

DOE/OR/22012--T12

STANDARD REPORT FORM

STATIC RENEWAL TESTS USING PIMEPHALES PROMELAS
(FATHEAD MINNOWS) AND CERIODAPHNIA DUBIA (DAPHNIDS)

Test Title: Clinch River - Environmental Restoration Program (CR-ERP)
Study, Ambient Water Toxicity

Principal Investigator: Cynthia L. Russell

Starting Date: July 22, 1993

Ending Date: July 29, 1993

1.0 EXECUTIVE SUMMARY

Clinch River - Environmental Restoration Program (CR-ERP) personnel and Tennessee Valley Authority (TVA) personnel conducted a study during the week of July 22-29, 1993, as described in the Statement of Work (SOW) document. [1] The organisms specified for testing were larval fathead minnows, Pimephales promelas, and the daphnid, Ceriodaphnia dubia. Surface water samples were collected by TVA Field Engineering personnel from Clinch River Mile 19.0 and Mile 22.0 on July 21, 23, and 26. Samples were split and provided to the CR-ERP and TVA toxicology laboratories for testing.

Exposure of test organisms to these samples resulted in no toxicity (survival, growth, or reproduction) to either species in testing conducted by TVA.

2.0 SAMPLE COLLECTION/TREATMENTS

- 2.1 Test Sample Identification (Chemical/Effluent/Elutriate, etc.): Samples were collected for biomonitoring at the following two sites: Clinch River Mile 19.0, downstream of the mouth of White Oak Creek and upstream of Grubb Island, and Clinch River Mile 22.0, downstream of Melton Hill Dam and upstream of White Oak Creek. Clinch River samples were collected at approximately mid-channel.
- 2.2 Control and/or Dilution Water: Laboratory culture medium consisting of moderately hard reconstituted water was used as control and dilution water for toxicity tests. The water used for daphnid testing was enriched with 10 percent filtered Tennessee River water and selenium as described in Section 3.2.2.
- 2.3 Sample Dates and Times: Test samples were collected on July 21, 23, and 26, 1993. Collection times were between 0900 and 1200 CDT.

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- 2.4 Sampling Method: All samples were collected using an Isco peristaltic pump with the inlet tubing lowered to approximately 1.0-1.5 meters below the surface. Pumping rate was approximately two liters per minute. A 20 L composite was collected at each station and partitioned (split) according to the workplan for shipping to the TVA Aquatic Research Laboratory (ARL) at Browns Ferry Nuclear Plant site or direct transfer to ORNL (DOE) personnel in the field.
- 2.5 Pertinent Site Conditions: Weather conditions were clear and sunny during sampling on July 21, 23, and 26.
- 2.6 Sample Storage/Handling: All samples were placed on ice in ice chests after partitioning. Zero headspace was established in each container by filling full and expressing any air bubbles before sealing. Samples remained on ice until shipped or transferred directly to ORNL (DOE) personnel. Excess composite sample was discarded. Samples were stored in refrigerators at $4^{\circ}\text{C} \pm 1^{\circ}\text{C}$ after arrival at the Aquatic Research Laboratory (ARL).
- 2.7 Sample Transport: Samples collected on July 21, 23, and 26 were transported to Browns Ferry Nuclear Plant by overnight TVA mail courier. Personnel from ARL picked up samples from the mailroom and transported them to ARL.
- 2.8 Sample Pretreatment: Sample temperature was raised to 25°C in a warm water bath and samples were aerated as necessary to bring DO levels down to near 100 percent saturation. Adequate water for use in test initiation or daily renewal was filtered through a 100 μm nylon mesh filter into 2000 mL beakers, and appropriate dilutions were prepared where applicable.
- 2.9 Test Treatments: Samples from Clinch River Mile 19.0 and Mile 22.0 were tested at 100 percent (undiluted) and diluted to 50-percent using the appropriate culture media.

3.0 TEST ORGANISMS/CULTURING CONDITIONS

3.1 Species: Pimephales promelas, Fathead minnow

3.1.1 Source: ARL inhouse culture

3.1.2 Culture Water: Culture medium consisted of 50 percent dechlorinated tap water and 50 percent moderately hard reconstituted water. Dechlorination was achieved by activated carbon filtration and verified by DPD titration. Reagents for reconstituted water were added to reverse osmosis product water.

Both waters were passed through a pack column degasser to bring dissolved gases to saturation. Culture medium was continuously aerated to help ensure aseptic conditions. Total hardness was approximately 95 mg/L as CaCO_3 .

3.1.3 Temperature of Culture: $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$

3.1.4 General Maintenance: Adult fathead minnows are maintained in glass aquaria in a flow through recirculating system. Flow rate to aquaria used for spawning is one aquarium volume per hour.

Approximately 20 percent of the water volume is replaced twice weekly. Adults are fed three times daily. Sexually mature fish are placed in 21-L glass aquaria (one male, four females) and reproduction is checked and recorded daily. Spawns are removed from aquaria and incubated in 1-L glass beakers under aeration to the proper stage of development for the target test.

Fish health is monitored regularly and corrective action is taken if necessary. Spawning frequency from individual aquaria is tracked and sexually spent individuals are replaced as necessary. Every 4-6 months a group of the same age fish from at least three spawns is reared to adults for replacement spawners.

3.1.5 Spawn Date: July 17, 1993

3.1.6 Hatch Date/Time: July 21, 1993/1015 CDT - July 22, 1993/0645 CDT

3.1.7 Culture/Acclimation Water: Moderately hard reconstituted water

3.1.8 Acclimation Temperature: $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$

3.1.9 Mean Dry Weight at Start of Test: 0.06 mg

3.1.10 Diseases and Treatment: None.

3.1.11 Food and Feeding: Larvae were fed brine shrimp (Artemia) nauplii <24-h old twice daily beginning after hatching to ensure food availability if larvae began feeding prior to test initiation.

3.2 Species: Ceriodaphnia dubia, daphnids

3.2.1 Source: Inhouse culture, TVA, Aquatic Research Laboratory

3.2.2 Culture Water: Moderately hard reconstituted water containing 10 percent filtered Tennessee River water and 1.0 ppb selenium. [2] Total hardness was approximately 95 mg CaCO_3/L .

3.2.3 Temperature of Culture: $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$

3.2.4 General Maintenance: Adults used to produce neonates for test initiation are selected as neonates from broods as described below on 2 or 3 consecutive days 6-10 days prior to test initiation. (Adults up to 14 days old may be used for neonate production.) These animals are raised individually (a brood may be raised as a group until Day 3 at which time animals are transferred to

individual cups), and a record is made of their reproduction. Their fourth brood is generally the second brood with 8 or more young and is the earliest brood used for test initiation.

