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Assessing Contractor Capabilities for Streamlined Site Investigations

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1.0 INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

Innovative technologies are making a significant impact on the cost, schedule, and effectiveness of environmental clean-up projects. The impact of these technologies has been demonstrated on CERCLA and RCRA investigations and should be incorporated in brownfields projects as well. The purpose of this document is to familiarize and encourage brownfields decision makers to investigate and employ innovative methods for characterizing their sites, to assist brownfields decision makers in assessing contractors' capabilities and familiarity with these methods, and to suggest additional items for contractors to consider in conducting their activities.

1.2 BACKGROUND

In the past, the approach for characterizing a contaminated site typically relied on a standard process and a few techniques to gather data. The process generally included: (1) reviewing past records for information about likely contaminants disposed at the site, (2) drilling one well upgradient from the suspected contaminated location to gain information on the background chemical levels at a site, and then three wells downgradient to determine the location and quantitative levels of the contamination, (3) sending the samples to an off-site Contract Laboratory Program (CLP) laboratory with an expected turnaround of one to three months for data results, and (4) perhaps some geophysical surveying to try to locate geological formations that would influence the contaminant distribution, such as aquifers or aquitards or fractures located below the site. Reliance on this lineal approach often resulted in multiple sampling events and mobilizations to gather sufficient data for complete characterizations of a site and design of clean-up options. Years of experience using this characterization approach showed the inefficiency and ineffectiveness of this process.

Typically, too little data is taken to confirm the lateral and vertical extent of site contamination. Since wells are typically screened over a depth of thirty feet, the information on the exact depth of the contamination is lost. Experience has taught us that contaminated groundwater typically migrates along very discrete pathways. These pathways are typically narrow "fingers" of contaminant flowing along a very discrete depth horizon. Thus, trying to find a migrating plume by drilling three wells typically has proven unsuccessful. All too often the wells are not placed in the plume area or the screens are located at the wrong depths. Both scenarios can miss detection of the plume altogether. Because too many wells simply have “none detect” results, this “hit or miss” approach is too costly.

1.3 EXAMPLES OF INNOVATIVE INVESTIGATION TECHNOLOGIES

To overcome these inefficiencies, many new innovative techniques and approaches have been developed over the last five to ten years which are now emerging on the market. These technologies are designed to capture greater detail of information, and frequently, with immediate data output. For example, chemical screening tools are typically handheld devices that take a reading and display the results immediately. Direct push drilling techniques can be rigged with screening detection devices on the tip of the rod which collect continuous depth profiles of geological and chemical information as the probe is penetrating the subsurface. Or these drilling techniques can collect soil, soil vapor, or water samples at any discrete depth. Either way, the process is fast (one borehole in minutes to hours depending on the geology) and does not leave a permanent well in place to monitor. Mobile labs give the flexibility of providing SW-846 (and other) method analyses on site with 24-hour, or less, turnaround for results. These are just a few examples of new techniques and technologies that are used in characterization activities today.

1.4 INNOVATIVE STRATEGIES INCORPORATING NEW TECHNOLOGIES

New innovative characterization strategies include flexible or dynamic field plans. A field plan is designed to sample in locations to verify where the suspected contamination is located. But, if the original suspected contaminant locations are incorrect, a new sampling plan can be designed immediately on site which takes advantage of (1) all the equipment on site avoiding a second (or multiple) remobilization and (2) this new information which guides additional sampling to pinpoint the contaminated areas. Using multiple types of techniques during one field mobilization allows multi-disciplined teams to interact and interpret the data. When all the equipment is on site, cost effective strategies can be employed, such as collecting data from multiple co-located sites. By determining the ultimate goals for the site up front, data can be (and should be) collected to support all characterization needs throughout the process, including data needed to design clean-up and re-use options.

All of these strategies emphasize more comprehensive up-front planning designed to collect only the data that will lead to the decisions that need to be made at the site, but simultaneously gathering *all* the data required to make a decision. The process to achieve data quality objectives (DQO) (see EPA guidance EPA QA/G-4, 1994 and EPA QA/G-4HW, 1999) outlines a constructive planning process that results in a focused characterization plan with clear decision rules outlined that define how decisions are being made during the characterization phase. Further, today's computer graphics allow data to be directly input into a 3-D visualization program to view the contaminant plume distribution and thus enhance the communication between all decision-making parties involved on the site.

Some sites require more innovative methods over others. For example, properties expected to be relatively uncontaminated and near water bodies such as rivers, lakes, and coastal plains often have straightforward geology and hydrogeology and therefore lend themselves to straightforward sampling collection and analysis to confirm their environmental status. Other sites have complex geology and hydrogeology, such as in fractured rock regions, which require extensive data to identify the contaminant and its vertical and lateral extent. The selection of innovative technologies should be evaluated against the particular site and situation.

