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By Email

May 15, 2014

James E. Woolford
Director
Environmental Protection Agency
Office of Superfund Remediation and Technology Innovation
1200 Pennsylvania Avenue, N.W.
Room S5622 (MC5201P)
Washington, DC 20460

Dear Mr. Woolford:

In our letter of March 20, 2014, we advised that our clients, Occidental Chemical Corporation, Maxus Energy Corporation and Tierra Solutions, Inc., would submit a conceptual bioremediation approach for the Lower Passaic River. Please find enclosed for EPA's review, comment, and approval a Statement of Work for a field-scale in-situ sediment bioremediation pilot project.

This Statement of Work was developed by Professor John Pardue, Director of the Louisiana Water Resources Research Institute in the College of Engineering and Co-Director, Hazardous Substance Research Center, South & Southwest, at Louisiana State University. In the interest of time, our clients requested that Dr. Pardue begin preparations to develop a detailed Pilot Study Work Plan based on the attached Statement of Work. Accordingly, we seek EPA's approval of the Statement of Work as early as possible.

Following EPA's approval of the Statement of Work and the soon-to-be-submitted Pilot Study Work Plan, Dr. Pardue will oversee the implementation and operation of the Pilot Study. It is our understanding that, if approved, this Pilot Study will be largest of its kind ever conducted in the United States, and perhaps anywhere globally. This is a significant opportunity at many levels, not the least of which will be an opportunity for the local community to participate in a potentially-revolutionary program.

Dr. Pardue has studied many similar contaminated sites in which this type of bioremediation was applied, and he has been a key player in relatively-recent advancements in the science and technology of in-situ sediment bioremediation, He is enthusiastic about the prospects of its success in the Lower Passaic River.

Given the convergence of recent science and technology advancements, along with the rise of mega-contaminated sediment sites in need of better remedial solutions, Dr. Pardue believes the time has come to launch a large Field Scale Pilot Study to demonstrate and prove that in-situ sediment bioremediation provides a viable, sustainable, and ecologically friendly solution -- a 21st Century technology -- that can achieve comparable, if not superior, human health and ecological risk reduction at large and complex mega sediment sites, when compared to 19th Century dredging technology.

Once EPA approves the Statement of Work, Dr. Pardue estimates that the Pilot Study Work plan can be submitted in a matter of three weeks, and following EPA's approval of the Pilot Study Work Plan, he anticipates that mobilization and placement of the caissons described in the Statement of Work could commence within four weeks. During this time, we envision reaching out to New Jersey universities regarding potential partnership, collaboration, and educational/jobs training opportunities stemming from the Pilot Study. Our clients also contemplate perhaps establishing an independent, science Peer Review Panel to provide a scientifically sound and objective review of the Pilot Study that will withstand criticism and scrutiny from the public and science community. EPA's CLU-IN Program, and perhaps other similar programs, could fill a role in this effort.

Dr. Pardue will accompany us to our meeting with Deputy Administrator Perciasepe on May 29 and be available at any time that day to meet with you or others at EPA headquarters to explain the concept and its track record to date.

Please do not hesitate to let us know of any additional information you might find helpful to review in advance of our May 29th meeting with Deputy Administrator Perciasepe or any questions that may arise.

Very truly yours,

Carol Dinkins

Carol E. Dinkins

Enclosures

cc: Steve Ells
Walter Mugdan
Eric Schaaf

STATEMENT OF WORK FOR A FIELD SCALE IN-SITU SEDIMENT BIOREMEDIATION PILOT PROJECT IN THE LOWER PASSAIC RIVER

SUMMER 2014 - FALL 2015

Prepared by Dr. John Pardue, Elizabeth Howell Stewart Professor, Civil and Environmental Engineering Department, Louisiana State University; Director, Louisiana Water Resources Research Institute, College of Engineering, Louisiana State University; and Co-Director, Hazardous Substance Research Center, Louisiana State University

I. Introduction

This Statement of Work ("SOW") provides an overview of the work that will be carried out by Maxus Energy Corporation, Inc. (Maxus) and Louisiana State University (LSU) on behalf of Occidental Chemical Corporation, to further inform and refine the Remedial Investigation and Feasibility Study (RI/FS) that is under development for the Lower Passaic River Study Area (LPRSA) portion of the Diamond Alkali Superfund Site. Technical work described in this SOW is intended to provide more information to Maxus, USEPA, and USEPA's Partner Agencies (US Army Corps of Engineers (USACE), New Jersey Department of Transportation (NJDOT), National Oceanic and Atmospheric Administration (NOAA), US Fish and Wildlife Services (USFWS) and New Jersey Department of Environmental Protection (NJDEP))."

