U.S. Environmental Protection Agency
Science Advisory Board
SAB Workgroup on Katrina Soil and Sediment Sampling Plan
Collected Individual Comments on U.S. EPA Region 4 "Quality Assurance Project Plan, Katrina Response, Environmental Soil and Sediment Sampling, Gulf Coast of Mississippi, September, 2005"

As of October 4, 2005 (12:00 p.m.)

NOTE: The Workgroup will have a public conference call meeting
Wednesday, October 5 from 11:30 – 2:30 Eastern Time
For Further Information, visit www.epa.gov/sab

Ivan J. Fernandez

Review Comments on: Quality Assurance Project Plan, Katrina Response Environmental Soil and Sediment Sampling, Gulf Coast of Mississippi

By: Ivan J. Fernandez, University of Maine, SAB EPEC

Date: October 2, 2005

I find this QAPP to be sufficiently precise so as to document the intent of the project, and the manner in which the project will be carried out on the ground. I am not directly familiar with many of the other documents referenced in this QAPP containing details of analytical protocols and procedures, and therefore assume completeness in that regard.

I have made only a couple of broad comments below regarding my review of the document. Then I have pasted the text of the QAPP below that and have made additional comments in Word edit mode for your consideration.

General Comments

(1) The first Charge question has to do with the clarify of project objectives. By the time one has reviewed the document, it is clear what is intended. However, it is not until 2.1.1 on page 9 that we read a clear statement of purpose that I recommend be italicized at a minimum: *It must be strongly emphasized that this investigation is not intended to provide a comprehensive assessment of potential releases beyond the operational perimeters of these facilities. Rather, it is intended to provide a first look at these areas post-Katrina.*

I would almost prefer to see this moved up in the document and expanded to discuss further what this study is not. This is not a comprehensive assessment of concentrations in the areas noted since a statistically based sampling design is not used

nor is baseline data established to determine sample population needs. This is not a loading study to determine the amount of new sediment, or changes in total soil burdens (or sediment, but the concept is less relevant there). In this context this is not a criticism, but simply that this is a rapid and qualitative assessment of soil and sediment concentrations in potentially impacted areas, limited in scope by time and the critical nature of the circumstance.

(2) Soil and sediment sampling is operationally defined in a manner consistent with a modal soil concept. That is, a standard A horizon with no change due to the flooding. Sediments are more vaguely described as a grab sample up to 6 in.

For sediments, is there more than can be said for the sampling criteria as to depth? It would seem to standardize the results to say a depth of some standard amount, say 3 in, unless conditions warranted a different increment and talk about what might be encountered. If there is a gravelly bed over fine sediments, or the opposite for some flooding phenomenon, is all just sampled the same? Is there any insight on particle size for these samples to go along with the interpretation of the chemistry data?

For soils, the idea here is to get a quick look at surface material concentrations. However, if there are major differences in the morphology of the native soils among sites, then this could be confounded by what is being sampled. If flooding eroded surface Ap horizons in some areas and not in others, or flooding deposited an overburden in some areas than not in others, then a 0-3" depth from the physical surface could be sampling many different materials, and composite samples would complicate the issue further. I have no idea about the nature of the soils in the wetland at Gulfport, but if soil sampling is going to take place, are there surface O horizon layers involved? For these reasons I recommend some additional language regarding the sampling procedure to be followed, and that a digital photo record of the sampled sites be included. I also recommend that evidence of sediment overburden or erosion be noted as to depth. For the purpose of this initial survey of these sites, a surface 0-3" likely remains the best course of action without the time for reconnaissance evaluations. However, the document should discuss the issues and emphasize the operationally defined nature of the sampling planned. And despite the likeklihood of all of the soil sites being disturbed lands, some language should address the use, or the lack of applicability, for NRCS soil survey information for these sites. If these survey identify major soil types in areas that have not been drastically altered by past human activity, then these could be used to guide some of the soil sampling.

DFO Note: Dr. Fernandez provided the following comments as inserts to the text in the document.

Section 1.0

"Phosphates complex will also be analyzed using gamma spectroscopy in addition to the parameters listed above."