Mass cultures may also be maintained in 8-L glass battery jars in light and temperature controlled incubators. New cultures are started weekly (7-10 days) with approximately 50 neonates. These neonates are selected from the third or fourth brood of the adult, from broods containing 8 or more young.

- 3.2.5 Food and Feeding: Food used for Ceriodaphnia cultures and this study was obtained from a commercial source (Aquastar) and consists of YCT and Selenastrum prepared according to EPA requirements. Individual animals contained in cups with 15 mL medium were fed 0.1 mL food and algae at renewal.

4.0 TEST METHODS

- 4.1 Fathead Minnow (Pimephales promelas) Larval Survival and Growth Test, EPA Test Method 1000.0. [3]
- 4.1.1 Modification/Amendments to Method 1000.0:
- 4.1.1.1 A 100-micron mesh nylon screen was used to filter samples rather than a 60-micron mesh as described in EPA methods.
- 4.1.1.2 The Clinch River Mile 19.0 sample storage temperature on Day 6 and the Clinch River Mile 22.0 sample storage temperature on Day 1 were below the prescribed $4^{\circ}\text{C} \pm 1^{\circ}$. These temperatures were 2.8°C and 2.5°C , respectively. Temperatures of samples received on ice ranged from 1.7°C to 3.7°C .
- 4.1.2 Date/Time Test Initiated: July 22, 1993/1010 CDT
- 4.1.3 Date/Time Test Terminated: July 29, 1993/0930 CDT
- 4.1.4 Test Chamber: 600-mL borosilicate glass beakers
Volume per chamber: 350 mL
- 4.1.5 Number of Test Organisms per Chamber: 10
- 4.1.6 Number of Replicates per Treatment: 4
- 4.1.7 Dilution Water/Control Water: Moderately hard reconstituted water
- 4.1.8 Renewal Period: 24-h
- 4.1.9 Test Temperature: $25.0^{\circ}\text{C} \pm 1^{\circ}\text{C}$
- 4.1.10 Feeding Regime During Test: Fathead minnow larvae were fed brine shrimp (Artemia) nauplii <24-h old 3 times daily ad libitum.

- 4.1.11 Physical and Chemical Parameters Measured: Parameters measured daily (initially) on test solutions and control waters were temperature (temperature was adjusted to equal "final" temperature before renewal), DO, pH and conductivity. In addition, alkalinity, hardness, and total residual chlorine were measured on each new sample at the time of first use (7/22, 7/24 and 7/27).

Final measurements taken daily before renewal were temperature and DO in every test beaker and pH and conductivity in one replicate per treatment. Mean values and ranges are reported in section 6.3.

4.1.12 Statistics:

Revised statistical procedures contained in the second edition of EPA's short-term chronic toxicity methods require a decision process for testing statistical assumptions before selecting a specific test method to determine toxicity endpoints. [3] Decision processes followed for testing survival and sublethal (growth) effects are shown in sections 6.1.2.2 and 6.1.3.1. Based on tests for normal distribution and homogenous variance of data, the statistical test used for endpoint determination of survival data was Steel's Many-one Rank Test and for growth data was Dunnett's Test.

4.2 Geriodaphnia Survival and Reproduction Test, EPA Test Method 1002.0. [3]

4.2.1 Modifications/Deviations to Method 1002.0:

4.2.1.1 Enriched culture medium (see Section 3.2.2.).

4.2.1.2 A 100-micron mesh nylon screen was used to filter samples rather than a 60-micron mesh as described in EPA methods.

4.2.1.3 The Clinch River Mile 19.0 sample storage temperature on Day 6 and the Clinch River Mile 22.0 sample storage temperature on Day 1 were below the prescribed $4^{\circ}\text{C} \pm 1^{\circ}$. These temperatures were 2.8°C and 2.5°C , respectively. Temperatures of samples received on ice ranged from 1.7°C to 3.7°C .

4.2.2 Date/Time Test Initiated: July 22, 1993/1045 CDT

4.2.3 Date/Time Test Terminated: July 29, 1993/1000 CDT

4.2.4 Test Chamber: 1-ounce plastic cups (Plastics, Inc., #P.I.-1)
Volume per Chamber: 15 mL

4.2.5 Number of test organisms per chamber: 1

4.2.6 Number of replicates per treatment: 10

- 4.2.7 Dilution Water/Control Water: Enriched moderately hard reconstituted water
- 4.2.8 Renewal Period: 24 hours
- 4.2.9 Test Temperature: $25.0^{\circ}\text{C} \pm 1^{\circ}\text{C}$
- 4.2.10 Feeding Regime During Test: Each organism was fed 0.1 mL of prepared food and algae concentrate daily (added to renewal water before introduction of test organism).
- 4.2.11 Physical and Chemical Parameters Measured: Parameters measured daily ("initial") on test solutions and control waters were temperature (temperature was adjusted to equal "final" temperature before renewal), DO, pH and conductivity. In addition, alkalinity, hardness, and total residual chlorine were measured on each new sample at the time of first use (7/22, 7/24, and 7/27).
- "Final" measurements of temperature were made in 10 randomly selected cups when the tray was removed from the incubator. DO and pH were measured daily in 1 cup per treatment following renewal. Mean values and ranges are reported in section 6.3.

4.2.12 Statistics:

Revised statistical procedures contained in the second edition of EPA's short-term chronic toxicity methods require decision process for testing statistical assumptions before selecting a specific statistical test to determine toxicity endpoints. [3] Fisher's Exact Test was used to evaluate Ceriodaphnia survival effects during the study. Statistical evaluation of daphnid reproduction was not required because all treatment values were greater than the control.

5.0 QUALITY ASSURANCE

- 5.1 Toxicity Test Methods: All phases of the study including, but not limited to, sample collection, handling and storage; glassware preparation; test organism culturing/acquisition and acclimation; test organism handling during test; and maintaining appropriate test conditions were conducted according to the protocol as described in this report and EPA/600/4-89/001. [3] Any known deviations were noted during the study and are reported herein.
- 5.2 Physical and Chemical Methods
- 5.2.1 Reagents, Titrants, Buffers, etc.: All chemicals were certified products used before expiration dates (where applicable). All ARL chemicals are recorded in a bound Laboratory Chemical Logbook and specific chemicals used were documented on a chemical record sheet contained in the study notebook.

