CIMARRON CORPORATION
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S. JESS LARSEN
VICE PRESIDENT

June 28, 1996

Mr. Michael F. Weber, Chief
Low-Level Waste Management
and Decommissioning Projects Branch
Office of Nuclear Material Safety
and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Re: Docket No. 70-0925
License No. SNM-928
Cimarron Facility Soil Survey

Dear Mr. Weber:

In accordance with License No. SNM-928, Amendment No. 10, dated November 4, 1994 which authorizes on-site burial of soil contaminated with low-enriched uranium as defined in the Branch Technical Position (Federal Register 52061) Option 2 concentration range, Cimarron Corporation herein submits four copies of a report detailing the radiological characterization of a fourth contaminated soil pile. Cimarron believes the fourth pile is acceptable for disposal, as demonstrated in the report.

Placement in the on-site burial cell of the three soil piles previously authorized by NRC staff for disposal is complete, and the job has progressed very smoothly. In order to maintain the level of progress currently enjoyed, Cimarron respectfully urges NRC staff's early review of this report. The staff's timely authorization for disposal of this fourth pile could ensure the flow of work will continue without a pause.

Cimarron believes the report supplies sufficient information to demonstrate characterization of this pile is consistent with the two submissions covering three piles previously approved by NRC for disposal. Please call Joe Kegin at 405/282-6722 or me at 405/270-2288 if you have any questions concerning this matter.

Sincerely,

Jess Larsen

Jess Larsen
Vice-President

Enclosures: 4 copies

copies: G. D. Christiansen (w/o enclosure)
J. C. Stauter (w/o enclosure)
J. L. Kegin
Cimarron License file

KERR-McGEE CORPORATION

Report on the

Radiological Survey Results

of

Option 2 Stockpile No. 4

License No. SNM-928
Docket No. 70-0925

CIMARRON CORPORATION
OKLAHOMA CITY, OKLAHOMA

RADIOLOGICAL CHARACTERIZATION RESULTS

FOR OPTION #2 SOIL STOCKPILE NO. 4

LICENSE NO: SNM-928
DOCKET NO: 70-0925

CIMARRON FACILITY

CIMARRON CORPORATION

OKLAHOMA CITY, OKLAHOMA

JUNE, 1996

1.0 Introduction

On November 4, 1994, the Nuclear Regulatory Commission (NRC) issued an amendment to Cimarron Corporation's License SNM-928 (Amendment #10). Condition #23 of that amendment allows on-site disposal of up to 14,000 cubic meters (500,000 cubic feet) of soil having a uranium concentration consistent with limits specified in the NRC Branch Technical Position on Disposal or Onsite Storage of Thorium or Uranium Wastes From Past Operations, Federal Register/Vol. 46, No. 205/page 52601, (BTP) Option 2. Table 1-1 shows the BTP Option limits for enriched uranium. The concentration of thorium and plutonium in the soil must not exceed 10 pCi/g and 1 pCi/g, respectively. All contaminated soil and debris shall be buried at a minimum depth of four feet below ground surface and shall be compacted in one foot lifts.

Cimarron Corporation has been stockpiling soil and debris contaminated with enriched uranium at BTP Option #2 concentrations on-site. This contaminated material is placed in a stockpile as it is removed from an area being decommissioned. This allows for final characterization of the contaminated materials in the stockpile prior to placement of these materials in the on-site disposal cell. Two stockpiles (herein referred to as DAP-1 and DAP-2) of Option #2 material located northeast and east of the Uranium Plant Building were characterized in 1994 by Cimarron personnel. ORISE performed a confirmatory survey and sampling effort on the two piles and submitted a report of their findings to the NRC. DAP-1 and DAP-2 were subsequently approved for on-site disposal by the NRC by letter dated February 16, 1995 and were subsequently moved to the on-site disposal cell. DAP-3 was characterized in December 1994 by Cimarron personnel. ORISE performed a confirmatory survey and sampling effort on DAP-3 and submitted a report of their findings to NRC. DAP-3 was approved for on-site disposal by the NRC letter dated May 31, 1995 and was subsequently moved to the on-site disposal cell.

Accumulation of Stockpile DAP-4 was started in 1995. This stockpile is located in the uranium plant yard and is shown on Figure 1. Prior to placement of the contaminated material from DAP-4 in the on-site disposal cell, Cimarron Corporation has performed a characterization of the materials in accordance with the guidance contained in Draft NUREG/CR-5849. The procedures used for this characterization are identical to those reviewed and approved by the NRC for stockpiles DAP-1, DAP-2 and DAP-3.

The purpose of this report is to present the DAP-4 characterization data to the NRC for review prior to giving approval for on-site disposal. This report also describes the methodologies and procedures utilized by Cimarron Corporation while performing the characterization of DAP-4.

2.0 Characterization of DAP-4

A volume of approximately 56,500 cubic feet (1,600 cubic meters) of contaminated soil and debris has been placed in DAP-4. The contaminated soil and debris contained in DAP-4 is the result of on-going site decommissioning activities. Contaminated materials placed in DAP-4 were removed from the burial area #2, the uranium building east yard and the Lined Sanitary Lagoon. These locations are shown on Figure 1.

2.1 Data Generation

The surface of DAP-4 was leveled in order to facilitate surveying and sampling of the stockpile. DAP-4 was subdivided on a 5 meter by 5 meter grid which was tied directly to an established survey reference point for the site. The survey reference point is shown on Figure 1. DAP-4 was then surveyed using a micro-R survey meter at the surface and at a height of one meter. The surface was also surveyed using a shielded 3" x 0.5" NaI detector. Boreholes were drilled through the stockpile to obtain soil samples at various depths. Soil samples were collected and composited over each half meter interval through the entire depth of the stockpile. The soil samples were then counted utilizing the on-site soil counter (gamma spectrum analysis). In addition, a dirt probe consisting of a 1.5" x 4" NaI detector was utilized to obtain a count rate at each 0.5 meter depth interval for each borehole.

2.2 Data Evaluation

The individual survey and soil sample data and the statistical data analyses and summaries resulting from the characterization effort are contained in Appendix 1. This information is also displayed on drawings in Appendix 2. A total of 167 soil samples were analyzed for both total uranium and natural thorium. Total uranium concentrations ranged from 9 pCi/g to 204 pCi/g for the 167 samples, with an average total uranium concentration of 43.7 ± 17.9 pCi/g (1 sigma error). Natural thorium concentrations ranged from 1 to 2 pCi/g, and averaged 1.4 pCi/g for the 167 samples. This information is presented in Appendix 3. Samples sent to off-site laboratories as part of the Cimarron quality assurance program were also analyzed for Plutonium-239. Plutonium-239 concentrations reported by Core laboratory ranged from 0.1 pCi/g to 0.2 pCi/g for the three samples analyzed, while the concentrations reported by Lockheed Analytical Services ranged from 0.0017 pCi/g to 0.087 pCi/g.

Uranium concentrations in samples were averaged utilizing the methodology provided in Draft NUREG/CR-5849 (Equation 8-13) to determine if the average uranium concentration for the stockpile was equal to or less than the guideline value,

at the 95 percent confidence level. The comparison testing was calculated utilizing the formula listed below:

$$\mu_\alpha = \text{Mean} + t_{1-\alpha,df}\,(S_x/\sqrt{n})$$

Where:

Number of samples, n	= 167
Sum of sample concentrations	= 7303
Mean	= 43.7 pCi/g U (Equation 8-11)
Standard Deviation, S_x	= 17.9 pCi/g U (Equation 8-12)
95% C.L. for mean, $t_{1-\alpha,df}$	= 1.657 for 142 degrees of freedom
Guideline value (Criterion)	= 100 pCi/g total uranium average

$$\mu_\alpha = 43.7 + 1.657(17.9/\sqrt{167}) = 45.9952 = 46.0 \text{ pCi/g uranium}$$

∴ **CRITERION SATISFIED**.

The calculated value of μ_α is less than the criterion value of 100 pCi/g total uranium.

As discussed in Section 1.0 of this report, the guideline value for contaminated soil and debris to be disposed of on-site is 100 pCi/g total uranium average (this corresponds to the BTP Option #2 concentration limit for 100% soluble enriched uranium contamination). One soil sample location in DAP-4 had total uranium concentrations which exceeded the guideline value of 100 pCi/g. This sample location, along with the surrounding sample locations, were averaged utilizing the "hot-spot" averaging criteria provided in Draft NUREG/CR-5849 (Equation 8-10) to determine if the average total uranium concentration in the 100 square meter contiguous area was equal to or less than the guideline value. The weighted average was calculated utilizing the formula listed below:

$$X_w = (NEA)[(1-A)/100] + (EA)(A/100)$$

where:

NEA	=	"Non-elevated average", average of samples less than 100 pCi/g uranium;
EA	=	"Elevated average", average of samples exceeding 100 pCi/g uranium;
A	=	Area taken up by all samples exceeding the criteria.
X	=	Weighted average in pCi/g.

The average value calculated through the use of the above formula for this "hot-spot" was below the guideline value of 100 pCi/g total uranium. The calculation results are presented in Tables 2-1.

3.0 Cimarron Radiation Protection Program

The Cimarron Radiation Protection Program ensures that all employees, visitors and the general public are protected from radiological hazards which may be present due to licensed activities conducted at the facility. Cimarron Corporation maintains a Radiation Protection Program which meets or exceeds all applicable regulatory requirements associated with all activities conducted under Special Nuclear Materials License SNM-928 and By-Product License 35-12636-02.

The Cimarron Radiation Protection Program currently in place for all decommissioning activities is administered through the use of the following documents:

- Cimarron Radiation Protection Procedures
- Cimarron Site Health and Safety Plan
- Cimarron Quality Assurance Plan and Procedures
- Cimarron Emergency Plan

Corporate audits for regulatory and internal requirements are conducted on a periodic basis and include the review of the Cimarron Radiation Protection Program and the associated elements. Assessments of program effectiveness are also performed periodically by the Cimarron Radiation Safety Officer/Health Physics Supervisor. Additionally, the program is inspected for compliance with applicable rules and regulations by the Oklahoma Department of Health, NRC Region IV, and NRC Headquarters staff.

3.1 Cimarron Quality Assurance Program

The Cimarron Corporation Quality Assurance Plan and Procedures are an integral part of the Cimarron Radiation Protection Program. A principal component of this program is to affirm the quality of project work performed during decommissioning by assuring that all tasks are performed in an organized manner by qualified personnel. The Program ensures that all samples are collected, controlled and analyzed in accordance with all applicable quality controls such that data accuracy and validity are verifiable. The data generated is compared to the criteria discussed in Sections 1.0 and 2.2 and managed per approved Cimarron procedures. Such quality controls allow for the independent verification of analysis results by third party review, thereby assuring that all characterization data is accurate and complete.

The Cimarron Quality Assurance Program is implemented and maintained in accordance with written policies, procedures, and instructions. This Quality Assurance Program is administered under the direction of the Quality Assurance Manager. Periodic audits and reviews are conducted to ensure that all aspects of the Cimarron Quality Assurance Program are addressed. The Cimarron Quality Assurance Program satisfies the applicable requirements of 10 CFR 50, Appendix B and NQA-1.

3.1.1 Sample Chain of Custody

Field data are gathered and maintained in field logs for all samples in accordance with the Cimarron QA program. Necessary data are transferred to the laboratory sample log when the sample is brought to the on-site laboratory for analysis. The sample logs provide a record of sample collection and transport and are placed into the facility quality assurance files at appropriate intervals.

Samples shipped to off-site independent laboratories for analysis are accompanied by a chain of custody form in accordance with the Cimarron Quality Assurance Program. These forms provide documentation of sample handling and are maintained by the Quality Assurance Manager as permanent records.

3.1.2 Verification Samples

Off-site analysis of split samples is an integral part of the quality assurance program. Results for these samples is presented in Section 5.0.

4.0 Instrumentation

The instrumentation utilized to generate the characterization data discussed above are calibrated and maintained at the Cimarron site in accordance with the associated Radiation Protection Program procedures. These procedures utilize the guidance contained in ANSI N323-1978, "Radiation Protection Instrumentation Test and Calibration". Specific requirements for instrumentation include traceability of calibrations to NIST standards, field checks of operability, background radioactivity checks, operation of instruments within established environmental bounds, training of individuals, scheduled performance checks, calibration to isotopes with energies similar to those to be measured, quality assurance tests, review of data, and record keeping. The specific instrumentation utilized during this characterization effort for DAP-4 is listed in the following sections.

4.1 Survey Instrumentation

Portable survey instruments (micro-R survey meters, α/β survey meters, dose rate instruments, scalers/ratemeters, etc.) are calibrated on a quarterly basis. All instrumentation is calibrated with NIST traceable standards. Where applicable, activities of sources utilized for calibration are corrected for decay. In addition to the quarterly calibration requirements, source checks are required for all instruments being utilized for characterization work on a daily basis. A calibrated electronic pulse generator is utilized for instrument scale linearity checks.

All calibration and source check records are completed, reviewed and retained in accordance with Cimarron Quality Assurance Plan and Procedure requirements.

Survey results generated through the use of site instrumentation have continued to show general agreement with survey measurements recorded during independent confirmatory surveys performed at the Cimarron site. Such independent surveys have been conducted by the NRC, ORISE and the State of Oklahoma.

4.2 Shielded 3" x 0.5" NaI Gamma Detector

The 3" x 0.5" detector is a sodium iodide (NaI) crystal gamma detector which is lead-shielded around the sides and socket end in order to ensure that the detector is as directional as possible. The NaI detector is utilized with a portable scaler/ratemeter that has single channel analyzer capability. Americium-241, Uranium-235, and Natural Thorium sources are utilized to set the instrumentation window and threshold to detect gamma energies in the range of 50 to 250 keV. This energy range corresponds to the energies of interest when surveying for uranium and natural thorium contamination. The instrument is normally operated in the window "out" mode, meaning that the instrument response is for the entire range of detectable energies. This mode of operation ensures the detection of elevated areas corresponding to gamma emitters outside the energy range of 50-250 keV. The window "in" mode is utilized to perform additional characterization of elevated areas that are detected using the window "out" mode.

Ranges are established for differentiating between Option #1, Option #2, and Option #4 materials by correlating counts per unit time to known uranium and/or thorium concentrations in the soil or debris. This allows the 3" x 0.5" NaI detector to be used for qualitative "in-situ" surface identification and differentiation of contaminated soil and debris. Quantitative analysis of contaminated materials is performed with the on-site counter.

4.3 Unshielded 1.25" x 4" NaI Gamma Detector (Dirt Probe)

The 1.25" x 4" detector is a sodium iodide (NaI) crystal gamma detector encased in a length of 2" PVC pipe with a brass tip that can be inserted into a bucket or pile of dirt. This detector is referred to as the "dirt probe" by Cimarron personnel. The NaI detector is utilized with a portable scaler/ratemeter that has single channel analyzer capability. Americium-241, Uranium-235, and Natural Thorium sources are utilized to set the instrumentation window and threshold to detect gamma energies in the range of 50 to 250 keV. This energy range corresponds to the energies of interest when surveying for uranium and natural thorium contamination. The instrument is normally operated in the window "out" mode, meaning that the instrument response is for the entire range of detectable energies. This mode of operation ensures the detection of elevated areas corresponding to gamma emitters outside the energy range of 50-520 keV.

The instrumentation described above is then calibrated by inserting the probe into a tube positioned in several drums of soil with defined uranium concentrations. A range is then established for differentiating between Option #1, Option #2, and Option #4 materials by correlating counts per unit time for each drum to known uranium concentrations in each drum. This allows for qualitative "in-situ" identification and differentiation of sub-surface contaminated soil and debris. Quantitative analysis of contaminated materials is performed with the on-site soil counter.

4.4 Soil Counter (Gamma Spectroscopy)

The Cimarron Soil Counter consists of a 4" x 4" x 16" sodium iodide crystal housed in a shielded chamber which is computer linked to a multi-channel analyzer (MCA). Data from the MCA is processed through an EG&G Ortec Analysis Program which, in turn, determines uranium and thorium concentrations in soil samples.

Calibration of this counting system is traceable to NIST standards through contractor laboratory evaluations of the on-site standards. The standard concentrations have been confirmed through measurements performed by the Oak Ridge Institute for Science and Education (ORISE). ORISE has been used by the NRC for verification of a majority of the decommissioning work completed to date at the Cimarron site. ORISE has conducted an evaluation of the Cimarron Soil Counting system's ability to accurately measure total uranium concentrations in soil samples. This was done by comparing ORISE sample analysis results obtained by alpha pulse height analysis and gamma spectroscopy with the results obtained from the use of the Cimarron Soil Counter. ORISE and Cimarron analysis results compared favorably at levels above background. Background level concentrations were noted to be biased high for the soil counter when analyzing soil samples with uranium concentrations at or below

background concentrations (see August 31, 1989 letter from Mr. J. Berger (ORISE) to Mr. R. Hurt (NRC)).

