

PLANNING RISK ASSESSMENTS

Kathryn A. Wurzel

NewFields

1349 West Peachtree St. Suite 2000 Atlanta, GA 30309

Phone: (404) 347-9050, email: kwurzel@newfields.com

Introduction

A risk evaluation, whether it is a risk-based screening or a complete baseline risk assessment, requires planning to ensure that appropriate and sufficient data are available. *Risk Assessment Guidance for Superfund (RAGS) Part A* emphasizes the importance of risk assessor involvement early in the investigation process, ideally when the scope of work for the field investigation is being prepared. Sampling strategies (purposive or random) and data analysis methodologies (statistics) will determine how much data is required to adequately assess the potential risk posed by a site of environmental contamination. The sampling strategy also impacts how “hotspots” will be evaluated and whether sufficient data are available to evaluate exposure scenarios (i.e., surface and subsurface soils).

Laboratory analytical methods must also be selected that will provide detection limits comparable to the risk-based criteria. High laboratory detection limits may result in the inability to perform risk-based screening and/or skewed exposure point concentrations. CERCLA and RCRA both require the evaluation of the *incremental* risk posed by constituent releases that are a result of site activities; therefore, establishment of a site-specific background concentration for naturally occurring and anthropogenic constituents is necessary.

Methods for addressing these issues are presented to assist the non-risk assessor in preparing or reviewing work plans for field investigations that require an evaluation of risk to human health.

Discussion

There are three levels of risk evaluation used under the CERCLA and RCRA programs: Screening, baseline risk assessment, and remedy evaluation. Figure 1 provides a representation of the tiered risk assessment approach with the frequency of each tier's implementation demonstrated by the size of the box (e.g., the screening assessment is the most frequently performed evaluation). The screening tier can be done in an iterative fashion by conducting a preliminary screen followed by a site-specific screen if necessary. However, the same basic data needs/evaluation techniques must be addressed in each of these tiers. In order to prevent numerous mobilization efforts for data collection, the data needs, the evaluation techniques, and the decisions that will result from the evaluation should be determined very early in the process.



FIGURE 1

The two most frequently used sampling methodologies are purposive and random. Purposive sampling is generally conducted during the Preliminary Assessment/Site Investigation (PA/SI) phase of work. The sampling is biased toward areas most likely to have been impacted to determine if contamination is present at a site. This type of sampling can be useful in the preliminary risk screening because the maximum detected concentrations can be compared to the risk-based standards to determine if the “worst case” conditions present a potential threat to human health. If the preliminary screening does not indicate a potential threat, there is no need to proceed to a baseline risk assessment. However, if the use of the biased data in the preliminary screening indicates a potential threat, a baseline risk assessment would be performed. It is inappropriate to assess the potential long-term risk of exposure at a site using only data collected from impacted areas (unless, of course, the entire site is impacted at the same level as the biased samples). A risk assessment should be conducted using representative exposure point concentrations based on average concentrations across the entire exposure domain, not just the areas with biased sampling. Random sampling is the most appropriate method to obtain data that is representative of exposure domains. Unfortunately, most of the time the data for a risk assessment is biased toward the most impacted areas. This bias can be addressed to provide more accurate exposure point concentrations by selecting the appropriate statistical method for data analysis.

Classical statistics, which are generally used for calculating exposure point concentrations, assumes that the data being evaluated is unbiased and uncorrelated; it does not consider whether the highest concentrations are in close proximity to one another but rather views each concentration as an independent, random variable. The vast majority of the data available for risk assessment is biased and correlated due to the pattern of release and our sampling methodologies. Geostatistics take into account the spatial relationship of the data and therefore provides a more representative exposure point concentration when the data are biased and correlated. Variography is performed and the resulting variogram provides significant information on how the contamination is distributed at the site and what techniques will provide the most representative exposure point concentration. Figure 2 provides examples of variograms that are commonly associated with environmental contamination:

