



[Home](#) » [TGM](#) » [Section 21](#) » Appendix 21-G

APPENDIX 21-G

SAMPLE CONTENTS OF A BERA WORK PLAN/SAMPLING AND ANALYSIS PLAN AND BERA REPORT

Contents of a BERA Work Plan/Sampling and Analysis Plan

(see [Subsection 21.6.3](#) and [Subsection 21.6.4](#) for guidance on preparing the BERA Report)

1.0	INTRODUCTION
2.0	REFINED PROBLEM FORMULATION
2.1	Environmental Setting, COPCs, and Receptors of Concern
2.2	Assessment and Measurement Endpoints
2.3	Refined Conceptual Site Model
2.4	Identification of Decision Units
3.0	STUDY DESIGN AND DATA QUALITY OBJECTIVE PROCESS
3.1	Data Quality Objectives
3.1.1	Problem Definition
3.1.2	Decision Statement
3.1.3	Inputs to the Decision
3.1.4	Study Boundaries
3.1.5	Decision Rules

3.1.6	Limits on Decision Errors
3.2	Sampling Design
3.2.1	Sample Analytics
3.2.2	Sediment Sampling
3.2.3	Pore Water Sampling
3.2.4	Surface Water Sampling
3.2.5	Biological Surveys
3.2.6	Field-Collected Tissue Samples
3.2.7	Laboratory Toxicity Tests
3.2.8	Laboratory Bioaccumulation Studies
4.0	References Cited
Tables	
Figures	
Appendices	

CONTENTS OF A BERA REPORT

(see [Subsection 21.6.3](#) for guidance on preparing the BERA WP/SAP)

1.0	INTRODUCTION
1.1	INVESTIGATORY HISTORY
1.2	OVERVIEW OF THE ECOLOGICAL RISK ASSESSMENT PROCESS
1.3	REPORT ORGANIZATION
2.0	SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

2.1	DATA SOURCES AND ASSUMPTIONS USED IN THE SLERA	
2.1.1	STEP 1: SCREENING LEVEL SITE CHARACTERIZATION DATA AND ECOLOGICAL EFFECTS EVALUATION	
2.1.2	STEP 2: ESTIMATE PRELIMINARY EXPOSURE CONCENTRATIONS AND CALCULATE HAZARD QUOTIENTS	
2.2	SLERA PROBLEM FORMULATION	
2.2.1	BIOLOGICAL RESOURCES AT THE SITE	
2.2.1.1	MARINE ALGAE AND VEGETATION	
2.2.1.2	MARINE INVERTEBRATES	
2.2.1.3	MARINE AND ESTUARINE FISHES	
2.2.1.4	SEA TURTLES	
2.2.1.5	MARINE BIRDS	
2.2.1.6	MARINE MAMMALS	
2.2.1.7	THREATENED AND ENDANGERED SPECIES	
2.2.2	DESCRIPTION OF AVAILABLE DATA	
2.2.3	DESCRIPTION OF ECOLOGICAL DECISION UNITS	
2.2.3.1	DU-1	
2.2.3.2	DU-2	
2.2.3.3	DU-3	
2.2.3.4	REFERENCE LOCATION (FOR EACH DU, IF NECESSARY)	
2.2.4	PRELIMINARY ECOLOGICAL CONCEPTUAL SITE MODEL	
2.2.4.1	CHEMICAL STRESSORS	
2.2.4.2	NON-CHEMICAL STRESSORS	
2.2.4.3	EXPOSURE PATHWAYS AND CRITICAL RECEPTORS	
2.2.5	ASSESSMENT AND MEASUREMENT ENDPOINTS	
2.3	SLERA EXPOSURE ESTIMATES AND RISK CALCULATIONS	