1.5 PROVEN RESULTS

No matter what the case, innovative strategies employing innovative analytical and sampling technologies have resulted in more effective and accurate descriptions of the contaminant distribution. Those technological advances primarily provide the ability to collect greater data density in the subsurface and the flexibility to change a sampling program in the field if the data warrants such a decision. This, in turn, results in a better understanding of where the contaminant resides and a higher success rate for the remediation designs. Thus, today's characterization plans would benefit by incorporating these technical advances.

2.0 EVALUATING CONTRACTOR CAPABILITIES AND ENHANCING CONTRACTOR SUPPORT

The purpose of this section is to provide information to assist brownfields decision makers in evaluating the capabilities of contractors who are being considered to perform work in support of site investigations, and to identify potential activities for contractors to perform to enhance the site investigation process through innovative approaches. The information is presented as a series of questions that decision makers can use in interviewing contractors and evaluating contractor qualifications. The questions are presented under ten topics. Each topic represents a separate aspect of the process for conducting site investigations; all topics may not apply at each site. In addition to the questions, each topic area also presents information to explain the relevance of the questions (and potential answers) to assist the decision maker in encouraging the use of innovative technologies for performing site investigations.

2.1 USE OF CREATIVE STRATEGIES

Questions:

- How would you streamline the site investigation process?
- What are some possible strategies you would use?
- What approaches or strategies could be used to accelerate the schedule without sacrificing quality?
- Give examples of methods or approaches you have used before.
- How would you minimize field mobilizations and still ensure you are collecting adequate data to define contamination and to support clean-up and redevelopment goals?
- What types of "economies of scale" strategies could you use at this site?
- Under what circumstances would you consider using a mobile lab for this site?
- What types of statistical methods or modeling programs do you use for your sampling location selection or for your final site conceptual model?
- What data would be collected or processes used to gain more information about the site without taking additional chemical samples?
- What techniques would you use to gain broad area information?
- What non-invasive techniques could be used other than geophysical methods to gain more information about the site?
- What expertise will you provide through your project team?
- How will the individual experts on the team be involved in the decision process?

Relevance:

As data is collected daily, it can immediately be incorporated into a model that is used to conceptualize the site. Thus, real time data integration occurs while the team is in the field. This expedites data interpretation and formation of conclusions. The core team is now armed with the information needed to decide whether further sampling is needed while the equipment is still in the field.

Multiple field programs could occur simultaneously, particularly if the sites are located near each other. This maximizes the use of the field equipment, and it allows efficient use of the field personnel, reducing the number of times they return to the site. You also get “economies of scale” when all volatile organic compounds (VOCs), for example, from all sites can be measured during the same field mobilization.

Portions of the field report can be written as the data is collected daily and integrated into the model. This shortens the report writing phase at the end of the project.

Mobile labs can be more expensive than sending the samples off site in some instances. But if you are taking many samples in a day (especially from multiple sites) and want the efficiency of 24-hour turnaround on results, the time saved is an advantage that offsets the cost differential. SW-846 methods can be used in the mobile lab if that remains a requirement for the project. Multiple types of equipment can be running multiple analyses, e.g., gas chromatograph (GC) or GC/mass spectroscopy (MS) for volatile compounds and x-ray fluorescence for metal analyses. Most importantly, if contamination is discovered at a site or found to be more extensive than expected (frequently the case), a mobile lab allows flexibility in the field program to analyze additional samples to identify the extent of the problem. An additional mobilization of equipment is not needed.

Many new innovative geophysical techniques are available today to map large areas of subsurface conditions. Additionally, remote sensing techniques are becoming more available to use in gaining extensive information about the site, either for past or present activities. These services are typically offered from experts in select companies.

2.2 QUALIFICATIONS TO USE INNOVATIVE FIELD METHODS

Questions:

- Describe your experience with the use of field analytical methods, test kits, or field screening methods? What contaminants were they used for?
- How often do you use innovative methods in your field programs?
- Do you use a multi-disciplined team? For example, a team consisting of geologists or geophysicists, hydrogeologists, chemists, graphics specialists, etc.
- Does the team collecting samples also interpret the information?
- Describe how your core team analyzes and redirects the sampling plan on a daily basis.
- Has your core team designed field programs to gather data for short turnaround times (i.e., 24 hours), assimilated that data collection, and then adjusted the next day's sampling based on the new information?
- How do you ensure that the quality of the analytical data is sufficient to meet the decision needs of the site?