Recent release of the focused feasibility study (FFS) from EPA Region II has recommended a dredging and capping solution for the disposition of the contaminated sediments in the lower eight miles of the Passaic River (the Lower Passaic River). Despite a growing volume of Agency guidance promoting and encouraging EPA to consider innovative remedial technologies, the FFS did not include an evaluation of innovative technologies such as *in situ* bioremediation; even though it would result in permanent destruction and detoxification of contaminants in the Lower Passaic River sediments, without the negative environmental side effects inherent with dredging.

This SOW presents plans for a unique field scale pilot study that will demonstrate the effectiveness and potential of *in situ* bioremediation as a permanent and ecologically

sustainable solution to the risks that EPA asserts are posed by sediments in the Lower Passaic River. Accordingly, the purpose of this project is to demonstrate to EPA and the public that the science and technology of in-situ sediment bioremediation has advanced to a level which can achieve, if not surpass, the same level of human health and ecological risk reduction as conventional dredging techniques, and therefore, should be seriously considered and evaluated by EPA for inclusion as a remedial alternative/technology for the Lower Passaic River.

II. Lower Passaic *In Situ* Sediment Bioremediation Field Scale Pilot Study

Over the past decade, significant scientific and technological advances have occurred which have altered our understanding of the biodegradation of hydrophobic chlorinated organics such as polychlorinated biphenyls (PCBs) and polychlorinated dibenzodioxins and polychlorinated dibenzofurans (PCDD/PCDFs). Advances in genome-based identification have confirmed that *Chloroflex*i bacteria groups (e.g., *Dehalococcoides* sp) are present in contaminated environments similar to the LPRSA[1]. These bacteria have been found to be capable of degradation of PCBs[2] and PCDD/PCDFs[3], resulting in substantial reduction in the toxicity of these complex mixtures. This group of organisms is widely distributed at groundwater sites contaminated with chlorinated solvents and their activity forms the basis for many remedial actions selected in records of decision (RODs) at these sites. Substantial fundamental and practical experience has been gained at these sites in stimulating these organisms by providing carbon sources that ferment to H_2, the preferred electron donor for these populations, or by adding H_2 directly. Once these populations become active, they use chlorinated organic compounds in their metabolism as an electron acceptor, resulting in the sequential removal of chlorines, thus reducing their toxicity. In sites where these organisms are absent, bioaugmenting with commercially available cultures is widely practiced. Because of this practical experience in creating conditions for

[1] Tas et al., 2011. AEM 77: 4437–4445; Tas et al., 2009, AEM 75: 4437–4445
[2] Zhen et al., 2014. Wat. Research 52:51-62.
[3] Bunge et al., 2003. Nature 421:357-360.; Liu and Fennell, ES&T, 42:602–607

growth and activation of these populations, there is a reasonable chance of success to permanently reduce the toxicity of these sediments.

This pilot scale demonstration of *in situ* bioremediation will consist of biostimulation and/or bioaugmentation activities in caissons designed to isolate segments of the lower Passaic River sediments for study. The study will utilize six to eight steel caissons divided between 2 river locations, pile driven to depths up to 12 feet into the Lower Passaic River sediments, to form test cells. Each caisson is expected to be approximately 15'-20' X 15'-20' and will be subdivided into a paired control section and a treatment section(s). Depending on the treatment, caisson may isolate the sediment alone or the sediment and water column, Measures will be taken to ensure that there are no leaks into or out of each test cell, thereby isolating the treatment from the rest of the Passaic River. A series of amendment or bioaugmentation strategies will be developed to enhance populations of *Chloroflexi, or* other dechlorinating microbial populations to degrade PCBs and PCDD/PCDFs to lower chlorinated daughter products, thus substantially reducing their toxicity and risk within the sediments. A consequence of these activities will be the formation of sulfides, which can completely sequester Hg and other heavy metals present in the sediments.

Tasks are described below that will be performed and that will report the results of the pilot study.

III. Tasks

Task 1. Preparation of a Detailed Pilot Study Work Plan

Maxus and LSU will submit to EPA a detailed In Situ Bioremediation Pilot Work Plan (IBPWP) for review and approval in accordance with the document submittal schedule set forth in Section IV of this SOW. The work plan will provide detailed justification for a series of activities and measurements to demonstrate the feasibility of *in situ* bioremediation as a remedial technology for the Lower Passaic. The IBPWP will define the location, depth, and amendment schedule for each of the caisson experimental units, and the sampling and

analytical methods to be utilized to demonstrate the effectiveness of an *in situ* bioremediation strategy for risk reduction in the Lower Passaic. Attachments to the IBPWP shall include a sampling and analysis plan (SAP), a Quality Assurance Project Plan (QAPP), and a Health and Safety Plan (HASP).

