4441 E. Holmes St.
Tucson, AZ 85711
October 13, 1987

Mr. John Buckley
U.S. Nuclear Regulatory Commission
623-SS
Washington, D.C. 20555

RE: Re-estimation of Elevations
Within the Cohassett Flow

Dear John:

Enclosed are the revised 4 pages from the above report that contain a few changes. These changes were necessitated by the fact that the initial one-sided confidence interval as used by Taylor and subsequently used by me in the above report failed to take into account the joint probability of having both BFLT and TFLB satisfy the one-sided confidence interval at the same time.

Please replace 4 pages of the original report with the enclosed.

Sincerely,

Y.C.
Young C. Kim, Professor

Using the kriged elevations and associated kriging standard deviations, the minimum differences in elevations at a pre-specified level of confidence were computed next at each grid point and these values were contoured. This difference is computed using the following equation:

$$\text{DIFFERENCE} = (\text{BFLT} - Z*\text{KRG1.STD}) - (\text{TFLB} + Z*\text{KRG2.STD}) \qquad (4)$$

where

KRIG1.STD = kriging standard deviation of BFLT elevation
KRIG2.STD = kriging standard deviation of TFLB elevation
Z value is obtained from standard normal tables.

Figure 12 is the contour of the minimum differences at 64% confidence level assuming normality of errors and using one-sided rather than two-sided interval (i.e.,Z = 0.84 in Eq.4). This 64% confidence level is based on the joint probability of having both BFLT and TFLB satisfy the 80% one sided confidence interval, i.e., .80 x .80 = .64. (Please note that Taylor's 80% C.I. should be changed to 64% as well). From this figure, a minimum thickness of approximately 212' is found along the western edge of the repository layout area, which is different than Taylor's results (See Figure 19 on p. 33). At 90% (.95 x .95 = .90) confidence, the minimum thickness is now reduced to approximately 188' which is still thick enough to satisfy buffer zone requirements of the repository design (See Figure 13).

CONCLUSIONS

1. Re-estimated elevations of the bottom of Cohassett flow-top (BFLT) and the top of Cohassett flow-bottom (TFLB) using universal kriging are quite similar to those given by Taylor.

2. Re-estimated kriging standard deviations given in this report are substantially smaller than Taylor's because of the direct estimation used here instead of the multi-step approach used by Taylor.

3. As Taylor states in his conclusions, the most important information that geostatistics provides is the uncertainty (or the risk) of the estimate. Quantifying this uncertainty, however, is much more susceptible to the correct modelling of the variogram parameters than obtaining the estimate itself.

4. The results given in this report should be accepted with some degree of caution, simply because only 13 data points were used for variogram modelling and only 10 data points were used for cross-validation and universal kriging.

