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TETRA TECH NUS, INC.
661 Andersen Drive ▪ Pittsburgh, Pennsylvania 15220-2745
(412) 921-7090 ▪ FAX (412) 921-4040 ▪ www.tetratech.com

PITT-02-3-030

February 14, 2003

Project Number 2863

Ms. Kymberlee Keckler
Remedial Project Manager
U.S. Environmental Protection Agency – Region 1
1 Congress St.
Suite 1100 (HBT)
Boston, Massachusetts 02114-2023

Subject: Responses to EPA's January 16, 2003 Comments and Page Changes
Final Year 2 Annual Groundwater Monitoring Report for the Area A Landfill
Naval Submarine Base-New London, Groton, Connecticut

Reference: CLEAN Contract Number N62467-94-D-0888
Contract Task Order Number 0816

Dear Ms. Keckler:

On behalf of the U.S. Navy, Tetra Tech NUS, Inc. (TtNUS) is pleased to submit to the U.S. Environmental Protection Agency, Region 1 (EPA), 2 copies of the subject information. As indicated in the Response-to-Comment document, no changes were required to address Comment 1. However, minor changes to the text of Section 4 were necessary to address Comment 2. The appropriate revised Section 4 pages are enclosed.

If you have any questions regarding the enclosed information, please contact Mr. Mark Evans of Engineering Field Activity Northeast at (610) 595-0567 (ext. 162) or me at (412) 921-8984.

Sincerely,

Corey A. Rich, P.E.
Project Manager

Enclosure(s)

c: Mr. Mark Lewis, CTDEP (1 copy)
Mr. Mark Evans, EFANE (2 copies)
Mr. Richard Conant, NSB-NLON (3 copies)
Mr. Roger Boucher, EFANE (w/o enclosures)
Ms. Jennifer Hayes Stump, Gannett Fleming (1 copy)
Mr. John Trepanowski, TtNUS-KOP (1 copy)
CTO 816 – File Copy

RESPONSES TO USEPA's JANUARY 16, 2003 COMMENTS
FINAL YEAR 2 ANNUAL GROUNDWATER MONITORING REPORT
FOR THE AREA A LANDFILL, NSB-NLON, GROTON, CONNECTICUT
February 14, 2003

Comment 1: p. 2-16, §2.3.7

The second paragraph summarizes site-specific observations with respect to turbidity, TDS, and total and dissolved metals. The paragraph then makes some generic statements about arsenic use. While it is prudent to recognize potential anthropogenic sources, it is not clear why these statements appear in the middle of a discussion of site-specific data. They do not seem to be offered as an interpretation. The paragraph concludes with the statement, "Dissolved arsenic does not react strongly with aquifer solids and its transport in groundwater is not retarded." It is agreed that arsenic is not retarded in the sense that the term is usually used with regard to organic contaminants partitioning to organic carbon in the aquifer. However, as discussed in Section 2.2.5 (Site Conceptual Model), under oxidizing conditions, and in the presence of iron oxyhydroxides, arsenic can be sorbed and effectively retarded.

Response:

Agree with clarification. The subject information included in Section 2.3.7 was taken from the Year 1 Groundwater Monitoring Report that was prepared in May 2001. The statements provide general information regarding arsenic. The conceptual model information discussed in Section 2.2.5 was prepared during finalization of the Year 2 Groundwater Monitoring Report (2002). Additional efforts were made to understand geochemical conditions at the landfill affecting arsenic during the Year 2 evaluation. Because the statements made in Section 2.3.7 are actual statements made in the Year 1 report and the statements do not affect the conclusions of the Year 2 report or the current understanding of arsenic mobility at the site, the Navy does not propose to make any changes to the final Year 2 Groundwater Monitoring Report in response to this comment.

Comment 2: p. 4-19, §4.5

The last paragraph on this page reviews total and dissolved arsenic concentrations in the reference well 2WMW21S from the Phase II RI and the landfill monitoring program. It concludes, "These results also indicate that high suspended solids may have caused the high arsenic concentrations." The intended implications of this statement are not clear. For the two wells cited earlier in the paragraph, total arsenic was observed to be significantly higher than dissolved arsenic, and the conclusion is that particulates account for the difference. However, for 2WMW21S, the analytical results for total and dissolved arsenic are essentially indistinguishable, both in the Phase II RI and in recent monitoring. However, it is striking that arsenic at this well was over 100 micrograms per liter in the first round of sampling in the Phase II RI, but under 10 micrograms per liter in the landfill monitoring program, for *both* unfiltered and filtered samples. The Phase II RI sampling apparently was performed in 1994, before the "low-flow" sampling protocol was widely used. A change in sampling method may play a role in the apparent drop in arsenic at this well, and may be related to suspended solids. However, if so, it would appear to be because of mobilization of sub-0.45-micron particulates in the earlier sampling that is minimized in the low-flow sampling of more recent rounds.

