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LETTER REGARDING PROPOSAL AND COST ESTIMATE FOR IN-SITU CHEMICAL OXIDATION APPLICATION SITE 10 ALLEGANY BALLISTICS LABORATORY ROCKET CENTER WV
2/13/1998
MANTECH ENVIRONMENTAL CORPORATION

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A ManTech International Subsidiary

February 13, 1998

ATTN: Ms. Dawn Hayes
Commander Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street
Norfolk, Virginia 23511-2699

RE: *In-Situ* Chemical Oxidation Application at Allegheny Ballistics Laboratory, Site 10

Dear Ms. Hayes:

ManTech Environmental Corporation (ManTech), in conjunction with CleanOX Environmental Services, Inc. (CleanOX), the inventor and patent holder of the CleanOX *in-situ* chemical oxidation process (CleanOX Process), has prepared this proposed technical approach and engineering cost estimate for conducting a bench-scale and pilot-scale application of the CleanOX Process at Site 10, Allegheny Ballistics Laboratory (ABL). The CleanOX Process is proposed for the remediation of groundwater contaminated with volatile organic compounds, predominantly trichloroethene (TCE), associated with a former solvent recovery still operated at the site. The pilot test we are proposing will serve to remediate a portion of the 500 ppb alluvial aquifer plume.

ManTech is working with CleanOX under a long-term contractual arrangement to implement the Process, and for this project, CleanOX will be a subcontractor to ManTech. CleanOX is the sole owner, provider, and licensee of the CleanOX Process, which is patented under United States and International patent registrations. CleanOX is permitted in 23 states and has been used successfully at over 40 sites in the United States to remediate a wide range of organic constituents, including the volatile organic compounds detected at Site 10. Further, West Virginia Division of Environmental Protection remedial managers have received information on the technology and have expressed interest in its application.

CleanOX is an *in-situ* process that involves the application of a site-specific formulation of chemical reagents to rapidly oxidize a wide range of organic compounds in groundwater. The basis of the CleanOX Process is related to the well-known Fenton's Reaction wherein hydrogen peroxide reacts with ferrous ions to produce an hydroxyl radical in an acidified aqueous medium containing the contaminants. The resultant hydroxyl free radical (OH) is an extremely powerful oxidizer which progressively reacts with organic contaminants through a series of oxidation reactions. During the process, the oxidation reactions proceed by degrading the organic constituents to progressively less complex, shorter chemical chains, ultimately yielding carbon dioxide and water.

Application of the technology is easily scalable so that a variety of objectives can be met. While it is possible to cost-effectively and quickly treat entire groundwater plumes with CleanOX, the

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most dramatic cost savings are realized through applications at the most heavily contaminated areas and contaminant preferential pathways (i.e. higher permeability troughs as suggested at ABL Site 10). This application strategy leads to elimination of highly contaminated "source" areas within the plume. As a result, the site aquifer model will allow natural attenuation forces to play a significant role leading to monitoring and ultimate site closure.

ManTech has reviewed the Draft Focused Feasibility Study for Soil and Groundwater at Site 10 (FSS) dated 11/96; the Phase II Aquifer Testing Report dated October 1997; and, the 35% completed Remedial Design, all prepared by CH2M HILL. Site 10 is defined as the area around Building 157 at the ABL facility. A solvent recovery still was operated in Building 157 from 1959 until the early 1960s. The primary contaminants detected in soil and groundwater are volatile organic compounds (VOC), with TCE being the predominant VOC. We understand that the Navy is in the process of designing a groundwater extraction system at this site which will extract TCE contaminated groundwater and deliver it to a treatment plant being designed for groundwater treatment at nearby Site 1 at ABL.

Human health and ecological risk analysis in the FSS concluded that no remedial alternatives were needed to address the contaminants detected in the surface and subsurface soil at the site. The FSS also presents an analysis of potential impacts of residual soil contamination on site groundwater which concludes that TCE concentrations in soil are below concentrations where leaching would impact groundwater. A brief discussion in the FSS regarding the nature and extent of soil contamination indicates that TCE was detected at concentrations between 52 ug/kg and 280 ug/kg localized around the former still location, and only very low concentrations were detected outside this area.

