6.0 Data Analysis, Validation, and Interpretation

Data usefulness is paramount relative to the BERA and related testing and analysis. The principal objective in the study design is to ensure that the hypotheses are effectively tested and rejected or accepted with a high degree of confidence. A summary of the statistical methods is provided below, and a discussion of hypothetical results follows. These hypothetical results should assist the reader in better understanding the usefulness of the collected data as they relate to characterizing risk to terrestrial and riparian receptors within and around the IMR ranges.

6.1 Data Analysis and Validation

As described in the problem formulation, the surface soils at the IMR ranges have been characterized by their capacity to bind inorganic compounds. Three metal-binding soil classifications (high, medium, and low) have been established. Figures 5-1, 5-2, and 5-3 present the sample locations for a five-point concentration gradient within each of the three metal-binding soil types. It is important to note that, in order to obtain sample soils with various lead concentrations from the three different soil types, soil samples will be collected from both the IMR and BGR ranges.

The hypothetical results provided in Table 6-1 would indicate that the NOAEL for low binding capacity soils may be as low as 266 ppm for lead, while the NOAEL for medium and high binding capacity soils could be as high as 1,890 ppm and 7,100 ppm, respectively. Results such as these could be useful to risk managers in setting possible soil cleanup goals based on soil type. The sediment toxicity tests with chironomids will provide similar data; the objective of which is to determine NOAELs and LOAELs for the sediment COPECs.

The overall objective in conducting the field- and laboratory-based studies is to test the null hypotheses stated in the BERA's problem formulation (IT, 2002a). Each hypothesis will be accepted or rejected based on findings from the relevant toxicity test or field measurement. Acceptance or rejection of each hypothesis will be instrumental in characterizing ecological risks associated with the surface soils and sediments at the IMR ranges.

Earthworm and chironomid LC_{50} values will be computed using the EPA-recommended Probit Analysis (EPA, 1989); NOAEL and LOAEL values will be derived using Dunnett's procedure or Steel's Many-One Rank Test. Dunnett's procedure is a parametric test that assumes that observations within treatments are independent and normally distributed and that the variance of the observations is homogenous across all toxicant concentrations. The Shapiro-Wilk's test will

Table 6-1

Hypothetical Test Results
Terrestrial Old Field Habitats
Small Arms Ranges at Iron Mountain Road and Bains Gap Road Ranges
Fort McClellan, Calhoun County, Alabama

Soil Binding Capacity Type	Lead Concentration (ppm)	Test/Measure	Significant Difference When Compared to Reference Location at p = 0.05		LOAEL/ NOAEL
			Yes	No	
High Binding Capacity (IMR Ranges)	114,000	Earthworm Toxicity	X		
		Earthworm Tissue Conc.	X		
	25,300	Earthworm Toxicity	X		LOAEL
		Earthworm Tissue Conc.	X		
	7,100	Earthworm Toxicity		X	NOAEL
		Earthworm Tissue Conc.		X	
	1,300	Earthworm Toxicity		X	
		Earthworm Tissue Conc.		X	
	147	Earthworm Toxicity		X	
		Earthworm Tissue Conc.		X	
Medium Binding Capacity (BGR Ranges)	30,700	Earthworm Toxicity	X		
		Earthworm Tissue Conc.	X		
	11,800	Earthworm Toxicity	X		
		Earthworm Tissue Conc.	X		
	8,810	Earthworm Toxicity	X		LOAEL
		Earthworm Tissue Conc.	X		
	1,890	Earthworm Toxicity		X	NOAEL
		Earthworm Tissue Conc.		X	
	221	Earthworm Toxicity		X	
		Earthworm Tissue Conc.		X	
Low Binding Capacity (IMR Ranges)	116,000	Earthworm Toxicity	X		
		Earthworm Tissue Conc.	X		
	28,0000	Earthworm Toxicity	X		
		Earthworm Tissue Conc.	X		
	8,110	Earthworm Toxicity	X		
		Earthworm Tissue Conc.	X		
	1,150	Earthworm Toxicity	X		LOAEL
		Earthworm Tissue Conc.	X		
	266	Earthworm Toxicity		X	NOAEL
		Earthworm Tissue Conc.		X	

BGR - Bains Gap Road.
IMR - Iron Mountain Road.
LOAEL - Lowest observed adverse effects level.
NOAEL - No observed adverse effects level.
ppm - Parts per million.

be used to test for normality in order to decide whether to use parametric (Dunnett's) or nonparametric (Steel's Many-One Rank) analyses. In order to test the variances of the data obtained from each toxicant concentration and the control, Bartlett's test for variance will be employed.

It is important to note that the field-collected soil samples will not be cut or diluted into a dilution series but will be tested as 100 percent "un-cut" samples. Derivation of toxicity response curves in the form of LD_{50} values, NOAELs, and LOAELs will be done via the lead concentration gradient. By collecting soil samples with five concentrations of lead from each of the three soil types, a gradient series will be present and appropriate toxicity response curves can be computed. Therefore, Dunnet's Procedure (for parametric distributions) or Steel's Many-One Rank Test (for nonparametric distributions) can be applied.

In addition to deriving toxicant dose-response curves (i.e., LC_{50}, LD_{50}, NOAEL, LOAEL), it is critical to apply Analysis of Variance (ANOVA) tests to determine if soil or sediment samples differ from off-site reference samples, thus dictating whether null hypotheses are accepted or rejected. A significance level of $= .05$ will be adopted as a probability of committing a Type I or Type II error.

In comparing toxicity or bio-measurement results, single and nested ANOVAs will be conducted coincident with appropriate normality and variance testing.

6.2 Data Interpretation

Interpretation of bioassay results is dependent upon bracketing a response or effect level and a no effect level. Effects will be measured via toxicity responses within a specified exposure period depending on the exposure medium and test species. At a confidence level of 95 percent ($p \leq 0.05$), test responses consisting of acute toxicity will be compared to reference soil or sediment responses. Test chambers that are statistically different from reference chambers will be characterized as "effect concentrations," while those exhibiting no significant difference will be listed as "no-effect concentrations." The highest no-effect concentration and the lowest effect concentration will be reported as the NOAEL and LOAEL, respectively.

A second use of the data relates to COPEC concentrations measured within earthworm and chironomid tissues following completion of the exposure periods. Organisms from each replicate chamber will be tested as separate and distinct composite samples. The mean concentration and 95 percent UCL for each exposure concentration will be used to derive body burden concentrations, which will then be used as input values for the food chain models as

described in Section 5.0. These models, representing the various terrestrial and riparian trophic levels, will then be employed for HQ derivations.