- 5.2.2 Instruments: All identification, service, calibration, and standardization information pertaining to ARL laboratory instruments is contained in bound Laboratory Instrument Logbooks and specific instruments used were documented on an instrument record sheet contained in the study notebook.
- 5.2.3 Temperature was measured using glass mercury thermometers. The instrument was standardized and inspected with readings made according to TVA procedure DS-42.11. [4]
- 5.2.4 Dissolved oxygen was measured using a YSI Model 57 oxygen meter. The instrument was standardized (using the Winkler method) and readings were taken according to TVA procedures S&F DS-43.6 and DS-42.4, respectively. [4]
- 5.2.5 The pH was measured using an Orion Model SA250 meter equipped with an Orion Ross combination electrode. The instrument was standardized and readings were made according to TVA procedures DS-43.7 and DS-42.8, respectively. [4]
- 5.2.6 Conductance was measured using a YSI Model 32 SCT meter. The instrument was standardized and readings were taken according to TVA procedures DS-43.3 and DS-42.3, respectively. [4]
- 5.2.7 Alkalinity was measured by titration of 100 mL samples with 0.02 N H_2SO_4 to an end point of 4.5 according to TVA procedure DS-42.1. [4]
- 5.2.8 Hardness was determined by titration of 50 mL samples with EDTA to a colorimetric endpoint using an indicator (Instructions provided by Reagent Manufacturer [Calgon]), Schwarzenbach Method.
- 5.2.9 Total residual chlorine (TRC) was determined using the DPD Titrimetric Method according to TVA procedure DS-42.9, Rev. 0. [4]
- 5.3 Reference Toxicant Tests
- 5.3.1 Test Type: Fish - 7-day chronic (NOEC)
Daphnids - 7-day chronic (NOEC)
- 5.3.2 Standard Toxicants Used:
Copper Sulfate Reference Toxicant Solution - fish and daphnids
Source/Brand: EPA
- 5.3.3 Dilution Water Used: Moderately hard reconstituted water (enriched for daphnids) - fish and daphnid chronic.
- 5.3.4 Statistics: Chronic Test, FH Survival/Growth and Ceriodaphnia Reproduction, NOEC - Dunnett's Test or Steel's Many-one Rank Test, EPA Bootstrap Procedure - IC₂₅
Ceriodaphnia Survival - Fisher's Exact Test

6.0 RESULTS

6.1 Fathead Minnow Larval Survival and Growth Test

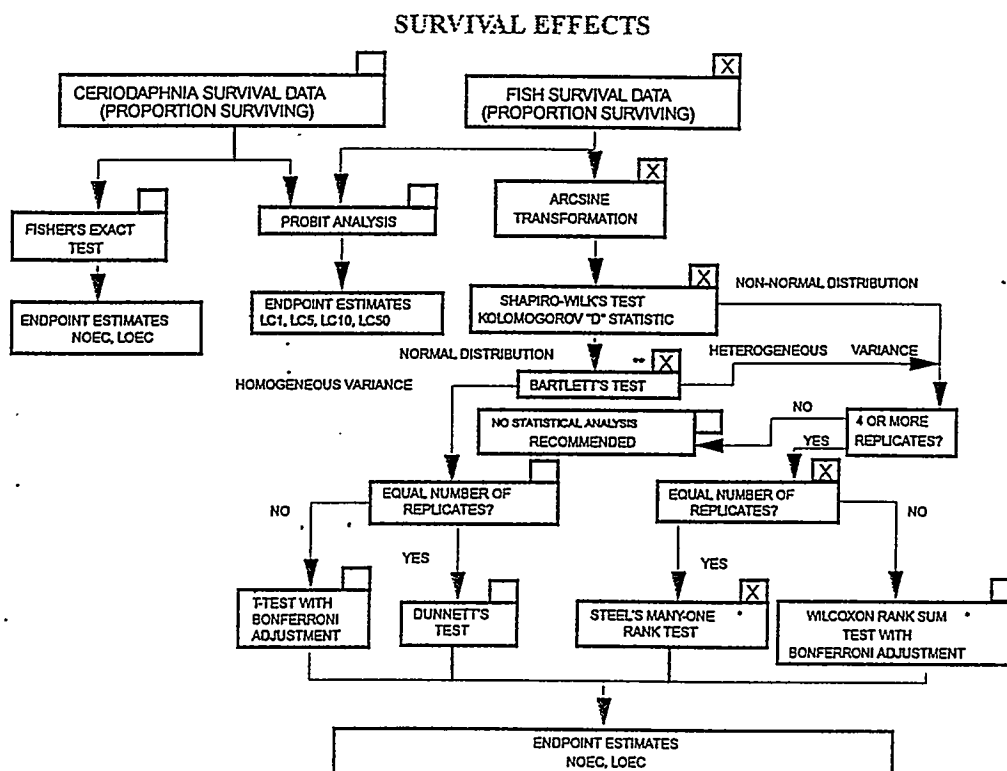
6.1.1 Summary of Results: No survival or growth effects were demonstrated in fathead minnows exposed to Clinch River Mile 19.0 or Mile 22.0 samples during the CR-ERP Ambient Water Toxicity Study conducted from July 22-29, 1993.

6.1.2 Results, Survival Data:

6.1.2.1 Daily Percent Survival Summary for Fathead Minnow Larval Survival Test, CR-ERP Study, July 22-29, 1993.

Treatment	Total Daily % Survival						
	Day 1	2	3	4	5	6	7
Medium	100	100	100	100	100	100	100
CRM 19.0-50%	100	100	100	100	100	100	100
CRM 19.0-100%	100	100	100	100	100	100	100
CRM 22.0-50%	100	100	100	100	100	100	100
CRM 22.0-100%	100	100	100	100	100	98	98

6.1.2.2 Statistical Decision Process for Determining Toxicity Endpoints for 7-Day Survival of Fathead Minnows, CR-ERP Study, July 22-29, 1993.



6.1.2.3 Analysis of Survival Data Using Steel's Many-one Rank Test for Fathead Minnow 7-Day Larval Survival Test, CR-ERP Study, July 22-29, 1993.

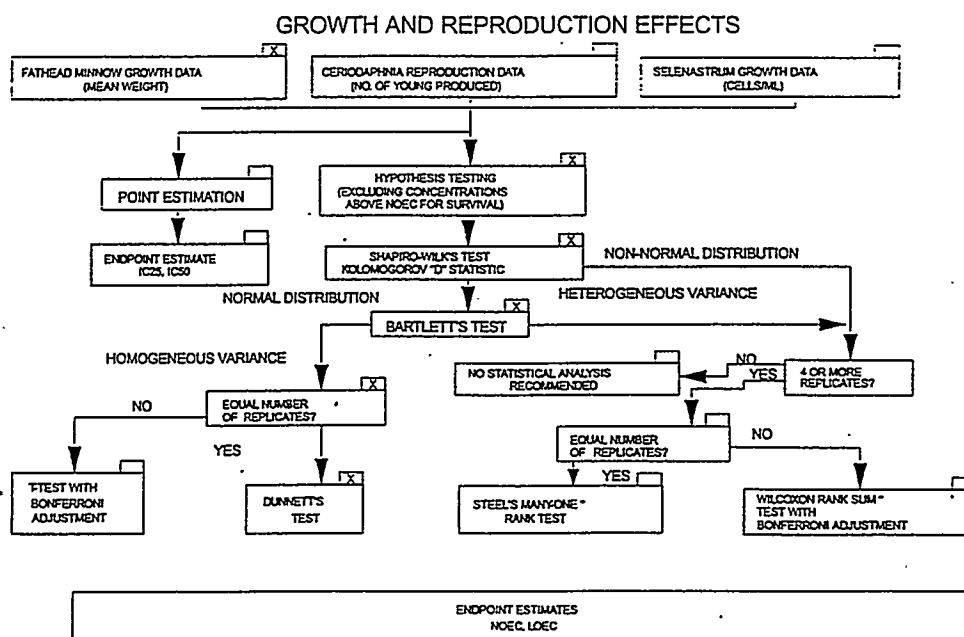
Group	Survival (%) Data										Mean	S*
	Replicate											
	1	2	3	4	5	6	7	8	9	10		
Medium	100	100	100	100							100	
CRM 19.0–50%	100	100	100	100							100	
CRM 19.0–100%	100	100	100	100							100	
CRM 22.0–50%	100	100	100	100							100	
CRM 22.0–100%	100	100	90	100							98	