A continuous and extensive quality control and calibration verification program has continued on the Cimarron Soil Counter. In the ORISE report Confirmatory Survey for the South Uranium Yard Remediation (Docket 79-925, November, 1995) a comparison of ORISE soil count results and cimarron soil count was performed. This report states that the results of the Wilcoxon Signed Ranks test indicated, as a whole, ESSAP's and the licensee's analytical results are statistically identical.

Established quality assurance measures for the soil counter include cesium-137 centroid checks, Chi-square tests, background determination, and the counting of appropriate standards each time the soil counter is used. All of these quality assurance measures are plotted on control charts and are trended on a continuing basis.

Standards used for calibration and quality assurance checks on the soil counter have been analyzed by outside laboratories and are NIST traceable through these analyses. Comparison results between the standards as counted using the soil counter and two off-site laboratories are presented in Table 3-1. The assigned values for the standards are the average of the results obtained for the off-site labs, when the standards were analyzed by more than one lab. As shown in Table 3-2, the standards range in concentration from 4.5 pCi/g to 292 pCi/g, thus covering the entire range of interest for the Cimarron characterization and remediation activities.

The soil counter determines uranium and thorium activities based upon the evaluation of net counts. Activities are calculated through the use of efficiency and correction factors obtained using appropriate standards. Soil concentrations are calculated by dividing the net activity by the soil mass or weight. Soil weights are determined on a laboratory scale which is checked on a daily basis, when in use, utilizing NIST traceable standards. Total uranium concentrations are calculated from the uranium data by applying the site average enrichment value of 2.7 weight percent for Uranium-235.

5.0 Independent Laboratory Analysis Data Comparison

Three random samples were taken from DAP-4 and split with two off-site independent laboratories for comparison with the Cimarron Soil Counter analysis results. Analysis for total uranium by gamma spectroscopy, isotopic uranium by alpha spectrometry, and total thorium by gamma spectroscopy is shown in Table 3-1. In addition, ten soil samples from other areas on the Cimarron site were submitted for off-site analysis to Core Lab during the first quarter to satisfy the quarterly QA/QC requirements for the soil counter. This data is

also included in Table 3-1. Total uranium results as measured by Core Lab were plotted and compared to sample results from the Cimarron soil counter for 13 samples ranging in concentration from 8.9 to 126.7 pCi/g (as reported by Core Lab). As shown by Figure 2, the results are in good agreement. Comparison of analytical results show general agreement between the laboratories.

Calibration standards used to check performance of the Cimarron Soil Counter have been analyzed by independent laboratories. The comparison results are shown in Table 3-1.

6.0 Cimarron Site Background

Natural background concentrations for uranium and thorium in soil have not been subtracted from the reported sample analysis results at Cimarron. Background has not been subtracted in order to ensure that a conservative estimate of uranium and thorium concentrations in soil is utilized during decommissioning activities.

Natural background for uranium and thorium in soil have been established through numerous measurements by Cimarron personnel utilizing the on-site soil counter and by independent laboratories. The Cimarron soil counter was designed in 1985 for use in the sorting of enriched uranium at concentrations of greater than 30 pCi/g (Option #2) from soils containing lower concentrations. This counting system uses a 4" by 4" by 16" NaI detector and a computer based multi-channel analysis system with spectrum analysis software. **The soil counter assumes an enrichment of 2.7 weight percent U-235, which has been established as the average enrichment for uranium in soils at Cimarron.** The soil counter efficiency is based upon the utilization of standards with activities ranging from background levels to approximately 300 pCi/g total uranium. All standards, as well as samples analyzed, have a mass of approximately 750 grams. The initial use of the Cimarron soil counter was for the segregation of soils greater than Option #1 (>30 pCi/g) above background. This application was performed using a sample counting time of 5 minutes. The a priori minimum detectable concentration (i.e. per draft NUREG/CR-5849 equation 5-4) for the soil counter, based on a 5 minute count time, is approximately 10 pCi/g total uranium.

Numerous areas of the Cimarron Facility have been released using this counting system with confirmation from outside independent laboratories, including Oak Ridge Institute for Science and Education (ORISE, previously known as ORAU) and the Nuclear Regulatory Commission (NRC).

The Cimarron soil counter has recently been used for the purpose of determining concentrations of total uranium in unaffected areas of the site. Due to the lower concentrations of total uranium expected in unaffected areas, a 30 minute counting time for

Background soil samples have been collected and analyzed by Cimarron on the soil counter. In addition, ORISE has reported the results of background samples collected as part of their confirmatory process on behalf of the NRC. The data from these evaluations is presented below. In addition, recommendations and conclusions are presented regarding appropriate uses of background as it applies to releases of areas within the Cimarron site, while also considering materials with total uranium concentrations greater than Option #1 (> 30 pCi/g).

Data Presentation and Evaluation

ORAU prepared a report, "Confirmatory Radiological Survey Former Burial Ground Cimarron Corporation Facility Crescent, Oklahoma, July, 1992", which included analysis of six background soil samples collected near the Cimarron facility. Total uranium in the six background soil samples ranged from less than 1.2 pCi/g to 2.0 pCi/g, based upon calculations performed using the gamma spectroscopy data. The average concentration for the samples, assuming that the actual concentration for the two reported "less than" values are equal to the maximum possible values, was reported as 1.6 pCi/g.

In May, 1995, ORISE collected and analyzed an additional six off site background samples at NRC request. Samples were analyzed by alpha pulse height analysis. Total uranium results were calculated by summing the U-234, U-235 and U-238 results. Concentrations of total uranium ranged from $0.80 \pm 0.15(2\sigma)$ pCi/g to $1.86 \pm 0.23(2\sigma)$ pCi/g. The average total uranium concentration for the six samples was 1.33 ± 0.84 (2σ) pCi/g.

Cimarron personnel collected 30 site background surface soil samples from the perimeter of the Cimarron site during the first quarter of 1995. Locations were selected along the east and west boundaries as the prevailing wind directions at the facility are from the south, southeast, and the north. **Total uranium results for the 5 minute counts ranged from 2 pCi/g to 10 pCi/g, with an average of 6.7 ± 3.5 (2σ).** The 5 minute counting data are biased high due to several factors. The on-site soil counter reports certain results as "less than" a certain value. When "less than" values are reported by the counting system, the concentration of total uranium is calculated based upon the assumption that the sample contains uranium activity at the maximum possible concentration. Additionally, the reported concentrations assume an enrichment of 2.7 weight percent U-235, which results in an overestimate for total uranium in soil samples in which the actual U-235 enrichment is less than 2.7%.

NOTE: For samples at natural enrichment, this overestimate is equal to the factor 2.2, which is equal to the activity ration of enriched uranium to natural uranium (i.e. 1.5 pCi/μg ÷ 0.67 pCi/μg). However, the Cimarron soil counter provides results in terms of enriched uranium in order to provide a conservative estimate of soil sample activity.

Past remediation activities at the Cimarron facility have focused mainly upon the affected areas of the facility. More recent activities have involved the characterization of unaffected areas containing lower concentrations of total uranium in soil. Cimarron Corporation elected to increase the soil sample counting time to 30 minutes for samples collected in unaffected areas in order to lower the a priori minimum detectable concentration (MDC) for 2.7% enriched total uranium to approximately 4 pCi/g. As demonstrated below, this MDC is consistent with total uranium in average background soils.

Total uranium ranged from 2.3 pCi/g to 6.6 pCi/g, with an average of 4.0 ± 2.6 (2σ) pCi/g. The correction factor of 0.67/1.5 provides results in terms of naturally enriched uranium, which results in a range from 1.0 pCi/g to 2.9 pCi/g, with an average of 1.8 ± 1.0(2σ) pCi/g.

NOTE: The Cimarron soil counter results compare favorably to ORISE/ORAU results when corrections for enrichment are applied to the data.

The draft NUREG/CR-5849 provides criteria to be used in evaluation of the adequacy of background data relative to the guideline value. NUREG/CR-5849 states in section 8.6 "For the purposes of this Manual, the background has been considered to be insignificant if it is <10% of the guideline, although the licensee may use such background levels in determining net residual activity...".

NOTE: The average total uranium background [1.8 ± 1.0(2σ) pCi/g] is less than 10 percent of the guideline value for Option #1 material (30 pCi/g). Therefore, it can be stated that the average background is "insignificant" with respect to the Option #1 guideline value, in accordance with NUREG/CE 5849.

Based upon the measurements of background soils performed on the Cimarron soil counter, it can be stated that measurements of background soils should fall below 2.8 pCi/g 95% of the time, when results are reported in terms of natural enrichment. This concentration represents the upper 95 percent confidence interval for total uranium (naturally enriched) for the 28 background samples. The above statement can be interpreted with respect to Cimarron soil counter results reported in terms of 2.7% enriched interval value. **Application of the conversion factor results in a total uranium concentration of 6.2 pCi/g. This concentration represents the upper 95% confidence interval for total uranium in background soil samples reported as 2.7% enriched.**

Conclusions

Background samples were collected for the purpose of documenting the site background. Five minute counts of these samples on the Cimarron soil counter ranged from 2 pCi/g to 10 pCi/g total uranium, with an average of $6.7 \pm 3.5(2\sigma)$ pCi/g. This data is known to be biased high due to the reporting of "less than" values at the maximum possible concentration and the assumption that the uranium is enriched at 2.7 weight percent.

Twenty eight of the 30 background soil samples were analyzed for a 30 minute counting time to achieve more accurate results. Total uranium concentration in the 28 samples ranged from 2.3 pCi/g to 6.6 pCi/g, with an average of $4.0 \pm 2.6(2\sigma)$ pCi/g. These results also assumed that the uranium was present at an enrichment of 2.7 percent.

A conversion factor was applied to the 30 minute background count data to obtain results in terms of natural enriched activity. The background concentration for total uranium in soil was calculated as $1.8 \pm 1.0(2\sigma)$ pCi/g. This value is in agreement with prior measurements reported by ORAU and ORISE. Cimarron has also established the upper 95% confidence interval for total uranium in background soils as 2.8 pCi/g.

NOTE: A site background of 4.0 pCi/g Total Uranium and 1.5 pCi/g Thorium(Natural) has been established and approved by NRC.

In addition, site background has not been subtracted from the sample results for DAP-4, thus resulting in the use of conservative values for purposes of determining the acceptability of materials for disposal.

Background exposure rates have been established at the Cimarron site by taking micro-R readings at off-site sample locations, in addition to Cimarron site areas which are unaffected by past operations. Site background rates of approximately 7 μR/h have been observed in background areas by Cimarron personnel utilizing a Ludlum Micro-R survey meter. Site background exposure rates of approximately 7 μR/h have also been determined by ORISE personnel utilizing similar instrumentation. In addition, site background exposure rates have been determined by ORISE personnel utilizing a pressurized ion chamber (PIC). Based on the PIC measurements, the site background was determined to be approximately 10 μR/hr.

NOTE: The site background exposure rate ranges from 7-10 μr/h.

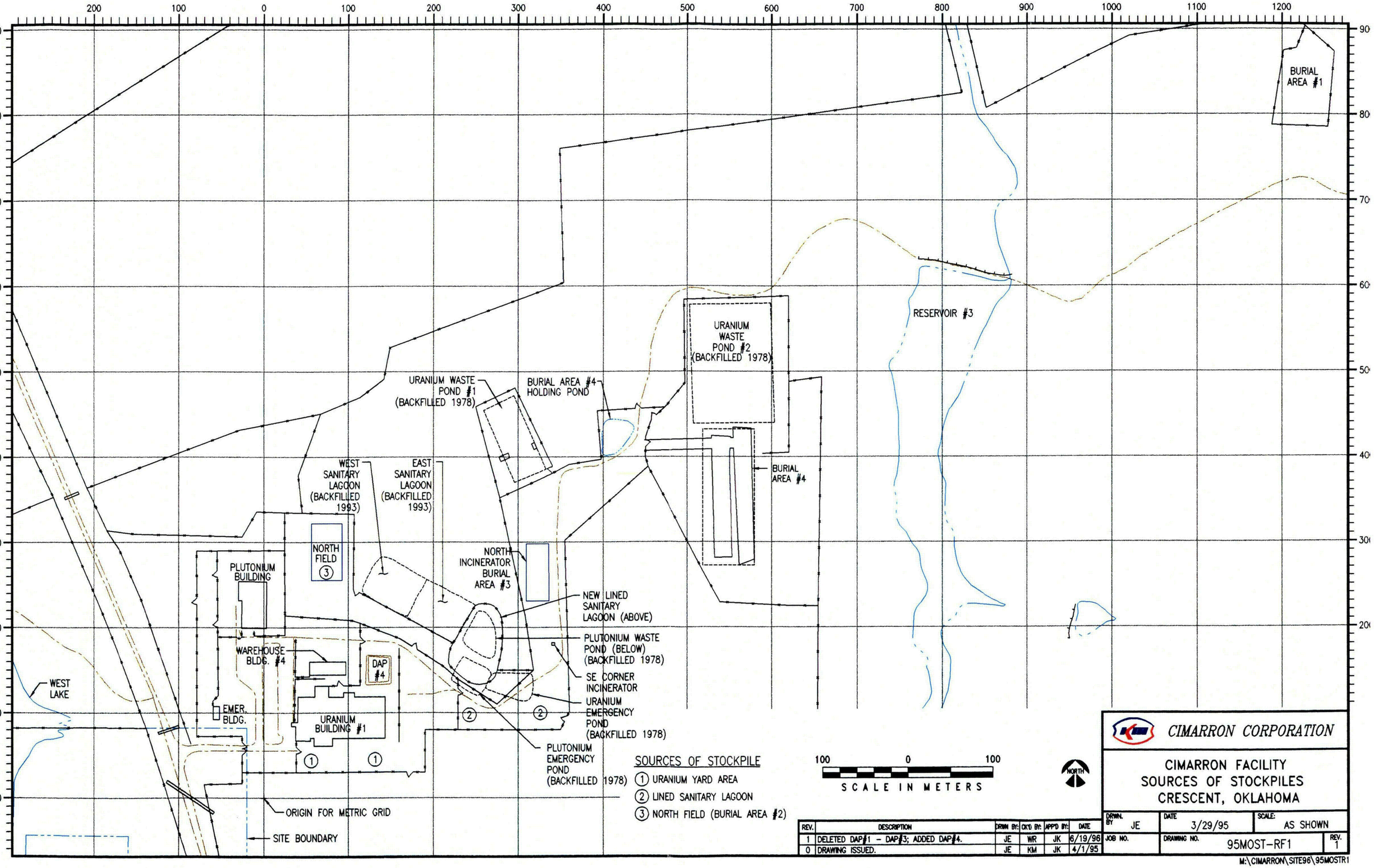
7.0 Training

Cimarron Corporation provides continuing training for all Cimarron personnel and any other personnel (i.e, contractors, visitors, etc.) who are allowed access to the Cimarron site. All personnel associated with the characterization of DAP-4 were trained on the project work plan and the associated special work permits, which included all survey procedures and quality assurance requirements associated with the DAP-4 characterizations.

8.0 Conclusion

Cimarron Corporation has completed the characterization of stockpile DAP-4. The characterization of stockpile DAP-4 is identical to that performed on DAP-1, DAP-2 and DAP-3, which were approved for on-site disposal by the NRC after confirmation by ORISE. This characterization has shown that all materials contained in stockpile DAP-4 are below the guideline value for on-site disposal (100 pCi/g) as established in amendment #10 to license SNM-928.

Cimarron Corporation believes that a confirmatory survey by ORISE on DAP-4 is unnecessary based upon the use of the Cimarron Quality Assurance Program and independent off-site laboratories during the characterization of DAP-4. Therefore, Cimarron Corporation requests an expedited review and approval from the NRC to dispose of the soil and debris contained in stockpile DAP-4 in the on-site disposal cell.



REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
1	DELETED DAP#1 – DAP#3; ADDED DAP#4.	JE	WR	JK	6/19/96
0	DRAWING ISSUED.	JE	KM	JK	4/1/95

CIMARRON CORPORATION, CIMARRON FACILITY
DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP-4

Grid Run #: 125E Date: April 29, 1996

Grid Number	3" Det. CPM	Micro "R" IM	Micro "R" SUR	0 - .5M Total U	0 - .5M Th (Nat)	0 - .5M Dirt Probe	.5M - 1M Total U	.5M - 1M Th (Nat)	.5M - 1M Dirt Probe	1M - 1.5M Total U	1M - 1.5M Th (Nat)	1M - 1.5M Dirt Probe	1.5M - 2.0M Total U	1.5M - 2.0M Th (Nat)	1.5M - 2.0M Dirt Probe
125E-137N	2942	8	8	43	1	19280	35	2	22274	30	2	22680	40	2	22224
125E-139N	2924	8	9	9	2	22152	19	1	20470	27	2	20924	45	1	24112
125E-144N	3212	8	8	21	2	18322	42	2	24784	33	2	25020	47	1	26176
125E-149N	3282	7	9	35	1	19820	26	2	22882	43	2	25534	45	2	21610
125E-154N	3506	9	10	29	1	21302	40	2	21826	62	2	26650	47	1	24440
125E-159N	3674	8	10	22	1	18742	58	1	24640	40	1	22934	28	1	23420
125E-164N	3758	8	10	31	1	19714	36	1	20720	37	2	24366	30	1	25220

INSTRUMENTS	RESULTS IN	BACKGROUND	MDA
LUDLUM MICRO "R" METER-MODEL 12S-S/N-9081	µr/hr	7	1-2
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N-50057	CPM	2000	250
LUDLUM 2220 1 1/2" X 4" DETECTOR DIRT PROBE S/N 50056	CPM	21500	700
		U(Total) 4	10
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	Th(Nat) 1.5	1

SITE BACKGROUND NOT SUBTRACTED

REVIEWED BY: W. G. Rogers Date: 5-15-96

CIMARRON CORPORATION, CIMARRON FACILITY
DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP-4

Grid Run #: 127E Date: April 29, 1996

Grid Number	3" Det. CPM	Micro "R" IM	Micro "R" SUR	0 - .5M Total U	0 - .5M Th (Nat)	0 - .5M Dirt Probe	.5M - 1M Total U	.5M - 1M Th (Nat)	.5M - 1M Dirt Probe	1M - 1.5M Total U	1M - 1.5M Th (Nat)	1M - 1.5M Dirt Probe	1.5M - 2.0M Total U	1.5M - 2.0M Th (Nat)	1.5M - 2.0M Dirt Probe
127E-137N	3094	9	9	34	2	22070	49	2	29412	43	2	27846	33	2	25354
127E-139N	3238	9	9	69	1	23452	39	2	24180	31	2	21254	31	2	23318
127E-144N	3214	8	8	46	2	22590	37	1	22404	33	2	20020	29	1	23356
127E-149N	3078	8	8	36	1	22522	25	2	22766	34	1	22264	31	1	21980
127E-154N	3208	8	8	61	1	25022	34	1	23670	34	2	23914	26	1	24968
127E-159N	3608	8	8	42	1	21252	50	1	26270	43	2	22434	38	2	22436
127E-164N	3192	7	8	33	1	19280	34	2	23092	29	1	23090	33	1	23446

INSTRUMENTS	RESULTS IN	BACKGROUND	MDA
LUDLUM MICRO "R" METER-MODEL 12S-S/N-9081	µr/hr	7	1-2
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N-50057	CPM	2000	250
LUDLUM 2220 1 1/2" X 4" DETECTOR DIRT PROBE S/N 50056	CPM	21500	700
		U(Total) 4	10
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	Th(Nat) 1.5	1

SITE BACKGROUND NOT SUBTRACTED

REVIEWED BY: W. G. Rogers Date: 5-15-86

CIMARRON CORPORATION, CIMARRON FACILITY
DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP-4

Grid Run #: 132E Date: April 29, 1996

Grid Number	3" Det. CPM	Micro "R" IM	Micro "R" SUR	0 - .5M Total U	0 - .5M Th (Nat)	0 - .5M Dirt Probe	.5M - 1M Total U	.5M - 1M Th (Nat)	.5M - 1M Dirt Probe	1M - 1.5M Total U	1M - 1.5M Th (Nat)	1M - 1.5M Dirt Probe	1.5M - 2.0M Total U	1.5M - 2.0M Th (Nat)	1.5M - 2.0M Dirt Probe
132E-137N	3452	9	9	45	1	23440	32	1	27806	29	2	21814	31	2	25240
132E-139N	3544	8	8	59	2	22234	46	1	23740	40	1	26156	29	2	25248
132E-144N	4012	9	9	45	2	21880	36	1	22156	31	1	21874	29	1	22250
132E-149N	3460	8	9	49	1	20552	38	1	20884	32	1	21458	35	1	22170
132E-154N	3634	9	9	43	1	21430	35	2	19218	46	1	21082	40	1	19356
132E-159N	3208	7	8	88	2	24906	33	2	25460	40	2	23984	75	2	24082
132E-164N	2800	7	7	45	2	22224	46	2	26570	35	2	20978	39	1	23034

INSTRUMENTS	RESULTS IN	BACKGROUND	MDA
LUDLUM MICRO "R" METER-MODEL 12S-S/N-9081	µr/hr	7	1-2
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N-50057	CPM	2000	250
LUDLUM 2220 1 1/2" X 4" DETECTOR DIRT PROBE S/N 50056	CPM	21500	700
		U(Total) 4	10
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	Th(Nat) 1.5	1

SITE BACKGROUND NOT SUBTRACTED

REVIEWED BY: W. a. Rogers Date: 5-15-86

CIMARRON CORPORATION, CIMARRON FACILITY
DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP-4

Grid Run #: 137E Date: April 29, 1996

Grid Number	3" Det. CPM	Micro "R" IM	Micro "R" SUR	0 - .5M Total U	0 - .5M Th (Nat)	0 - .5M Dirt Probe	.5M - 1M Total U	.5M - 1M Th (Nat)	.5M - 1M Dirt Probe	1M - 1.5M Total U	1M - 1.5M Th (Nat)	1M - 1.5M Dirt Probe	1.5M - 2.0M Total U	1.5M - 2.0M Th (Nat)	1.5M - 2.0M Dirt Probe
137E-137N	3426	8	8	44	1	22420	38	2	21348	50	1	26552	33	1	25864
137E-139N	3936	9	10	40	1	21610	46	1	19944	34	1	27156	34	1	27810
137E-144N	4252	9	9	64	2	24396	55	1	20572	49	1	22390	47	1	21974
137E-149N	4320	8	10	56	1	20410	57	1	23688	48	2	23992	48	1	20484
137E-154N	4238	9	10	33	2	21010	60	1	22384	35	1	21978	49	1	21022
137E-159N	3544	8	8	75	1	30250	64	2	31016	39	1	21904	54	1	24498
137E-164N	2506	7	7	27	1	17632	36	1	21214	47	2	29830	37	1	25436

INSTRUMENTS	RESULTS IN	BACKGROUND	MDA
LUDLUM MICRO "R" METER-MODEL 12S-S/N-9081	µr/hr	7	1-2
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N-50057	CPM	2000	250
LUDLUM 2220 1 1/2" X 4" DETECTOR DIRT PROBE S/N 50056	CPM	21500	700
		U(Total) 4	10
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	Th(Nat) 1.5	1

SITE BACKGROUND NOT SUBTRACTED

REVIEWED BY: W.A. Rogers Date: 5-15-96

CIMARRON CORPORATION, CIMARRON FACILITY
DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP-4

Grid Run #: 142E

Date: April 29, 1996

Grid Number	3" Det. CPM	Micro "R" IM	Micro "R" SUR	0 - .5M Total U	0 - .5M Th (Nat)	0 - .5M Dirt Probe	.5M - 1M Total U	.5M - 1M Th (Nat)	.5M - 1M Dirt Probe	1M - 1.5M Total U	1M - 1.5M Th (Nat)	1M - 1.5M Dirt Probe	1.5M - 2.0M Total U	1.5M - 2.0M Th (Nat)	1.5M - 2.0M Dirt Probe
142E-137N	5158	9	10	55	1	20948	43	1	19372	32	1	23220	32	2	22456
142E-139N	4690	10	10	68	1	22910	45	1	20616	40	1	19908	35	1	23210
142E-144N	4000	9	10	59	1	24392	44	1	21890	48	1	23576	33	2	19684
142E-149N	4514	10	10	70	2	25910	71	1	26236	56	2	22384	45	2	22368
142E-154N	4052	8	10	41	1	25260	44	2	25538	49	2	25374	51	2	26742
142E-159N	3496	8	8	44	1	23604	44	1	25890	54	1	27306	62	2	27420
142E-164N	2510	7	7	34	1	19130	23	2	23006	32	1	26654	204	2	31350

INSTRUMENTS	RESULTS IN	BACKGROUND	MDA
LUDLUM MICRO "R" METER-MODEL 12S-S/N-9081	µr/hr	7	1-2
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N-50057	CPM	2000	250
LUDLUM 2220 1 1/2" X 4" DETECTOR DIRT PROBE S/N 50056	CPM	21500	700
		U(Total) 4	10
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	Th(Nat) 1.5	1

SITE BACKGROUND NOT SUBTRACTED

REVIEWED BY: W.A. Rogers

Date: 5-15-96

CIMARRON CORPORATION, CIMARRON FACILITY
DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP-4

Grid Run #: 147E

Date: April 29, 1996

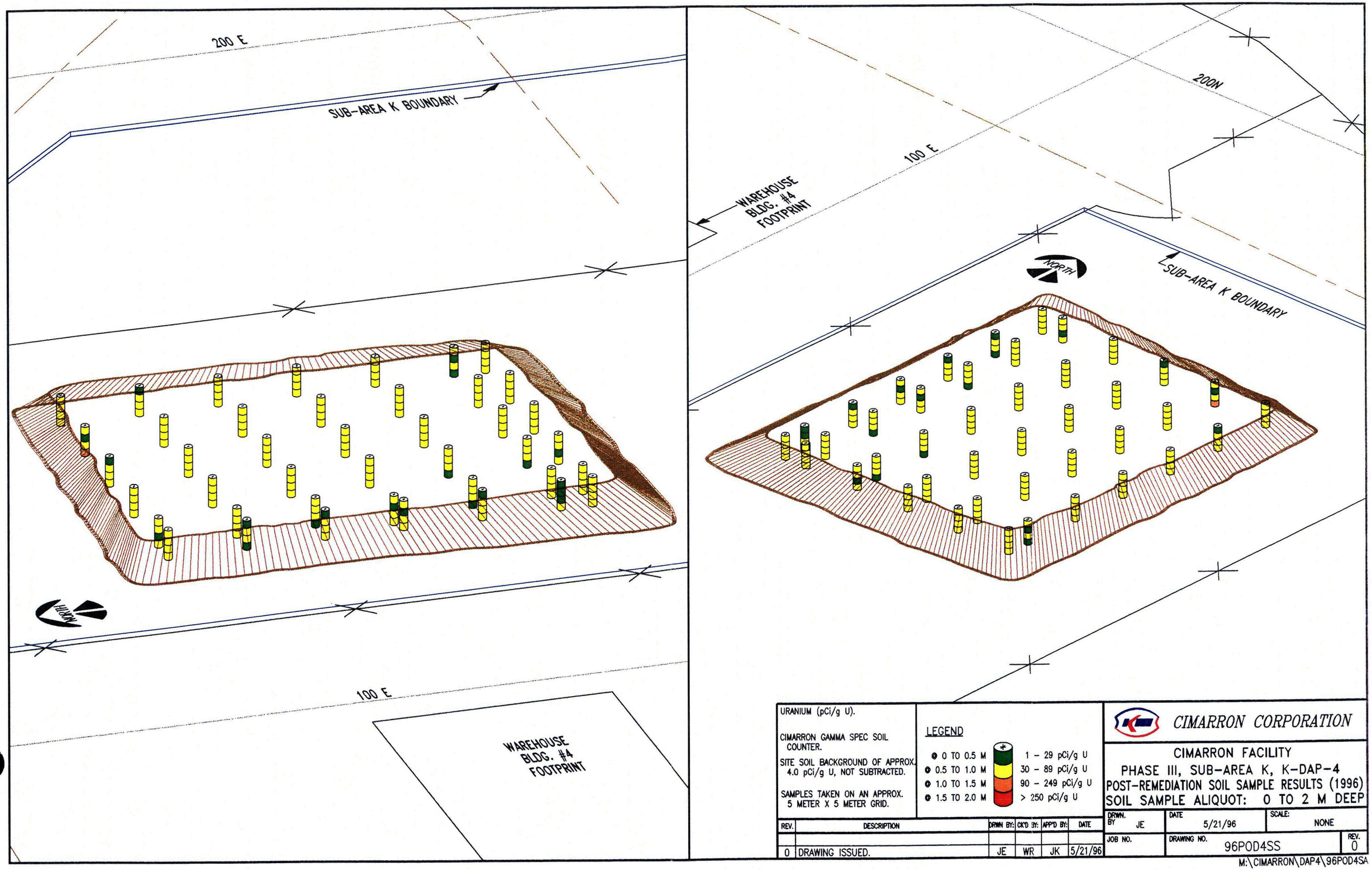
Grid Number	3" Det. CPM	Micro "R" IM	Micro "R" SUR	0 - .5M Total U	0 - .5M Th (Nat)	0 - .5M Dirt Probe	.5M - 1M Total U	.5M - 1M Th (Nat)	.5M - 1M Dirt Probe	1M - 1.5M Total U	1M - 1.5M Th (Nat)	1M - 1.5M Dirt Probe	1.5M - 2.0M Total U	1.5M - 2.0M Th (Nat)	1.5M - 2.0M Dirt Probe
147E-137N	3654	9	10	46	1	19750	41	1	23702	46	1	25658	33	2	26778
147E-139N	3590	9	9	44	2	17884	23	2	27798	48	1	23452	NA	NA	NA
147E-144N	3860	8	8	70	1	24196	58	1	23122	45	2	22590	41	1	23526
147E-149N	3530	8	8	64	2	25554	68	2	23456	61	1	22560	50	2	22588
147E-154N	4058	8	10	63	2	29312	37	1	19846	74	2	26648	68	2	24984
147E-159N	3656	8	10	25	2	23252	56	1	25334	36	2	25290	59	2	25792
147E-164N	3620	9	9	37	1	20902	46	1	17678	43	1	18434	36	1	23536

INSTRUMENTS	RESULTS IN	BACKGROUND	MDA
LUDLUM MICRO "R" METER-MODEL 12S-S/N-9081	µr/hr	7	1-2
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N-50057	CPM	2000	250
LUDLUM 2220 1 1/2" X 4" DETECTOR DIRT PROBE S/N 50056	CPM	21500	700
		U(Total) 4	10
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	Th(Nat) 1.5	1

SITE BACKGROUND NOT SUBTRACTED

REVIEWED BY: W. A. Rogers

Date: 5-15-96



URANIUM (pCi/g U).

CIMARRON GAMMA SPEC SOIL COUNTER.

SITE SOIL BACKGROUND OF APPROX. 4.0 pCi/g U, NOT SUBTRACTED.

SAMPLES TAKEN ON AN APPROX. 5 METER X 5 METER GRID.

LEGEND

0 TO 0.5 M	1 – 29 pCi/g U
0.5 TO 1.0 M	30 – 89 pCi/g U
1.0 TO 1.5 M	90 – 249 pCi/g U
1.5 TO 2.0 M	> 250 pCi/g U

REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
0	DRAWING ISSUED.	JE	WR	JK	5/21/96

CIMARRON CORPORATION

CIMARRON FACILITY
PHASE III, SUB-AREA K, K-DAP-4
POST-REMEDIATION SOIL SAMPLE RESULTS (1996)
SOIL SAMPLE ALIQUOT: 0 TO 2 M DEEP

DRWN. BY	DATE	SCALE:
JE	5/21/96	NONE

JOB NO.	DRAWING NO.	REV.
	96POD4SS	0

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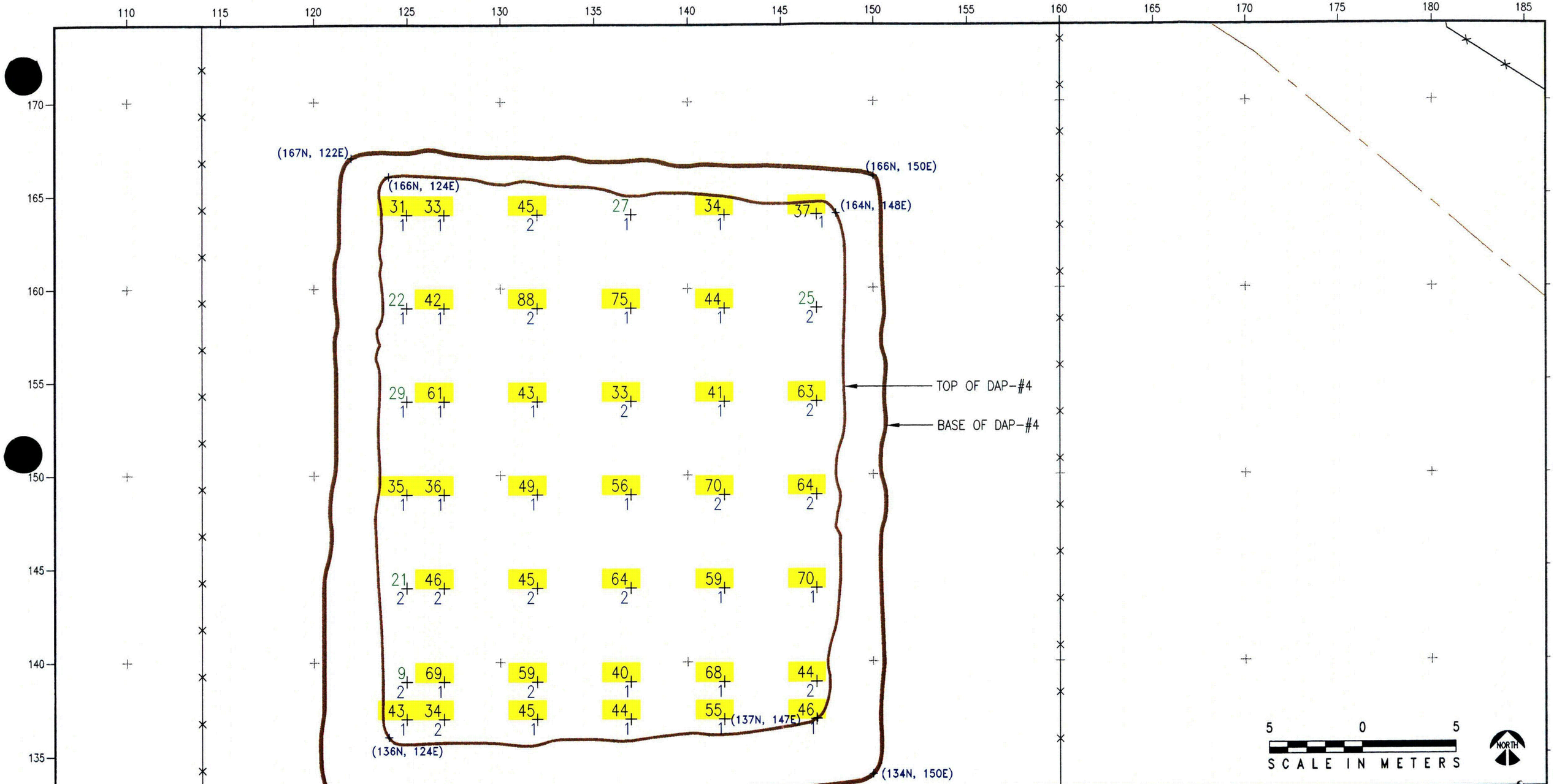

URANIUM (pCi/g U) AND THORIUM (pCi/g Th).

