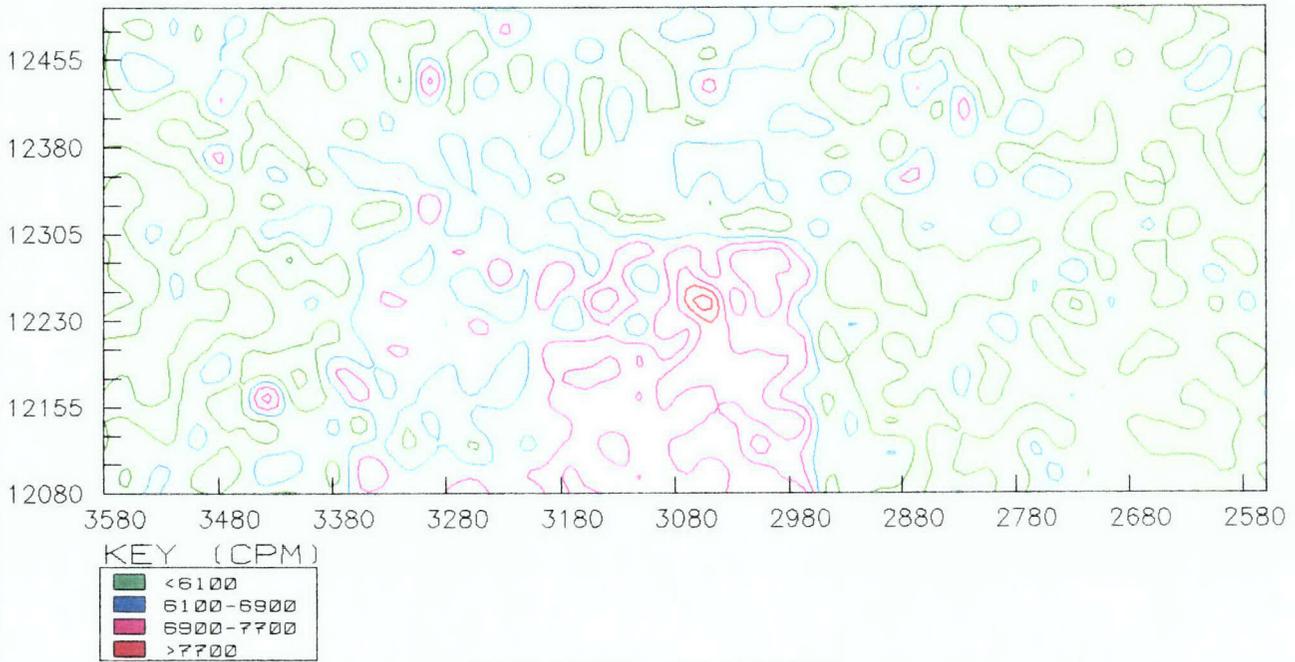
0 50 100
MAP SCALE
(FEET)

USRADS SURVEYS
EMP/Site Investigative Surveys

FIGURE 2

618-11 USRADS SURVEY RADIOLOGICAL CONTOUR

COUNT RATE (2X2 NaI)