Comment: As written, this seems to mix the instrument for analysis (gamma spectroscopy) with parameters measured by referring the parameters above. I think this should say what is being measured along with the instrument if desired.

Section 1.2

Risk Management Plan (RMP) Facilities. "There was a minor cholorine leads on piping…"

Comment: It might be technical language I am not familiar with, but is this talking about "leaks"?

"FeCL"

Comment: If this is chloride, it's a lower case "l".

Section 2.1.1

"It must be strongly emphasized that this investigation is not intended to provide a comprehensive assessment of potential releases beyond the operational perimeters of these facilities. Rather, it is intended to provide a first look at these areas post-Katrina."

Comment: Might want to italicize as this is critical information for the context of this study.

Section 2.1.2

"The ??? will help define the objectives of the field investigation."

Comment: something missing?

Section 2.1.3

"The primary inputs needed to support the decision are surface soil and sediment samples."

Comment: Wouldn't the primary inputs be results from the analysis of surface soil and sediment samples, not just the physical samples?

"Samples from the Chevron Refinery – Pascagoula, First Chemical, and MS Phosphates complex will also be analyzed using gamma spectroscopy in addition to the parameters listed above."

Comment: state for what?

Comment: state for what?

Section 2.1.4 – Temporal Boundaries

“All efforts will be made to obtain quick turnaround on the analytical results to expedite decision making.”

Comment: Shouldn’t ”decision-making” be hyphenated throughout?

Section 2.1.7

“Samples will be collected on an authoritative basis, from areas deemed most likely to be impacted.”

Comment: Meaning?

“Two grab samples will be collected from ditches draining the facility to St. Louis Bay.”

Comment: To be analyzed separately or composited?

Section 3.3

“The surface soil samples will, where appropriate, be collected as 5-point composites (“X” pattern, with aliquots in center and on corners) using stainless steel hand augers.”

Comment: Other protocols referred to likely include this information, but it might be good to indicate here that operators are wearing a specific type of glove, and whether they use new gloves for each sample.

“All grass, roots and other vegetative material, as well as small rocks or stones, will be removed from the sample matrix during sample mixing, prior to containerization.”

Comment: Is there any guidance for operators on where they sample, or rather when they deviate from 100 ft? Persumably a major obstruction like a wall would be good reason. But what about a messy sample due to roots or rocks or signs of disturbance? This speaks to how rigidly systemic vs modal the samples end up being.

“Sediment samples will be collected at the selected locations using stainless steel scoops, stainless steel spoons and/or stainless steel hand augers. The depth to be sampled should not exceed 6” but may be less.”

Comment: Based on what criteria? I might be better to state an initial target interval for the sediment but then the guidance for modifications thereof.

Section 3.4

“Samples from the Chevron Refinery – Pascagoula, First Chemical, and MS Phosphates complex will also be analyzed for Radium 226 and radionuclides using gamma spectroscopy …”

Comment: Finally! This information should be included above as well.

Section 3.6

"A duplicate sample is a co-located sample, usually collected less than six inches from the primary sample at a location and is collected to show variability of the matrix sampled."

Comment: Are there any other standards or QA samples involved in the project? I am thinking if there is a field standard used, such that it is a known sample matrix that is put in the same bags, carried to the field in coolers and simply "takes the ride" to determine if there are changes in concentrations that might occur from the handling process?

Section 3.7

"The locations of all samples will be logged using a GPS capable of one meter accuracy, as specified in **Section 2.1.7**. If a sample location is in an area where a GPS signal cannot be received, sampling stations will be located using a tape and compass from a known point."

Comment: I would recommend a digital photo of each sampling location is collected that could aid in later interpretations, or the use of the data from this study for future monitoring of changes over time.

Section 3.9

"It should be noted that time constraints do not allow for the normal QA/QC checks for the pre-cleaned sample containers as specified in the EISOPQAM."

Comment: Without knowing this document and its protocols, this could be addressed by putting lab standards into a clean bottle and taking to the field for handling as a 'field blank'?