CIMARRON GAMMA SPEC SOIL COUNTER.

SITE SOIL BACKGROUND OF APPROX. 4.0 pCi/g U & 1.5 pCi/g Th, NOT SUBTRACTED.

SAMPLES TAKEN ON AN APPROX. 5 METER X 5 METER GRID.

LEGEND

- 6 URANIUM 1 – 29 pCi/g U
- 58 URANIUM 30 – 89 pCi/g U
- 129 URANIUM > 90 pCi/g U
- 2 THORIUM 1 – 5 pCi/g Th

REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
0	DRAWING ISSUED.	JE	WR	JK	5/21/96

CIMARRON CORPORATION

CIMARRON FACILITY
PHASE III, SUB-AREA K, K-DAP-4
POST-REMEDIATION SOIL SAMPLE RESULTS (1996)
SOIL SAMPLE ALIQUOT: 0 M – 0.5 M

DRWN. BY	DATE	SCALE:
JE	5/21/96	AS SHOWN

JOB NO.	DRAWING NO.	REV.
	96POD4SS-0	0

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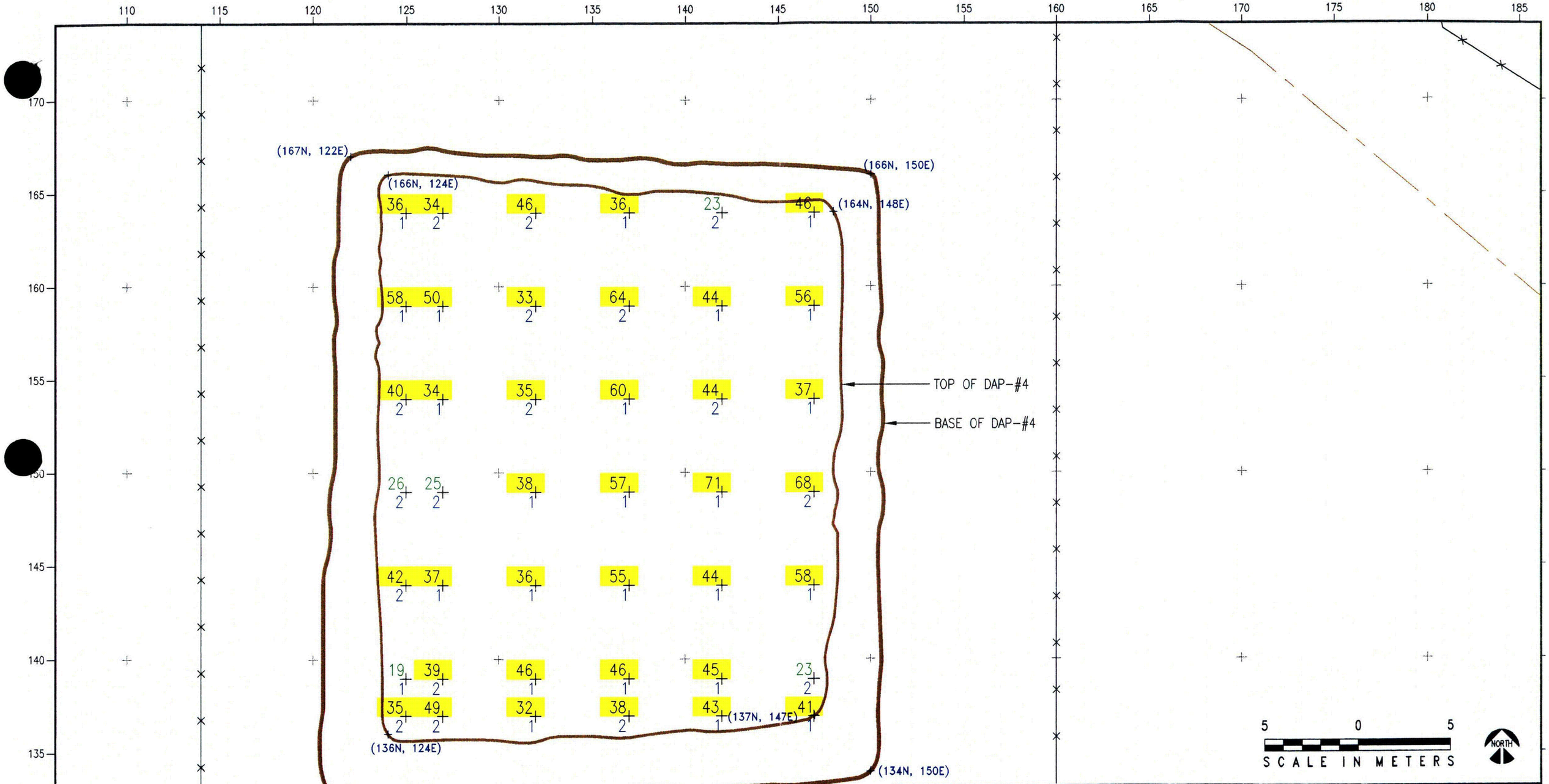

URANIUM (pCi/g U) AND THORIUM (pCi/g Th).

CIMARRON GAMMA SPEC SOIL COUNTER.

SITE SOIL BACKGROUND OF APPROX. 4.0 pCi/g U & 1.5 pCi/g Th, NOT SUBTRACTED.

SAMPLES TAKEN ON AN APPROX. 5 METER X 5 METER GRID.

LEGEND

- 6 URANIUM 1 – 29 pCi/g U
- 58 URANIUM 30 – 89 pCi/g U
- 129 URANIUM > 90 pCi/g U
- $+_2$ THORIUM 1 – 5 pCi/g Th

REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
0	DRAWING ISSUED.	JE	WR	JK	5/21/96

CIMARRON CORPORATION

CIMARRON FACILITY
PHASE III, SUB-AREA K, K-DAP-4
POST-REMEDIATION SOIL SAMPLE RESULTS (1996)
SOIL SAMPLE ALIQUOT: 0.5 M – 1.0 M

DRWN. BY	DATE	SCALE:
JE	5/21/96	AS SHOWN
JOB NO.	DRAWING NO. 96POD4SS-1	REV. 0

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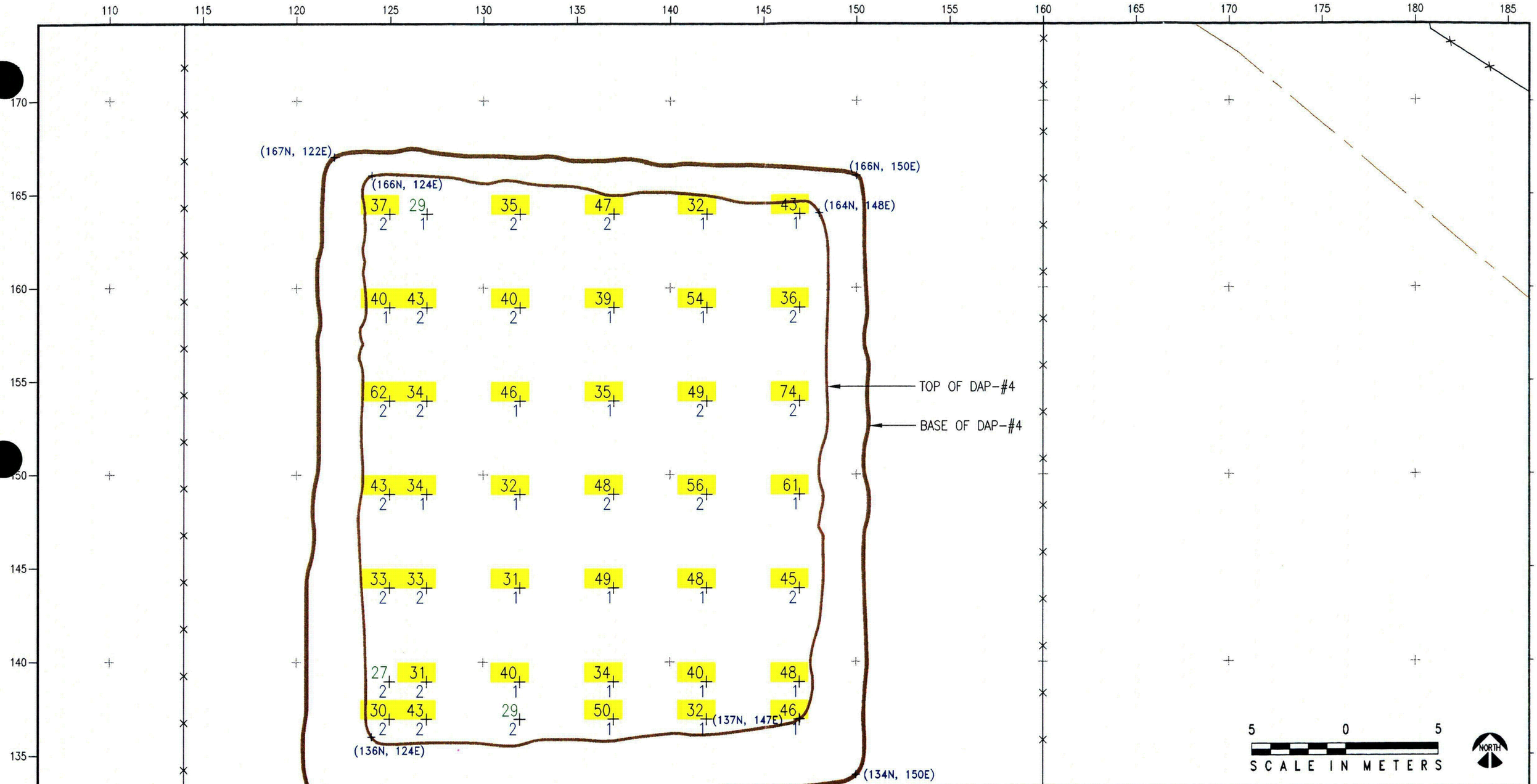

URANIUM (pCi/g U) AND THORIUM (pCi/g Th).

CIMARRON GAMMA SPEC SOIL COUNTER.

SITE SOIL BACKGROUND OF APPROX. 4.0 pCi/g U & 1.5 pCi/g Th, NOT SUBTRACTED.

SAMPLES TAKEN ON AN APPROX. 5 METER X 5 METER GRID.

LEGEND

- 6 URANIUM 1 – 29 pCi/g U
- 58 URANIUM 30 – 89 pCi/g U
- 129 URANIUM > 90 pCi/g U
- $+_2$ THORIUM 1 – 5 pCi/g Th

REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
0	DRAWING ISSUED.	JE	WR	JK	5/21/96

CIMARRON CORPORATION

CIMARRON FACILITY
PHASE III, SUB-AREA K, K-DAP-4
POST-REMEDIATION SOIL SAMPLE RESULTS (1996)
SOIL SAMPLE ALIQUOT: 1.0 M – 1.5 M

DRWN. BY	DATE	SCALE:
JE	5/21/96	AS SHOWN
JOB NO.	DRAWING NO. 96POD4SS-2	REV. 0

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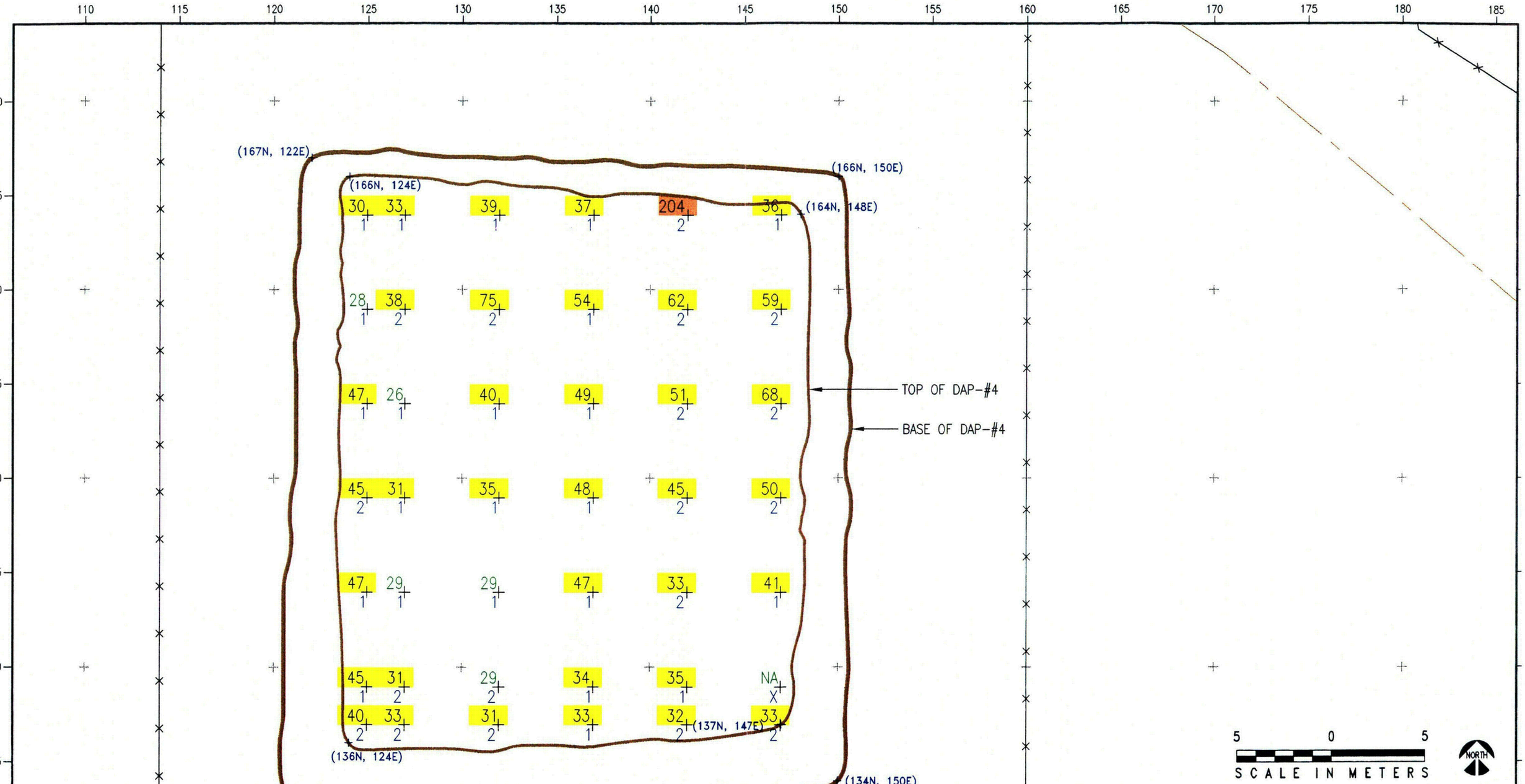

URANIUM (pCi/g U) AND THORIUM (pCi/g Th).

CIMARRON GAMMA SPEC SOIL COUNTER.

