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LETTER AND U S NAVY RESPONSE TO COMMENTS REGARDING ARSENIC BACKGROUND STUDY FOR NS MAYPORT FL
6/17/2008
TETRA TECH NUS

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June 17, 2008

Project Number 112G00436

Naval Facilities Engineering Command, Southeast
ATTN: Mr. Dana Hayworth
Remedial Project Manager
135 Ajax Street North, Building 135
Naval Air Station Jacksonville
Jacksonville, FL 32212-0030

Reference: CLEAN IV Contract Number N62467-04-D-0055
Contract Task Order Number 0033

Subject: Response to Comments, Arsenic Background Study
Naval Station Mayport
Mayport, Florida

Dear Mr. Hayworth:

Tetra Tech NUS, Inc. (TtNUS) is pleased to submit this letter responding to the comments on the Arsenic Background Study at Naval Station (NAVSTA) Mayport. The questions and/or comments received by TtNUS from Mr. Stephen M. Roberts, Ph.D., from the University of Florida are addressed below.

UNIVERSITY OF FLORIDA

Comment 1: In the analysis of soil data from Naval Station Mayport, raw (un-transformed) data were examined and found not to be normally distributed. Based upon this observation, nonparametric methods for comparison were chosen. Soil concentration data are typically skewed. As a result, transformation of the data, such as logarithmic, is often utilized so that the assumption of normality is more nearly met, allowing normal-based methods to be used. These methods have more power than non-parametric methods.

Response: A log transformation of the data was conducted. The log transformed data were then fit to a normality plot and the Shapiro Wilk statistic was calculated. From examination of the probability plots and the Shapiro Wilk statistic is was concluded that the log transformation does not improve the fit to normality (See Normality Attachment). In addition to conducting a log transformation the distributions of the data were evaluated using the Pro UCL 4.0 software. The output from Pro UCL 4.0 can be seen in Distributions Attachment. From the various distribution tests conducted it was concluded that the data do not follow a normal or a log normal distribution.

Comment 2: Because the null hypothesis was consistently taken to be that the medians of background and site were equal, no justification is given that the sample size is large enough to give confidence in the conclusion that contamination is not present.

Response: For case where the Kruskal Wallis nonparametric ANOVA was computed with the hypothesis that the medians of the background and site were equal. This will be replaced with a Monte Carlo Approach.

The surface soil comparison will be changed to the following:

A Monte Carlo Test was conducted to test the null hypothesis that the mean site concentrations are greater than or equal to the background concentrations. This test employed a resampling technique to generate a t-statistic data distribution based on the data that have already been collected. The already computed test statistic from the actual data was then compared to this distribution to determine whether it has a significant probability of occurring for reasons other than random chance. For this test the site data were not required to exceed the background by an offset value. If an offset had been used then the test result would b more statistically significant but this added significance was not necessary, as described below. The description of the Monte Carlo method follows.