Relevance:

Companies familiar and experienced with field methods are aware of the latest technologies available. Experienced teams will have personnel qualified in the use of these field methods or at least know where they can obtain the service. The design of analytical quality control protocols will be done by a qualified analytical chemist who can ensure that all analytical methods used will produce data commensurate with site decision making needs.

All too often, the team collecting the samples is not integrated with the core site team (consultants) directing the program. The result can be less communication between the field team and the decision makers. This can be less efficient when data is collected on site in real time with screening methods or fast analytical methods. In-field analysis gains efficiency in the program only if a trained scientist or engineer is interpreting the data on site as the data comes in.

2.3 SELECTION OF LOCATION OF SAMPLING POINTS

Questions:

- Other than upgradient or downgradient considerations, what data or other considerations would primarily influence your decision for borehole or sampling locations?

- Which statistical methods or modeling programs would you use to assist in the selection of sampling locations?
- What geophysical methods would you use to gain a better understanding of the geology at the site?
- What geophysical methods would you use to determine where subsurface utilities or below surface structures exist?
- What geological features will influence your sampling locations?
- What additional geological information will you seek? Why is it important?

Relevance:

The geology of a site will control where the contaminant migrates. Once the geology is defined at a particular site, predicting where the contaminants might migrate becomes more reliable. Thus, predicting sampling locations where contaminants exist turns into a higher detection rate.

Also, trained geochemists or chemists on a team can predict the mobility of the contaminants. For example, if metals were released on the site, mobility of the metals is dependent on the speciation of the metal, which in turn is dependent on the reduction oxidation (redox) conditions at a site. For example, metals such as chromium (commonly used in industry) are only mobile in the CrVI state. Thus, a chemist can predict if Cr will migrate to the groundwater and thus predict where to sample for it. On the other hand, if the contaminant is a solvent, it will very likely migrate with the groundwater and breakdown to other chemical species. Those are clues that will allow for better prediction of appropriate sampling locations.

2.4 HYDROGEOLOGIC CONDITIONS

Questions:

- How would you determine the detailed groundwater flow patterns on the site?
- How would this influence your decision on the sampling site locations?
- Describe your capability to obtain information about groundwater flow patterns other than using published potentiometric surfaces?

Relevance:

Usually, environmental teams acquire hydrological information by getting regional groundwater flow maps or by using the potentiometric plots derived from groundwater levels taken from existing wells. Today new groundwater flow meters have been designed to attach onto drilling equipment such as cone penetrometry technology (CPT) probes that can place flowmeters at any particular saturated depth. Another option is to use the pore pressure information from the CPT or geoprobe technologies to provide detailed information on the flow patterns at a particular site.

2.5 BOREHOLES AND DRILLING METHODS

Questions:

- What methods will you use to obtain soil depth profiles?
- What considerations would play into your decision about the use of standard drilling methods versus direct push methods such as geoprobes or CPT?
- Do you have sensors for the tips of the direct push technologies to determine at what depths the contaminant exists?
- Will direct push methods work in the geology at the site?
- What methods will you use to collect the soil samples analyzed?
- Will you get *continuous* subsurface soil depth profiles?
- How will this information influence what soil samples are taken?
- What decisions will influence the total number of soil samples taken?

Relevance:

In the past, drilling usually involved taking core samples as the drill advanced, screening the well over a thirty-foot interval either in the groundwater or the vadose zone, and then completing the installation of the well. That well had to be maintained and sampled in the future, adding costs to the site remediation program. Today, depending on the nature of the site geology, soil depth profiles may be obtained quickly (within minutes to hours) with direct push techniques, providing geological information continuously as the probe penetrates the subsurface. The probe can be withdrawn while exuding grouting material so that the borehole is sealed and no well remains to be maintained. This capability allows characterization teams to quickly gather complete soil depth and groundwater information continuously while drilling. A complete record can be captured at one location very quickly.

2.6 SOIL SAMPLES

Questions:

- What field analytical methods would you use for this site?
- What field methods would you use for determining volatiles such as benzene or trichloroethylene (TCE)?
- What field methods would you use for determining particular semi-volatiles?
- What field methods would you use for analyzing metals?
- How would you obtain these measurements?
- How many samples could you measure in a day?
- How quick is the turnaround from sample collection to analyte reading or measurement?
- How would you confirm the accuracy of the measurements?
- What happens to the data as it is collected daily? Is it stored for future interpretation or incorporated into the conceptual site model?
- What would be the strategy or justification for the mix of field analytical methods versus laboratory analyses you might choose?
- Would you use test kits on this job? Which ones would you select?