The IBPWP shall specify key tasks to be accomplished to complete the pilot study. The IBPWP shall describe the overall management strategy for planning, executing, and documenting activities associated with the pilot. The IBPWP shall specify the responsibility and authority of all organizations and key personnel involved in performing investigative tasks. The IBPWP shall discuss the timing of/schedule for all subsequent related documents or activities described in Section IV of this SOW.

Elements of the IBPWP will include, but not be limited to, the following:

- A summary of the recent advances described in the literature and practice of *in situ* bioremediation for dioxins, furans and PCBs.
- A data gap analysis that defines the required knowledge of microbial and biogeochemical conditions at different areas in the Lower Passaic where sampling and analysis will be necessary to refine the amendment strategy at the site.
- A complete study design outlining replicated treatments for amendment and/or microbial bioaugmentation with appropriate paired controls.
- A final design of caisson experimental units which will be utilized to test amendment and/or bioaugmentation strategies in the system
- A Project Management plan, describing the strategy for managing activities associated with the pilot study and achieving timely submittal of deliverables.
- An organizational chart defining the roles of study participants including collaboration plans with local NJ universities and the composition of an external advisory board to provide additional oversight and advice for the study
- A project schedule, including a timeline for completion of all pre-design subtasks and activities associated with the pilot study, for submittal to EPA of interim and final deliverables, including but not limited to the deliverables enumerated in Section IV of this SOW.
- The composition and individual qualifications of the technical team or teams of personnel and/or subcontractors responsible for subtasks associated with the pilot study.

- Listing of standards, criteria, and regulations applicable to the pilot study.
- A Data Management Plan that includes:
    - A unique identification code assigned to all caisson sampling locations;
    - Location data and descriptive information recorded and encoded of all monitoring and sampling stations described in NJ State Plane Plane Coordinates;
    - Analytical results and other observations correlated with the caisson location and descriptive code using common identification codes assigned to station locations.
- A list and description of individual sampling and analysis activities designed to demonstrate effectiveness of the proposed approach and to close data gaps necessary to perform these activities at full-scale. These would include, but not be limited by the following activities:
    - Passive sampling methods and analyses to determine the biogeochemical conditions at depths associated with high concentrations of PCBs and PCDD/PCDFs.
    - Microbial characterization, including:
        - Bulk measures of microbial populations
        - Methods for specific identification of *Chloroflexi* populations and their diversity
        - Methods for quantitation of population size changes during the biostimulation activities
    - Consumption and production of electron donors added to the caissons
    - Changes in congener distributions of PCBs, PCDDs/PCDFs over time and methodology for constructing a mass balance of these compounds in the caissons
    - Changes in concentrations or forms of other chemicals-of-concern including PAHs and Hg
    - Testing of optimal amendment injection techniques into the caissons
    - Water quality changes in the overlying water of the caissons

The IBPWP will be submitted to EPA in draft format for review and revision or modification. Following satisfactory incorporation of EPA revision(s) or modification(s), the Final IBPWP, with the schedules for performance of related activities and submission of deliverables, shall be

incorporated into this SOW by reference and shall be implemented in accordance with the approved schedule. The IBPWP will also include the following elements:

A. Sampling and Analysis Plan (SAP)

Respondent shall submit to EPA a SAP for review and approval in accordance with the document submittal schedule set forth in Section IV of this SOW. The purpose of the SAP is to provide the specifics of the sampling program during the pilot study and to obtain the necessary information needed to fill the data gaps summarized in the IBPWP.

The SAP shall describe the sampling objectives, the rationale for the sampling approach (based in part on the data gaps identified during the summary of existing data) and plans for data use, and shall provide a detailed description of sampling tasks, consistent with EPA standard methods, ASTM International (originally known as the American Society for Testing and Materials or ASTM) methods, or other protocols used previously in activities associated with the LPRSA, as applicable. The SAP shall describe specifications for sample identifiers; operation of major sampling equipment (e.g. vibracores); the type, number, and location of samples to be collected; the analyses to be performed; descriptions of sampling gear and methods to be used; documentation of samples; sample containers, collection and handling; and the sampling schedule.

The SAP shall describe the data quality objectives (DQOs), and identify and describe measures that will be taken during performance of all sampling and analysis tasks to ensure fulfillment of the DQOs. DQOs will reflect criteria or threshold values used for potential future remedial decisions.

