EVALUATION OF "WORK PLAN FOR ADDITIONAL ENVIRONMENTAL INVESTIGATION, PACIFIC DRY DOCK YARDS I AND II," PREPARED BY GEOMATRIX CONSULTANTS FOR THE PORT OF OAKLAND, SEPTEMBER 1997

Prepared For:

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Prepared By:

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December 9, 1997

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December 9, 1997

Mr. Barney Chan
Hazardous Materials Specialist
Alameda County Health Care Services Agency
Division of Environmental Protection,
Department of Environmental Health
1131 Harbor Bay Parkway, 2nd Floor
Alameda, California 94502

Dear Barney:

Enclosed please find one copy of *Evaluation of "Work Plan for Additional Environmental Investigation, Pacific Dry Dock Yards I and II," Prepared by Geomatrix Consultants for the Port of Oakland, September 1997*, dated December 9, 1997.

We trust you will find this helpful in your evaluation of the workplans submitted by the Port of Oakland and by Crowley Marine Services. If you have any questions, please call me at (916) 395-4964.

Sincerely,

Risk-Based Decisions, Inc.

Ijaz S. Jamall, Ph.D., DABT
Principal Toxicologist

ISJ/fl
Enclosure
c: Mr. Stephen Wilson
Crowley Marine Services, Inc.

EVALUATION OF "WORK PLAN FOR ADDITIONAL ENVIRONMENTAL INVESTIGATION, PACIFIC DRY DOCK YARDS I AND II," PREPARED BY GEOMATRIX CONSULTANTS FOR THE PORT OF OAKLAND, SEPTEMBER 1997

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1.0 CONCLUSIONS

The subject Workplan (herein after "Geomatrix Workplan") provides an overview of alleged "data gaps" and proposes a scope of work to fill them. The Geomatrix Workplan is invalid and its proposed scope of work does not meet its stated objectives. If carried out, the plan would produce erroneous results that could lead to incorrect environmental management decisions.

The Geomatrix Workplan is invalid in three important ways:

1. It translates its stated purpose into improper investigation goals that can not reasonably be achieved. It calls for more "characterization" of the site than is needed.

2. It is insufficiently objective. It provides little quantitative or scientific basis for its recommended actions. In addition, the Geomatrix Workplan glosses over important historical data that significantly affects the basis for some of the proposed sample locations.

3. It uses invalid methods to select sampling locations. Data obtained using this Geomatrix Workplan will not meet the plan's goals. Such data are likely to be misinterpreted and improperly used.

2.0 DISCUSSION

2.1 Evidence that the Geomatrix Workplan Establishes Improper Investigation Goals

The Geomatrix Workplan states two principal objectives:

1. Evaluate potential risks, if any, posed by each site.
2. Identify onsite areas containing chemicals of concern.

Accepting the premise that humans will be exposed, if at all, to chemicals in the shallow soil only, the Geomatrix Workplan immediately translates the first objective into that of estimating "representative chemical concentrations in shallow soil." This translation has been misinterpreted within the Geomatrix Workplan.

The U.S. Environmental Protection Agency (EPA) provides guidance in its publications *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A)* ("RAGS," 1989) and *Supplemental Guidance to RAGS: Calculating the Concentration Term* (1992). The latter reiterates that the concentration term "is an estimate of the arithmetic average concentration for a contaminant." In emphasized text it adds that "<u>because of the uncertainty associated with estimating the true average concentration at a site, the 95 percent upper confidence limit (UCL) of the arithmetic mean should be used for this variable</u>." This statement makes it clear that the baseline risk assessment is not a mere academic "characterization" of a site, but really is a tool to be used in an environmental management decision.

The UCL is never correctly used to "estimate representative concentrations"; it is too strongly biased to be widely effective for that purpose. Coupled with a

concentration target and a valid sampling plan, as it must be for risk assessment purposes, it is a statistical procedure for evaluating evidence. (See the EPA guidance, *Methods for Evaluating the Attainment of Cleanup Standards Volume 1: Soils and Solid Media*, 1989, Section 2.4 - Components of a Risk-Based Standard.) This procedure has only two possible outcomes. One is that no further action or investigation is necessary. This is the outcome strongly suggested by evidence from previous investigations. The other outcome, naturally, is that further action or investigation should be conducted.