SITE SOIL BACKGROUND OF APPROX. 4.0 pCi/g U & 1.5 pCi/g Th, NOT SUBTRACTED.

SAMPLES TAKEN ON AN APPROX. 5 METER X 5 METER GRID.

LEGEND

- 6 — URANIUM 1 – 29 pCi/g U
- 58 — URANIUM 30 – 89 pCi/g U
- 129 — URANIUM > 90 pCi/g U
- 2 — THORIUM 1 – 5 pCi/g Th

CIMARRON CORPORATION

CIMARRON FACILITY
PHASE III, SUB-AREA K, K-DAP-4
POST-REMEDIATION SOIL SAMPLE RESULTS (1996)
SOIL SAMPLE ALIQUOT: 1.5 M – 2.0 M

REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
0	DRAWING ISSUED.	JE	WR	JK	5/21/96

DRWN. BY	DATE	SCALE:
JE	5/21/96	AS SHOWN

JOB NO.	DRAWING NO.	REV.
	96POD4SS-3	0

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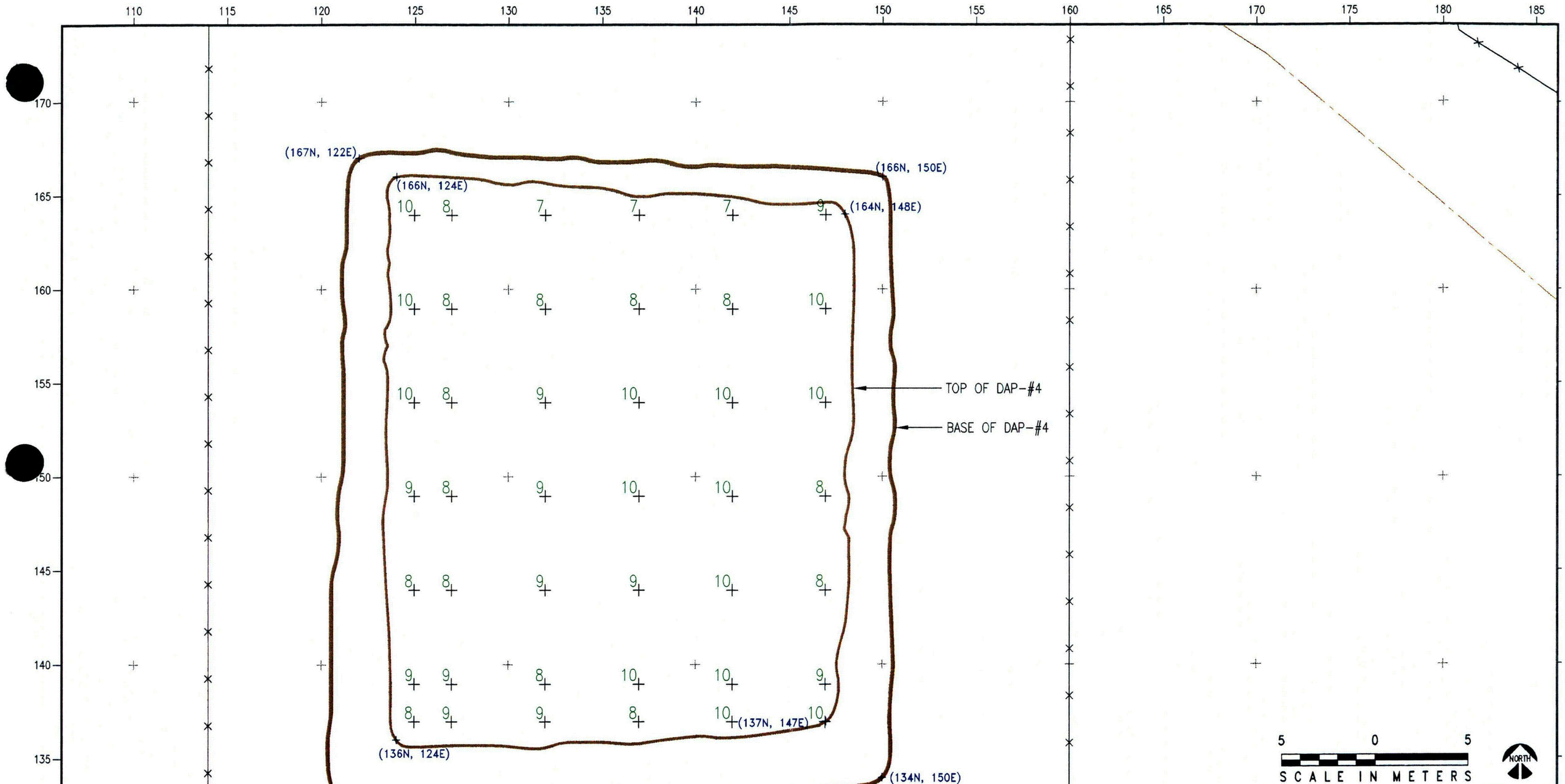

READINGS ARE IN MICRO-R/HR (μR/Hr).

INSTRUMENT: LUDLUM MICRO-R METER
SERIAL NO: 9081
BACKGROUND: 7 μR/Hr.

READINGS TAKEN ON AN APPROX. 5 METER X 5 METER GRID.

REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
0	DRAWING ISSUED.	JE	WR	JK	5/22/96

CIMARRON CORPORATION

CIMARRON FACILITY
PHASE III, SUB-AREA K, K-DAP-4
POST-REMEDIATION MICRO-R SURVEY (1996)
AT LAND SURFACE

DRWN. BY	DATE	SCALE:
JE	5/22/96	AS SHOWN
JOB NO.	DRAWING NO. 96POD4UR-0	REV. 0

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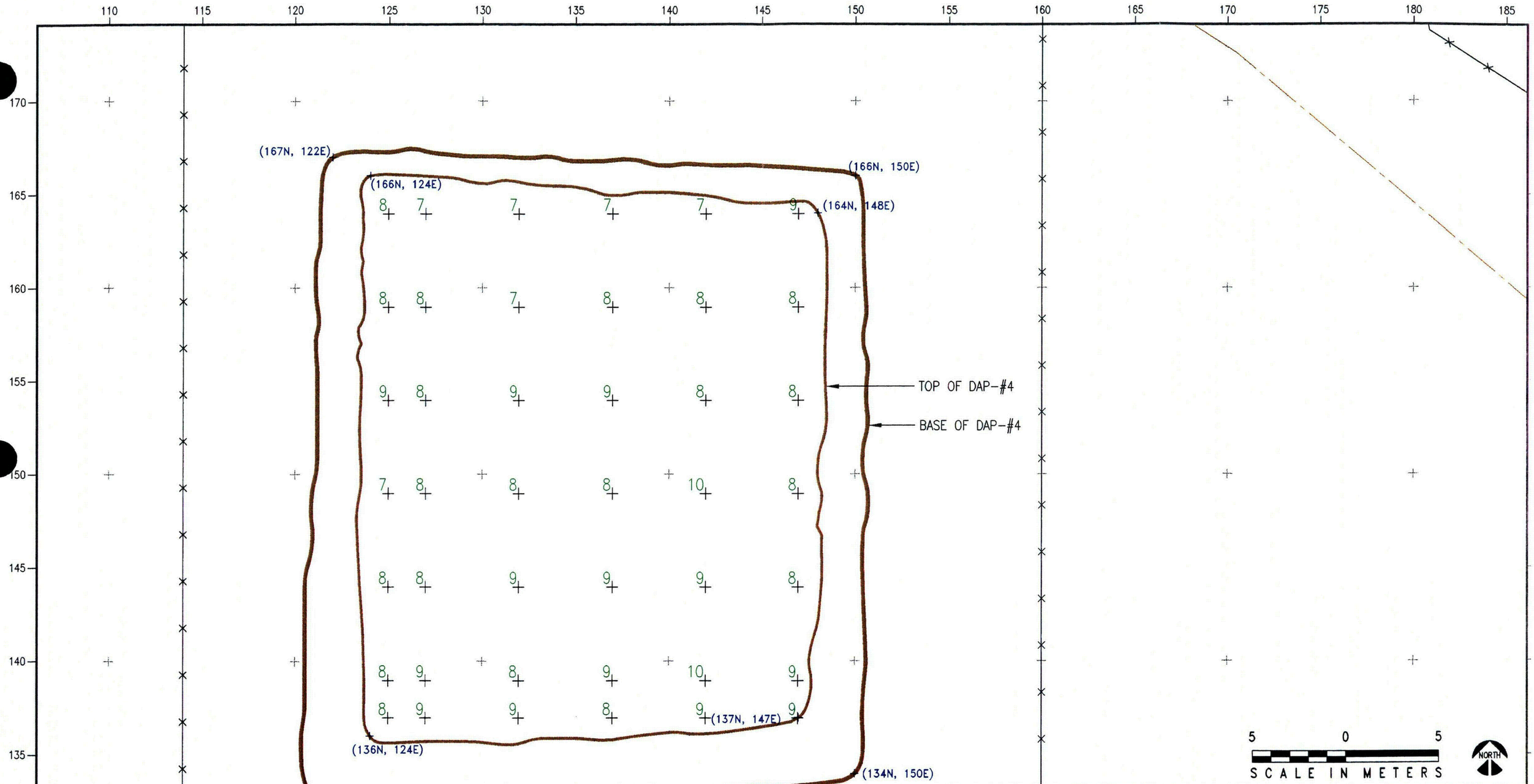

READINGS ARE IN MICRO-R/HR (μR/Hr).

INSTRUMENT: LUDLUM MICRO-R METER
SERIAL NO: 9081
BACKGROUND: 7 μR/Hr.

READINGS TAKEN ON AN APPROX. 5 METER X 5 METER GRID.

REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
0	DRAWING ISSUED.	JE	WR	JK	5/22/96

CIMARRON CORPORATION

CIMARRON FACILITY
PHASE III, SUB-AREA K, K-DAP-4
POST-REMEDIATION MICRO-R SURVEY (1996)
AT ONE METER ABOVE SURFACE

DRWN. BY	DATE	SCALE:
JE	5/22/96	AS SHOWN
JOB NO.	DRAWING NO.	REV.
	96POD4UR-1	0

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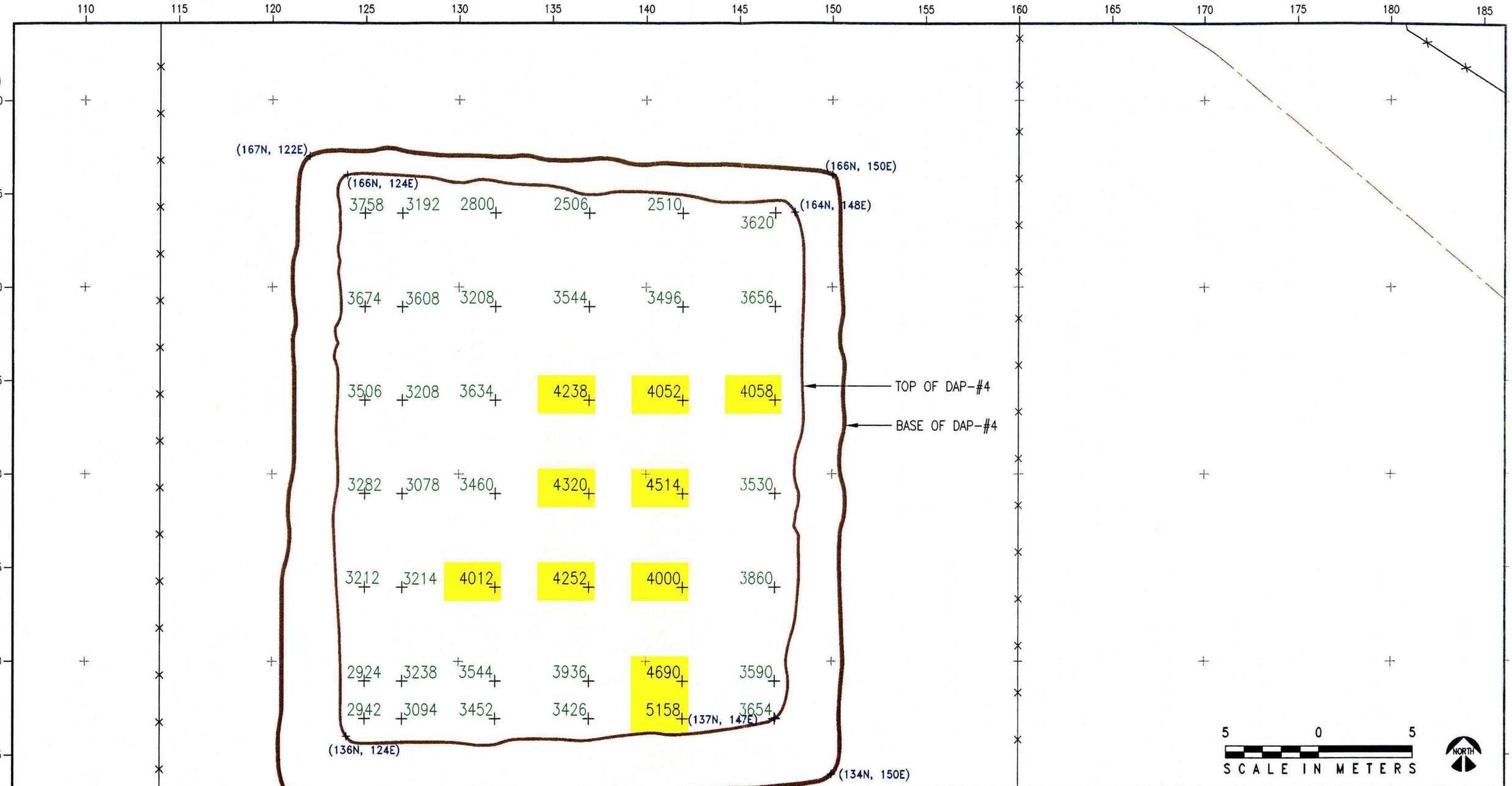

INSTRUMENT: LUDLUM 2220, S/N 50057, LEAD-SHIELDED 3" X 1/2" NaI DETECTOR.

BACKGROUND: 2000 CPM

READINGS TAKEN ON A APPROX. 5 METER X 5 METER GRID.

LEGEND

2506 < 4000 CPM

5158 >= 4000 CPM

CIMARRON CORPORATION

CIMARRON FACILITY
PHASE III, SUB-AREA K, K-DAP-4
POST-REMEDIATION GAMMA SURVEY (1996)
READINGS IN CPM (3" DET.) AT SURFACE

REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
0	DRAWING ISSUED.	JE	WR	JK	5/22/96

DRWN. BY	DATE	SCALE:
JE	5/22/96	AS SHOWN
JOB NO.	DRAWING NO. 96POD43D-0	REV. 0

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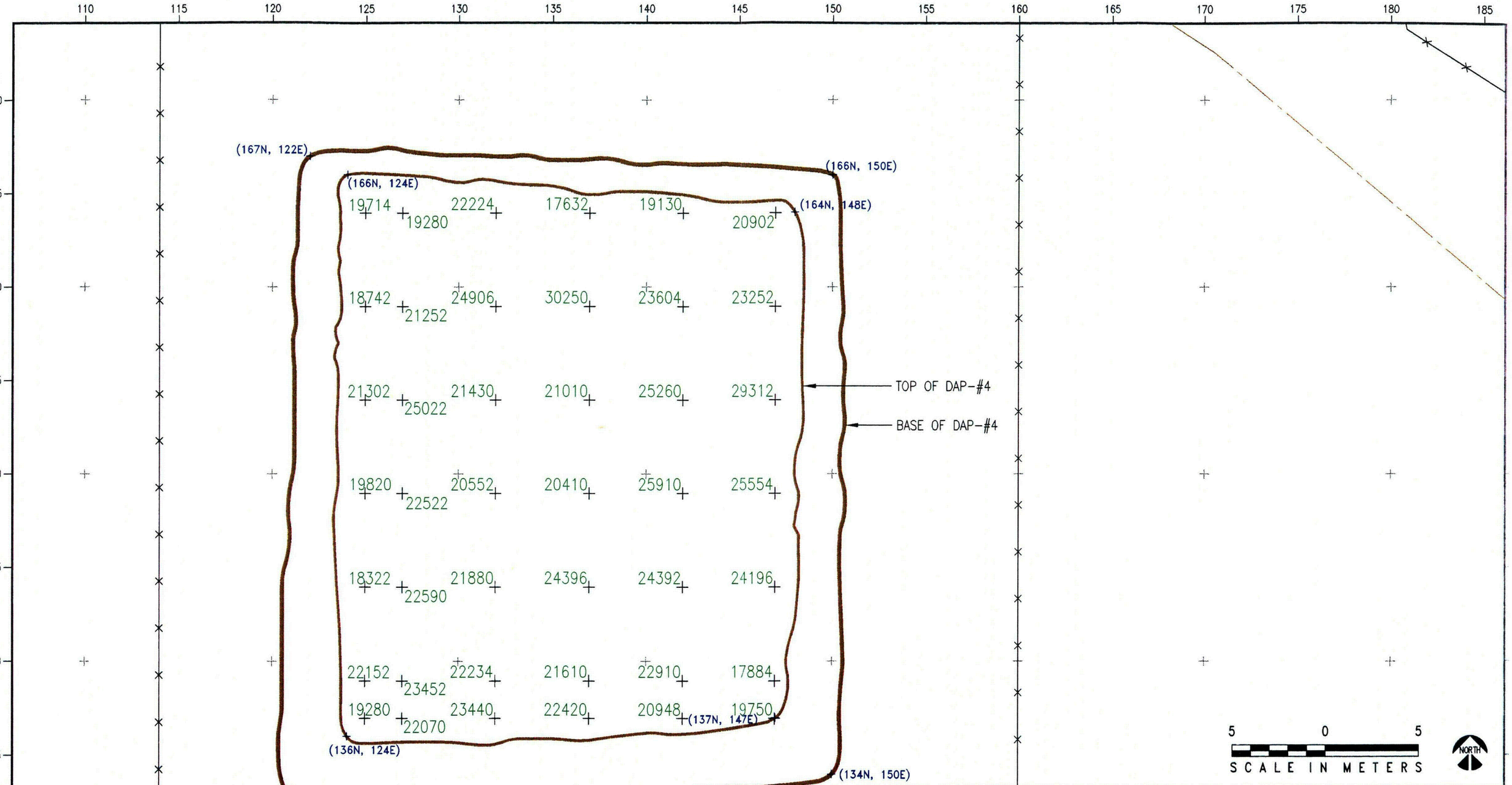

INSTRUMENT: LUDLUM 2220, S/N 50056, LEAD-SHIELDED 1 1/2" x 4" NaI DETECTOR.