Section 4.2

"Analyses for metals, VOCs, semivolatiles, pesticides and PCBs will be performed by CLP laboratories."

Comment: Is there anywhere in this document where the list of metals is actually spelled out? That could be useful, depending on the users of this document.

Section 5.2.2

"Following collection of the initial sample that is to be duplicated, the sample will be re-collected with clean equipment."

Comment: Since soil samples, I believe, will be composited, it is not clear to me at what level the duplication is taking place. This is presumably a duplicate of a single specific sample (not a composite of 5), and therefore the duplicate is located nearby. However, the data from the primary sample will only be from a composited sample. This may be my confusion, or just the use of standard language that needs some modification or clarification for the specific design employed here. Same issue for Splits in 5.2.3.

Michael McFarland

Quality Assurance Project Plan Katrina Response Environmental Soil and Sediment Sampling Gulf coast of Mississippi – McFarland Comments

In general, the quality assurance project plan (QAPP) provides a clear and concise description of the data collection activities designed to document the potential hazardous material and constituent releases from Risk Management Plan, Tier 2 and Toxic Release Inventory (TRI) facilities in the Hancock, Harrison and Jackson Counties of Mississippi. Based on facility history and operation, the soil and sediment sampling program will focus on a specific suite of hazardous chemicals. Results from the soil and sediment sampling activities should provide a valuable "snapshot" of the extent of contamination associated with chemical releases from the various facilities. The quality control measures appear sound and should result in ensuring the integrity of laboratory results.

Response to the SAB Charge:

Project Objectives – are they clearly stated?

The answer to this question is clearly no. There are obvious inconsistencies between some of the statements found within the data quality objectives (DQO) process description as well as statements found in other parts of the document. For example, under Section 2.1.2 (DQO), it states that the decision is to "determine what areas of the Mississippi Gulf Coast, in immediate proximity of the hazardous waste facilities, may be the site of potential releases of hazardous materials to surrounding soils and/or sediments". The data collection efforts will clearly support the resolution of this decision. However, in Section 2.1.5 (DQO), it is stated that the data will be utilized by the Technical Services Section to "make a preliminary assessment … of whether exposure to contaminated soil and sediment may pose an actionable human health risk". The data collection activity, as presently designed, will not support this decision. Similarly, in Section 4.0 (SAMPLING DESIGN AND RATIONALE), the QAPP states that "the collection of these samples will help determine if an acceptable risk to human health exist in the affected areas". The collected data will not support a decision of whether there is acceptable risk to human health because the data collection program was not designed to specifically address that issue.

In summary, the project objectives need to be more explicit. In the current document, the reader is left to infer what the QAPP project objectives are meant to be. In some cases, it appears that the objective is simply to provide an estimate of the extent of contamination present at certain physical locations (e.g., snapshot) while, in others, the objective seems to be to determine if, as a result of chemical releases, soils and/or sediments pose an unacceptable risk to public health.

Sampling design – will it provide the data needed to meet the stated objectives?

The data collection activity will establish a "snapshot" of the extent of contamination associated with potential releases of hazardous materials and constituents from specific Risk Management Plan, Tier 2 and Toxic Release Inventory (TRI) facilities. This objective, which is described in Section 2.1.2 (Identify the decision) of the QAPP, is supported by the described field sampling activities. However, the data collection activity will not support a decision of whether or not exposure to contaminated soil and sediment poses an actionable human health risk.

In my opinion, the overarching limitation of the QAPP to address the issue of human health risk stems from failure of the document to fully complete the DQO process. The problem starts in Section 2.1.5. (i.e., Decision Rule). The decision rule is normally structured as an "if - then" statement. For example, the decision rule could state simply that if the field sampling data results in chemical concentrations above some actionable threshold, then the decision-makers will conclude that there is an unacceptable human health risk associated with the soil and/or sediment.

The problems associated with Section 2.1.5 then extend to Section 2.1.6 (i.e., Error Limits). In Section 2.1.6, there appears to be some confusion as to what is meant by decision error and how it can be controlled. The QAPP is correct in that imprecision and systematic bias (what is termed variability in the document) in sample collection and analysis can lead to decision error. The DQO process recognizes this fact and allows the decision-maker to establish the tolerable error limits associated with decisions based on the results from field sampling.