The role of a workplan includes defining the sampling areas and specifying a sampling and analysis plan to support this decision. The purpose of a workplan is not to gather all the information needed to know exactly what all concentrations of all chemicals are at the site.

Language in the Geomatrix Workplan often suggests it was written with that latter, incorrect, purpose in mind:

> "These data are clearly inadequate to assess or characterize metals concentrations..." [pp. 2-3],
>
> "These data are not sufficient to estimate representative metals concentrations..." [p. 3],
>
> "... the data on chemical concentrations must be sufficient to establish the representative concentration of each chemical of potential concern." [p. 1],

(emphases added). Whatever purpose was in mind, the language is so suggestive of a need to study, investigate, and exhaustively sample that one must suspect the Geomatrix Workplan of erring in favor of too much investigation.

2.2 Evidence that the Sampling Plan was Not Objectively Developed

"Objective" here means the application of accepted, rational principles using existing information and clearly stated criteria. It is valid to use historical information on chemical use and site operations and the long history of field activities, provided that such information is documented. Certainly, there are degrees of non-objectivity shading into pure subjectivity, which here means drawing conclusions without any stated basis. In this sense, the workplan language is subjective. It supplies little basis for many of its conclusions, simply sounding variations on the theme that data are "inadequate:"

> "These data are clearly inadequate" [pp. 2-3],
> "These data may be adequate" [p. 3],
> "These data are not sufficient" [p. 3],
> "There are very few analyses" [p. 3],

and so on. These statements are accompanied by no objective statements or comparisons of the data to documented criteria. They may or may not be correct, but the Geomatrix Workplan provides very little supporting information.

A more serious omission is that the Geomatrix Workplan supplies no design criteria for its proposed sampling plan. It calls for "a grid sampling program on approximately 100 foot centers" in Yard I and "on approximately 120 foot centers" in Yard II. The Geomatrix Workplan mentions no procedure or criteria for deriving these spacings. The ideal grid spacing depends partly on the complexity of the site, partly on the sizes of potentially affected areas, and partly on the expectations about the site's potential risk. The Geomatrix Workplan makes no reference to any of these considerations for deriving the grid spacing.

On the whole, the vague workplan language, the omission of important explanations and derivations, and the complete absence of clear criteria, suggest that the proposed sampling plan may be little more than a guess. Without much more information about the thinking behind the plan, it has to be classified as not wholly objective and lacking foundation.

2.3 Evidence that the Workplan Specifies Sample Locations Incorrectly

As shown previously, the purpose of sampling is to support an environmental management decision. This purpose will be accomplished in part using a UCL procedure. A UCL incorporates two crucial pieces of information: an estimate of average concentrations and an estimate of the uncertainty in that average. To yield quantitative information about uncertainty, the sampling plan must indicate (if only implicitly) the probability with which any sample in the population could have been selected. As will be shown below, the need for this showing can not be obviated by the sheer number of samples to be collected.

The Geomatrix Workplan specifies two kinds of samples: grid samples and targeted samples.

2.3.1 GRID SAMPLING

The Geomatrix Workplan calls for soil samples on a 100 foot square grid in Yard I and on a 120 foot square grid in Yard II. For Yard II, it mentions that "grid samples were ... moved slightly ... or eliminated" in favor of target samples. Apart from this description, the only other Geomatrix Workplan documentation for the proposed grid sampling is in the figures. They show 10 such samples at Yard I [Figure 8] and 14 at Yard II [Figure 15].

This approach is valid in principle, but the implementation is seriously and fatally flawed. Decisions made using results from this sampling procedure will have no known statistical properties and could be in error.

The basic reason for this conclusion is that every possible sample in each site must have a known non-zero (*i.e.*, positive number greater than zero but one or less than one) probability of being included. The process of "moving" grid locations - which originally had definite relationships to each other and could produce data with definite statistical properties - results in an arbitrary and subjective selection of points. This process is identical to the long discredited practice of allowing pollsters to choose their respondents or to let the respondents select themselves. No finite, even huge, amount of sampling can overcome the problem. The direction and size of this bias are unknowable and can not be corrected.