Steel's Many-one Rank Test			
Treatment	Replicates	Critical Rank Sum	Rank Sum*
CRM 19.0-50%	4	10	18.0
CRM 19.0-100%	4	10	18.0
CRM 22.0-50%	4	10	18.0
CRM 22.0-100%	4	10	16.0

*Values less than or equal to the Critical Rank Sum are significantly less than the control (Medium).

6.1.3 Results, Growth Data:

6.1.3.1 Statistical Decision Process for Determining Toxicity Endpoints for 7-Day Growth of Fathead Minnows, CR-ERP Study, July 22-29, 1993.



* Test requires 4 replicates/treatment

6.1.3.2 Analysis of Dry Weight (mg) Data Using Dunnett's Test for Fathead Minnow 7-Day Larval Growth Test, CR-ERP Study, July 22-29, 1993.

No transformation applied before data analysis. For this set of data, the minimum significant difference is 0.09.

This represents an 18.42% decrease in dry weight, mg.

T = 2.36 Alpha = 0.05 (one-tailed test)

Treatment	Growth Data (mg)										Mean	S*
	Replicate											
	1	2	3	4	5	6	7	8	9	10		
Medium	0.43	0.55	0.43	0.47								0.47
CRM 19.0-50%	0.47	0.42	0.48	0.53								0.47
CRM 19.0-100%	0.49	0.54	0.39	0.43								0.46
CRM 22.0-50%	0.43	0.53	0.46	0.44								0.47
CRM 22.0-100%	0.48	0.38	0.45	0.42								0.43

*Values significantly less than the control (Medium). EMS = 0.003.

6.2 Ceriodaphnia Survival and Reproduction Test

6.2.1 Summary of Results: No survival or reproduction effects were demonstrated in daphnids exposed to Clinch River Mile 19.0 or Mile 22.0 samples during the CR-ERP Ambient Water Toxicity Study conducted from July 22-29, 1993.

6.2.2 Results, Survival Data:

6.2.2.1 Daily percent survival summary for Ceriodaphnia Survival Test, CR-ERP Study, July 22-29, 1993.

Treatment	Total Daily % Survival					
	1	2	3	4	5	6
Medium	100	100	100	100	100	100
CRM 19.0-50%	100	100	100	100	100	100
CRM 19.0-100%	100	100	100	100	100	100
CRM 22.0-50%	100	100	100	100	100	100
CRM 22.0-100%	100	100	100	100	100	100

6.2.3 Results, Reproduction Data:

6.2.3.1 Statistical Decision Process for Determining Toxicity Endpoints for 7-Day (3-Brood) Reproduction of Ceriodaphnia, CR-ERP Study, July 22-29, 1993.

Not applicable.

6.2.3.2 Reproduction (# young/female/7 days) Data for Ceriodaphnia (7-Day)
Reproduction Test, CR-ERP Study, July 22-29, 1993.

Treatment	Reproduction (# young/female/7 days) Data										Mean	S*
	Replicate											
	1	2	3	4	5	6	7	8	9	10		
Medium	17	22	20	21	20	21	18	21	16	14	19.00	
CRM 19.0-50%	17	16	22	20	20	21	22	21	24	18	20.10	
CRM 19.0-100%	18	21	17	41	18	19	25	23	20	13	21.50	
CRM 22.0-50%	19	19	21	24	23	22	25	22	18	19	21.20	
CRM 22.0-100%	22	25	24	27	21	19	33	22	16	22	23.10	
TR	18	18	19	23	24	22	22	22	9	14	19.10	

*Indicates values significantly less than control (TR).

6.3 Physical/Chemical Parameters

6.3.1 Overall Test Temperature

6.3.1.1 Fathead Minnow: 24.9°C (24.5°-25.2°C)

6.3.1.2 Ceriodaphnia: 25.3°C (25.1°-25.6°C)

6.3.2 Water chemistry summary for CR-ERP Study, July 22-29, 1993.

See: Appendix A Water Chemistry Mean Values and Ranges
for Fathead Minnow and Ceriodaphnia Tests,
CR-ERP Study, July 22-29, 1993

6.4 Reference Toxicant Tests

6.4.1 -Summary of Results:

Reference toxicant tests conducted prior to CR-ERP Study showed
chronic results consistent with ARL control chart ranges for
fathead minnows and daphnids.

6.4.2 Fathead Minnows

6.4.2.1 Date/Time of Most Recent Test:
July 6, 1993/1055 CDT to July 13, 1993/1000 CDT

6.4.2.2 LOEC: 0.02 mg Cu/L
NOEC: 0.008 mg Cu/L
IC₂₅: 0.012 mg Cu/L

6.4.2.3 Control Chart Information:

Number of standard tests completed by laboratory: 45

LOEC Range: 0.008-0.02 mg Cu/L (one concentration increment)

NOEC Range: 0.003-0.008 mg Cu/L (one concentration increment)

IC₂₅ Range: 0.004-0.012 mg Cu/L

6.4.3 Ceriodaphnia

6.4.3.1 Date/Time of most recent test:

July 12, 1993/0935 GDT to July 18, 1993/1028 GDT

6.4.3.2 LOEC: 0.05 mg Cu/L

NOEC: 0.02 mg Cu/L

IC₂₅: 0.026 mg Cu/L

6.4.3.3 Control Chart Information:

Number of standard tests completed by laboratory: 43

LOEC Range: 0.008-0.05 mg Cu/L (two concentration increments)

NOEC Range: 0.003-0.02 mg Cu/L (two concentration increments)

IC₂₅ Range: 0.011-0.030 mg Cu/L

7.0 CONCLUSION

Tests conducted using Clinch River Mile 19.0 and Mile 22.0 samples collected on July 21, 23, and 26 showed no toxicity (survival, growth, or reproduction effects) to fathead minnows or Ceriodaphnia.