Response:

Agree. It is likely that a change in groundwater sampling protocol between the Phase II RI and the groundwater monitoring program is the main reason for the substantial decrease in the arsenic concentrations at well 2WMW21S. Because total and dissolved concentrations of arsenic were similar in this well during the Phase II RI, it would also appear that the elevated concentrations were the result of mobilization of sub-0.45-micron dredge spoil particles versus filterable suspended solids. The last sentence on p. 4-19 was deleted and replaced with the following text.

> "These results indicate that changes in groundwater sampling protocol between the Phase II RI and groundwater monitoring program have resulted in a substantial decrease in arsenic concentrations at well 2WMW21S. It would also appear that the historically elevated arsenic concentrations in this well were the result of mobilization of sub-0.45-micron dredge spoil particles versus filterable suspended solids."

The appropriate pages were re-issued.

is provided below that indicates that a variety of factors may be causing the elevated arsenic concentrations.

Concentrations of arsenic detected in soil samples from the Area A Landfill during previous investigations ranged from 0.59 mg/kg to 3.7 mg/kg in surface soil and 0.94 mg/kg to 10.6 mg/kg in subsurface soil. Arsenic concentrations detected in soil samples collected from the Area A Wetland during previous investigations ranged from 1 mg/kg to 14.1 mg/kg in surface soil and sediment and 2.2 mg/kg to 11.7 mg/kg in subsurface soil. Sediment samples collected from the Thames River contained arsenic at concentrations ranging from 2.7 mg/kg to 18.5 mg/kg. Soil samples collected during the installation of the monitoring wells in the Area A Wetland for the Area A Landfill monitoring program ranged from 1.2 mg/kg to 15.1 mg/kg. These ranges of arsenic concentrations are very consistent between the different areas and media and do not indicate that material disposed in the Area A Landfill has elevated arsenic concentrations compared to the wetland soils/dredge spoils.

TCLP test results for soil samples collected from the Area A Landfill and Area A Wetland indicate that natural arsenic is leachable from the soil. For a sample collected from the Area A Landfill, the arsenic concentration in the TCLP leachate was 0.3 mg/L (300 µg/L) for a soil sample with 2.2 mg/kg of arsenic. The test results indicate that if acidic conditions are present within the landfill, arsenic could leach from the natural soil at concentrations exceeding the primary monitoring criteria (4 µg/L). However, the pH measurements taken during groundwater sampling activities (Table D-1 in Appendix D) do not show low pH groundwater in the downgradient wells. Therefore, it does not appear that low pH leachate from the landfill is the cause of the high arsenic concentrations. One other potential cause that is pH-related, is acid rain. Low pH precipitation and runoff deposit in the wetland and may cause some of the elevated arsenic concentrations.

The detected concentrations of arsenic in groundwater samples collected from monitoring wells in the vicinity of the Area A Landfill during previous investigations were variable, but there seems to be a correlation with the dredge spoils. Maximum concentrations of total arsenic detected in groundwater samples collected from within the Area A Landfill during the Phase II RI were 19.6 µg/L (2LMW13S) and 37 µg/L (2LMW7S). Both of these wells were partially completed in dredge spoils. Dissolved concentrations of arsenic detected in these same samples were less than 7 µg/L, indicating suspended solids caused the high arsenic concentrations. Arsenic concentrations detected in the reference monitoring well 2WMW21S during the Phase II RI were 109 µg/L (total) and 138 µg/L (dissolved) during Round 1 and 56.1 µg/L (total) and 49.5 µg/L (dissolved) during Round 2. This well was completed in dredge spoils. The maximum concentrations of arsenic detected in this well during the Area A Landfill monitoring program were 8.8 µg/L (total) and 7.2 J µg/L (dissolved) during Round 1 of the program. These results indicate that changes in groundwater sampling protocol between the Phase II RI and

groundwater monitoring program have resulted in a substantial decrease in arsenic concentrations in well 2WMW21S. It would also appear that the historically elevated arsenic concentrations in this well were the result of mobilization of sub-0.45-micron dredge spoil particles versus filterable suspended solids.

Other factors that could be causing the elevated arsenic levels in the groundwater were also evaluated. Total arsenic concentrations detected during the Area A Landfill monitoring program were compared to dissolved arsenic concentrations. As can be seen on Figure 4-8, there is a fairly good correlation between the concentrations, but there is some scatter to the data. Based on the information recorded on the sample log sheets, the color of many of the groundwater samples collected from monitoring wells installed in the dredge spoils has been gray to black. Turbidity levels have also been high in several of the samples. This information indicates that even though low-flow sampling techniques are being employed, a representative groundwater sample is not being collected and suspended solids may be partially responsible for the elevated arsenic concentrations.