Groundwater contamination exceeding risk-based goals for cancer and non-cancer risks extends approximately 1,000 feet down gradient, toward the North Branch Potomac River, in the alluvial soils aquifer. The FSS reports that the most contaminated portion of the alluvial groundwater plume has migrated approximately 300 feet down gradient. The bedrock aquifer plume is inferred to not have migrated as far as the alluvial aquifer plume. The FSS indicates that the bedrock plume has "not moved far" and is "relatively condensed". Figure 4-9 of the Aquifer Test Report shows a combined alluvial/bedrock plume delineation. The TCE plume over 5 ppb measures about 1,400 ft long by 750 ft wide (1 million sq ft) and resides mainly in the alluvial aquifer. The TCE plume over 200 ppb residing primarily in the bedrock aquifer measures about 300 ft long by 200 feet wide (60,000 sq ft). The TCE plume over 500 ppb residing primarily in the alluvial aquifer measures about 200 ft long and 125 ft wide (25,000 sq ft) and is located near well 10GW11. It is for this higher TCE concentration alluvial aquifer plume that we are proposing pilot-scale testing of the CleanOX application. Conducting the pilot test in this area will remediate a portion of the plume in the 500 ppb plume area and demonstrate that the technology is appropriate for this site.

The site aquifer is described as alluvial soils over fractured bedrock. The alluvial soils consist of silty sands over clayey gravel. This gravel layer is on top of fractured bedrock. The silty sand layer ranges from 8 to 15 ft thick and the clayey gravel ranges from 10 to 15 ft thick. Groundwater is encountered at about 10 ft below grade in alluvial wells. Groundwater flow gradient has been estimated at 0.00429 ft/ft and hydraulic transmissivity has been estimated at 600 to 1,100 ft^2/d. Additionally, a vertical gradient ranging from 0.0004 to 0.0071 ft/ft upward from the bedrock aquifer to the alluvial aquifer has been observed. Groundwater parameters such as pH, temperature, specific conductance, redox potential, and dissolved oxygen content were presented in the Aquifer Testing report.

The first step of the CleanOX process would be bench-scale testing which can be completed within two weeks at a cost of approximately $2,500 with samples being obtained from well 10GW11 (TCE at 830 ug/l) and provided to ManTech by others. The bench-scale test is conducted to confirm that site geochemistry is the same as is anticipated from previous study data and to demonstrate that the CleanOX process will effectively reduce contaminant concentrations. Assuming that a site groundwater sample would be collected by others and then provided to ManTech, the bench-scale test will include recording certain geochemistry parameters before, during, and after chemical application followed by collecting and analyzing a sample of the treated groundwater by USEPA Method 8010. Post-treatment TCE content will be compared to previous sampling data and bench-scale results will then be reported in a brief letter report.

Based on the bench-scale test, a pilot-scale test would be conducted to confirm the effectiveness of the process in the field and to obtain site-specific information for a full-scale application. The pilot-scale application includes installing three application wells; groundwater sampling and analysis by USEPA Method 8010 from well 10GW11 and the three application points before and after chemical application; application of CleanOX chemicals; and a final technical report. The proposed application wells would be constructed of four-inch diameter PVC risers with 15 feet long stainless steel well screens to a total depth of 25 feet below grade. The three wells would be positioned approximately 40 feet northeast, east, and southeast of well 10GW11. Following groundwater sample collection from the four wells, chemical application would occur at well 10GW11 and the three application wells. All four wells would be sampled again approximately two weeks following chemical application.

The pilot-scale test could be completed over a four to six week period. Cost to implement the pilot test described ranges from $75,000 to $100,000. A more detailed technical approach and cost proposal following DCAA pricing guidelines can be prepared if you wish to proceed. Our cost estimate includes installing the three application points; pre- and post-treatment groundwater sampling and analysis (eight groundwater samples plus two trip blanks for ten total samples); chemical application at four wells; and, project management, engineering, and

reporting. We have assumed that work plans for well installation and groundwater sampling will not be required and that we can rely on the existing site health and safety plan.

ManTech will be pleased to prepare a more detailed cost proposal following DCAA pricing guidelines if you are interested in pursuing this low-cost, fast-acting alternative to address the TCE groundwater contamination at ABL Site 10. Please call me at 301/315-8140 should you need any additional information or have any questions.

Sincerely,

Ronald F. Adams, P.E.
Director, Remedial Operations