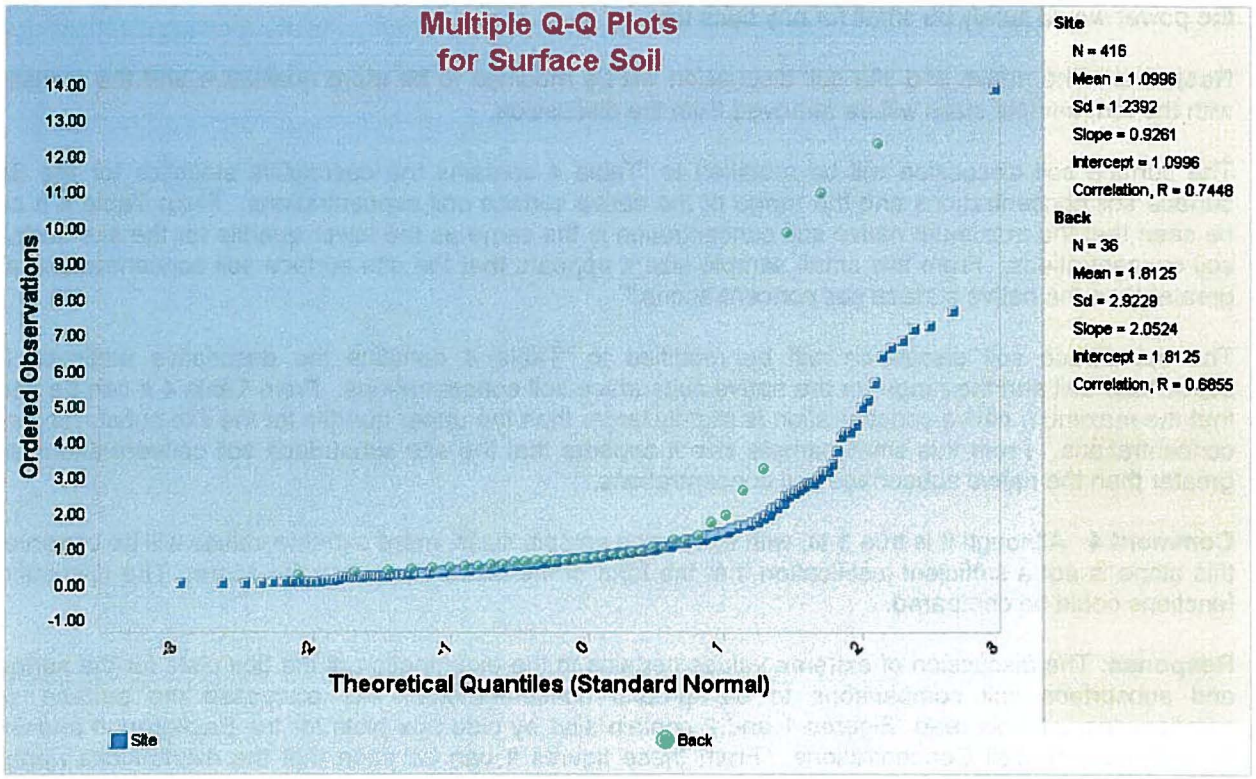
First the t-statistic (see Data Quality Assessment: Statistical Methods for Practitioners page 67 for calculation) for the original site and background data was computed to be -1.45. Next the site and background data were placed into one data set. 400 samples with replacement were taken of size 416 and size 36 to represent the site and background data sets, respectively. Then t-statistics were computed for each of the 400 data sets. From this a p-value was computed. The p-value is the proportion of t-statistics from the Monte Carlo simulations that are less than the test statistic for the original data sets. The null hypothesis will be rejected if the p-value is less than 0.05. For the surface soil simulations 6 out of 400 test statistics were smaller than the test statistic from the original test. This results in a p-value of 0.015. Therefore, the null hypothesis that the site concentrations are greater than the background concentrations was rejected. It is concluded that the site surface soil concentrations are within the range of the background surface soil concentrations.

The subsurface soil comparison will be changed to the following:

A Monte Carlo Test was conducted to test the null hypothesis that the mean site concentrations are greater than or equal to the background concentrations. This test employed a resampling technique to generate a t-statistic data distribution based on the data that have already been collected. The already computed test statistic from the actual data was then compared to this distribution to determine whether it has a significant probability of occurring for reasons other than random chance. For this test the site data were not required to exceed the background by an offset value. If an offset had been used then the test result would b more statistically significant but this added significance was not necessary, as described below. The description of the Monte Carlo method follows.

First the t-statistic (see Data Quality Assessment: Statistical Methods for Practitioners page 67 for calculation) for the original site and background data was computed to be -1.34. Next the site and background data were placed into one data set. 400 samples with replacement were taken of size 395 and size 36 to represent the site and background data sets, respectively. Then t-statistics were computed for each of the 400 data sets. From this a p-value was computed. The p-value is the proportion of t-statistics from the Monte Carlo simulations that are less than the t-statistic for the original data sets. The null hypothesis will be rejected if the p-value is less than 0.05. For the subsurface soil simulations 13 out of 400 test statistics were smaller than the test statistic from the original test. This results in a p-value of 0.03. Therefore, the null hypothesis that the site concentrations are greater than the background concentrations was rejected. It is concluded that the site subsurface soil concentrations are within the range of the background surface soil concentrations.