8.0 REFERENCES

1. Phipps, T. L., and L. A. Kszos, Statement of Work, Environmental Sciences Division, Biomonitoring Group, Oak Ridge National Laboratory (April 1993, revised June 1993).
2. Weber, C. I. (ed.), Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms, EPA/600/4-90/027 (September 1991).
3. Weber, C. I., W. H. Peltier, T. J. Norberg-King, W. B. Horning, F. A. Kessler, J. R. Menkdick, T. W. Neiheisel, P. A. Lewis, D. J. Klemm, Q. H. Pickering, F. L. Robinson, J. M. Lazorchak, L. J. Wymer, and R. W. Freyberg. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms. EPA/600/4-89/001 (March 1989) and EPA/600/4-89/001a (September 1989).
4. Field Operations Natural Resource Engineering Procedures Manual, Vol. 1, Division of Natural Resource Operations, Tennessee Valley Authority.

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Appendix A

Water Chemistry Mean Values and Ranges for Fathead Minnow and Ceriodaphnia Tests, CR-ERP Study, July 22-29, 1993

Source	Temperature		Dissolved Oxygen			pH		Conductivity		Alk	Hardness		Chlorine
	Fish	Cerio	Initial	Final	Final	Initial	Final	Initial	Final		Initial	Initial	
	(°C)	(°C)	(mg/L)	(mg/L)	(mg/L)	(S.U.)	(S.U.)	(µmhos)	(µmhos)	*	*	(mg/L)	
CRM 19.0-50% w/F.Medium†	24.9 (24.5-25.2)	- (25.1-25.6)	8.4 (8.3-8.4)	6.0 (5.2-6.5)	-	7.9 (7.7-8.1)	7.8 (7.7-7.9)	304 (298-308)	307 (301-312)	-	-	-	-
CRM 19.0-50% w/E.Medium‡	-	25.3 (25.1-25.6)	8.3 (8.3-8.4)	-	7.4 (7.3-7.5)	7.9 (7.8-8.1)	-	294 (289-296)	-	-	-	-	-
CRM 19.0-100%	24.9 (24.5-25.2)	25.3 (25.1-25.6)	8.3 (8.3-8.4)	6.0 (5.6-6.5)	7.4 (7.3-7.5)	7.7 (7.5-7.9)	7.9 (7.8-7.9)	270 (268-276)	273 (270-280)	105 (104-105)	123.7 (121.4-128.3)	<0.1 (<0.1-0.1)	
CRM 22.0-50% w/F.Medium†	24.9 (24.8-25.1)	-	8.3 (8.3-8.4)	6.0 (5.3-6.5)	-	7.9 (7.7-8.1)	7.8 (7.7-7.8)	302 (298-306)	306 (300-311)	-	-	-	-
CRM 22.0-50% w/E.Medium‡	-	25.3 (25.1-25.6)	8.3 (8.3-8.4)	-	7.4 (7.3-7.4)	8.0 (7.8-8.1)	-	293 (291-294)	-	-	-	-	-
CRM 22.0-100%	24.9 (24.6-25.2)	25.3 (25.1-25.6)	8.3 (8.3-8.4)	6.1 (5.5-6.5)	7.4 (7.2-7.4)	7.8 (7.5-8.1)	7.9 (7.9-8.0)	269 (267-270)	271 (270-273)	106 (105-108)	124.3 (123.1-124.8)	<0.1 (<0.1-0.1)	
Fish Medium†	24.8 (24.5-25.1)	-	8.3 (8.2-8.3)	6.3 (5.9-6.7)	-	8.2 (8.1-8.3)	7.8 (7.8-7.9)	342 (335-348)	344 (335-350)	-	-	-	-
Enriched Medium‡	-	25.3 (25.1-25.6)	8.3 (8.2-8.3)	-	7.4 (7.3-7.5)	8.2 (8.1-8.3)	-	324 (320-328)	-	-	-	-	-
TR	-	25.3 (25.1-25.6)	6.9 (6.6-7.4)	-	7.4 (7.2-7.5)	7.9 (7.6-8.2)	-	160 (156-162)	-	53 (50-55)	61.6 (59.9-66.7)	<0.1 (<0.1-0.1)	

*mg/L as CaCO3

†Fathead Minnow Test

‡Ceriodaphnia Test

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ATTACHMENT I

CR-ERP AMBIENT WATER TOXICITY STUDY
Chain-of-Custody Forms - Originals

24-1-85

FCOC Rev. 4 01JUL93

DOCUMENT ID:

FIELD CHAPTER OF CUSTODY

TVA $\rightarrow$ B. Ferry

[illegible]

TV A $\rightarrow$ B. ferry

FCC Rev. 4 01JUL93

DOCUMENT ID:

ATTACHMENT II

CR-ERP AMBIENT WATER TOXICITY STUDY
Toxicity Test Bench Sheets and Statistical Analyses

ARL CHRONIC TOXICITY TEST MASTER CHECKLIST

Study: DOEDate Issued: 7-19-93 To: DRH From: Jm

1. Test organism availability: FH Minnows-T.L.* ✓ C.U.† ✓ Date Jm
Daphnids - T.L. ✓ C.U. ✓ Date (6-22-93)

2. Sample Collection Coordination: Date 7-19 By Jm With L. Graser
T. Phipps

3. Glassware availability: T.L. OK Tech. E.E.P. Date 7-21-93

4. Glassware prep. complete: Date 7-21-93 By OK

5. Data Sheet prep. complete: Date 7-22-93 By OK

6. Test organism availability verification: FH-OK? TS Daphnids-OK? OK

7. FH Minnow acclimation:

Day 1 2

By W/A

8. Test Initiation: FH-Date/Time 7/22/93/10:10 Daphnid-Date/Time 7-22-93/10:45
FH Sample, By: OK

9. Test Renewal:	Day #:	0	1	2	3	4	5	6	7
Log Samples	- T.L.	<u>OK</u>	<u>N/A</u>	<u>OK</u>	<u>N/A</u>	<u>N/A</u>	<u>OK</u>	<u>OK</u>	<u>N/A</u>
	T.M.†		<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Initial Chem.	- T.L.	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>N/A</u>
	T.M.	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>N/A</u>
Final Chem.	- T.L.	<u>N/A</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>
	T.M.	<u>N/A</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>
F.H.	- T.L.	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>
	T.M.	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>
Daphnid	- T.L.	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>	<u>OK</u>
	T.M.	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>