BACKGROUND: 21,500 CPM

READINGS TAKEN ON AN APPROX. 5 METER X 5 METER GRID.

LEGEND

26270 + < 43,000 CPM

CIMARRON CORPORATION

CIMARRON FACILITY
PHASE III, SUB-AREA K, K-DAP-4
POST-REMEDIATION DIRT PROBE RESULTS (1996)
READINGS IN CPM: 0 TO 0.5 M DEEP

REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
0	DRAWING ISSUED.	JE	WR	JK	5/22/96

DRWN. BY	DATE	SCALE:
JE	5/22/96	AS SHOWN

JOB NO.	DRAWING NO.	REV.
	96POD4DP-0	0

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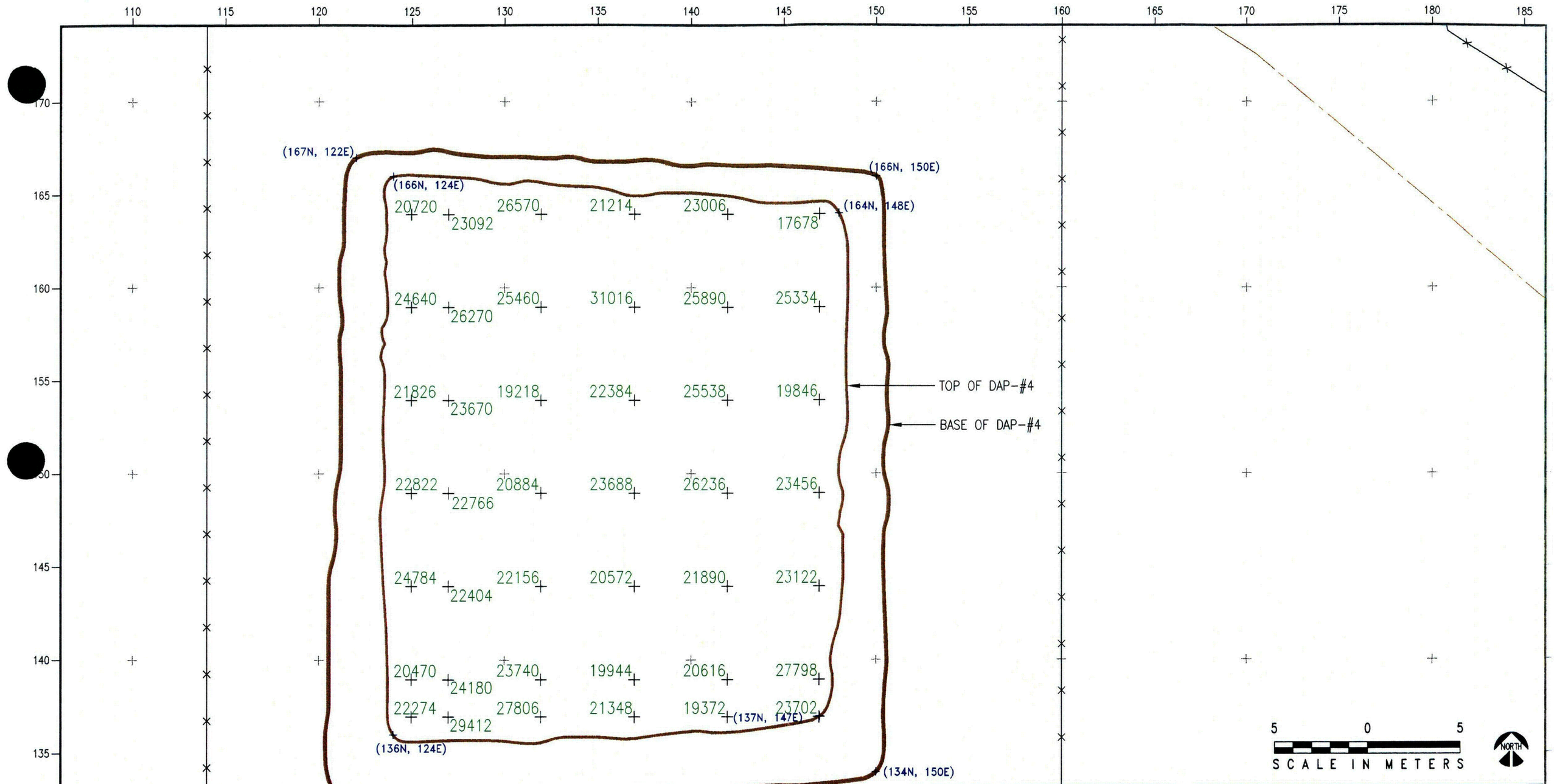

INSTRUMENT: LUDLUM 2220, S/N 50056, LEAD-SHIELDED 1 1/2" x 4" NaI DETECTOR.

BACKGROUND: 21,500 CPM

READINGS TAKEN ON AN APPROX. 5 METER X 5 METER GRID.

LEGEND

26270 + < 43,000 CPM

REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
0	DRAWING ISSUED.	JE	WR	JK	5/22/96

CIMARRON CORPORATION

CIMARRON FACILITY
PHASE III, SUB-AREA K, K-DAP-4
POST-REMEDIATION DIRT PROBE RESULTS (1996)
READINGS IN CPM: 0.5 TO 1.0 M DEEP

DRWN. BY	DATE	SCALE:
JE	5/22/96	AS SHOWN
JOB NO.	DRAWING NO. 96POD4DP-1	REV. 0

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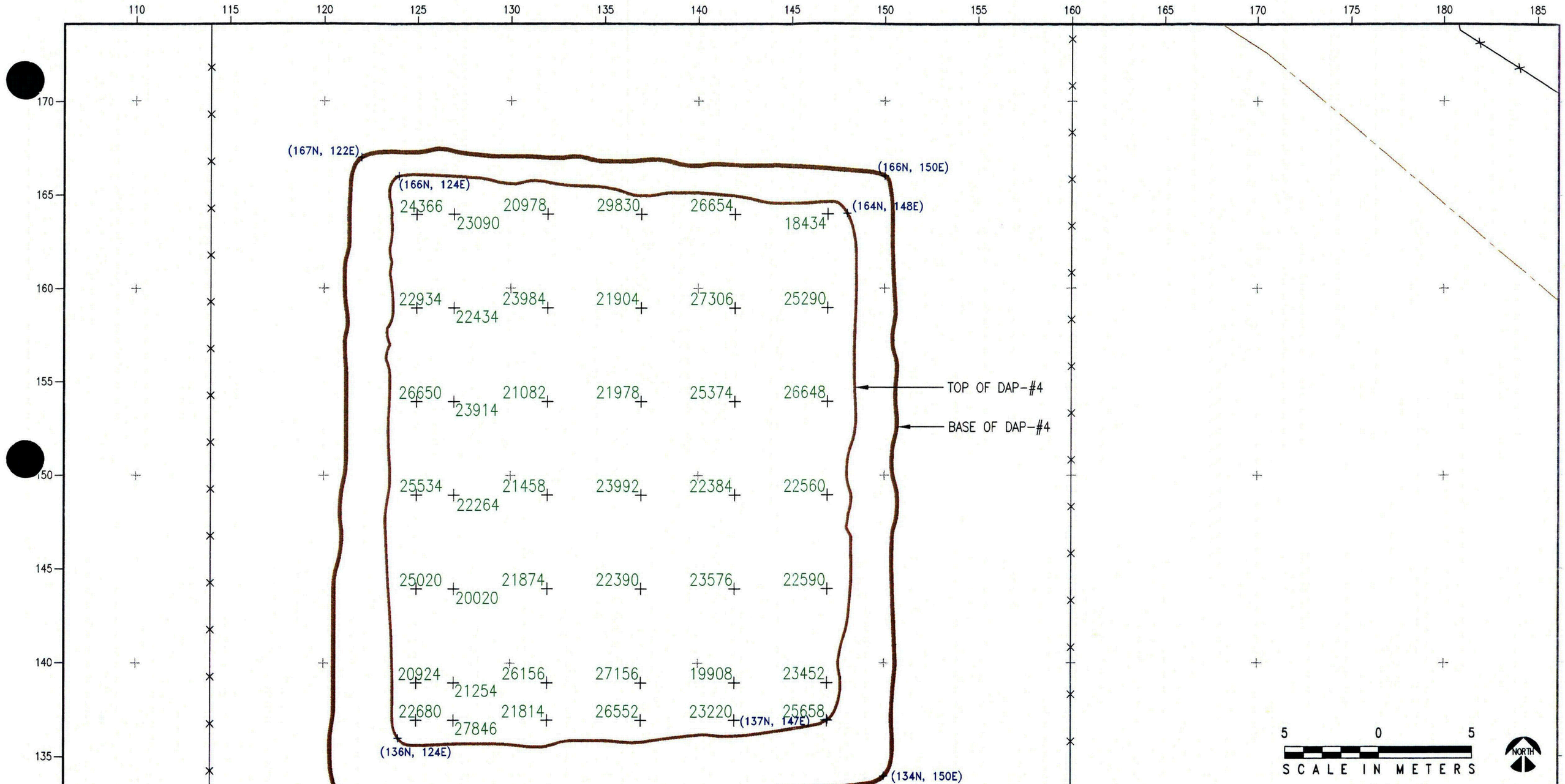

INSTRUMENT: LUDLUM 2220, S/N 50056, LEAD-SHIELDED 1 1/2" x 4" NaI DETECTOR.

BACKGROUND: 21,500 CPM

READINGS TAKEN ON AN APPROX. 5 METER X 5 METER GRID.

LEGEND

26270 + < 43,000 CPM

CIMARRON CORPORATION

CIMARRON FACILITY
PHASE III, SUB-AREA K, K-DAP-4
POST-REMEDIATION DIRT PROBE RESULTS (1996)
READINGS IN CPM: 1.0 TO 1.5 M DEEP

REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
0	DRAWING ISSUED.	JE	WR	JK	5/22/96

DRWN. BY	DATE	SCALE:
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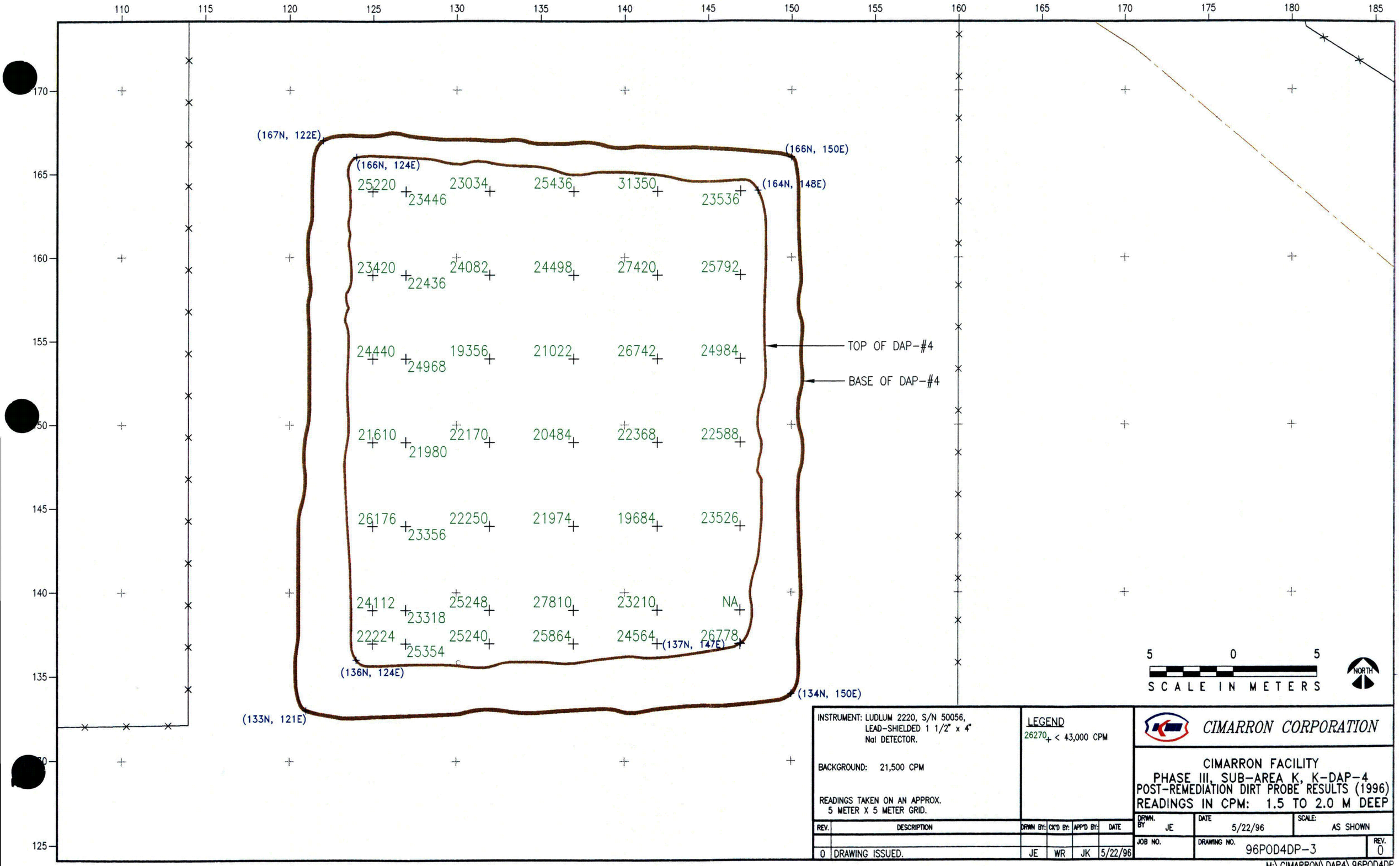


INSTRUMENT: LUDLUM 2220, S/N 50056, LEAD-SHIELDED 1 1/2" x 4" NaI DETECTOR.

BACKGROUND: 21,500 CPM

READINGS TAKEN ON AN APPROX. 5 METER X 5 METER GRID.

