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Los Alamos
NATIONAL LABORATORY
memorandum

Environmental Restoration Project
EM/ER, M992

To/MS: Distribution
From/MS: Jorg Jansen, EM/ER, MS M992
Phone/FAX: 7-0808/5-4747
Symbol: EM/ER:95-275
Date: June 9, 1995

SUBJECT: FIELD COLLECTED QUALITY ASSESSMENT SAMPLES

The attached memo represents Chapter 5 of the Environmental Restoration Quality Assurance Project Plan Guidebook (under development) and describes a method for determining the numbers and types of Quality Assessment (QA) samples for a particular potential release site (PRS) or PRS aggregate. The method described is a major break from the traditional "1 Quality Assessment sample for every 20" samples collected. This new method was developed to provide the various field units the ability to obtain better information for laboratory performance and data assessment purposes. Utilizing the method should reduce the collection of unnecessary and unusable QA samples resulting in savings in the areas of sample collection, sample handling, sample analysis, and data assessment.

As a result of the improvement in information and the potential for cost savings, I have decided to implement this method immediately. The attached memo provides the instructions for reviewing your sampling and analysis plans, classifying your PRSs and determining how many QA samples to collect at your sites.

Larry will be scheduling time to assist each of you with implementing this system of quality assessment sample design. Should you have any questions on the implementation of these instructions, please call Larry Souza at 5-0470.

JJ/TF/bp

Attachment: Memorandum EM/ER:95-276

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Los Alamos
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memorandum
Environmental Restoration Project
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To/MS: Jorg Jansen,EM/ER, MS M992
From/MS: Larry Souza, EM/ER, MS M992
Phone/FAX: 5-0470/5-4747
Symbol: EM/ER:95-276
Date: June 9, 1995

SUBJECT: RECOMMENDATIONS FOR PROJECT QUALITY ASSESSMENT DESIGN

SUMMARY

The Los Alamos National Laboratory's (Laboratory's) Environmental Restoration (ER) Project has developed a new approach to determining the type and number of quality assessment samples taken or introduced in the field. This approach is Chapter 5 of the ER Quality Assurance Project Plan (QAPP) guidebook currently under development. This approach focuses on quality assessment samples that are needed to assess the performance of the measurement systems employed by the Laboratory's ER Project over a given field season, and those samples that will provide useful estimates of variability and bias to support the design of subsequent phases of data collection and to support the analysis of decision errors. The new approach departs from the quality assessment sample design approach the Laboratory has historically adopted: 1 in 20, 1 per day or even 1 per site per day of each of several types of quality assessment samples. The new approach incorporates judgment to allocate quality assessment samples where they will provide the largest benefit.

There are two major considerations in the Laboratory's quality assessment design approach: first, that quality assessment samples that are needed to assess the overall performance of the measurements systems employed in a given field season are identified, allocated and collected to support Quality Assurance Oversight activities. Second, that quality assessment samples that have the potential to provide information that will assist in determining data sufficiency for decision making at individual potential release sites (PRSs) are allocated to those sites.

The quality assessment design process occurs in two phases: First, quality assessment samples are allocated to individual sites (PRSs or PRS aggregates) based on a prescribed method. Second, a determination is made as to what additional quality assessment samples, if any, are needed to provide information for quality assurance oversight. In general, the approach allocates more quality assessment samples to sites which are judged likely to fail a screening assessment than to those where no positive detects are considered likely. For quality assurance oversight purposes, a minimum of 5 collocated or split samples and 5 field blanks will be inserted by each

Field Unit (FU) for each major media type and each major analyte class per field season. Field blanks will also be inserted in coolers that contain samples for VOA analyses. Rinsate blanks are generally not recommended because they have added no measurable value to the Laboratory's ER Project.

In most cases, the quality assurance oversight data needs will not require samples beyond those required by current sampling and analysis plans (SAPs). Laboratory QC samples required by the Laboratory's subcontracts with its support laboratories will continue to be used. The results from these samples [which are essentially the same as required by the Environmental Protection Agency (EPA) Contract Laboratory Program (CLP)] will provide information on the validity of individual measurements and will provide the majority of the information needed for laboratory oversight and tracking activities. The use of matrix specific performance evaluation (PE) samples submitted to participating labs on at least a quarterly basis will provide additional quality assurance oversight information.