10. Test Termination: FH-Date/Time 7-29-93/9:30 Daphnid-Date/Time 7-29-93/10:00
Clean-up, By: _____

11. Weigh Fish: Date 7-30-93 By OK

07-30-93 Cur
12. Run Stats: Date 07-29-93 By Cur

13. Report Prep.: Date 08-09-93 By Cur

14. Report Final: Date 8-18-93 By Jm Approved: NCW

*Team Leader

†Culture Unit

‡Team Member

CHRONIC STUDY (FATHEAD MINNOW) RECORD SHEET

Study DOE July 93
 Beginning Date/Time 7-22-93 / 10:10
 Ending Date/Time 7-29-93 9:30
 Personnel QH
 Control/Dilution Water F-med

Sample ID	Sample #	Used	Sample ID	Sample #	Used
1. <u>CPM 19</u>	<u>2008</u>	<u>7-22-93</u>	1. <u>CPM 22</u>	<u>2010</u>	<u>7-22-93</u>
2. <u>CPM 19</u>	<u>2008</u>	<u>7-23-93</u>	2. <u>CPM 22</u>	<u>2010</u>	<u>7-23-93</u>
3. <u>CPM 19</u>	<u>2037</u>	<u>7-24-93</u>	3. <u>CPM 22</u>	<u>2037</u>	<u>7-24-93</u>
4. <u>CPM 19</u>	<u>2037</u>	<u>7-25-93</u>	4. <u>CPM 22</u>	<u>2037</u>	<u>7-25-93</u>
5. <u>CPM 19</u>	<u>2037</u>	<u>7-26-93</u>	5. <u>CPM 22</u>	<u>2037</u>	<u>7-26-93</u>
6. <u>CPM 19</u>	<u>2066</u>	<u>7-27-93</u>	6. <u>CPM 22</u>	<u>2068</u>	<u>7-27-93</u>
7. <u>CPM 19</u>	<u>2066</u>	<u>7-28-93</u>	7. <u>CPM 22</u>	<u>2068</u>	<u>7-28-93</u>

Test Treatment Identification:

1. CPM 19 50%
2. CPM 19 100%
3. CPM 22 50%
4. CPM 22 100%
5. F-med
6. _____
7. _____
8. _____

Spawn Date	Tile #	Hatch Date/Time to Date/Time
<u>07-17-93</u>	<u>10, 13, 21, 22, 23, 25, 28</u>	<u>07-21-93 / 1015</u> <u>07-22-93 / 0645</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Test # _____
 LOEC > 100%
 NOEC > 100%
 Notes:

H 7/21 AF 1015
 BF 0645 7/22

7/17 Hs 10, 13, 21, 22, 23, 25, 28

FATHEAD MINNOW LARVAL SURVIVAL AND GROWTH TEST

Study DOE July 93

Beginning Date/Time 7-22-93/10:10

Ending Date/Time 07-29-93/0930

Personnel H. Russell

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Russell, Helen

— Number Alive —

Treatment	Rep	Day						
		1	2	3	4	5	6	7
CRM 19 50%	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	4	10	10	10	10	10	10	10
	By:	DL	DH	DH	DH	DH	DH	DH
CRM 19 100%	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	4	10	10	10	10	10	10	10
	By:	DH	DH	DH	DH	DH	DH	DH
CRM 22 50%	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	4	10	10	10	10	10	10	10
	By:	DH/TS	DH/TS	DH/TS	DH/TS	DH	DH/TS	DH/TS
CRM 22 100%	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10 ⁹	9	9
	4	10	10	10	10	10	10	10
	By:	TS	TS	TS	TS	CR	TS	CR
F med	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	4	10	10	10	10	10	10	10
	By:	TS	TS	TS	TS	CR	TS	CR
	1							
	2							
	3							
	4							
	By:							

Notes:

A few fish that have been released but are small have been stuck in the mouth/side area and

AA one of the two mentioned above died.

Fed- Time/By:

0630/AT 0645/AT 0645/AT 0645/AT 0630/AT 0630/AT
1015/TS 4:56/AT 0930/AT 0945/TS 9:55/TS 10:00/AT 0945/TS
15:30/AT 15:30/AT 15:30/AT 15:45/AT 15:30/AT 01:53/AT

Dilution Water ID:

1402 1404 1404 1407 1408 1410

(PLARC501-257) Reviewed By:

DL DH DH DH DH DH DH

Analysis of Survival

DOE #2
Starting Date: 07/22/93

Survival (%) Data

Treatment	Replicate										Mean
	1	2	3	4	5	6	7	8	9	10	
MEDIUM	1.00	1.00	1.00	1.00	.	.	.	.	.	.	1.00
CRM19 50%	1.00	1.00	1.00	1.00	.	.	.	.	.	.	1.00
CRM19 100%	1.00	1.00	1.00	1.00	.	.	.	.	.	.	1.00
crm22 50%	1.00	1.00	1.00	1.00	.	.	.	.	.	.	1.00
crm22 100%	1.00	1.00	0.90	1.00	.	.	.	.	.	.	0.98

Steel's Many-One Rank Test

Treatment	No. of Replicates	Critical Rank Sum	Rank Sum*
RM19 50%	4	10	18
RM19 100%	4	10	18
rm22 50%	4	10	18
rm22 100%	4	10	16

* Values less than Critical Rank Sum significantly less than the control (MEDIUM).

FATHEAD DRY WEIGHT RECORD SHEET

Page 1 of 1Study/Date DOE July 93Personnel DHPans: Date/Time of Drying 7-29-93/7:00-8:00Fish: Date/Time of Drying 7-30-93/7:45-9:45Pans: Date/Time of Weighing 7-29-93/11:30-1:00Fish: Date/Time of Weighing 7-30-93/10:15-

Notes:

Sample ID	Tare Wt.	Tare + Fish Wt.	Fish Wt.	# Fish	Mean Wt.	Mean Wt. Difference
Initial	1. 1.03860	1.03921		10		
	2. 1.06234	1.02684		10		
	3. 1.03834	1.03890		10		
	4. 1.05305	1.05369		10		
Initial Mean Wt.						
19-502	1. 1.03689	1.04162		10		
	2. 1.04474	1.04893		10		
	3. 1.03236	1.03811		10		
	4. 1.12182	1.12661		9.6		
19-10092	1. 1.03410	1.03903		10		
	2. 1.11456	1.11993		10		
	3. 1.08257	1.08645		10		
	4. 1.11070	1.11502		10		
22-5050	1. 1.05444	1.05870		10		
	2. 1.02072	1.02600		10		
	3. 1.04893	1.05353		10		
	4. 1.05134	1.05570		10		
22-10090	1. 1.07163	1.07646		10		
	2. 1.06815	1.07193		10		
	3. 1.10938	1.11345		9		
	4. 1.04756	1.05177		10		
Fwed	1. 1.06745	1.07176		10		
	2. 1.03263	1.03813		10		
	3. 1.08797	1.09230		10		
	4. 1.10916	1.11388		10		
1.						
2.						
3.						
4.						