DOSE RATE

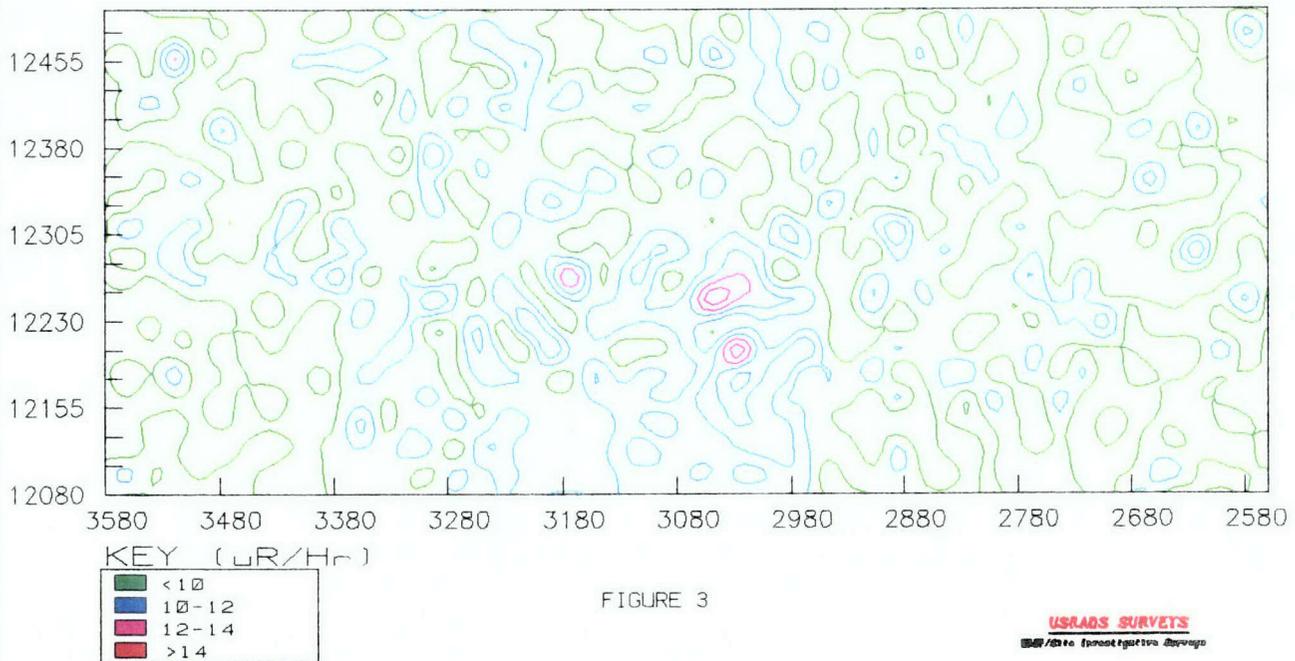


FIGURE 3

USRADS SURVEYS
U.S. Environmental Protection Agency

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618-11 USRADS SURVEY RADIOLOGICAL PROFILE

COUNT RATE (2X2 NaI)