The Geomatrix grid sampling plan suffers the same defects, both serious and one fatal:

- The grid sample points evidently were obtained not from the entire site, but from some (unmapped, undescribed) portion lying away from the targeted samples. This is the analog of sending questionnaires to a Republican-leaning readership whose precise composition is not known.

- The grid sample points were then moved. We are not told how far, in what direction, or even exactly which ones were moved. This is the analog of allowing a pollster to choose respondents arbitrarily (instead of randomly or by some valid systematic design). The effect is likely to produce bias, but in what direction and by how much is impossible to determine.

These problems are worsened (if they could be worse) by an omission. The Geomatrix Workplan does state that some grid points in Yard II were moved, but it does not state that grid points in Yard I were moved, strongly implying they were not. An analyst would be tempted to overcome the Geomatrix Workplan's deficiencies by introducing a correction term in the UCL calculation. This would be a serious error, since measurement of point spacing on the Geomatrix Workplan's Figure 8 clearly shows that some of the points were moved.

2.3.2 Targeted Sampling

"Targeting" areas to sample is a common and acceptable way to conduct a preliminary investigation. Most of the historical samples obtained evidently were targeted. Target areas are areas of known or suspected chemical use or contamination based on documented site operations or previous sampling data.

Targeted sample results can be fit into the environmental decision procedure framework. The probabilities are known: the samples obtained had a 100% chance of being included in the database and the other samples within the target regions had 0% chance. Clearly these results are not representative, but they are useful when the target areas are clearly delineated. A good choice of target areas can increase the chance of obtaining an extreme result. Knowledge of the extremes and the regions where they occur is useful information for risk management.

The Geomatrix Workplan's target sample locations can, therefore, be evaluated against three criteria:

1. The correct location of target areas.

2. The degree to which target areas are clearly delineated and target samples are unambiguously indicated as such.

3. The necessity for targeting particular areas.

2.3.2.1 The Geomatrix Workplan Misplaces Some of the Target Areas

For example, the area at the north of Yard II in the Geomatrix Workplan's Figure 15 is labeled "Former Disposal Area." Crowley Marine says it is not; a bilge water disposal area did exist near the boathouse parking lot (not shown on Figure 15). For another example, Crowley Marine points out that a sample shown in the Geomatrix Workplan's Figure 8 within the "Former Gear House" lies above water, since that area has been reclaimed. Evidently, a lot of repair and restoration also has occurred along the northeast portion of Yard II, calling into question the existence of or the need for the target samples shown there in the Geomatrix Workplan's Figure 15.

2.3.2.2 The Geomatrix Workplan Does not Delineate the Target Areas

The EPA guidance on evaluating soils (*op. cit.*) talks about "the importance of the sample area definition. ... It is important to ensure that sample areas are clearly defined during the design phase" and to make management decisions "independently for each area" [p. 3-3]. Thus, without a delineation, the risk

management decision can not be made. Worse, it might not be made correctly. A reviewer, unfamiliar with the particulars of this methodology who reviews the results of this Geomatrix Workplan - were it carried out - would readily suppose that there are just two sampling areas, all of Yard I and all of Yard II, and proceed to afford the targeted results the same statistical treatment as the gridded results. This would violate the EPA's precept to make management decisions independently for every sampling area. Also, the resulting UCL would likely be grossly incorrect (and too high).

2.3.2.3 Many Target Samples are Not Needed

Many target samples were established on the basis of some nearby historical measurement yielding total petroleum hydrocarbon (TPH) results in the 500 to 5,000 ppm range. TPH at these levels does not present a human health risk. The Geomatrix Workplan states that some target samples "are very close to locations where elevated TPH in some form has been reported but the data on possible PNA [polynuclear aromatic hydrocarbon] constituents are inadequate" [p. 4]. Earlier it states that PNAs "are typically associated with petroleum hydrocarbons." This use of TPH measurements as a surrogate for PNA concentration is valid, but the crucial thing missing from the Geomatrix Workplan is the rationale for selecting TPH in this particular range as an indicator of possible risk from PNA contamination.

This perhaps goes back to an earlier issue: targeting new samples near these areas might be a valid consideration if exhaustive characterization of a site is desired. However, it can be shown using published, peer reviewed data (McKee, Richard, and Plutnick, "Carcinogenic Potential of Gasoline and Diesel Engine Oils," *Fundamental and Applied Toxicology,* **13**:545-553, 1989) and the EPA Region IX Preliminary Remediation Goals, that TPH values below 5,000 ppm are very unlikely to be associated with enough PNAs to create a lifetime excess human cancer risk

exceeding 1 in 100,000. Therefore, to support a risk management decision, there simply is no need to collect additional data near these locations.