Relevance:

There are many test kits and handheld-instruments available today for soil field analyses. Using these techniques to gather quickly contaminant information that guides more expensive laboratory analyses is becoming common practice. Generally, regulators or site managers will stipulate the percent of duplicate analyses that must be run with standardized methods to ensure the quality of the field analyses methods, but dependence on a rote percentage should not be relied upon. A proper quality control protocol is constructed to support those specific aspects of data quality which are important to a defensible site decision. A quality control protocol must provide confidence that matrix interferences, equipment function, and other issues will not cause data to be ambiguous or misleading. Many field methods have been verified for their accuracy, precision, reliability, etc.

through formalized verification programs, but site-specific performance should always be assessed. Offering a mix of field methods with standardized analyses methods speeds up a field program and increases quality and informativeness of the data available to make conclusions about the site's condition.

2.7 WATER SAMPLES

Questions:

- How would you select what water samples to take?
- What analysis methods would you use?
- How would you select which instrumentation or test kits you use?
- What field analytical methods would you use for this site?
- What would be your strategy or justification for the mix of field analytical methods versus laboratory analysis you choose?

Relevance:

There are test kits and handheld-instruments available today for water field analyses. Using these techniques to gather quickly contaminant information that guide more expensive laboratory analyses is becoming common practice. Generally, regulators or site managers will stipulate the percent of duplicate analyses that must be run with standardized methods to ensure the quality of the field analyses methods. As discussed above for soil samples, a rote percentage of duplicative analyses should not be relied upon. Many field methods have been verified for their accuracy, precision, reliability, etc. through formalized verification programs, but site-specific performance should always be assessed. Offering a mix of field methods with standardized analyses methods speeds up a field program and increases quality and informativeness of the data available to make conclusions about the site's condition.

2.8 DATA ANALYSIS

Questions:

- Do you use any 3-D visualization or modeling software? What methods do you use to display or convey the final environmental conditions of the site?

- What primary methods do you use to interpret the data?

Relevance:

Field programs that incorporate the data into data visualization software programs add better understanding of the distribution of the contaminants at the site. Visualization programs present the data in such a fashion that more individuals can become involved in the decision making. Or, at the very minimum, a broader audience can understand what the data means. The scientific data is converted into a "picture" of the distribution of the contaminants. Decision support software also can aid greatly in making decisions regarding where additional sampling is warranted.

2.9 CONSIDERATIONS FOR NATURAL ATTENUATION

Questions:

- When is 'natural attenuation' an appropriate remediation technique?

- What parameters need to be tested to justify selection of a natural attenuation remediation program?

- Are there appropriate remediation options other than "excavation and removal" or "pump and treat" remediation processes?

Relevance:

There are many innovative in-situ remediation methods used today, but they frequently require specific information about the site to justify the selection. That information is collected more cost effectively during the characterization phase when the samples are being collected. For example, if the contaminant is TCE, are dissolved non-aqueous phase liquids (DNAPL) on the site? What information is required about the bacteria levels, the soil matrix, the water levels, etc. in order to determine if natural attenuation is occurring at the site? If the contaminant includes metals, what redox information is needed in order to consider use of *in situ* chemical treatment methods or "no action" options due to immobility of the metals on the site. Also, for possible consideration, should contaminant barriers or reactive barriers be used as a remediation option if the contaminant is flowing offsite (or onto the site)?

3.0 DATABASE RESOURCES

There are many databases listing new technologies, how they are used, if they have been demonstrated and proven effective and reliable, where they are most effective, what their performance specifications are, etc. The following list presents site characterization technology databases.

- EPA REACH IT at *http://www.epareachit.org*
- FRTR Field Sampling and Analysis Technologies Matrix and Reference Guide at *http://www.frtr.gov/site/*
- Department of Energy (DOE) Preferred Alternatives Matrix at *http://www.em.doe.gov/define*
- DOE Vendor Database for Environmental Applications at *http://www.cmst.org/vendor/*

4.0 CONCLUSIONS

As brownfields projects move forward, there will be numerous opportunities to use innovative technologies for characterizing sites. Innovative technologies can provide distinct advantages in expediting clean-up decisions. This time savings can contribute greatly to the success of a redevelopment project.

In selecting contractors to perform site characterization activities, decision makers must be assured that the contractor selected has the capabilities to (1) select the best innovative technologies for the site under review, (2) conduct appropriate sampling and analysis activities to characterized the site accurately, and (3) respond quickly to new information that is obtained as the characterization process is underway, thus, offering a mix of field methods with standardized analyses methods speeds up a field program and increases the data available to make conclusions about the site’s condition.

Decision makers can use the information in this guide as a tool for screening contractors to select the best qualified candidates. The information can then be used to work with the selected contractor to "fine tune" the approach that will be used for the site under review.

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