In addition to the Monte Carlo tests quantile plots were generated for the site and background concentrations. From these graphs it can be seen that the site concentrations are within the range of the background concentrations. The site and background data distributions are coincident over most of the observed concentrations ranges. In the upper ends of the ranges, the site data quantiles appear to deviate from background but are within the observed background concentrations.


Multiple Q-Q Plots
for Surface Soil
Ordered Observations
14.00
13.00
12.00
11.00
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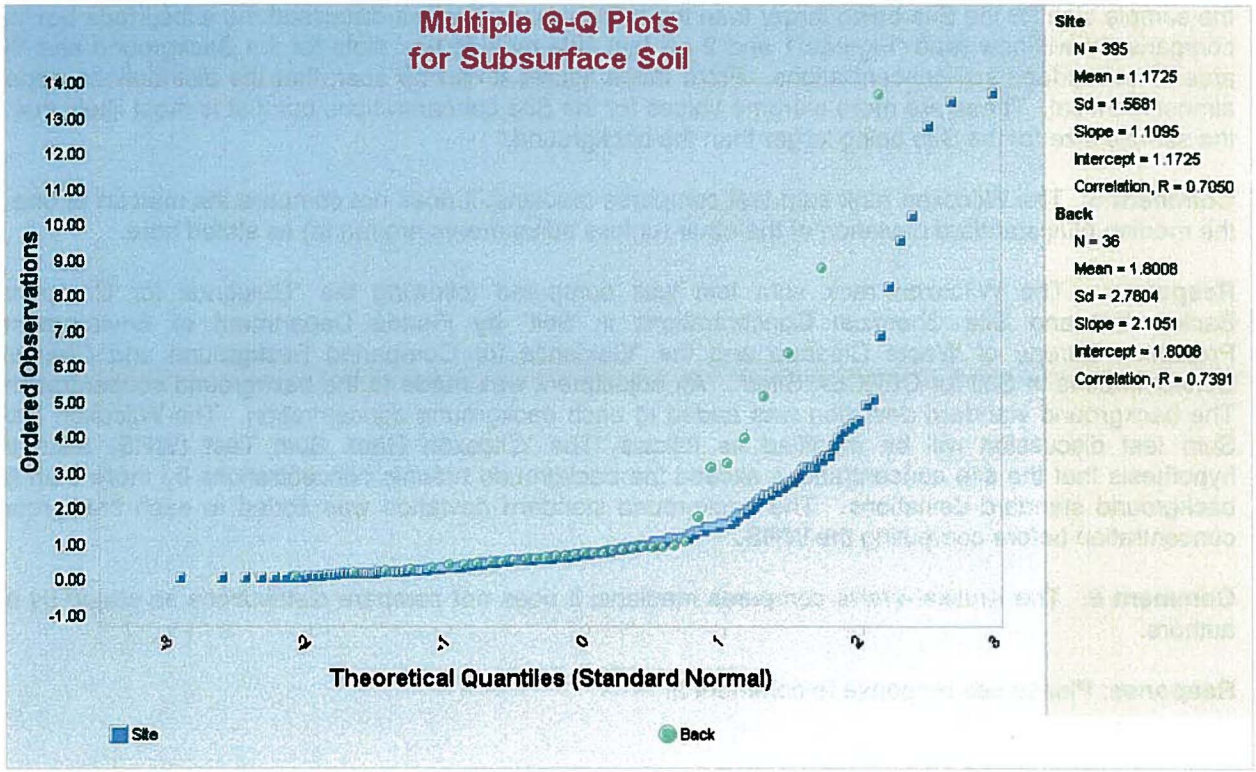
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
Theoretical Quantiles (Standard Normal)
Site
Back
Site
N = 416
Mean = 1.0996
Sd = 1.2392
Slope = 0.9261
Intercept = 1.0996
Correlation, R = 0.7448
Back
N = 36
Mean = 1.8125
Sd = 2.9229
Slope = 2.0524
Intercept = 1.8125
Correlation, R = 0.6855