To be specific, some of these locations apparently targeted solely on the basis of TPH results include:

In Figure 8 (Yard I):

- Orange dot labeled BH47, MW-4: TPHd at 1400 and 3000 ppm, respectively (at 5' to 8.5' depths).
- Orange dot labeled BH31: TPHd at 2800 ppm.
- Magenta X labeled BH17: TPHd at 1200 ppm.
- Magenta X labeled PDDI-3: TRPH at 4600 ppm.
- Magenta dot labeled 21E: TPHd at 530 ppm.
- Magenta dot labeled 31E: TPHd at 2400 ppm (at 7' depth).

In Figure 15 (Yard II):

- Orange X near PDDII-5: TRPH at 4900 ppm.
- Two blue dots near MW-4 and CH-1C: TPHd at 1600 and 910 ppm, respectively (at 5.5' and 4.5' depths).
- Orange dot near CH-3D: TPHd at 940 ppm.

(TRPH is total recoverable petroleum hydrocarbons, TPHd is the diesel range component of TPH, ppm is concentration by weight (mg/Kg), and historical sample depths were between 0.5 and 2 feet unless otherwise indicated.)

3.0 SUMMARY AND RECOMMENDATIONS

The Geomatrix Workplan prepared for the Port of Oakland appears to follow a standard investigation protocol. However, it documents no quantitative design criteria, violates fundamental statistical procedures in selecting sample locations, and fails to provide minimal acceptable documentation of the target sample areas. The language it employs suggests that it was not designed to collect data for risk management, but rather to perform an investigation for reasons other than to arrive at a risk management decision. Certain omissions in the text, revealed in the figures, indicate that data collected according to this Geomatrix Workplan will be impossibly biased and subject to misinterpretation by risk assessors and regulators.

The inadequacies in the Geomatrix Workplan have been corrected in the Crowley Workplan as summarized below. The two attached figures for the Yard I and II sites, respectively, also show a comparison of the sample locations proposed by Crowley Marine and contrasts these locations with those proposed in the Geomatrix Workplan. The Geomatrix Workplan relies on information on Yards I and II based on previously submitted reports and on their interpretation of figures and text in those reports. The Crowley Workplan is based on actual first hand knowledge of practices and operations at these sites. More specifically, the Crowley Workplan:

1. States the risk management decision criterion (for example, that EPA procedures will be followed to compare human health risks to the 1 in 100,000 lifetime excess cancer level for a worker exposure scenario).

2. Updates the maps to show the Yards as they currently exist and to correctly reflect historical activities.

3. Delineates the areas to "target" with non-randomized samples and documents the basis for the targeting and the delineation.