B. Quality Assurance Project Plan

Respondent shall submit to EPA a QAPP for pilot study sampling and analysis activities for review and approval by EPA in accordance with the document submittal schedule set forth in Section IV of this SOW. DQOs will reflect the criteria or threshold values used for potential future remedial decisions. The QAPP shall be prepared in accordance with EPA Requirements for Quality Assurance Project Plans (QA/R-5), March 2001 (Reissued May 2006), EPA/240/B-01/003; and EPA Guidance for Preparation of Quality Assurance Project Plans, EPA/240/R-

02/009, December 2002, QA/G-5 and in accordance with the requirements of the EPA Contract Laboratory Program (CLP – OLC03.2 or OLM04.3 or more recent statement of work for organic analysis) and shall contain the following elements:

- Title and Approval Sheet
- Table of Contents
- Distribution List
- Project/Task Organization
- Problem Definition/Background
- Project/Task Description
- Quality Objectives and Criteria for Measurement Data
- Special Training Needs/Certification
- Documents and Records
- Experimental Design
- Sampling Methods
- Sample Handling and Custody
- Analytical methods (including parameters, preparation and analysis methods, reporting limits, and volume of sample required for each matrix)
- Quality Control (including number/type of quality control samples, spikes and replicates required)
- Instrument/Equipment Testing, Inspection, and Maintenance
- Instrument/Equipment Calibration and Frequency
- Inspection/Acceptance of Supplies and Consumables
- Non-direct Measurements
- Data Management
- Assessments and Response Actions
- Reports to Management
- Data Review, Verification, and Validation
- Verification and Validation Methods
- Reconciliation with User Requirements

Where some of the QAPP information overlaps with the information required in the SAP, references to the appropriate section(s) of the SAP may be made in the QAPP.

C. Health and Safety Plan

Respondent shall submit to EPA a HASP for investigation sampling and analysis activities in accordance with the document submittal schedule set forth in Section IV of this SOW. The HASP must be consistent with the requirements of CERCLA and Occupational Safety and Health Administration (OSHA). The HASP shall identify specific monitoring and management responsibilities and activities to ensure the protection of human health and to promote safety

for the activities associated with investigation sampling. The HASP shall be modified as necessary for changes or revisions to the SAP and QAPP.

Task 2. Submission of Interim and Final Reports

In accordance with the document submittal schedule set forth in Section IV of this SOW, prior to preparation of the final IBPWP report, the Respondent shall submit to EPA data summary reports including all data from investigations conducted during this task. The schedule for submittal of the Investigation Data Summary Report is dependent upon whether additional sampling is needed. The data shall also be submitted in electronic format such as Excel or similar spreadsheet software consistent with EPA Region II's requirement to use the MEDD format. All data submitted to EPA must be of known and documented quality. Respondent will be responsible for ensuring and monitoring the quality of the data obtained from its contract laboratories.

EPA reserves the right to reject or qualify any data not generated/collected in accordance with the Settlement Agreement.

The IBPWP final report shall consist of the following sections, consistent with the suggested format described in Table 3-13 of USEPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA," October 1988, EPA/540/G-89/004:

- Introduction, including Purpose and Site Background
- Study Area Investigation including a presentation of historical data, data collected by the Regulatory Agencies, as well as data collected pursuant to the Settlement Agreement and this SOW
- Study Area Physical Characteristics
- Nature and Extent of Contamination in water column and sediment
- Redox conditions present in the lower Passaic under control and treatment conditions
- Success/challenges in amendment delivery
- Degradation rate(s) computed from changes in parent compounds and appearance of daughter compounds

- Data validation and interpretation
- Summary and Conclusions
- Appendices, including technical memoranda on field activities, analytical data and quality assurance and quality control (QA/QC) evaluation results.

Task 3. Community Involvement

USEPA will conduct community involvement in accordance with the Lower Passaic River Restoration Project and Newark Bay Study Final Community Involvement Plan (June 2006). Although implementation of the Community Involvement Plan (CIP) is the responsibility of USEPA, Maxus shall assist by providing information for dissemination to the public and participating in public meetings. The extent of Maxus' involvement in community involvement activities is left to the discretion of USEPA. All Respondent-conducted community involvement activities pursuant to the CIP will be subject to oversight by USEPA.

IV. Submittal and Performance Schedule

Activity	Timing
Submission of IBPWP (including SAP, QAP and HASP)	45 days after approval of SOW
Mobilization to field	30 days after approval of IBPWP and acquisition of all appropriate permits
Study duration	9-12 months minimum expected duration
Submittal of final report to EPA	60 days after completion of study