LEGEND

26270 + < 43,000 CPM

REV.	DESCRIPTION	DRWN BY:	CK'D BY:	APP'D BY:	DATE
0	DRAWING ISSUED.	JE	WR	JK	5/22/96

CIMARRON CORPORATION

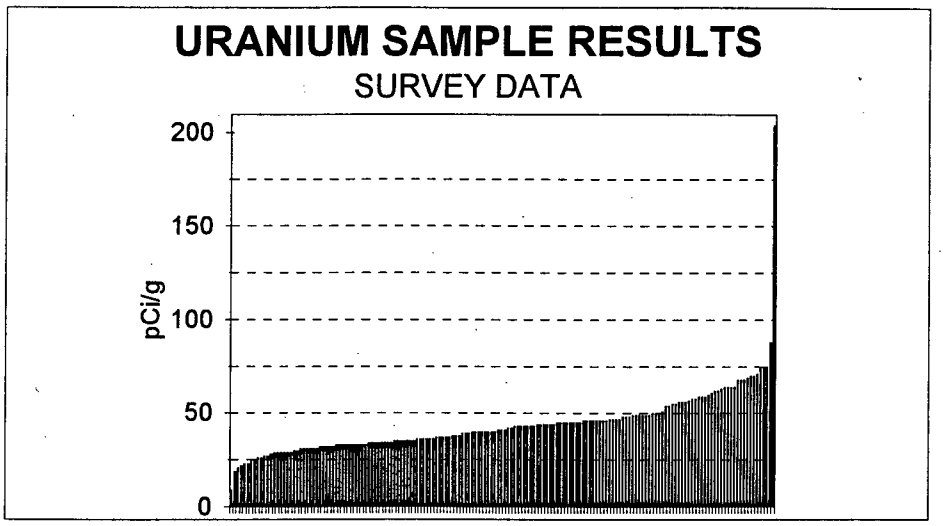
CIMARRON FACILITY
PHASE III, SUB-AREA K, K-DAP-4
POST-REMEDIATION DIRT PROBE RESULTS (1996)
READINGS IN CPM: 1.5 TO 2.0 M DEEP

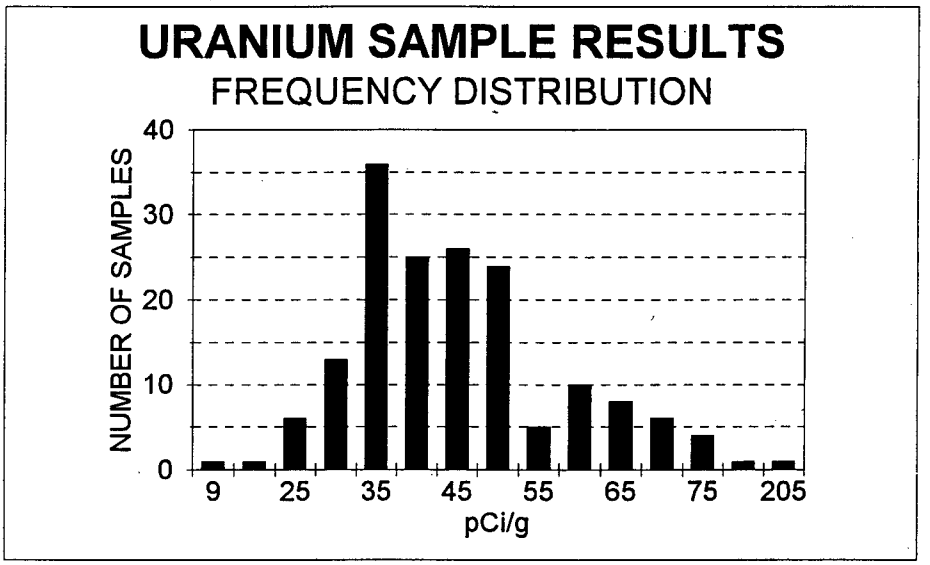
DRWN. BY	DATE	SCALE:
JE	5/22/96	AS SHOWN

JOB NO.	DRAWING NO.	REV.
	96POD4DP-3	0

M:\CIMARRON\DAP4\96POD4DP

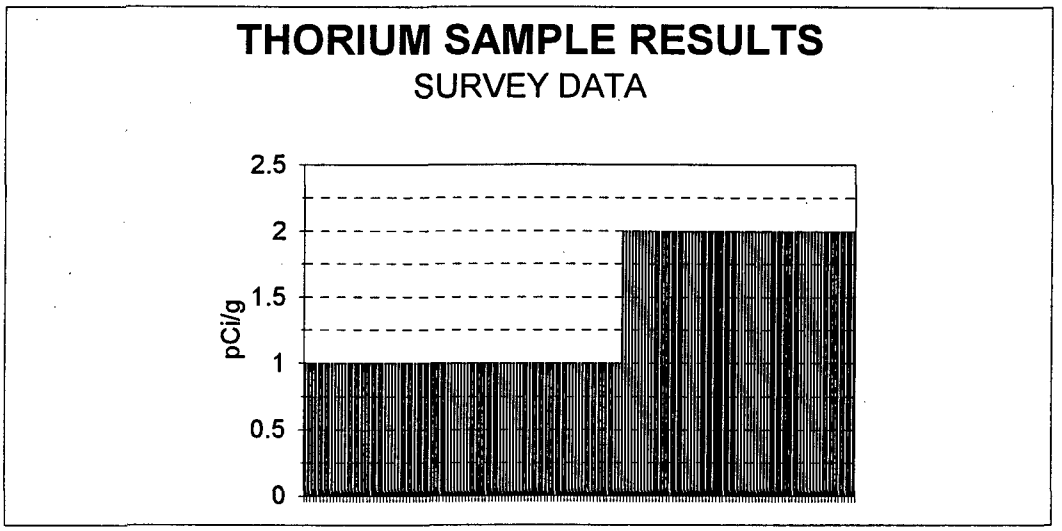
DAP-4 STOCKPILE CHARACTERIZATION
CIMARRON SOIL COUNTER
TOTAL URANIUM SOIL SAMPLE RESULTS
SITE BACKGROUND OF 4 pCi/g NOT SUBTRACTED
APRIL 1996

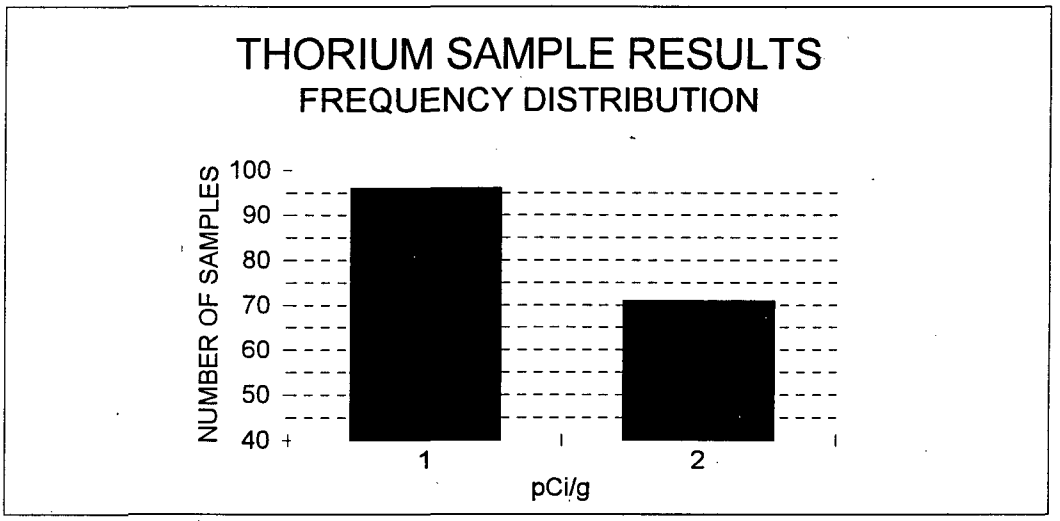




NUMBER OF SAMPLES	167
AVERAGE SAMPLE	43
MINIMUM SAMPLE	9
MAXIMUM SAMPLE	204
STANDARD DEVIATION	18

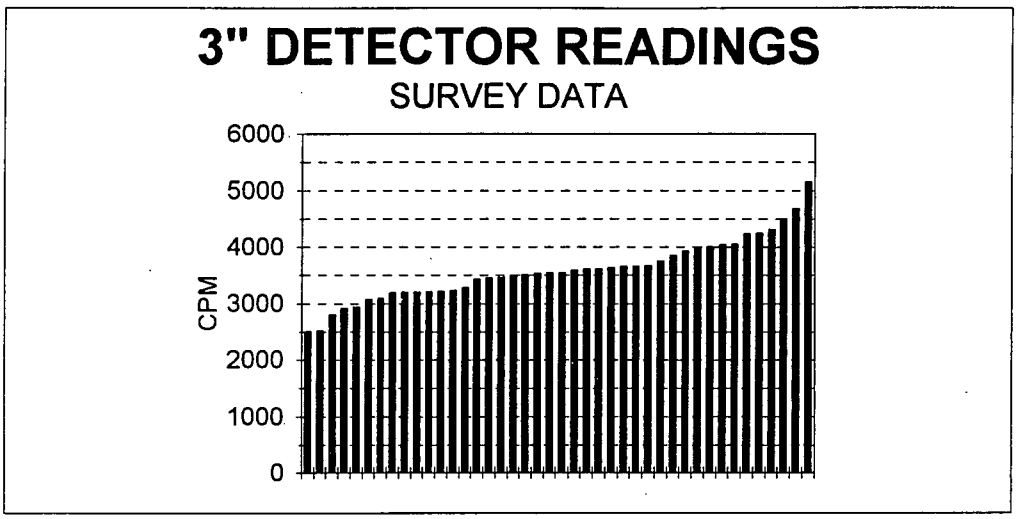
DAP-4 STOCKPILE CHARACTERIZATION
CIMARRON SOIL COUNTER
THORIUM (NAT) SOIL SAMPLE RESULTS
SITE BACKGROUND OF 1.5 pCi/g NOT SUBTRACTED
APRIL 1996

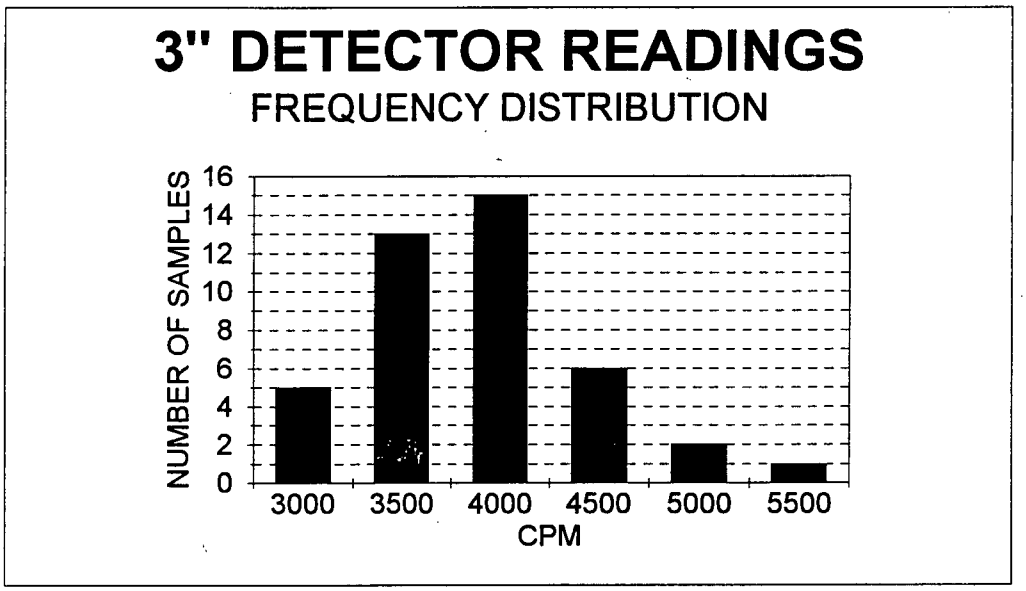




NUMBER OF SAMPLES	**167**
AVERAGE SAMPLE	**1**
MINIMUM SAMPLE	**1**
MAXIMUM SAMPLE	**2**
STANDARD DEVIATION	**0**

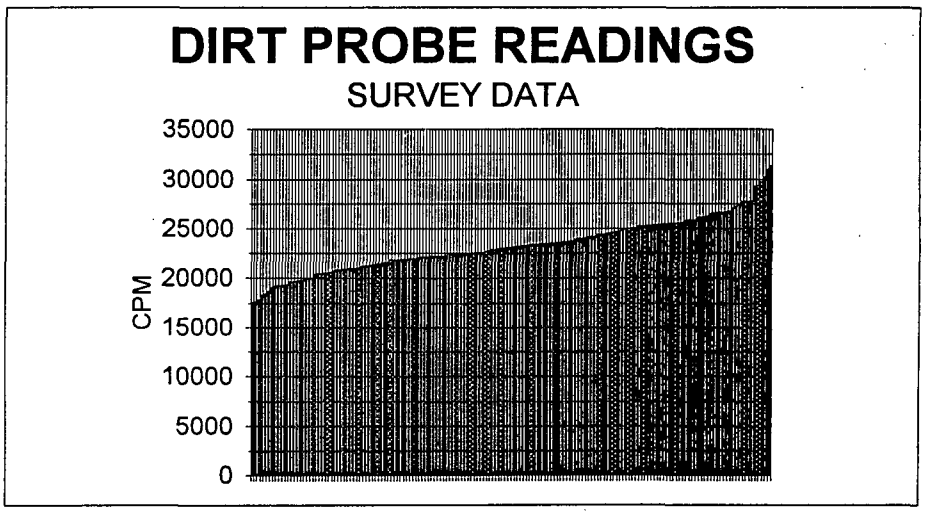
DAP 4 STOCKPILE CHARACTERIZATION
GROSS GAMMA READINGS IN CPM
LUDLUM MODEL 2220 S/N 50057
BACKGROUND AVERAGE: 2000 CPM
APRIL, 1996

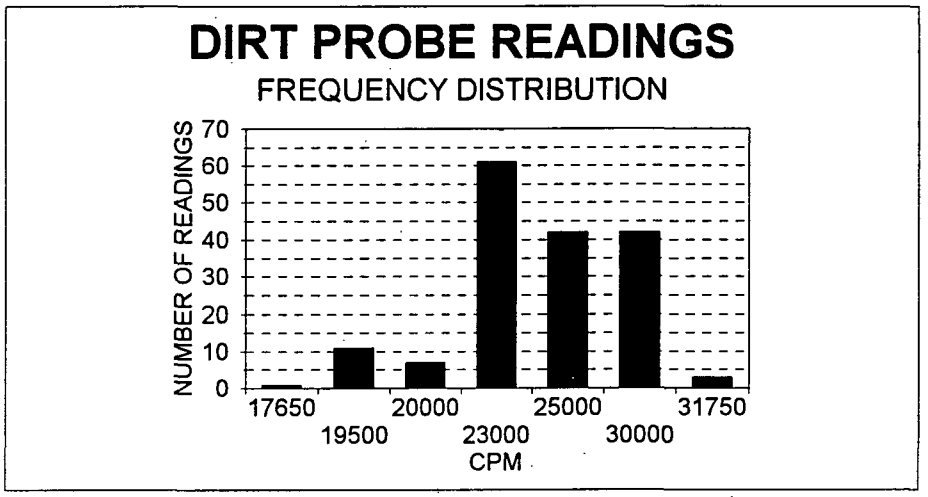




NUMBER OF READINGS	**42**
AVERAGE READING	**3587**
MINIMUM READING	**2506**
MAXIMUM READING	**5158**
STANDARD DEVIATION	**541**

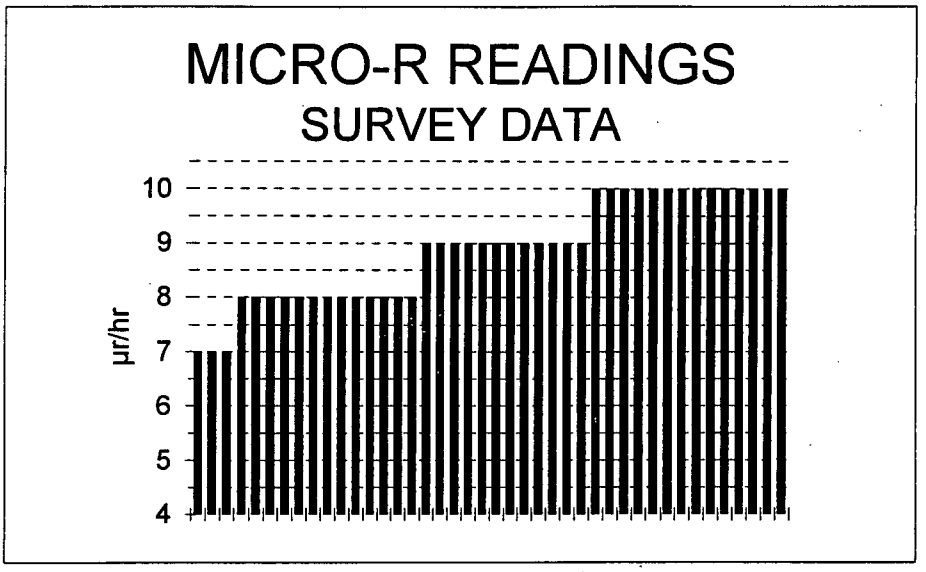
DAP-4 STOCKPILE CHARACTERIZATION
CIMARRON SOIL COUNTER
DIRT PROBE GAMMA READINGS IN CPM
LUDLUM MODEL 2220 S/N 50056
1/12" X 4" NaI, PVC ENCASED GAMMA DETECTOR
APRIL 1996