The error limits are basically the level of uncertainty that the decision-maker can tolerate in his/her decisions. In other words, does the decision maker want his/her decisions to be supported with 95% confidence, 99% confidence, 99.9% confidence etc. Once the decision-maker establishes the tolerable error limits (level of uncertainty) necessary to support decisions, that information can be used in conjunction with parameter variability to determine the minimum number of samples that must be collected. For example, if the decision-maker desires to have decisions supported with 99.9% confidence (i.e., the decision-maker wants to limit the probability of maker the wrong decision to no more than 0.001%), the number of field samples that must be collected will be significantly greater than if the decisions only need to be supported with 90% confidence (error limit of 0.10%), everything else being equal.

Since the QAPP does not specify the contaminant action levels, tolerable error limits or an estimate of parameter variability, the sampling design cannot be optimized (Section 2.1.7) in terms of collecting the correct amount of data to support decisions with a known level of confidence. Moreover, it appears that the specified number of soil/sediment samples to be collected in the current sampling program was established arbitrarily or, at least, was not based on a systematic process that explicitly recognized the decision-maker's specified data quality requirements.

Despite the QAPP's failure to account for the decision-maker's data quality requirements, the sampling plan does account for professional judgment in terms of where to collect samples, and, therefore, supports development of a "snap shot" or estimate of the extent of potential contamination. This information can be used, amongst other things, to establish the contaminants of concern as well as the variability in their concentration which, in turn, may be employed to develop a more focused field sampling activity specifically designed to address questions of public health risk.

Minor Recommendations

The following bullets summarize minor recommendations.

- Section 5.4 – The QAPP duly recognizes the importance of completing a follow-up data assessment to determine whether the data generated is of the correct type, quality and amount to be used for its intended purpose. This data assessment process should be systematic and, therefore, it is recommended that the QAPP incorporate the following document by reference - Guidance for Data Quality Assessment: Practical Methods for Data Analysis (QA/G-9): EPA/600/R-96/084.

- It would be of value to insert a list of acronyms in the front of the QAPP.

Douglas Splitstone

Quality Assurance Project Plan,
Katrina Response Environmental Soil and Sediment Sampling,
Gulf Coast of Mississippi
Splitstone Comments

Summary Comments

I found the subject quality assurance project plan (QAPP) to be a detailed description of where samples are to be collected, sample handling and field collection procedures to be employed, and sample assays to be performed. The description of precisely what is to be accomplished by this effort is fuzzy and apparently multifaceted. The sampling design chosen is understandably one of expediency. However, the decisions supported by an "authoritative" or "judgmental" sampling program are quite

limited in scope. This fact is not reflected in the QAPP.

It is obvious that should one or more of the designated analytes be detected at a "high" level, then further investigation will be initiated. There is no mention of what will happen if none of the target analytes are detected, let alone the risks of this outcome being false. The sampling design may permit the assessment of such a risk for some of the varied objectives listed in Table 1 (Rationale) but certainly not all. One such objective is "Evaluate potential for hazadous constituents to have drained from the site via ditch." However, the sampling would not permit such an assessment for "Evaluate potential for hazardous constituents to have moved North with the storm surge."

Clearly Stated Project Objectives

The objectives of the project appear to be stated differently in various sections of the QAPP. The objectives also appear to broaden in scope as one progresses through the document. In addition to the various "rationale" listed in Table 1, the following are some examples:

1.0 INTRODUCTION

"The analytical results will be evaluated to determine if these constituents are present in soils and sediments adjacent to the facilities, indicating a possible release to the environment, which may in turn lead to a more thorough assessment."

2.0 SAMPLING/DATA QUALITY OBJECTIVES

2.1 Data Quality Objectives

2.1.1 Problem Statement

"The problem is identifying these potential releases to surrounding soils and sediments. It must be strongly emphasized that this investigation is not intended to provide a comprehensive assessment of potential releases beyond the operational perimeters of these facilities. Rather, it is intended to provide a first look at these areas post-Katrina."