Reviewed By: Cur 6/30/93

FATHEAD DRY WEIGHT RECORD SHEET

Page 1 of 1

Study/Date DOE July 93 Rewt.

Personnel OH

Pans:Date/Time of Drying 7-30-93

Fish:Date/Time of Drying 7-30-93

Pans:Date/Time of Weighing 7-30-93

Fish:Date/Time of Weighing 7-30-93

Notes:

Sample ID	Tare Wt.	Tare + Fish Wt.	Fish Wt.	# Fish	Mean Wt.	Mean Wt. Difference
1.						
Initial 2. ✓	0.99854	0.99915	0.00061	10	0.00061	
3.						
4.						
Initial Mean Wt.						
1.						
2.						
3.						
4.						
CPM 1. ✓						
19.0 2. ✓	1.01396	1.01931	0.00535	10	0.00535	
100% 3. ✓	1.02484	1.02869	0.00385	10	0.00385	
4.						
1.						
2.						
3.						
4.						
1.						
2.						
3.						
4.						
1.						
2.						
3.						
4.						
1.						
2.						
3.						
4.						

Reviewed By: Cue

FATHEAD DRY WEIGHT RECORD SHEET

Study/Date: DOE #2

Personnel: DRH

Pans:Date/Time of Drying: 07-29-93/0700

Fish:Date/Time of Drying: 07-30-93/0745

Pans:Date/Time of Weighing: 07-29-93/1130

Fish:Date/Time of Weighing: 07-30-93/1015

Sample ID	Tare Wt.	Tare + Fish Wt.	Fish Wt.	# Fish	Mean Wt. grams	Mean Wt. Difference	Mean Wt. mg
1.	1.03860	1.03921	0.00061	10	0.000061	-	-
Initial	0.99854	0.99915	0.00061	10	0.000061		
2.	1.06234	1.02684	-0.03550	10	-0.003550	-	-
3.	1.03834	1.03890	0.00056	10	0.000056	-	-
4.	1.05305	1.05369	0.00064	10	0.000064	-	-
Initial						-0.0008422	
Mean Wt.						0.000061	
1.	1.06745	1.07176	0.00431	10	0.000431	0.001273	0.431
MEDIUM	2.	1.03263	1.03813	0.00550	10	0.000550	0.001392 0.550
3.	1.08797	1.09230	0.00433	10	0.000433	0.001275	0.433
4.	1.10916	1.11388	0.00472	10	0.000472	0.001314	0.472
1.	1.03689	1.04162	0.00473	10	0.000473	0.001315	0.473
CRM 19.0	2.	1.04474	1.04893	0.00419	10	0.000419	0.001261 0.419
50%	3.	1.03336	1.03811	0.00475	10	0.000475	0.001317 0.475
4.	1.12182	1.12661	0.00479	9	0.000532	0.001374	0.532
1.	1.03410	1.03903	0.00493	10	0.000493	0.001335	0.493
CRM 19.0	2.	1.11456	1.11993	0.00537	10	0.000537	0.001379 0.537
100%	3.	1.08257	1.08645	0.00388	10	0.000388	0.001230 0.388

Notes:

	4.	1.11070	1.11502	0.00432	10	0.000432	0.001274	0.432
=====								
	1.	1.05444	1.05870	0.00426	10	0.000426	0.001268	0.426
CRM 22	2.	1.02072	1.02600	0.00528	10	0.000528	0.001370	0.528
50%								
	3.	1.04893	1.05353	0.00460	10	0.000460	0.001302	0.460
	4.	1.05134	1.05570	0.00436	10	0.000436	0.001278	0.436
=====								
	1.	1.07163	1.07646	0.00483	10	0.000483	0.001325	0.483
CRM 22	2.	1.06815	1.07193	0.00378	10	0.000378	0.001220	0.378
100%								
	3.	1.10938	1.11345	0.00407	9	0.000452	0.001294	0.452
	4.	1.04756	1.05177	0.00421	10	0.000421	0.001263	0.421
=====								

Reviewed By: Russell

07-30-93 CRK

(1) 30.43
0.23

Analysis of 7-day Larval Growth Test

DOE #2

Starting Date: 07/22/93

Analysis of Dry Weight (mg) Data Dunnett's Test

No transformation applied before data analysis.

For this set of data, the minimum significant difference is 0.09

This represents a 18.42 % reduction in Dry Weight (mg).

T = 2.36 ALPHA = 0.05

Dry Weight (mg) Data

Replicate

TREATMENT	1	2	3	4	5	6	7	8	9	10	MEAN	S
MEDIUM	0.43	0.55	0.43	0.47	.	.	.	.	.	.	0.47	
2 CRM1950%	0.47	0.42	0.48	0.53	.	.	.	.	.	.	0.47	
3 CRM19100%	0.49	0.54	0.39	0.43	.	.	.	.	.	.	0.46	
4 CRM22 50%	0.43	0.53	0.46	0.44	.	.	.	.	.	.	0.47	
5 CRM22 100%	0.48	0.38	0.45	0.42	.	.	.	.	.	.	0.43	

Asterisk (*) indicates values significantly less than control (MEDIUM).

Analysis of Variance

Source	DF	Sum OF Sq.	Mean Sq.	Calc F	F(0.05)
Among	4	0.004	0.001	0.410	0.7975
Within	15	0.040	0.003		
Total	19	0.000			

DOE #2	072293 MINS	1 MEDIUM	10.00	10.00	10.00	10.00
	INITIAL NUMBER		10.00	10.00	10.00	10.00
DOE #2	072293 MINS	2 CRM19 50%	10.00	10.00	10.00	10.00
	INITIAL NUMBER		10.00	10.00	10.00	10.00
DOE #2	072293 MINS	3 CRM19 100%	10.00	10.00	10.00	10.00
	INITIAL NUMBER		10.00	10.00	10.00	10.00
DOE #2	072293 MINS	4 crm22 50%	10.00	10.00	10.00	10.00
	INITIAL NUMBER		10.00	10.00	10.00	10.00
DOE #2	072293 MINS	5 crm22 100%	10.00	10.00	10.00	10.00
	INITIAL NUMBER		10.00	10.00	9.00	10.00
				10.00	10.00	10.00

DOE #2	072293	MING	1	MEDIUM	0.43	0.55	0.43	0.47
DOE #2	072293	MING	2	CRM1950%	0.47	0.42	0.48	0.53
DOE #2	072293	MING	3	CRM19100%	0.49	0.54	0.39	0.43
DOE #2	072293	MING	4	CRM22 50%	0.43	0.53	0.46	0.44
DOE #2	072293	MING	5	CRM22 100%	0.48	0.38	0.45	0.42