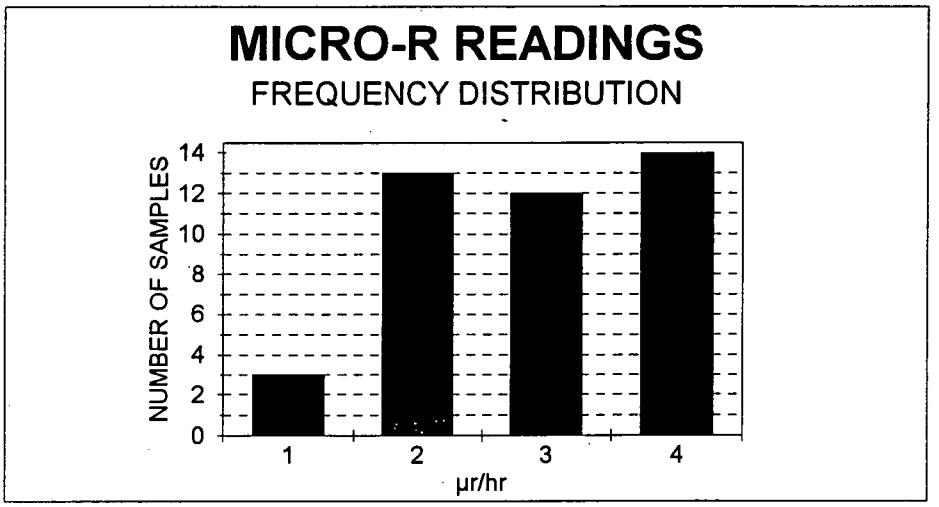




NUMBER OF READINGS	167
AVERAGE READING	23299
MINIMUM READING	17632
MAXIMUM READING	31350
STANDARD DEVIATION	2659

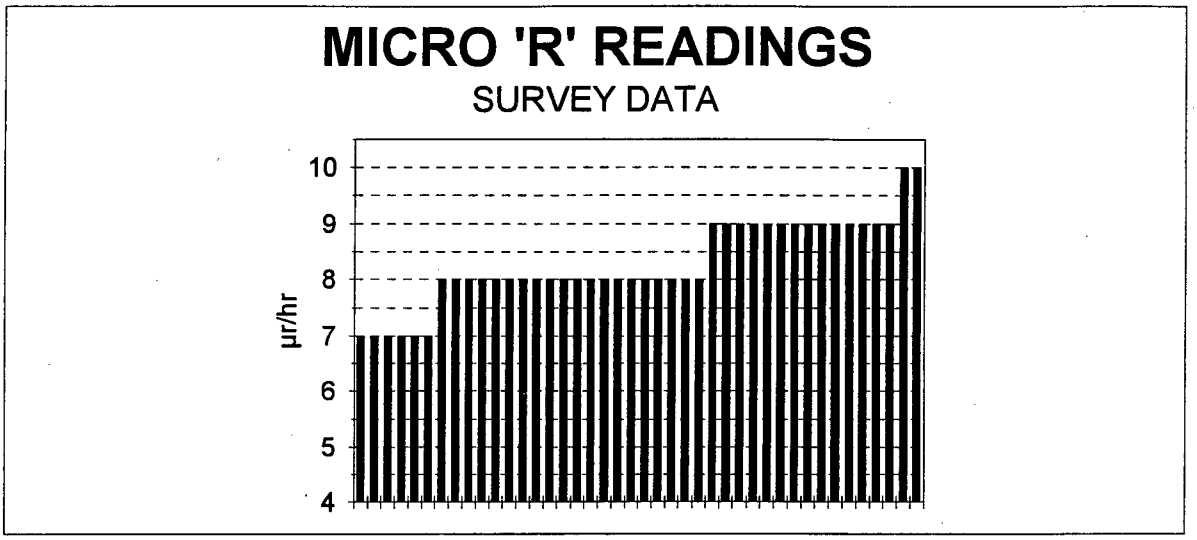
DAP-4 STOCKPILE CHARACTERIZATION
MICRO-R ;METER READINGS AT SURFACE
LUDLUM MODEL 12S S/N 9081
RESULTS IN µR/hr
APRIL 1996

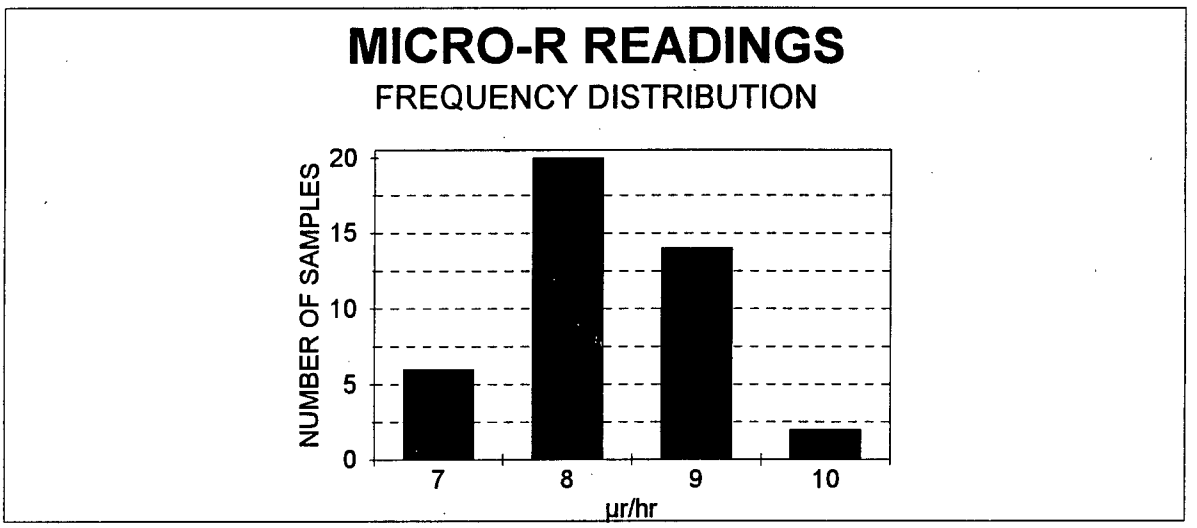




NUMBER OF READINGS	**42**
AVERAGE READING	**9**
MINIMUM READING	**7**
MAXIMUM READING	**10**
STANDARD DEVIATION	**1**

DAP-4 STOCKPILE CHARACTERIZATION
MICRO-R READINGS AT ONE METER ABOVE SURFACE
LUDLUM MODEL 12S S/N 9081
RESULTS IN µR/hr
APRIL, 1996





NUMBER OF READINGS	42
AVERAGE READING	8
MINIMUM READING	7
MAXIMUM READING	10
STANDARD DEVIATION	1

Table 1-1

ENRICHED URANIUM pCi/g	BRANCH TECHNICAL POSITION PAPER OPTION NO. 1	2	3	4
SOLUBLE	30	100	--	1,000
INSOLUBLE	30	250	--	2,500

Note: Cimarron isolates and packages for shipment to a licensed low level waste burial site soils found with concentrations in excess of the option 2 limits.

Applying DRAFT NUREG-5849 averaging criteria, Option 2 material can be defined as having an average concentration of uranium less than or equal to 100 pCi/g with a maximum concentration less than or equal to 300 pCi/g.

At cimarron, the average concentration limit is based on 100% solubility, and may be adjusted upward, not to exceed the guideline value of 250 pCi/g, on the basis of solubility determined by a method acceptable to NRC staff.

Table 2-1

CIMARRON CORPORATION
CIMARRON FACILITY
DESIGNATED AREA DIRT PILE #4
HOT SPOT AVERAGING (5 METER X 10 METER GRID)

(HOT SPOT) LOCATIONS: 142E-164N (204 pCi/gU)
(2 METERS IN DEPTH)

NORTH END OF DIRT PILE #4
166N

137E-164N	142E-164N	147E-164N
37	204	36
54	62	59
137E-159N	142E-159N	147E-159N

LOCATION	pCi/gU
137E-164N	37
147E-164N	36
137E-159N	54
142E-159N	62
147E-159N	59

TOTAL pCi/gU: 248 pCi/gU AVERAGE: 49.6 pCi/gU

X_w = 49.6 [1 - 25/100] + 204 [25/100]

X_w = 49.6 [.75] + [204 X .25]

X_w = 37.2 + 51 = 88.2

X_w = 88.2 pCi/gU OR 88 pCi/gU

PERFORMED BY: Irving Powell DATE: 5-7-96

REVIEWED BY: W. A. Rogers DATE: 5-13-96

TABLE 3-1

Comparison of Cimarron Soil Counter Sample Results to Laboratory Analytical Results

Soil Samples analyzed using the Cimarron Soil Counter and submitted for analysis to CORE Lab and Lockheed Analytical Services.

Following is a comparison of analytical results to Cimarron soil counter results.
Note: The total U for analytical results is the sum of the isotopics:

SAMPLE	CIMARRON COUNTER	CORE LAB ALPHA PULSE HEIGHT							CIMARRON COUNTER	CORE LAB ALPHA PULSE HEIGHT					
	U	TOTAL U	U-234		U-235		U-238		Th	Th-228		Th-232		PU-239	
	pCi/g	pCi/g	pCi/g	±	pCi/g	±	pCi/g	±	pCi/g	pCi/g	±	pCi/g	±	pCi/g	±
FA-129	13.4	8.9	5.0	0.8	0.2	0.1	3.7	0.7	1.4	1.3	0.4	1.0	0.3		
BUR-2-1150	16.4	15.3	12.1	1.8	0.6	0.2	2.6	0.6	1.7	1.1	0.4	1.1	0.4		
BUR-2-1230	20.9	17.6	13.6	1.8	0.5	0.2	3.5	0.6	1.5	0.9	0.3	0.9	0.3		
BG-2-1226	20	18.9	14.4	2.0	0.6	0.2	3.9	0.7	1.3	0.9	0.3	0.7	0.2		
BG-2-1155	28.6	33.8	25.2	3.3	1.0	0.3	7.6	1.2	1.1	0.8	0.3	0.6	0.2		
BG-2-1152	34.4	33.7	27.2	3.5	0.9	0.3	5.6	0.9	1.8	1.0	0.3	1.0	0.3		
BG-2-1154	36	33.8	26.4	3.2	1.3	0.3	6.1	0.9	1.8	0.9	0.3	1.3	0.4		
EUY-889	75.8	87.3	71.8	9.9	2.9	0.7	12.6	2.0	1.2	0.8	0.2	0.7	0.2		
EUY-899	106.3	117.5	97.5	11.8	3.9	0.7	16.1	2.2	1.7	0.8	0.3	0.7	0.3		
DAP-4-10	92.7	126.7	103.0	12.5	4.1	0.8	19.6	2.6	1.6	1.0	0.3	1.3	0.4		
DAP-4-181	27.1	24.9	21.0	2.9	1.0	0.3	2.9	0.6	1.1	0.6	0.2	0.5	0.2	0.1	0.1
DAP-4-183	68.6	83.7	64.4	12.5	6.0	1.8	13.3	3.2	1.8	0.9	0.3	0.8	0.3	0.2	0.1
DAP-4-186	54.9	58.7	47.6	6.7	3.4	0.7	7.7	1.3	1.6	0.8	0.2	0.9	0.3	0.1	0.1

SAMPLE	CIMARRON COUNTER	LOCKHEED ANALYTICAL SERVICES ALPHA PULSE HEIGHT							CIMARRON COUNTER	LOCKHEED ANALYTICAL SERVICES ALPHA PULSE HEIGHT					
	U	TOTAL U	U-234		U-235		U-238		Th	Th-228		Th-232		PU-239	
	pCi/g	pCi/g	pCi/g	±	pCi/g	±	pCi/g	±	pCi/g	pCi/g	±	pCi/g	±	pCi/g	±
DAP-4-182	27.7	26.65	22.1	1.2	1.12	0.12	3.43	0.25	1.1	0.668	0.098	0.716	0.092	0.0017	0.0033
DAP-4-185	62.5	74.95	59.4	3.1	3.23	0.25	12.32	0.72	1.7	1.03	0.12	0.848	0.099	0.087	0.033
DAP-4-187	53.1	60.77	49.2	2.6	2.51	0.21	9.06	0.55	1.3	1.02	0.12	0.841	0.099	0.017	0.016

NOTE:

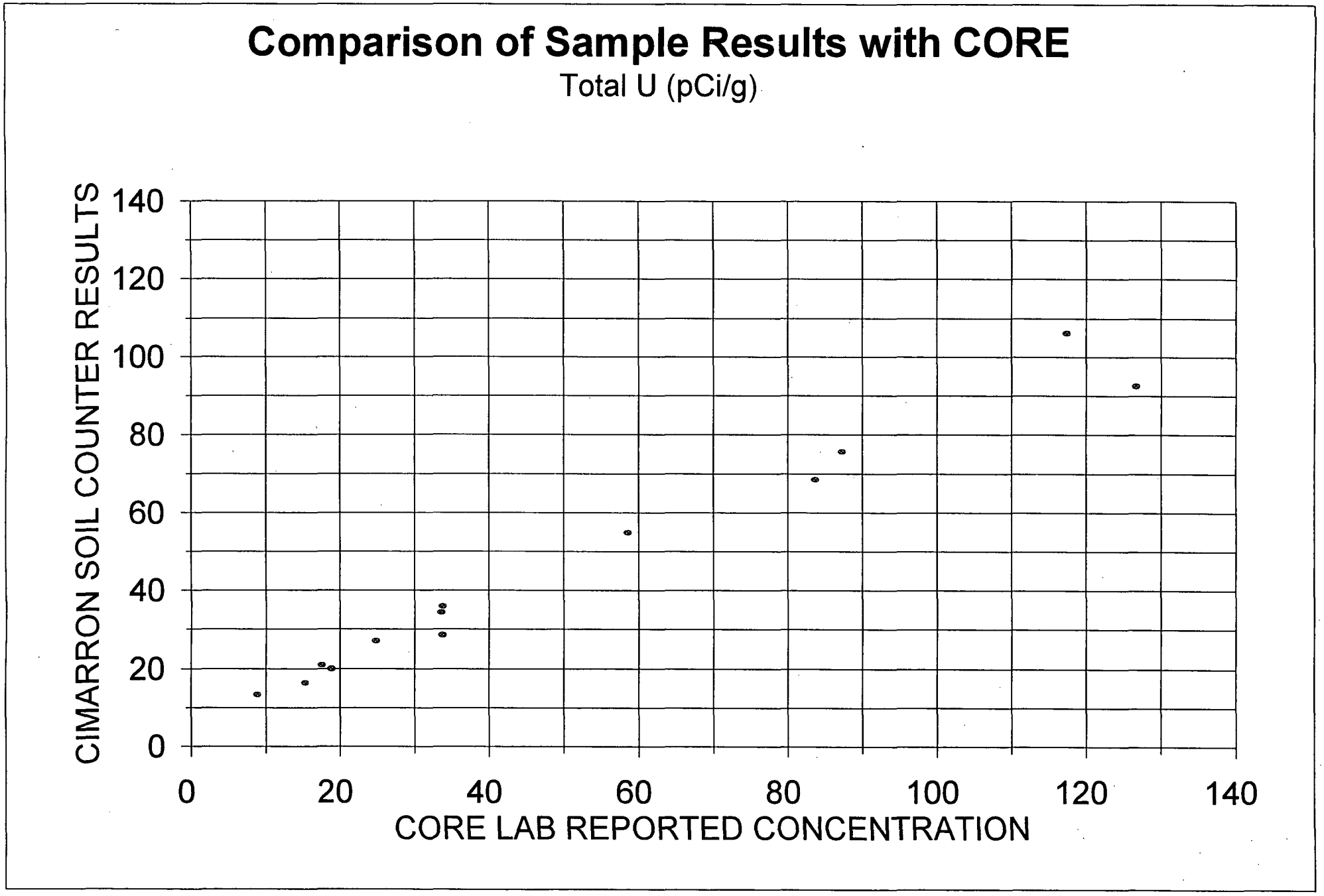
Samples DAP-4 181 & 182 are splits of the same sample.
Samples DAP-4 183 & 185 are splits of the same sample.
Samples DAP-4 186 & 187 are splits of the same sample.

Table 3-2

CIMARRON SOIL COUNTER STANDARDS COMPARISONS

SAMPLE I.D.	CIMARRON COUNTER (pCi/g) RANGE		RESULTS ± 2σ	LABORATORY RESULTS (pCi/g)		
	LOW	HIGH	AVERAGE	LAB-1	LAB-2	ASSIGNED
Bkg. Std.	3.8	9.6	6.3 ± 4	4.53	---	4.5
U-1-2	24.8	31.6	27.7 ± 10	27.4	29.9	28.7
DP-2	113.3	125.7	116.7 ± 21	132.2	137	134.6
DP-1	272.4	291.2	280.0 ± 33	289.6	293	291.6
Th-1	8.5	9.9	9.4 ± 6	10.54	9.04	9.79

Figure 2


Comparison of Sample Results with CORE
Total U (pCi/g)
CIMARRON SOIL COUNTER RESULTS
0
20
40
60
80
100
120
140
CORE LAB REPORTED CONCENTRATION