2.3.1	DU-1
2.3.1.1	SURFACE SEDIMENT
2.3.1.2	SURFACE WATER
2.3.1.3	HIGHER TROPHIC LEVEL RECEPTORS
2.3.2	DU-2
2.3.2.1	SURFACE SEDIMENT
2.3.2.2	SURFACE WATER
2.3.2.3	HIGHER TROPHIC LEVEL RECEPTORS
2.3.3	DU-3
2.3.3.1	SURFACE SEDIMENT
2.3.3.2	SURFACE WATER
2.3.3.3	HIGHER TROPHIC LEVEL RECEPTORS
2.4	SOURCES OF UNCERTAINTY IN THE SLERA
2.4.1	ANALYTICAL DATA
2.4.2	USE OF SCREENING VALUES
2.4.3	UNCERTAINTIES ASSOCIATED WITH THE FOOD-CHAIN MODEL (REVISE THESE TOPICS AS APPROPRIATE FOR YOUR SITE)
2.4.3.1	BSAFS
2.4.3.2	SITE USE FACTORS
2.4.3.4	DIETARY COMPOSITION
2.4.3.5	BIOAVAILABILITY
2.4.3.6	BODY WEIGHT AND INGESTION RATES
2.4.3.7	TOXICITY REFERENCE VALUES
2.4.3.8	INTERSPECIES EXTRAPOLATION
2.4.3.9	INDIVIDUAL AND POPULATION VARIATION
2.4.3.10	CHEMICALS WITHOUT TRVS

2.4.3.11	USE OF MAXIMUM DETECTED CONCENTRATION
2.5	SLERA SUMMARY AND SCIENTIFIC MANAGEMENT DECISION POINT
3.0	BERA PROBLEM FORMULATION
3.1	ADDITIONAL INFORMATION CONSIDERED IN THE BERA (THESE ARE EXAMPLE TOPICS; REVISE AS APPROPRIATE FOR YOUR SITE)
3.1.1	BACKGROUND/REFERENCE SEDIMENT ANALYSIS
3.1.2	ADDITIONAL SITE-SPECIFIC SEDIMENT CHEMICAL ANALYSIS
3.1.2.1	PAHS, INCLUDING ALKYLATED PAHS
3.1.2.2	AVS/SEM/TOC
3.1.2.3	SEDIMENT PORE WATER ANALYSIS
3.1.3	TOXICITY TESTS
3.1.4	SEDIMENT BIOACCUMULATION TEST
3.1.5	SITE-SPECIFIC BIOTIC SURVEYS
3.1.5.1	BENTHIC AND EPIBENTHIC MACROINVERTEBRATES
3.1.5.2	FISHES AND SEA TURTLES
3.2	REFINEMENT OF COMPLETE EXPOSURE PATHWAYS AND COPECS
4.0	ANALYSIS OF EXPOSURE AND EFFECTS
4.1	EVALUATION OF EXPOSURE
4.1.1	BENTHIC AND OTHER AQUATIC INVERTEBRATES
4.1.1.1	SEDIMENT BULK CHEMISTRY
4.1.1.2	PAHS, INCLUDING ALKYLATED PAHS
4.1.1.3	AVS AND SEM
4.1.1.4	SEDIMENT PORE WATER
4.1.1.5	SEDIMENT BIOASSAY RESULTS

4.1.1.6	FIELD-COLLECTED TISSUE SAMPLES
4.1.1.7	LABORATORY/FIELD BIOACCUMULATION TEST
4.1.2	EXPOSURE OF FISH TO CHEMICALS IN WATER AND SEDIMENT
4.1.3	DAILY INGESTED DOSES FOR BIRDS AND MAMMALS
4.2	EVALUATION OF EFFECTS
4.2.1	BENTHIC AND OTHER AQUATIC INVERTEBRATES
4.2.1.1	SEDIMENT BULK CHEMISTRY
4.2.1.2	AVS AND SEM RESULTS
4.2.1.3	SEDIMENT PORE WATER RESULTS
4.2.1.4	BIOASSAY RESULTS
4.2.1.5	FIELD COLLECTED INVERTEBRATE RESULTS
4.2.1.6	BIOASSAY AND BIOACCUMULATION RESULTS
4.2.1.7	EVALUATION OF CRITICAL BODY RESIDUE CONCENTRATIONS IN INVERTEBRATES
4.2.2	EFFECTS ON FISHES
4.2.2.1	EFFECTS OF SURFACE WATER ON FISH
4.2.2.2	FISH WHOLE BODY CONCENTRATIONS
4.2.2.3	FORAGE FISH BSAFS
4.2.2.4	BIOMAGNIFICATION OF CHEMICALS IN FISH
4.2.2.5	EVALUATION OF CRITICAL BODY RESIDUE TISSUE CONCENTRATIONS IN FISH
4.2.3	BIRDS AND MAMMALS
4.2.3.1	HQS BASED ON DAILY DOSE TRVS
4.2.3.2	EVALUATION OF CHEMICALS WITH NOAEL HQS GREATER THAN 1.0
5.0	RISK DESCRIPTION
5.1	RISK TO BENTHIC AND OTHER AQUATIC INVERTEBRATES
5.1.1	DIRECT TOXICITY