4. Uses genuine randomization and honest grids to sample the non-targeted areas.

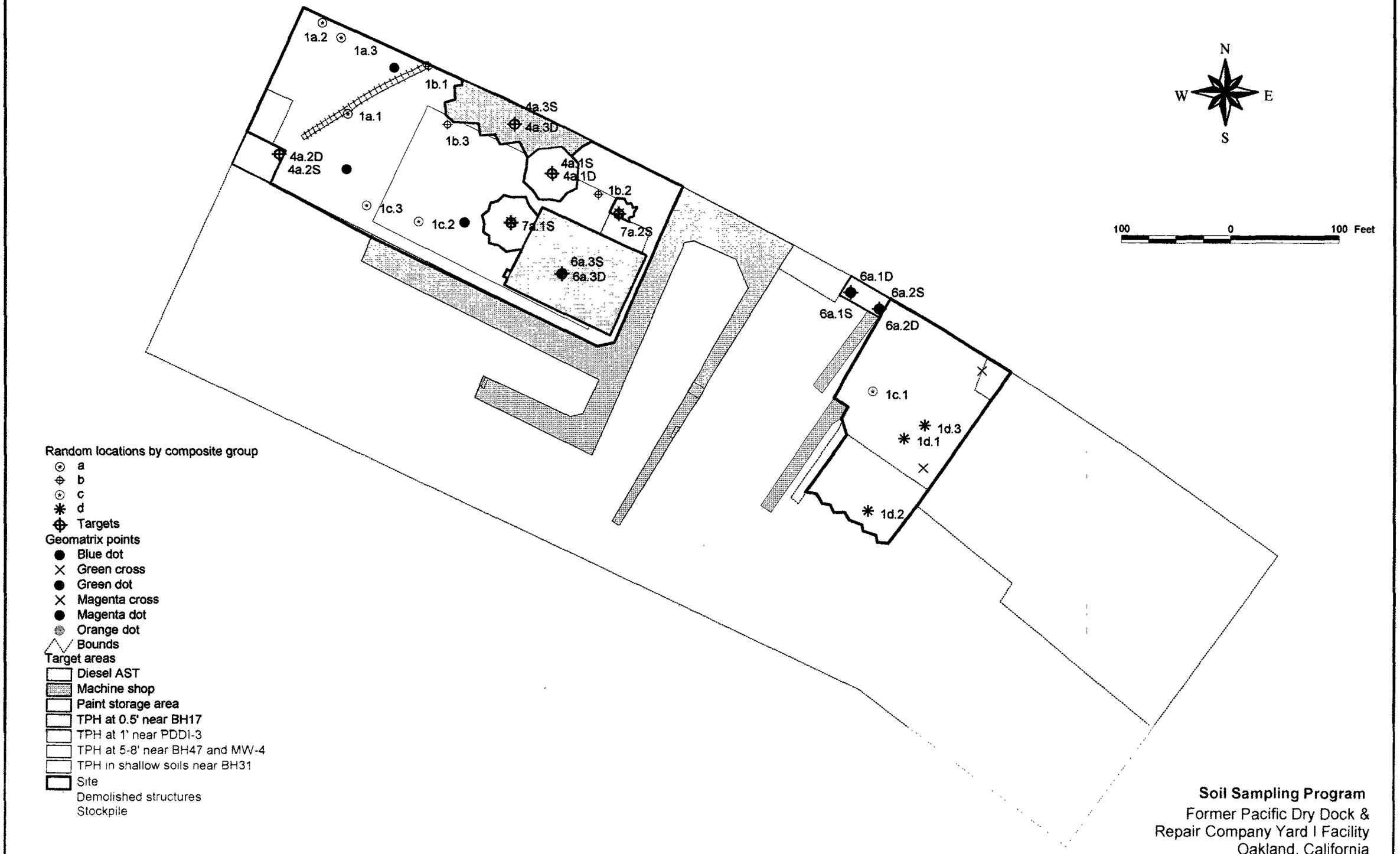
5. Determines the number of grid sample measurements to be at least the number needed to make the risk management decision with the desired level of confidence (95%, usually).

6. Obtains more than the minimum number of samples to ensure that a finer degree of spatial sampling coverage is desired (motivated by patterns of historical activities), but composites them before analysis to achieve the required number of measurements. (Measurements of volatile or fugitive compounds will be performed without compositing.)

7. Clarifies the two very different uses of the target sample and grid sample results for supporting decision making: the grid sample results can be used to develop a UCL; the target sample results merely indicate extremes and must be compared to risk-based thresholds on a case-by-case basis.

8. Documents and enforces different sample collection procedures for the grid and target locations to ensure that no bias is introduced in the grid sample collection while allowing the fullest range of professional judgment in selecting the target locations (within their delineated regions). (See the EPA soil evaluation guidance, *op. cit.*, Chapter 5 - Field Sampling Procedures.)