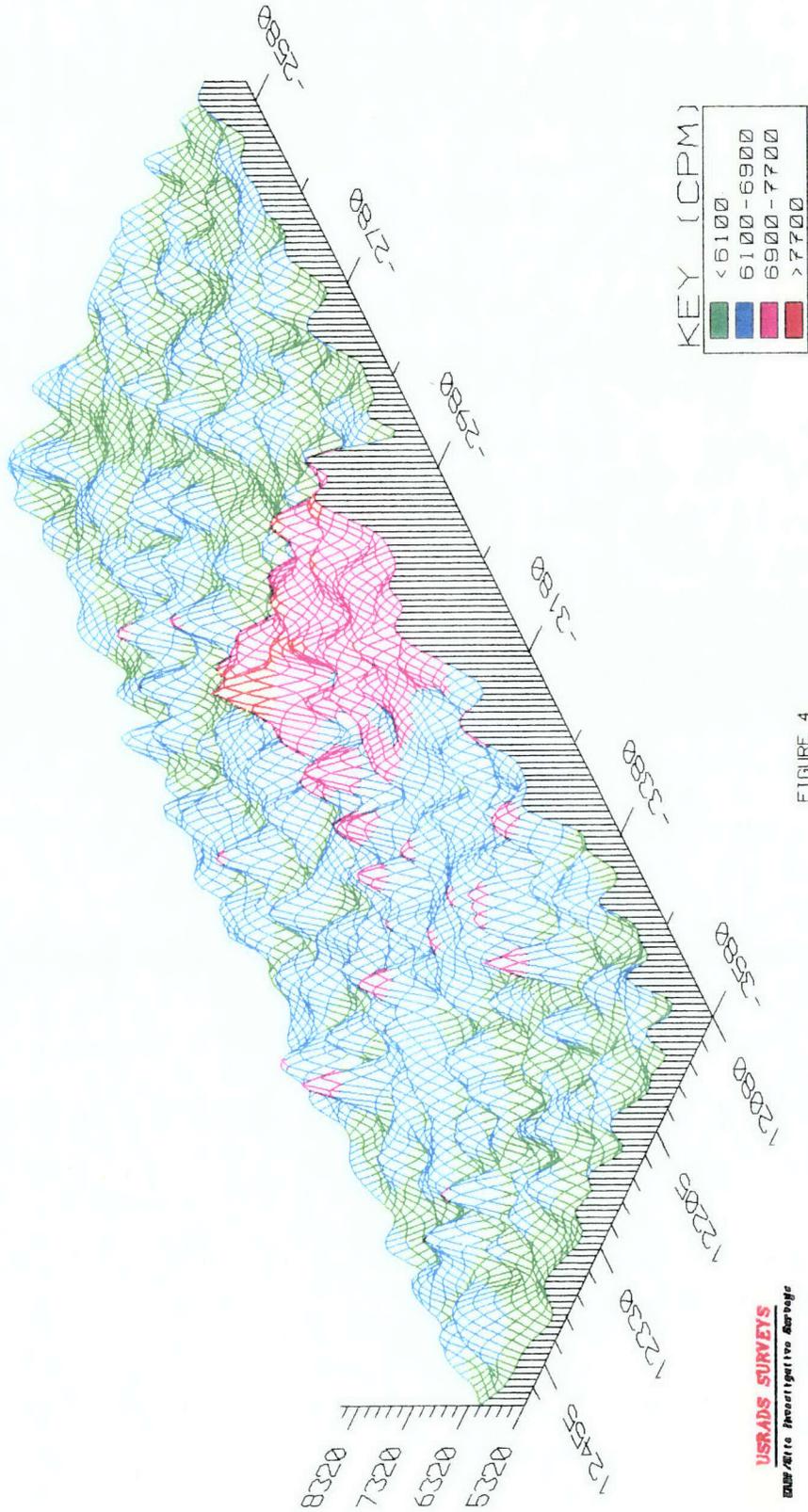


FIGURE 4

USRADS SURVEYS
Environmental Investigation Services

618-11 USRADS SURVEY RADIOLOGICAL PROFILE

DOSE RATE

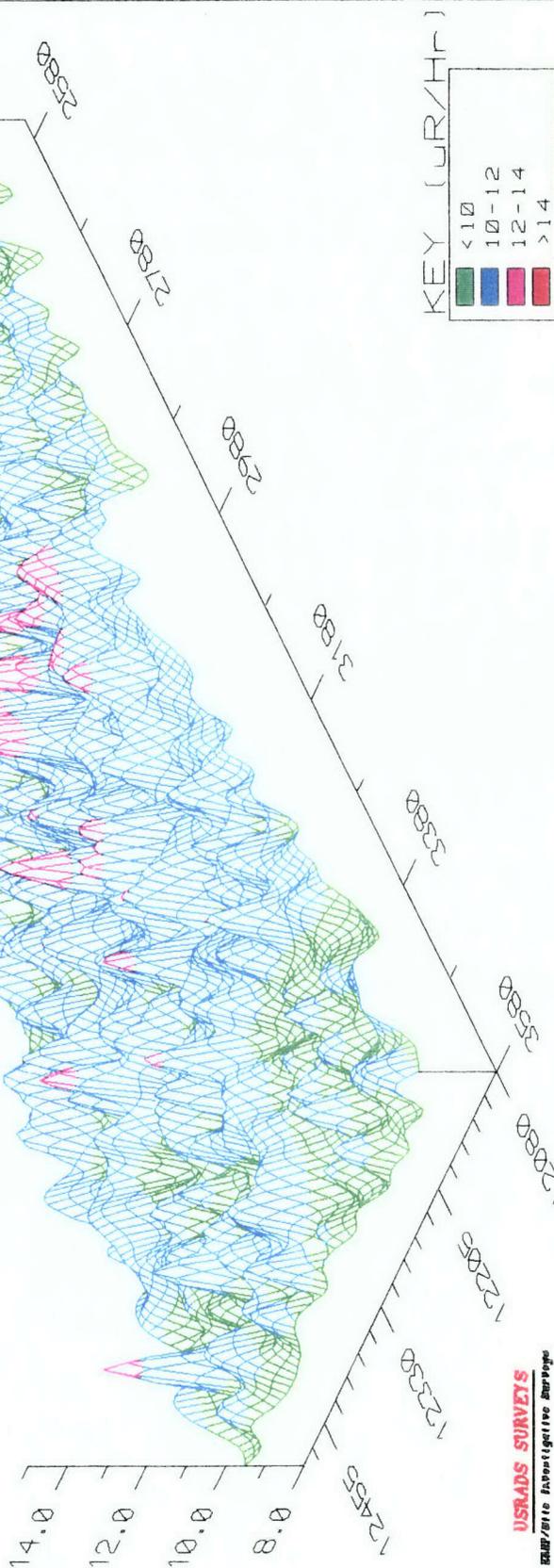


FIGURE 5

WHC-SD-EN-RPT-011

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**618-11 BURIAL GROUND
USRADS RADIOLOGICAL SURVEYS**

APPENDIX A

**AMBIENT RADIATION BACKGROUND
AND
MINIMUM DETECTABLE COUNT RATE DETERMINATION**

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LOW BACKGROUND SITE

Introduction

The Low Background survey was conducted to establish baseline radiological background conditions in a designated test plot known to have no history of radiological operations. The radiological data collected during this survey is considered representative of the undisturbed soil surfaces on the Hanford Site. The survey was conducted on August 27, 1992.

Location

The Low Background test plot, shown in Figure 1, is located in the 600 Area, between the 100-D/DR and 100-H Areas, approximately 2,000 feet from the Columbia River. The site had been previously staked on 100 foot intersects oriented along a north-south axis. The total size of the background plot is 500 by 500 feet.

Discussion