5.1.2	BIOACCUMULATION
5.2	RISK TO FISH AND TURTLES
5.2.1	FISH SPECIES DISTRIBUTION AND ABUNDANCE
5.2.2	EFFECTS OF SURFACE WATER ON FISH
5.2.3	EVIDENCE FOR CHEMICAL BIOAVAILABILITY
5.2.4	BIOMAGNIFICATION OF CHEMICALS IN FISH
5.2.5	EVIDENCE FOR WHOLE BODY TISSUE EFFECTS
5.2.6	EVIDENCE FOR DIETARY EXPOSURE IN PISCIVOROUS FISH
5.2.7	FILLET CONCENTRATIONS IN TOP PREDATOR FISH
5.2.8	SUMMARY OF COPECS FOR FISH
5.3	RISK TO SEA TURTLES
5.4	RISK TO BIRDS
5.4.1	BIRD 1
5.4.2	BIRD 2
5.4.3	BIOAVAILABILITY OF CHEMICALS TO BIRDS
5.5	RISK TO MARINE MAMMALS
5.5.1	MARINE MAMMAL 1
5.5.2	MARINE MAMMAL 2
5.5.3	BIOAVAILABILITY OF CHEMICALS TO MARINE MAMMALS
6.0	RISK DESCRIPTION BY DECISION UNIT (SUMMARY TABLES)
7.0	UNCERTAINTY ANALYSIS
7.1	COPEC SELECTION
7.2	EXPOSURE AND EFFECTS ANALYSIS

7.2.1	RECEPTOR EXPOSURE FACTORS
7.2.2	BIOAVAILABILITY OF CHEMICALS
7.2.3	SPECIES AND INDIVIDUAL VARIABILITY IN EFFECT RESPONSES
7.2.4	INTERPRETATION OF INVERTEBRATE SCARCITY
7.2.5	INTERPRETATION OF BIOASSAY RESULTS
7.3	DATA GAPS
7.3.1	SEASONAL CHANGES IN SURFACE WATER CONCENTRATIONS
7.3.2	SURFACE WATER-GROUND WATER INTERACTIONS
7.3.3	BIOAVAILABILITY OF CHEMICALS
7.3.4	INVERTEBRATE PREY TISSUE CONCENTRATIONS
8.0	BERA SUMMARY AND CONCLUSIONS
8.1	SUMMARY OF RISK IN DU-1
8.1.1	DIRECT EXPOSURE TO INVERTEBRATES IN DU-1
8.1.2	BIOACCUMULATION IN DU-1
8.1.3	INDIRECT EXPOSURE TO HIGHER TROPHIC LEVEL RECEPTORS IN DU-1
8.2	SUMMARY OF RISK IN DU-2
8.2.1	DIRECT EXPOSURE TO INVERTEBRATES IN DU-2
8.2.2	BIOACCUMULATION IN DU-2
8.2.3	INDIRECT EXPOSURE TO HIGHER TROPHIC LEVEL RECEPTORS IN DU-2
8.3	SUMMARY OF RISK IN DU-3
8.3.1	DIRECT EXPOSURE TO INVERTEBRATES IN DU-3
8.3.2	BIOACCUMULATION IN DU-3
8.3.3	INDIRECT EXPOSURE TO HIGHER TROPHIC LEVEL RECEPTORS IN DU-3

8.4	SUMMARY OF COECS BY DU
8.5	SPATIAL DISTRIBUTION OF TOXIC SEDIMENTS
9.0	REFERENCES

TABLES (THESE ARE EXAMPLES – REVISE AS APPROPRIATE FOR YOUR SITE)