1. BACKGROUND

A variety of Laboratory ER Project field quality assessment (QA[1]) samples (e.g., collocated samples, splits, blanks, and PE samples) are being introduced into the sample trains at great cost. The information obtained from the current allocation of field QA samples is of questionable value to the decision making process. In the interest of doing more with less, an evaluation was made of the types and numbers of field QA and other samples that should be introduced by the Laboratory during the sample collection and handling operations. Emphasis was placed on (1) identifying QA samples that provide information which is *necessary* to control and assess data quality for decision making, and (2) encouraging a minimum standard for use across the ER Project.

To generate information on the sampling and measurement systems that can be used to support decisions at individual potential release sites, as well as facilitate follow-on data collection designs for sites which are likely to fail the screening assessment, a number of assumptions were made:

- The Laboratory's ER Project approach to QA can be different from the standard approach (e.g., one in twenty or one per batch of a variety of samples),
- The Laboratory is interested in supporting decisions,
- The Laboratory-specific performance evaluation samples will be available soon,

[1] QA is used in this document to refer to quality assessment. not quality assurance

- The Laboratory contract required quality control will usually provide what is needed to perform laboratory quality assurance oversight and batch by batch control information, and

- The Laboratory defaults can be examined and changed if there is a persuasive argument to do so (e.g., cost savings without sacrificing decision-required data quality).

The recommendations contained in this memo are focused on the following decisions:

- Screening Assessment Decision (usually the Phase I investigation decision),

- Determine the volume and location of media to be remediated in a voluntary corrective action or expedited cleanup (VCA/EC), and

- Determine if EC and VCA cleanup goals are attained.

These decisions reflect the majority of work anticipated in the Fiscal Year (FY) 1995 field season. Quality assessment sample design in support of risk-based decisions will be considered at a later date.

A great deal of valuable information on the performance of laboratory analytical methods will be derived from the standard subcontract laboratory QA/Quality Control (QC) requirements. These requirements are essentially the same as those required by EPA's CLP.

The following recommendations outline the process to follow in determining the minimum number of each type of field QA sample to supplement our understanding of the performance of the measurement system. Specifically, QA data, when assessed in context with normal field samples, should support estimates of total measurement system precision and bias, by media and analyte[2]. Decision errors are directly impacted by the total measurement system performance in combination with statistical sampling error. In addition, QA data should be adequate to facilitate tracking of analytical laboratory performance over a field season. Finally, QA designs should be developed at the same time as the sampling

[2] Total measurement system error is the sum of all errors associated with generating an individual result including error introduced through the processes of sample acquisition, handling, transport and storage, preparation and analysis. An estimate of total measurement system variability can be obtained through the use of collocated and/or field split samples. Whenever practical, use of collocated samples are recommended, since in that way the sample acquisition process is repeated. This is typically impractical when dealing with subsurface cores, where samples should be split. Total bias is usually estimated by analyzing matrix specific PE samples and blanks. Additional lab procedures utilizing spiked samples, surrogates and reference materials will also provide some useful estimates of analytical bias.

and analysis plan is developed. Together, normal field samples and field QA samples should be allocated to provide an estimate of spatial contaminant variability. In cases where the QA sample design is developed after the field sampling plan, additional (neighboring) samples may be recommended as part of the field QA plan to reflect the spatial scales of interest (e.g., variability within a risk-based decision unit), when normal field samples do not appear to be adequate to yield this information.

2. FIELD INVESTIGATIONS TO SUPPORT THE SCREENING DECISION

2.1 The Screening Decision

The screening assessment decision rule can be stated as follows: If the concentration of any one constituent at a site exceeds its background concentration and exceeds its screening action level (SAL), or if multiple constituents at a site when considered together exceed a normalized SAL, then study the site further to determine if it poses an unacceptable risk that requires remedial action. If not, then propose the site for no further action (NFA).

The Laboratory's approach for designing data collection in support of the screening assessment decision, as well as the screening assessment decision rule are both structured to control "false negative" decision errors [i.e., incorrectly finding a site to be appropriate for NFA, when in truth at least one chemical of potential concern (COPC) exceeds its SAL]. It should be noted that the primary means of improving the chances of observing problems that exist is through the sample design, not through quality assessment of the measurement system. The probability of detecting contamination is maximized by using biased sampling designs based on observations and site history. A conservative decision rule is used which compares the maximum observed value of each chemical to its SAL and, in addition, requires multiple constituent comparisons. These comparisons add to the conservatism of the decision rule and may lead to action even when no individual constituent is observed greater than its SAL.