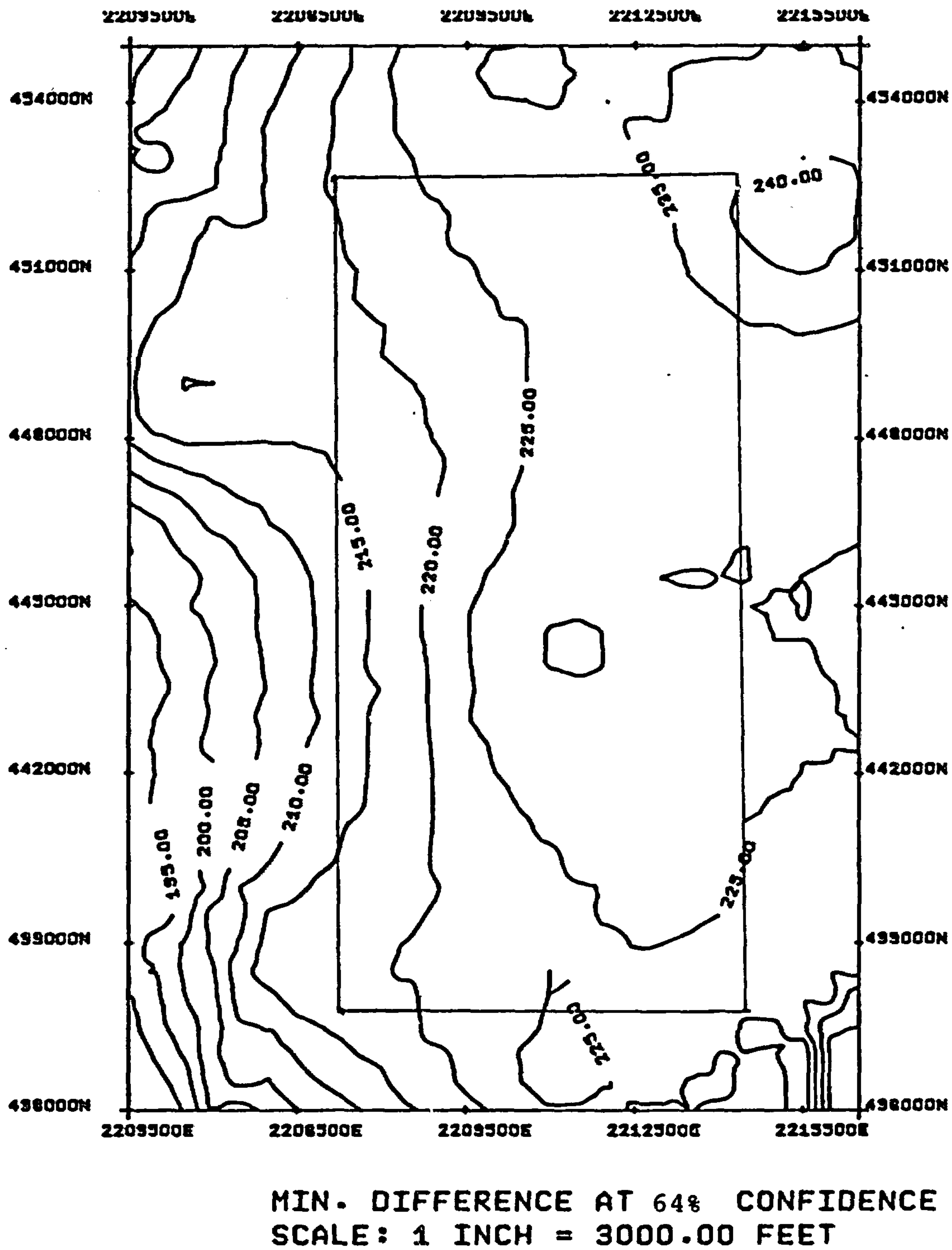
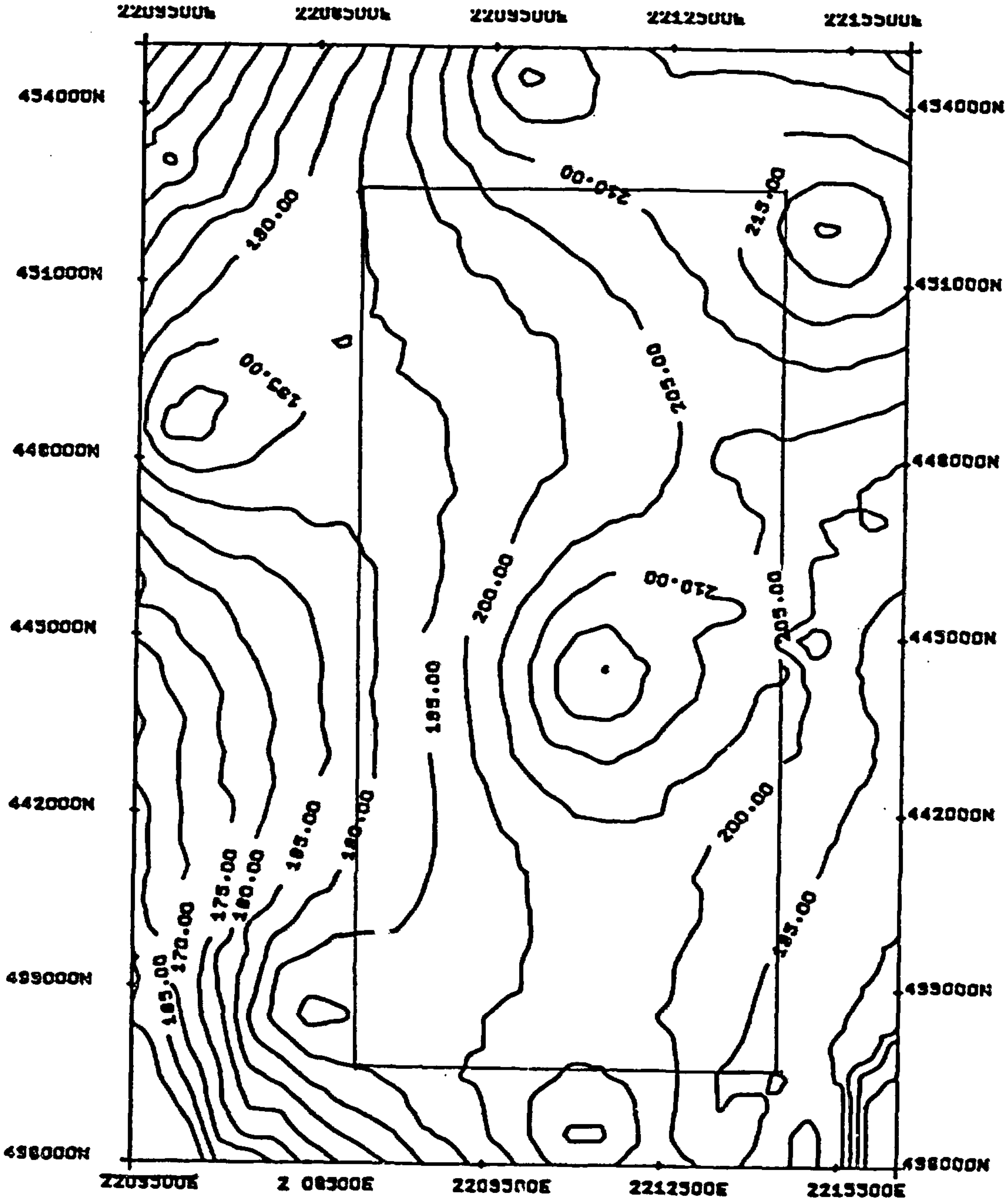