2.1.2 Identify the Decision

"The decision needed is to determine what areas of the Mississippi Gulf Coast, in immediate proximity to the hazardous waste facilities, may be the site of a potential release of hazardous materials to surrounding soils and\or sediments."

2.1.5 Decision Rule

"The Technical Services Section ...., will review the data and make a preliminary assessment whether soil or sediments may have been adversely impacted and whether

exposure to contaminated soil or sediment may pose an actionable human health risk."

2.1.7 Optimize Sampling Design

"Port Bienville Industrial Park (Polychemie, Inc.), ...

Grab sediment samples will be collected at the three indicated locations **to determine** if a potential release occurred as the storm surge receded. Two composite surface soil samples will be collected at the indicated locations **to determine** if contaminants may have moved further inland from the facility on the rising flood waters."

"Ershigs Fiberglass, ...

Four composite surface soil samples will be collected as shown, **to determine** if contaminants may have been deposited between the facility and nearby housing."

4.0 SAMPLING DESIGN AND RATIONALE

"The collection of these samples will help determine if an unacceptable risk to human health exist in the affected areas."

4.1 Sampling Design

"These sampling stations were selected to provide preliminary information on potential releases to nearby housing and sediments."

Adequacy of the Sampling Design

The sampling design is clearly described in Section 2.0 of the QAPP.

2.0 SAMPLING/DATA QUALITY OBJECTIVES

2.1 Data Quality Objectives

2.1.7 Optimize Sampling Design

"Samples will be collected on an authoritative basis, from areas deemed most likely to be impacted. Specifically, soils will be sampled adjacent to facility perimeters and sediment samples from drainage pathways. If samples cannot be safely collected, the sampling team will note the location and report it to the field project leader. Proposed sampling locations are presented in **Table 1**."

The limitations of the design of choice are not recognized. These limitations are clearly stated in several of the USEPA guidance documents regarding data quality. The

following is from *Guidance for Data Quality Assessment, Practical Methods for Data Analysis, EPA QA/G-9, QA97 Version*. Either the sampling design needs to be revised to meet the stated objectives or the objectives revised to be consonant with what the chosen sampling design can deliver.

1.3 DESIGNS FOR SAMPLING ENVIRONMENTAL MEDIA

Sampling designs provide the basis for how a set of samples may be analyzed. Different sampling designs require different analysis techniques and different assessment procedures. There are two primary types of sampling designs: authoritative (judgment) sampling and probability sampling. This section describes some of the most common sampling designs.

1.3.1 Authoritative Sampling

With authoritative (judgment) sampling, an expert having knowledge of the site (or process) designates where and when samples are to be taken. This type of sampling should only be considered when the objectives of the investigation are not of a statistical nature, for example, when the objective of a study is to identify specific locations of leaks, or when the study is focused solely on the sampling locations themselves. **Generally, conclusions drawn from authoritative samples apply only to the individual samples and aggregation may result in severe bias and lead to highly erroneous conclusions. Judgmental sampling also precludes the use of the sample for any purpose other than the original one**. Thus if the data may be used in further studies (e.g., for an estimate of variability in a later study), a probabilistic design should be used.

When the study objectives involve estimation or decision making, some form of probability sampling is required. As described below, this does not preclude use of the expert's knowledge of the site or process in designing a probability-based sampling plan; however, valid statistical inferences require that the plan incorporate some form of randomization in choosing the sampling locations or sampling times. For example, to determine maximum SO 2 emission from a boiler, the sampling plan would reasonably focus, or put most of the weight on, periods of maximum or near-maximum boiler operation. Similarly, if a residential lot is being evaluated for contamination, then the sampling plan can take into consideration prior knowledge of contaminated areas, by weighting such areas more heavily in the sample selection and data analysis. Probability samples are samples in which every member of the target population (i.e., every potential sampling unit) has a known probability of being included in the sample.