Proper selection of methods capable of measuring concentrations at or below SALs, and laboratory QA/QC samples aimed at detecting negative biases (e.g., recoveries of COPCs of less than 70%) should provide adequate assurance against false negatives, given the conservatism already conferred by the decision rule.

Given the built-in conservatism in the screening decision, the primary concern to be assessed with the QA samples are errors in the measurement system that would result in a false positive decision error (finding that a site exceeds the SAL or multiple constituent comparison, when in truth it does not). False positives would result in additional time and money spent on further data collection and/or analysis, and possibly a risk assessment or expedited response action when the resources could be better allocated to problems of greater concern.

2.2 QA Sample Design Considerations for the Screening Decision

The type and number of QA samples to support screening decisions is a function of:

- expected site conditions (site conceptual model),
- questions to be answered using QA samples, and
- the confidence desired in quantifying and managing decision errors.

To accommodate these factors during the screening assessment time frame, a process that incorporates the professional judgment of the Field Project Leader's (FPL's) team is recommended.

2.2.1 Recommended Process for QA Sample Design for Screening Assessments

Note: Designs based on the use of field methods must be considered separately, since all QC sample requirements needed to defend the use of these methods will have to be included in each method. Guidance to support the design of QC for field methods will be dealt with in a separate document. This proposed QA sample design will place the majority of samples in PRSs where detectable levels of constituents of interest are expected, rather than uniformly or haphazardly (as occurs in the traditional 1 in 20 approach), where many of the QA samples are likely to be reported as non-detects during the screening assessment timeframe.

The first step to determine field QA sample allocations is to classify each PRS into one of three categories based on historical data, field screening data and/or site operational knowledge. The categories are: "low," "medium," and "high" probability of requiring further action (i.e., failing the screening decision). Placing a site into a "high" category does not mean that high concentrations are expected; rather, that concentrations above the SAL are expected. Ideally, a range of concentrations from the detection limit to well above the SAL will be observed although in general historical information will not be adequate to ensure this. In general, at sites where very high concentrations are expected, one collocated or split sample should be collected, while at sites that are expected to be closer to the SALs, 3 collocated or split samples should be collected.

Sites where volatile sampling is planned, and/or where on-site measurements will be made (requiring on-site QC) will be noted, since these sites may require additional types and numbers of QA samples. QA samples that will provide information on a PRS by PRS (or aggregate) basis are then allocated to sites in the medium and high probability classes. Later phases (beyond the screening decision) of sampling will focus on areas that failed a screening assessment, hence the categorization of sites will be unnecessary. In all cases, additional types and/or numbers of QA samples based on problem/decision-specific situations may be appropriate.

Table 1, or its equivalent can be used to elicit most of the required information to determine what PRS-specific QA samples are needed. The table should be filled in by specifying a code for the media involved [e.g., soils = s, tuff = t, water = w, and sludge = sl]. After completing Table 1, the minimum types and numbers of QA samples geared toward providing information on an individual PRS scale can be determined by consulting Table 2.

TABLE 1

Worksheet for Classification of PRSs to be Investigated in the Current Fiscal Year According to the Expected Probability of Failing a Screening Assessment for Major Classes of Constituents

	RAD			INORGANICS			VOCs			SVOCs			PCBs/PESTICIDES		
PRSs in FU1	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
1															
2															
3															
4															
...															
PRSs in FU2															
1															
2															
3															
4															
...															

Table 2 presents recommendations for selecting QA samples to be added to PRS field sampling designs to both assist in data quality assessment activities and the design of any additional studies required. The samples recommended by Table 2 are used to gather information concerning variability and bias of the sampling and measurement system. Collocated samples provide data useful for assessing variation associated with sample collection, handling and transport and very small-scale inherent variation of contaminants. In addition to those samples recommended in Table 2, additional field samples (neighboring samples) should be considered, since these samples will yield information on variability on a larger scale. Spatial variability data obtained from such samples will be useful in determining the number of samples required for Phase II SAP designs and for assessing the potential for making an incorrect decision due to contaminant variability. Sampling plans should be reviewed jointly by the QPPL (Larry Souza) and the Decision Support team to determine if they contain enough samples to generate spatial variability information on an appropriate scale. Ideally this review should be conducted prior to submitting plans to the US Department of Energy and

EPA for review; however, as long as the review occurs prior to implementing the field campaign, designs can be adjusted to improve their chances of generating acceptable data.