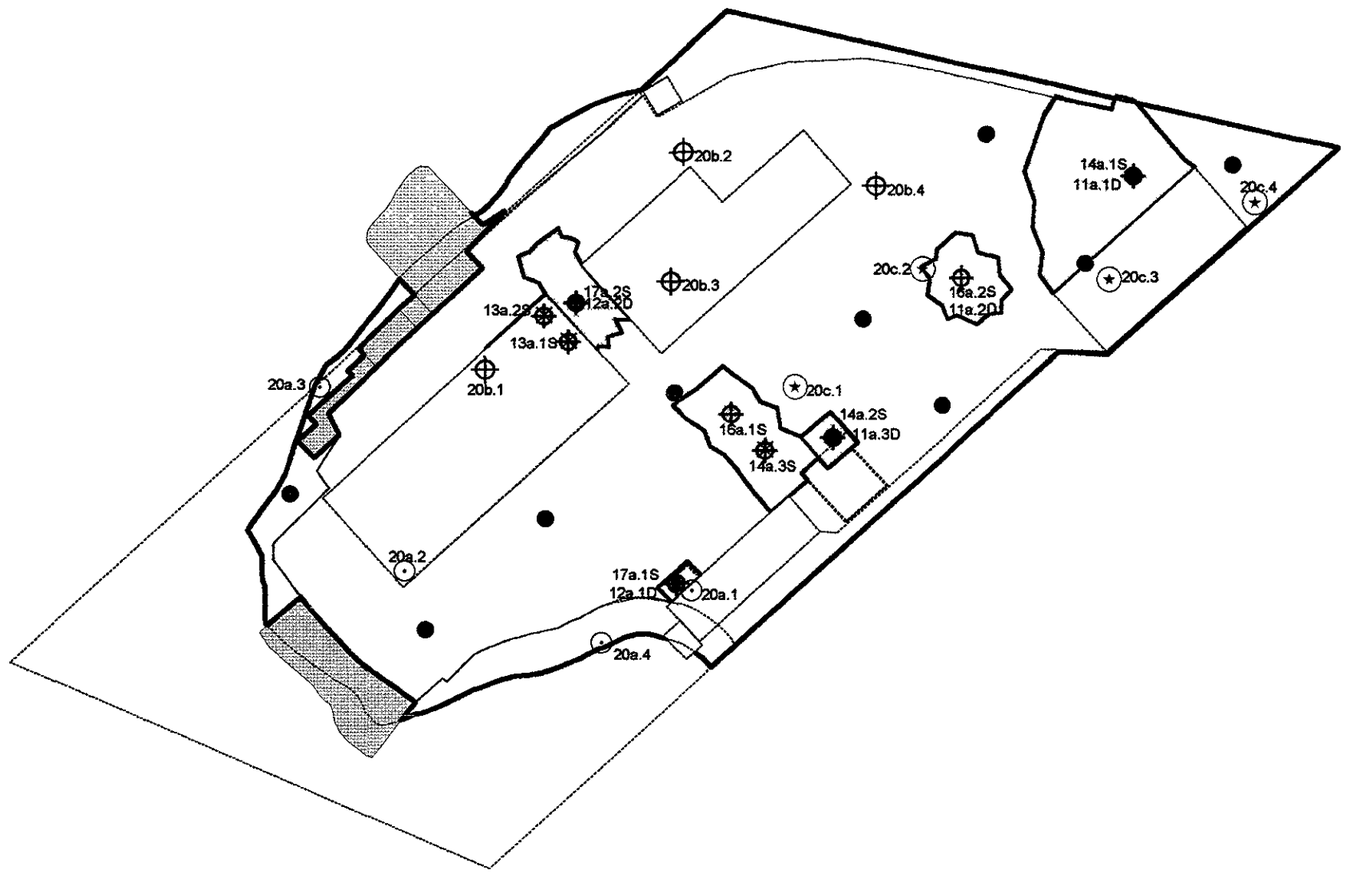
Additional EPA guidance for sampling plan design is available in *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, Final, 1994, and *Guidance for Data Quality Assessments*, EPA QA/G-9, Final, 1995.



Soil Sampling Program
Former Pacific Dry Dock &
Repair Company Yard I Facility
Oakland, California

Risk-Based Decisions, Inc

Figure 1



N
W E
S

100 0 100 Feet

Random locations by composite group
- a
- b
- c
- Targets

Geomatrix points
- Blue dot
- Green cross
- Green dot
- Magenta cross
- Magenta dot
- Orange dot
- Blue cross
- Orange cross
- Bounds
- Structures

Target areas
- AST
- Bilgewater disposal
- CH-3D (BTEX)
- Concrete AST containment area
- PDDII-3 (PCE)
- PDDII-5 & PDDII-8
- Wash area degreaser and sump
- Site
- Removed areas

Soil Sampling Program

Former Pacific Dry Dock &
Repair Company Yard II Facility
Oakland, California

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Figure 2