The survey was conducted using a Ludlum Model 2221 digital rate meter with a Ludlum Model 44-10, 2 by 2 inch sodium iodide detector and a Ludlum Model 19 Ur meter. The meters were coupled to the USRADS for the purpose of recording the data from the output of the individual detectors versus the location of that data within the survey area.

One survey was performed to cover the 40,000 square foot site. A total of 557 data points were collected within this site. A summary of the survey results can be found in Table 1. The survey grid layout and a track map of the surveyed area is shown in Figure 2. The grid block was traversed on approximately 25 foot transects.

Table 1

SURVEY	DATE	GRID	DATA PTS	MAX CPM	MEAN CPM	SIGMA	MAX uR	MEAN uR	SIGMA
LBS4A	08/27/92	LBS	557	8700	6982.3	704.64	14.72	9.34	1.61

As the surveyor traverses the survey area, the USRADS records the output data from the radiation detector versus the location of where in the survey area the data was detected - each second. Therefore, while the survey is in progress, a real-time map of the survey area is generated. When the survey is completed, the survey data set is saved on a computer disk.

The average background count rate for the Low Background Site was determined to be 6982 CPM and the average dose rate to be 9.34 uR/Hr.

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The minimum detectable count rate (MDC) was then calculated by employing the formula:

$$MDC = 60 \left(4.66 \sqrt{\frac{Rb}{60}} \right)$$

Where:

Rb = background count rate in CPM

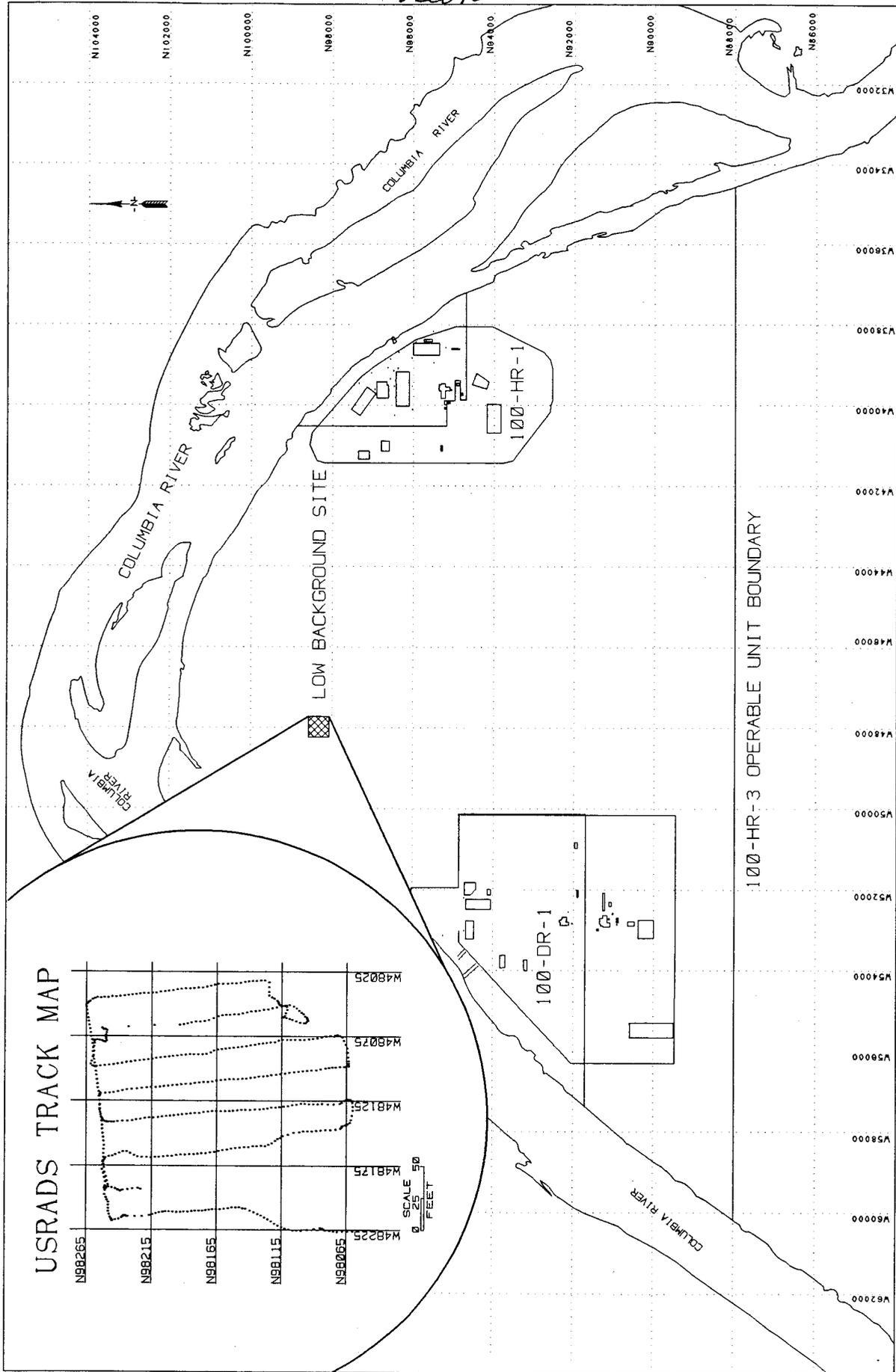
Based on the formula above, the minimum detectable count rate was $3016 + 6982 \text{ CPM} = 9998 \text{ CPM}$

One of the features of the USRADS is the ability to enter a "Threshold" setting upon initiating a survey. The threshold setting is a value that when exceeded, the data point plotted on the CPU monitor is highlighted. This feature alerts the CPU operator that the CPM data has exceeded the threshold, or preset value. For the purpose of conducting USRADS surface radiation surveys, it is desirable to establish a value for the threshold where readings above the setting could be considered for further investigations. The threshold value established for USRADS surface radiation surveys is 10,000 CPM. This value is practical base on the premise that too low a setting would highlight normal fluctuations above the calculated mean, and too high a setting would cut off the low end of surface radiation that might be present.

¹ Ref.: D.A. Gollnick, Basic Radiation Protection Technology, 2nd Edition.

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100 AREAS LOW BACKGROUND SITE



USRADS SURVEYS
EMRP/State Investigative Surveys

HANFORD SITE COORDINATES

FIGURE 1

0 1000 2000
Scale in Feet

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