Investing in the future by adding appropriate QA samples to sites where further study is likely to be required will be key to being able to generate efficient, statistical designs related to EC/VCA and risk decisions, and is therefore strongly encouraged. Without pertinent estimates of variability, subsequent phases of study will be forced to make unnecessarily conservative assumptions or increased reliance on professional judgment will be required in subsequent phases of study. Table 2 addresses only those samples that are to be identified, collected or introduced by field units. Where Table 2 indicates 1-3 samples, the determination of the actual number should be made based on the expected degree of heterogeneity and/or size of the PRS. This judgment should be made in consultation with the statistician assigned to the field unit.

Most of the cells in Table 2 are filled with "NONE," meaning that no samples of that type are recommended on a PRS by PRS basis for the particular category of site. At first this may cause concern that there will not be any samples to detect cross-contamination, or to generate estimates of variability. The reasons for these recommendations are several fold. First, for QA samples to provide information that is adequate to detect problems requiring a corrective action or to support the design of a Phase II study, most PRSs would be required to have more QA samples than field samples. Second, in cases where contamination at levels of interest is unlikely, little value will be added by analyzing QA samples, since the results are likely to be "non-detects." This situation will change for subsequent phases of study, since only sites where contamination at levels of concern will be sampled.

The second phase of the recommended approach (see Section 2.2.2) ensures that a minimum number of QA samples will be introduced across the project to support QA oversight activities. The results from PRS specific QA samples may also be used to assess the performance of the measurement systems in a field season by quality assurance oversight. However, by focusing on the PRS specific needs, there is no assurance that enough of each type of QA sample will be collected during a field campaign. The additional samples added for QA oversight will be designed to answer questions concerning the performance of the measurement systems being employed across PRSs, and therefore will be of value in assessing the sufficiency of data on a broader scale as well as providing valuable information concerning measurement error that can be used in subsequent designs.

2.2.2 QA samples in support of Quality Assurance Oversight

Additional QA samples that need to be taken to support an assessment of the performance of the ER Project measurement systems will be identified and allocated with assistance from the QA Oversight team once the PRS specific samples have

been identified and the gaps noted. These samples will be designed to help determine the performance of measurement systems employed across FUs for a given class of compounds (typically measured by a given method) and media, and to track performance over a field season. The QA Oversight Team will ensure that a minimum[3] of 20 of each type of QA sample included will be taken during a field season.

The proposed approach can be contrasted to the traditional use of 1 per batch of 20 or less of each type of QA sample. If 5,000 samples are to be taken in the FY95 field campaign, and the 1 in 20 approach is followed, 250 collocated samples or splits (duplicates), 250 field blanks and a variety of other rinsate and trip blanks would be taken and analyzed. This number would be taken without consideration of why it is needed, and what the added benefits are over taking 20 of each type over a field season (the proposed approach) from the standpoint of generating useful performance measures. If one plots the confidence intervals associated with estimates of variance as a function of sample size, it becomes clear that after obtaining 20 samples, there is little to be gained by additional samples. Given the requirements to do more-with-less, the objective is to optimize the expenditure on QA sampling and to gathering additional samples when these prove to be more valuable. Savings can be put toward implementing VCAs and ECs, with an emphasis on controlling decision errors by gathering more useful information or reducing risks.

To implement this approach, given that not all Work Plans/RFI reports will be available to the QA Oversight team at the same time, we recommend that the QA oversight team allocate additional samples, as necessary, to ensure at least 5 of each type of field QA sample are included[4] for each medium and analyte class in each FU's work package. The final percentage of QA samples in the total sample load will be a function of how many samples are collected during a field campaign, and how many QA samples are needed to generate the required estimates with an adequate level of confidence. It should be noted that the field QA samples affected by these procedures are to supplement those QA samples the contract labs are required to run (through their contracts and/or method requirements) which will be used by QA Oversight to track lab performance.