Total and dissolved arsenic concentrations were also compared to Total Dissolved Solids (TDS) to determine if there was a correlation (see Figures 4-9 and 4-10). The figures present all groundwater data collected during the monitoring program for all monitoring wells. The figures indicate that arsenic concentrations are not strongly correlated with TDS. However, as shown on Figures 4-11 and 4-12, when arsenic and TDS are plotted for only the monitoring wells completed within the dredge spoils that had high arsenic concentrations, it appears that there is a relationship between high TDS and sporadically high arsenic concentrations. As can be seen by comparing Figures 4-9 and 4-10 with Figures 4-11 and 4-12, respectively, the high arsenic concentrations occurred almost exclusively in the dredge spoil wells and when the TDS levels were higher than 2,000 mg/L.

The Inductively Coupled Plasma (ICP) method for analysis of aqueous samples for inorganics, which was used by the project laboratories used for the monitoring program to complete the analysis of the samples, was reviewed and it indicates that the method/instrument is susceptible to interferences. The EPA has cautioned that the ICP method can result in false positives for arsenic, lead, and thallium. The ICP methodology cautions that high levels of TDS (>1,500 mg/L) and salts can cause interference with the analysis. The current project laboratory was contacted about this issue and they said that samples are diluted to minimize interferences. The only drawback to dilution of the samples is that high detection limits result. High levels of both TDS and salinity were detected in the groundwater samples collected from the monitoring wells completed in the dredge spoils. Therefore, it is possible that the TDS and salinity may be causing some interferences which are affecting arsenic results.

Based on previous regulator comments, arsenic concentrations were also compared to iron concentrations to determine if there is a correlation. Arsenic is commonly sorbed onto ferric oxyhydroxide

coatings. Reducing groundwater can mobilize the arsenic by dissolution of the coatings. Figure 4-13 shows a comparison of iron and arsenic concentrations detected in shallow soil samples (less than 10 feet bgs) that were collected from the Area A Wetland. These samples consist mainly of dredge spoils. From the graph it can be seen that there is good correlation between the concentrations. Figures 4-14 and 4-15 show total and dissolved concentrations of iron and arsenic, respectively, that were detected in the groundwater samples from downgradient and reference dredge spoil wells in the monitoring program. Non-detects are included in both figures. One-half the detection limit was used for the non-detects. Neither graph indicates a strong correlation between arsenic and iron in groundwater. Figures 4-16 and 4-17 show similar iron and arsenic results as Figures 4-14 and 4-15, respectively, with the exception that all non-detects have been removed from Figures 4-16 and 4-17. The removal of the non-detects did not have any significant impact on the correlation between arsenic and iron.

TABLE 4-1

SUMMARY OF THE MONITORING LOCATIONS THAT WERE COMPARED FOR THE STATISTICAL ANALYSIS AREA A GROUNDWATER MONITORING PROGRAM NSB-NLON, GROTON, CONNECTICUT

UPGRADIENT MONITORING LOCATIONS	DOWNGRADIENT MONITORING LOCATIONS	RATIONALE
4MW1S and 2LMW20S	2WMW38DS, 2WMW39DS, 2WMW40DS, 2WMW41DS, 2WMW42DS, 2WMW43DS, 2WMW44DS, 2WMW45DS, 2WMW46DS, and 2WMW47DS	Monitoring wells 4MW1S and 2LMW20S are upgradient of the landfill and the comparison of concentrations detected in these wells to concentrations detected in the selected downgradient wells will indicate the influence of the landfill on the groundwater within the Area A Wetland.
2WMW21S	2WMW38DS, 2WMW39DS, 2WMW40DS, 2WMW41DS, 2WMW42DS, 2WMW43DS, 2WMW44DS, 2WMW45DS, 2WMW46DS, and 2WMW47DS	Monitoring well 2WMW21S is not located upgradient of the landfill, but it serves as a reference location. The well is completed in dredge spoils similar to the selected downgradient wells and it shows any impacts from groundwater migrating into the Area A Wetland from the east. Comparison of concentrations detected in this well to concentrations detected in the selected downgradient wells will indicate the influence of dredge spoils on the groundwater in the Area A Wetland and the influence of groundwater migrating into the Area A Wetland from the east.
4MW1S and 2LMW20S	3MSP01	Monitoring wells 4MW1S and 2LMW20S are upgradient of the landfill and the comparison of concentrations detected in these wells to concentrations detected in the selected monitoring location will indicate the influence of the landfill on the groundwater that seeps from this location into the OBDA Pond in Area A Downstream.
4MW1S and 2LMW20S	3MW37S	Monitoring wells 4MW1S and 2LMW20S are upgradient of the landfill and the comparison of concentrations detected in these wells to concentrations detected in the selected downgradient well will indicate the influence of the landfill on the groundwater migrating to the Area A Downstream.