Multiple Q-Q Plots
for Subsurface Soil
Ordered Observations
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5.00
4.00
3.00
2.00
1.00
0.00
-1.00
Theoretical Quantiles (Standard Normal)
Site
Back
Site
N = 395
Mean = 1.1725
Sd = 1.5681
Slope = 1.1095
Intercept = 1.1725
Correlation, R = 0.7050
Back
N = 36
Mean = 1.8008
Sd = 2.7804
Slope = 2.1051
Intercept = 1.8008
Correlation, R = 0.7391

Comment 3: The use of only four native observations highlights the concerns in the comment above, as the power would surely be small for any such test.

Response: The native and site soil discussion will be modified to be more qualitative and the statistics with the four sample sizes will be removed from the discussion.

The surface soil discussion will be modified to "Table 4 contains the descriptive statistics for the Site surface soil concentrations and the range of the native surface soil concentrations. From Table 4 it can be seen that the maximum native soil concentration is the same as the lower quartile for the site surface soil concentrations. From this small sample size it appears that the site surface soil concentrations are greater than the native surface soil concentrations."

The subsurface soil discussion will be modified to "Table 4 contains the descriptive statistics for subsurface soil and the range for the native subsurface soil concentrations. From Table 4 it can be seen that the maximum native concentration is slightly larger than the upper quartile for the site subsurface soil concentrations. From this small sample size it appears that the site subsurface soil concentrations are greater than the native subsurface soil concentrations.

Comment 4: Although it is true that, with increasing sample sizes, more extreme values will be observed, this alone is not a sufficient justification that the form of the distributions are the same. The distribution functions could be compared.

Response: The discussion of extreme values pertains to the examination of the box plots for the surface and subsurface soil comparisons to background concentrations. As discussed the surface soil comparisons will now read "Figures 1 and 2 contain side by side box plots for the Background and Site Arsenic Surface Soil Concentrations. From these figures it can be seen that the distributions appear almost identical. There are more extreme values for the Site concentrations but that is most likely due to the sample size for the Site being larger than the background. Also as discussed the subsurface box plot comparisons will now read "Figures 1 and 2 contain side by side box plots for the Background and Site arsenic subsurface soil concentrations. From these figures it can be seen that the distributions appear almost identical. These are more extreme values for the Site concentrations but that is most likely due to the sample size for the Site being larger than the background."

Comment 5: The Wilcoxon rank sum test compares medians; it does not compare the median of one to the median plus standard deviation of the other (unless adjustments are made) as stated here.

Response: The Wilcoxon rank sum test was computed following the "Guidance for Comparing Background and Site Chemical Concentrations in Soil" by Florida Department of Environmental Protection Bureau of Waste Cleanup and the "Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites". An adjustment was made to the background concentrations. The background standard deviation was added to each background concentration. The Wilcoxon Rank Sum test discussion will be modified as follows "The Wilcoxon Rank Sum Test (WRS) tests the hypothesis that the site concentrations exceed the background arsenic concentrations by more than the background standard deviations. The background standard deviation was added to each background concentration before computing the WRS.

Comment 6: The Kruskal-Wallis compares medians; it does not compare distributions as stated by the authors.

Response: Please see response to comment 2.

If you have any questions with regard to this submittal, please contact me via e-mail at Shina.Ballard@TetraTech.com or by phone at (904) 730-4669, Extension 222.

Sincerely,

Shina A. Ballard

Shina A. Ballard
Task Order Manager

SB

Enclosure

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Mr. Mike Halil, CH2M Hill
Mr. Casey Hudson, CH2M Hill
Ms. Debra Humbert, TtNUS
Mr. Mark Perry, TtNUS
CTO 0033 Project File