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[3] This number is subject to change based on an ER Project policy concerning the confidence required in estimates of variance and bias.

[4] By adding 5 of each type per FU, we expect to get at least 20 across the project in a given field season. We expect that not all FU's will have all contaminant classes in all media. Even if only three FU's include a given sample type for a specific media/analyte class, reasonable estimates of variance can be generated.

TABLE 2

Minimum Number of QA Sample Types to be Added to a SAP for an Individual PRS or PRS Aggregate to Support Screening Decisions.

Parameter Measured	Sample Type	Expectation that a Site will Fail the Screening Assessment		
		Low	Medium	High
Variability	Collocated and splits[5]	NONE	1 per aggregate	1 per PRS when very high concentrations are expected 2-3 per PRS when concentrations closer to SALs are expected
Bias	Rinsate Blank	NONE	NONE	NONE[6]
	Trip Blank	NONE	NONE	NONE
	Field Blank	NONE	NONE	1 per cooler for VOC samples
Rationale		False positives are unlikely, no PRS specific QA samples needed. Blanks taken for QA oversight purposes will demonstrate cross contamination is not a problem. False negatives due to poor recovery or variability can be assessed through use of laboratory analytical QA/QC data, the quarterly blind PE program and other QA oversight information.	The 1 collocated or split sample/PRS will supplement QA oversight information for both assessment of the chance of making an incorrect decision and design of subsequent studies, should they be necessary. False negatives can be assessed through use of laboratory analytical QA/QC data and QA oversight information.	Collocated or split samples will provide information on total measurement variance which can be used to support the design of follow-on studies and assessing the potential affect of the observed measurement variability on decision making. False negatives can be assessed through use of laboratory analytical QA/QC data and QA oversight information.

Using field blanks to assess the possibility of contamination (positive bias) from field operations is recommended *only* when there exists a high probability that the site will fail the screening decision. The rationale for this recommendation of limited use of different types of field blanks is manifold. The rare occurrences where

[5] Collocated samples should be taken when sampling surface soil or water. Splits should be taken when taking subsurface cores (except when analyzing for VOCs), where the cost of collocating a core is prohibitive.
[6] Rinsates should be considered only if equipment will be reused in the field and an untested or suspect decontamination procedure is to be used. In these cases, rapid analysis of rinsate blanks and feedback to the field team is recommended. Field reviews should be conducted periodically to ensure approved decontamination methods are being executed properly.

contamination has been experienced at the Laboratory has been traced to laboratory contamination. Even if contaminants do infiltrate into samples from field operations, the level of contamination is not likely to be high enough to cause a sample to exceed a SAL and the use of field blanks will not provide conclusive evidence regarding whether contamination entered any given sample. Instead of the traditional reliance on an extensive number of field blank samples, we recommend the increased use of surveillances and/or audits (as defined in the 1995 Laboratory ER QAPP) to ensure that field teams are executing procedures properly. An increased application of these activities coupled with effective corrective actions (carried to closure) when problems are noted should minimize the potential for field contamination of environmental samples.

While field units are expected to administer the sample types presented in Table 2, we recommend that PE samples be administered by a QA oversight team. That team, in addition to administering PE samples, will review draft SAPs, and add any additional QA samples needed to support a statistical analysis of the performance of the measurement system across the ER Project. The resulting data will be analyzed to generate periodic reports to FPLs and management concerning individual or project-wide field unit and laboratory performance.

3. FIELD INVESTIGATIONS TO SUPPORT THE EXPEDITED CLEANUP AND VOLUNTARY CORRECTIVE ACTION CLEANUP DECISIONS

3.1 EC and VCA Decisions[7]

The EC/VCA decisions to be made are:

1) The volume and location of each contaminated media to be remediated as part of the EC or VCA; and
2) Whether a particular EC or VCA site has been cleaned up to the desired level (attained the standard).

The first decision may be addressed for some PRSs in the current campaign using field screening methods; however, for sites under consideration for EC/VCA in next year's campaign, traditional sampling and analysis methods in addition to field screening methods may be appropriate. For sites where the screening assessment adequately characterized a PRS to support an EC/VCA, the primary data requirements will be associated with the second (attainment) decision above.