Figure 12. Minimum difference in elevations at 64% confidence interval (Contour interval = 5')



MIN. DIFFER. AT 90% CONFIDENCE
SCALE: 1 INCH = 3000.00 FEET

Figure 13. Minimum difference in elevations at 90% confidence interval (Contour interval = 5')

5. Assuming the variogram models represent true underlying spatial correlation of samples and also assuming that there will not be any unexpected findings in the future, the obtained minimum difference in elevations at 90% confidence interval is sufficient to allow the buffer zone requirements of the repository design.

REFERENCES

Taylor, H.D., 1987, Geostatistical Estimation of Elevations Within the Cohassett Flow at the Reference Repository Location, Report Prepared for Rockwell Hanford Operations, D.A.S.A. of Denver, Colorado.

Knudsen, H.P., and Kim, Y.C., 1978, A Short Course on Geostatistical Ore Reserve Estimation, University of Arizona, Tucson, Arizona.

Olea, R.A., 1975, Optimum Mapping Techniques Using Regionalized Variable Theory, Kansas Geological Survey, Lawrence, Kansas.

Kim, Y.C., 1982, "Program User's Guide for DRIFT.IBM and UNIVKRG.IBM Programs", University of Arizona, Tucson, Arizona.

Chauvet, P., 1982, "The Variogram Cloud", Proceedings of 17th International Symposium on Application of Computers and Operations Research in the Mineral Industry, Society of Mining Engineers, AIME, New York.

UNIVERSAL KRIGING UNDER SEVERELY LIMITED DATA

by

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ABSTRACT

This paper presents a step-by-step procedure adopted to estimate the elevations of geologic horizons at the proposed nuclear waste repository location in the state of Washington, U.S.A. Because of the presence of a trend in the data, universal kriging was used to estimate the elevations and associated kriging variances.

Starting with the initial 25 data points, 2 data points had to be eliminated because they were obvious outliers. Next, 7 more data points were eliminated based on the known geology and their distant placements with respect to the repository location. Finally, 3 more data points were eliminated because of their impact on the magnitude of residuals as well as on the variogram of residuals.

Estimation of the underlying variogram and the drift components was simply based on repeated trial-and-error, using the remaining 13 data points. Both the unbiased and the biased approaches of the underlying variogram estimation were tried. The final selection of the variogram parameters were those giving the best cross validation results.

The proposed repository location were kriged using 500'x500' grid points and using only 10 data points available near the repository. As expected, the kriged results were rather robust to the changes in the variogram parameters. However, the obtained kriging standard deviations were much more susceptible to the correct modeling of the variogram parameters.

D1004 PDR-1
LPDR - WM-10(2)
WM-11(2)
WM-16(2)

WM Record File D1004

WM Project 10, 11, 16
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