CHAPTER 2 TABLES	
•	APPROXIMATE AREAS OF EXPOSURE UNITS
•	SLERA ASSESSMENT AND MEASUREMENT ENDPOINTS
•	SEDIMENT SCREENING VALUES
•	SURFACE WATER SCREENING VALUES
•	AVIAN TOXICITY REFERENCE VALUES
•	MAMMALIAN TOXICITY REFERENCE VALUES
•	SUMMARY OF HIGHEST SURFACE SEDIMENT HQS WITHIN EACH ANALYTICAL GROUP – DU-1
•	SUMMARY OF SURFACE WATER HQS GREATER THAN 1.0 – DU-1
•	MAXIMUM SLERA HQS FOR BIRDS AND MAMMALS – DU-1
	(REPEAT SET OF 3 TABLES ABOVE FOR EACH DU)
•	SLERA SUMMARY: DU-1
•	SLERA SUMMARY: DU-2
•	SLERA SUMMARY: DU-3
CHAPTER 3 TABLES	
•	DISTRIBUTION AND ABUNDANCE OF TARGET ORGANISMS AT THE SITE
•	BERA ASSESSMENT AND MEASUREMENT ENDPOINTS
CHAPTER 4 TABLES	

•	HQS: SURFACE SEDIMENT UCL95/SCREENING CRITERION, DU-1 (REPEAT FOR EACH DU)
•	HQS: SURFACE WATER UCL95/SCREENING CRITERION, DU-1 (REPEAT FOR EACH DU)
•	SUMMARY OF Σ SEM – AVS/ FOC RESULTS
•	SEDIMENT PORE WATER HAZARD QUOTIENTS
•	PAH POTENCY RATIOS IN SEDIMENT PORE WATER
•	BIOASSAY RESULTS
•	REGRESSION ANALYSIS OF POTENTIAL STRESSORS WITH BIOASSAY RESULTS
•	BIOTA-SEDIMENT ACCUMULATION FACTORS > 1.0
•	BIOACCUMULATION, SURVIVAL, AND GROWTH RESULTS
•	BSAFS BASED ON LABORATORY BIOACCUMULATION
•	CRITICAL BODY RESIDUES IN INVERTEBRATES
•	SURFACE WATER HQS: FISH
•	FISH WHOLE BODY UCL95 CONCENTRATIONS BY DU AND GUILD
•	BERA HQS FOR BIRD 1
•	BERA HQS FOR BIRD 2
•	BERA HQS FOR MARINE MAMMAL 1
•	BERA HQS FOR MARINE MAMMAL 2

CHAPTER 5 TABLES

•	SUMMARY OF INVERTEBRATE MEASUREMENT ENDPOINT RESULTS
•	RELATIVE ELEVATED CONCENTRATIONS OF CHEMICALS IN FISH BY FORAGING GUILD AND DU
•	COPECS FOR FISH
•	DIETARY RISK TO BIRD 1
•	DIETARY RISK TO BIRD 2
•	DIETARY RISK TO BIRD 3
•	DIETARY RISK TO MARINE MAMMAL 1

	•	DIETARY RISK TO MARINE MAMMAL 2
CHAPTER 6 TABLES		
	•	BERA SUMMARY: DU-1
	•	BERA SUMMARY: DU-2
	•	BERA SUMMARY: DU-3
	•	SUMMARY OF COECS BY DU
	•	SPATIAL DISTRIBUTION OF TOXIC SEDIMENTS AT THE SITE
	•	LOCATIONS WARRANTING FURTHER INVESTIGATION

FIGURES (THESE ARE EXAMPLES – REVISE AS APPROPRIATE FOR YOUR SITE)

	•	LOCATION OF DECISION UNITS
	•	ECOLOGICAL CONCEPTUAL SITE MODEL (PER DU, IF APPROPRIATE)
	•	FOOD WEB OF SELECTED RECEPTORS
	•	SURFACE SEDIMENT SAMPLING REFERENCE LOCATIONS
	•	RESULTS OF SEDIMENT TOXICITY TESTS

APPENDICES (THESE ARE EXAMPLES – REVISE AS APPROPRIATE FOR YOUR SITE)

	•	BERA WP/SAP
	•	SPECIES KNOWN OR EXPECTED TO OCCUR AT THE SITE (WITH STATUS OF LEGAL PROTECTION)
	•	ALL SCREENING AND DATA SUMMARIES
	•	BIRD AND MAMMAL FOOD CHAIN MODELING <ul style="list-style-type: none"> • SPECIES PROFILES • DOSE PARAMETERS FOR EACH RECEPTOR • HAZARD QUOTIENT SUMMARIES FOR EACH RECEPTOR (SITE AND REFERENCE LOCATION)