It should be noted that an EC or VCA may be carried out on only part of a PRS and therefore these decisions may only apply to the designated area or volume. It is

[7] Waste characterization decisions will need to be made in conjunction with most EC/VCAs. QA requirements for waste characterization are not discussed in this document.

acknowledged that *a risk assessment* is not needed for these EC or VCA cleanup decisions but that *risk-based cleanup levels* are needed. Some related issues have a direct impact on the ability to follow through on ECs and VCAs. First, the waste characterization criteria and waste acceptance criteria must be known. Second, the cleanup criteria for the EC or VCA must be known.

An assumption was made that focused field screening will be used as much as practicable during ECs and VCAs. The focused screening may include the use of portable testing units (e.g., hand-held instruments and field test kits), mobile laboratories or quick turnaround analyses at a fixed laboratory. When using test kits, the knowledge that they may be biased toward positive results should be considered in determining the need for QA and QC samples. Independent confirmation of field screening results may be obtained through the use of alternate measurement methods that are implemented either in the field, in a mobile laboratory or in a fixed laboratory. Selection of the alternate methods and analysis locations should be based on performance characteristics of the methods, time constraints on the project, ease of transporting samples, etc. The ER Project QAPP may be consulted for guidance on method. The Laboratory ER Chemistry Team may also be consulted for advice on field method selection.

3.2 Selection of QA Samples

The volume and location decision is similar to the "High" expectation of a screening test failure discussed in Section 2. The data requirements differ, however, because the emphasis has usually shifted from detection of a problem to defining the spatial limits of the problem that require remediation.

The attainment (verification of clean-up) decision is similar to the "Low" expectation of a screening test failure presented in Section 2 because the area will have been remediated and therefore is expected to no longer present a problem. The decision rule, however, will change from use of the maximum observed value in a PRS, to use of average or upper confidence limits on the average concentrations observed in the PRS or some smaller unit (e.g., a remediation unit[8]) within the PRS. The recommended QA samples to be used in supporting the volume and location decision are presented in Table 3. The recommended QA samples to be used in supporting the attainment decision are presented in Table 4.

In addition to field QA samples, the sampling plan should be adequate to generate estimates of spatial variation of contaminant concentrations. Sampling plans

[8] Remediation units can be defined as the smallest area (and depth) one can remove or treat using a particular remedy. If the size of this unit is smaller than a PRS, data can be gathered to determine how many and which remediation units need to be treated or removed to achieve the clean up goal (which generally relates to the PRS as a whole). If the remediation unit is larger than the PRS, there is no need to gather data on a smaller spatial scale. Using this approach at Superfund sites has resulted in large cost savings without any negative impact on protecting human health or the environment.

should be carefully reviewed to determine if they already provide an adequate number of samples to generate estimates of spatial variability, or whether additional neighboring samples are needed. This is especially true when spatial variation is expected to be larger than variation introduced by the measurement system. By collecting one or more collocated or split samples, the relative contribution of measurement error in the variability estimated through normal field samples and any additional neighboring samples can be assessed. A determination of the tradeoffs between the cost of additional samples versus the cost of remediation should be made. If data are being generated to define the volume and location to be remediated and the remedial alternative is quite expensive, characterization at a finer scale to facilitate a "surgical" remediation may by optimal.

TABLE 3

Minimum Number of QA Sample Types to be Added to a SAP for an Individual EC or VCA Site to Support Volume and Location Decisions.

Parameter Measured	Sample Type	Number of Samples
Variability	Collocated and splits	1-3
Bias	Rinsate Blank	NONE, if SOPs are followed 1 or more in cases where reusable equipment is to be used and decontamination procedures are either untested or suspect.
	Trip Blank	NONE
	Field Blank	NONE
	Reference Materials	See discussion below
Rationale	The primary concern of studies to delineate the volume and location of material to be remediated is the distribution and variability of contaminants. Collocated or split samples will provide information from which the variability of the media can be distinguished from the variability of the measurement system (including very small scale spatial variability). It is considered unlikely that cross contamination will be of concern if SOPs are followed, and not worth adding the types and numbers of PRS specific blanks to the design that would be required to detect problems if they occurred. Further, even if some cross contamination occurs, the probability that it will change the decision of how much to dig up is considered very low.	