Louis Thibodeaux

COMMENTS SAB Reviewer of EPA Region 4 Hurricane Katrina Soil and Sediment sampling Plan.
Louis J Thibodeaux, LSU Baton Rouge, LA
3 October 2005

The storm surge. A hurricane surge is windstorm generated floodwaters originating from an ocean or lake moving onto the beach and points further inland. In the case of Katrina the high water mark appeared to be 24-30 feet above MSL in Long Beach, MS. It is characterized as a mass of water moving onshore at approximately the "over the bottom" speed of the eye. The water rise rate is of the order of meters in minutes. Wind waves are superimposed onto this rising tide. In combination the incoming water is moving very rapid and is very turbulent containing considerable suspended particles (i.e., TSS) derived from the bed sediment of the nearest upstream water body. Typically these include the near shore marine(MS Sound), the bay (Bay St. Louis), the bayou or river. On the rising flood the flow is usually more erosive than on the falling flood. During the slackwater time -period the flow is very mild and particles settle from the water column. The outflowing water is hindered by the counterflowing wind and the slow recession of the water level in the ocean, bay, etc.

Surge chemodynamics. The problem is identifying potential hazard chemical release to the surrounding soils and sediments (para. 2.1.1, p. 9) from impacted facilities containing these substances. To this end the above description of a general storm surge serves as a backdrop for developing a strategy for locating sampling sites. The following surge related chemodynamic dispersion events occur: 1. the incoming torrent will likely damage equipment, washout material from surface impoundments, erode exposed contaminated surface soils, entrain spilled liquids and solids, etc. 2. and move suspended and floating material inland with a vector heading in the direction of the flow velocity, 3. solubilize a fraction of the mobilized material and translocating a solid-bound fraction plus any free-phase material with density greater than water, 4. deposit relatively clean particles (sands then silts and clays) during the slackwater time-period upon the dislodged and translocated hazardous material, 5. and the out-going flow will move relatively rapid in the ditches and stormwater conveyences and erode much deposited material.

Comments and concerns about the plan.

Are the objectives twofold? Is the plan to collect soil and sediment samples (1) near impacted facilities to determine if

flooding from the storm surge released hazardous constituents and materials, and (2) to determine the dispersion/delivery of this material to residential settings(para. 2.1.1, p. 9).

It appears that the goal of the project is to obtain analytical results and to evaluate the data in order to decide whether releases from any potential sites have occured(para. 2.1.2, p. 9).

With limited resources and time a focus on locating release sites rather than human exposure sites may be more achievable primarily due to the higher concentration levels likely encountered at the release sites.

Having each team approach each site with a generic protocol for sampling is an excellent tactic(para. 2.1.7, p.11).

It appears that many of the located sample sites around some facilities are consistent with the chemodynamics of the surge process. They appear to be located in positions likely to intercept the contaminated sediment "plumes" produced by flood flows moving over expected source areas. Sample sites shown on Figs. 7,8 and 11 appear to be good examples.

The rationale for the 5-point composite for surface soils(para. 3.3, p. 12) is unclear. Corner samples one hundred feet from center outline a very large area. Locating sample spots using a generic protocol traversing projected sediment plume locations that originate from likely within-facility source areas may increase the probability of finding hazardous materials on surface soils.

A surface soil sample obtained upon removing all grass, roots, etc. taken from an interval 0" to 3" interval below ground surface (para. 3.3, p. 12)may be more representative of material layed down prior to Katrina. A protocol obtaining a scraping sample within the top 1 cm. layer of a 1 square meter area of surface soil may be more representative of katrina derived material.

In the case of sediment in layers deposited on soils, ditches, wastewater conveyances, etc., it may be appropriate to locate the fresh deposit sediment/pre-existing "soil" interface and sample the layers 0" to 3" upward. The First Chemical Corp.-Pascagoula primary products are aniline, nitrotoluene and nitrobenzene which are liquids with densities in the range of 1.1 to 1.2 gr/cm3. Being sinkers they likely will migrate to this interface. Also, contaminated solids eroded from the impacted facility arrive first and likely settle from the water column first while later arriving cleaner particles settle on top. They will likely be near this interface as well. The sediment column length sampled should not exceed 6" but may be less as noted in paragraph 3.3, page 12.