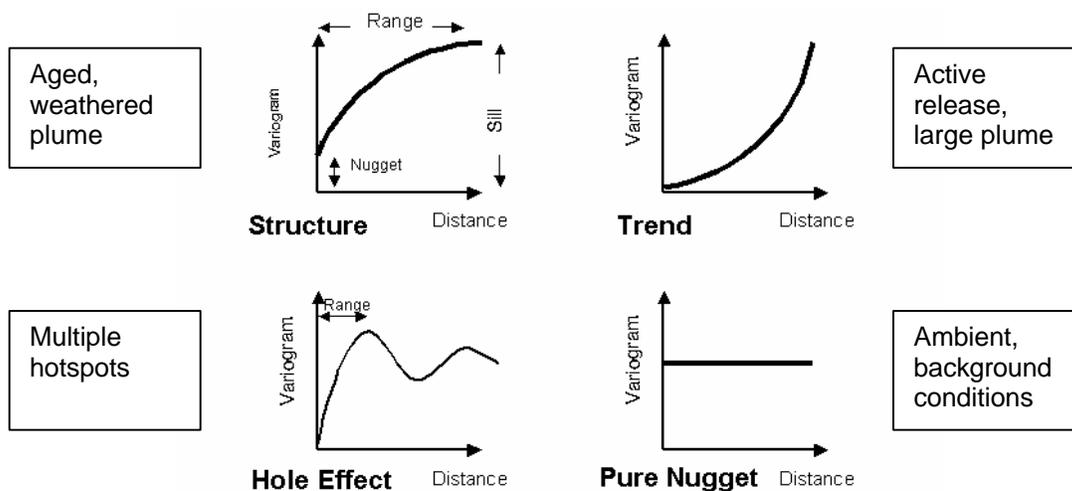


FIGURE 2

The potential size and constituent concentrations associated with the “hotspots” can be determined. The size and location of the “hotspots” will determine how they are evaluated in the risk assessment. RAGS states that hotspots are the intersection of elevated concentrations and areas of increased exposure, not just areas of elevated concentrations. An assessment of the location of the “hotspots” relative to site usage will determine if these areas should be evaluated separately in the risk assessment.

The calculation of the exposure point concentrations includes detected concentrations and concentration surrogates for constituents that are not present above the laboratory analytical method detection limit. The selection of analytical methods is crucial to both the screening and baseline risk assessment process; the risk-based screening concentrations for the various constituents should be reviewed before selecting the methods for analysis. Risk-based screening cannot be conducted if the detection limit is greater than the screening concentration because it is not possible to say with certainty that the constituent is present at a concentration below the screening concentration. In addition, the surrogate concentration used for constituents that are not

detected is one-half the detection limit. Elevated detection limits may result in the surrogate concentrations skewing the exposure point concentration and it may appear that there is a potential risk even if the majority of the samples did not detect the constituent.

The CERCLA and RCRA programs were developed to address potential human health and ecological risks associated with activities at a site of environmental contamination, i.e., the *incremental risk above background* conditions. Establishing background is thus very important in the process of determining risks that require management. Background for naturally occurring inorganic constituents is routinely considered, however anthropogenic background is not generally accepted by the regulatory agencies. There are numerous methods available for establishing background concentrations, many of which require complicated statistical calculations. A methodology that does not require extensive statistical manipulation and is becoming more widely accepted by regulatory agencies is determining the inflection point using probability plots. The inflection point (where the slope of the line changes) is indicative of two different populations. The inflection point can therefore be used to establish the point at which site concentrations are different than background concentrations. Figure 3 provides an example of inflection point analysis.

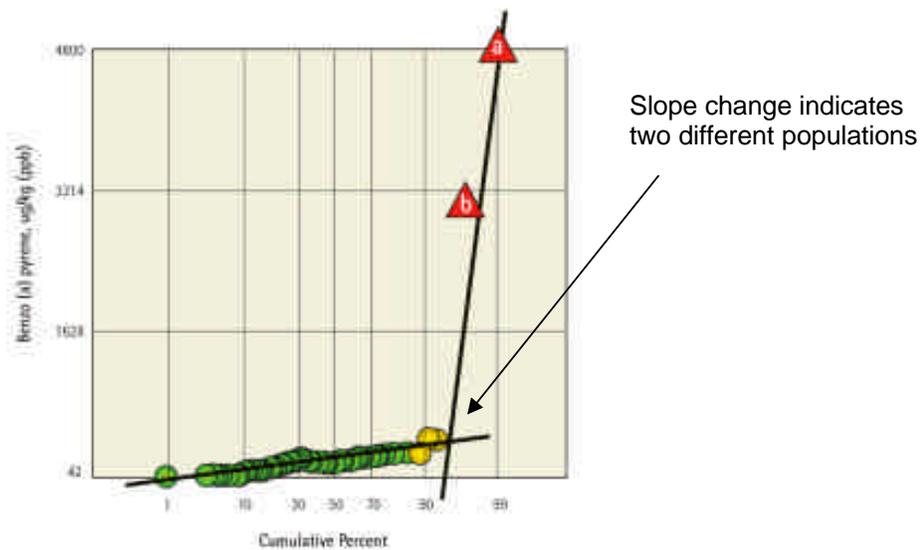


FIGURE 3

Summary

Risk assessors should be involved early in the RI/FS process. Planning a risk evaluation should include the selection of sampling methodologies and data analyses to ensure that adequate information is available to assess risk either through screening or a baseline risk assessment. Ideally, random sampling will be conducted, but if purposive sampling data is available, the use of geostatistics will provide a representative exposure point concentration. Hotspots should be identified as those areas where elevated concentrations intersect with increased exposure. The application of geostatistics can also provide an estimate of the size of the hotspots and allow the selection of the most appropriate means to evaluate these areas in the risk assessment. Detection limits play an important role in both screening and the baseline risk assessment. Failure to obtain detection limits adequate for comparison to risk-based concentrations may result in the inability to screen constituents, an apparent risk based on elevated detection limits, and the need to return to the field to obtain additional samples for analysis by a more sensitive method. Establishment of appropriate background concentrations is essential since the incremental risk associated with a CERCLA or RCRA release forms the basis for risk management decisions.