The inclusion of 1-3 close neighboring samples in the sampling design is recommended for several reasons. First, an estimate of combined small-scale sampling and measurement variability will be obtained. This estimate will support an analysis of the probability of making an incorrect attainment decision due to inadequate numbers of samples. Second, it provides an additional environmental sample and, thus, a better estimate of the mean contaminant concentration and increased confidence in conclusions related to attainment of cleanup levels. As mentioned above, the tradeoffs between simply excavating more, or collecting additional attainment samples should be examined.

Two approaches to estimating measurement system bias are useful. One is the use of reference materials; the other is the use of referee analytical methods. Use of reference materials (which include PE samples) rests on the following assumptions:

1. Reference materials (RMs) similar to Laboratory ER sample matrices are available with known contaminants at known (or demonstrated) mean concentrations;

2. The mean concentrations of the RMs will be accepted as the true values against which performance will be assessed;

3. The bias of routine ER analytical methods will be judged relative to the true values of the RMs through analysis of the RMs using the routine methods and other inter-comparison programs; and

4. The RMs will be administered by a group outside of the field units as part of a QA oversight function (However, a field unit may request that additional RMs be used to supplement existing QA/QC activities. Periodic analysis of RMs will provide continuing data on the suitability of the methods).

Use of referee analytical methods for determining bias is based on the following assumptions:

1. Use of the referee methods provides true contaminant concentration values, or data from which the reference values can be computed; and

2. The bias of analytical methods used by the Laboratory's ER Project will be judged relative to the true values derived from the referee methods applied to the same samples.

TABLE 4

Minimum Number of QA Sample Types to be Added to a SAP for an Individual EC or VCA Site to Support Attainment Decisions.

Parameter Measured	Sample Type	Number of Samples
Variability	Collocated and splits	NONE
Bias	Rinsate Blank	NONE
	Trip Blank	NONE
	Field Blank	NONE
	Reference Materials	See discussion below
Rationale	After implementing a remedy, the assumption is that the site is now clean, and therefore sample results will indicate low levels or non-detects. Adding QA samples that are likely to come back as duplicate non detects, is not considered worthy of the expense. Further, if the contamination has indeed been removed, the source for potential cross contamination has also been removed, therefore PRS specific blanks are not recommended. As discussed below, additional samples (neighbors) will be the most cost effective way of assessing the probability of a decision error.	

The referee methods may be methods that are already in use (i.e., routine analytical methods) but are accepted and identified as providing the "true" value for contaminant concentrations.

Whether RMs or referee methods are used to assess measurement bias, performance data on all ER analytical methods (whether they are routine or non-routine) with regard to the following performance characteristics should have been considered prior to selecting the method:

1. precision
2. bias
3. sensitivity
4. selectivity
5. linear dynamic range
6. major known interferences

These data will provide information as to the acceptability of a particular method for supporting attainment decisions.

When routine analytical methods are used without modification (e.g., SW-846 or CLP methods), the published performance characteristics should be adequate to support the method selection process unless there is reason to doubt their validity for the particular application. If a modified routine method is under consideration,

its performance characteristics should be evaluated by a qualified chemist. Additional QA/QC samples to assess the performance of these methods may be appropriate. While the design of a performance evaluation study are beyond the scope of this document, in general a study to determine the sensitivity of the method and to evaluate the variability and bias of the method at concentrations of interest will be required.

The use of standard operating procedures (SOPs) associated with analytical methods ensures consistency in data quality from one analyst to another. In a particular SOP the performance characteristics and applicability of the method must be documented. Surveillances and audits may be used to ensure compliance with SOPs.

The use of RMs as field analytical method control checks is encouraged. Such check samples would be included as part of the method quality control and would be prepared independently from field crews or mobile laboratories. The check samples would provide real time feedback concerning the quality of results being generated in the field.

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REFERENCE SET FOR TECHNICAL AREA 21
VOLUME 4

This reference set is provided to facilitate review of Laboratory Environmental Restoration (ER) Project documents and is organized by ER identification (ER ID) number.

ER Project documents use ER ID numbers to track reference items through its Records-Processing Facility. Because ER ID numbers are issued on an ongoing basis throughout the entire ER Project, gaps may be present in the numbers included in this table of contents.

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