CHRONIC STUDY (C. dubia) RECORD SHEET

Study DOE July 93.
 Beginning Date/Time 7-22-93 / 9:10:45
 Ending Date/Time 7-29-93 / 10:00 AM
 Personnel DN
 Control/Dilution Water C-med

Sample ID	Sample #	Used	Sample ID	Sample #	Used
1. CRM 19	2008	7-22-93	1. CRM 22	2010	7-22-93
2. CRM 19	2008	7-23-93	2. CRM 22	2010	7-23-93
3. CRM 19	2037	7-24-93	3. CRM 22	2039	7-24-93
4. CRM 19	2037	7-25-93	4. CRM 22	2039	7-25-93
5. CRM 19	2037	7-26-93	5. CRM 22	2039	7-26-93
6. CRM 19	2066	7-27-93	6. CRM 22	2068	7-27-93
7. CRM 19	2066	7-28-93	7. CRM 22	2068	7-28-93
8. _____	_____	_____	8. _____	_____	_____

Test Treatment Identification: _____

1. CRM 19.0 50%
2. CRM 19.0 100%
3. CRM 220 50%
4. CRM 220 100%
5. T.R.
6. C-med
7. _____
8. _____

Released From:

Date

Time

7-21-93 10:00pm

To:

Date

Time

7-22-93 6:00 AM

Test # _____

LOEC > 100%

NOEC > 100%

Notes:

Study: UCE July 93
 Beginning Date: 7-22-93
 Ending Date: 7-29-93

CERTODAPIINIA SURVIVAL AND REPRODUCTION TEST

Page 1 of 2
 Personnel: Harvey

Time: 10:45
 Time: 10:00

Number of Young/Day

Treatment	By Rep.	OH	OH	OH	DH	DH	DH	DH	Total Young
		1	2	3	4	5	6	7	
① CRM 19 50%	1	C	0	0	3	6	0	8	17
	2			0	3	6	0	7	16
	3			0	3	8	0	11	22
	4			0	4	8	8	0	20
	5			0	3	8	9	0	20
	6			0	4	7	10	0	21
	7			0	4	8	10	0	22
	8			0	4	8	0	9	21
	9	✓	✓	0	5	9	0	10	24
	10			0	4	7	7	0	18
② CRM 19 100%	1	0	0	0	3	8	0	9	18
	2			0	4	7	0	10	21
	3			0	0	4	6	7	17
	4			0	4	8	13	16	41
	5			0	3	6	9	0	18
	6			0	3	6	10	0	19
	7			0	4	7	14	0	25
	8			0	4	8	0	11	23
	9			0	3	8	9	0	20
	10	✓	✓	0	2	5	0	6	13
③ CRM 22 50%	1	0	0	0	3	6	10	0	19
	2			0	4	6	0	9	19
	3			0	4	8	9	0	21
	4			0	3	9	12	0	24
	5			0	4	8	11	0	23
	6			0	4	7	11	0	22
	7			0	4	9	12	0	25
	8			0	5	8	9	0	22
	9			0	3	7	0	8	18
	10	✓	✓	0	3	7	0	9	19
④ CRM 22 100%	1	0	0	0	4	7	0	11	22
	2			0	5	8	0	12	25
	3			0	4	8	0	12	24
	4			0	4	9	14	0	27
	5			0	3	6	12	0	21
	6			0	2	7	10	0	19
	7			0	4	7	10	12	26
	8			0	3	8	0	11	22
	9	✓	✓	0	0	6	0	10	16
	10			0	4	7	0	10	22

0 1 2 3 4 5 6 7 8

Chow ID#: 15-5 AS-5 AS-5 AS-5 AS-6 AS-6 AS-6

Algae ID#: 15-4 AS-4 AS-5 AS-5 AS-5 AS-5 AS-5

Dilution Water ID#: 1399 1399 1400 1400 1400 1405 1405

Reviewed By: SH SH DH DH DH

Notes:

PLARC501-310

CYL

CERIODAPHNIA SURVIVAL AND REPRODUCTION TEST

Page 2 of 2

Study: LOF July 93

Beginning Date: 7-22-93

Ending Date: 07-24-93

Time: 1045

Time: 1000

Personnel: _____

Number of Young/Day

Treatment	By Rep.	DH 1	DH 2	DH 3	DH 4	DH 5	DH 6	DH 7	DH 8	Total Young
⑤ TR.	1	0	0	0	4	6	8	0		18
	2			0	4	6	0	8		18
	3			0	2	6	10	0		19
	4			0	3	8	12	0		23
	5			0	4	9	11	0		24
	6			0	3	7	12	0		22
	7			0	2	9	11	0		22
	8			0	3	8	0	11		22
	9	↓	↓	0	2	0	3	4		9
	10	↓	↓	0	3	4	0	7		14
⑥ C-med.	1	0	0	0	3	8	0	8		17
	2			0	3	7	0	12		22
	3			0	3	7	0	10		20
	4			0	3	8	10	0		21
	5			0	3	7	10	0		20
	6			0	3	8	0	10		21
	7			0	4	6	8	0		18
	8			0	3	7	0	11		21
	9	↓	↓	0	3	5	0	8		16
	10	↓	↓	0	3	4	0	7		14
	1									
	2									
	3									
	4									
	5									
	6									
	7									
	8									
	9									
	10									

0 1 2 3 4 5 6 7 8

Chow ID#: _____

Algae ID#: _____

Dilution Water ID#: _____

Reviewed By: CR CR CR CR CR CR _____

Notes:

PLARC501-310

CR

CERIODAPHNIA RANDOMIZATION

study DOE July 93Personnel IONBeginning Date 7-22-93Ending Date 7-29-93

		Treatment											
Rep	10	2	4	7	3	5	6	1					
	9	2	3	5	6	7	1	4					
	8	3	7	1	6	4	5	2					
	7	4	3	5	7	1	6	2					
	6	7	2	5	4	6	3	1					
	5	6	1	3	2	7	5	4					
	4	2	5	4	6	3	1	7					
	3	5	6	1	3	2	7	4					
	2	3	2	7	1	6	5	4					
	1	7	1	5	2	4	6	3					

Treatment Identification:

Notes:

1. CRM 19.0 50%
2. CRM 19.0 100%
3. CRM 22.0 50%
4. CRM 22.0 100%
5. TR
6. C-med
7. Temp
8. _____
9. _____
10. _____

Date: 1218
 Date: 7-13-93
 Tray: H.C.

GERONODAPHNIA BROOD RECORD SHEET

Page No. 1 of 1
 Personnel: J. M. J. M.
 Reviewed By: L. M. J. M.

Brood Record
 1209-F-4-7th

Row 14- (Brood/Number Young)

10	4	5	0	11	13	15											
9	4	7	0	10	13	12											
8	4	7	10	0	13	10-16	2										
7	4	7	11	0	13	10-17	1										
6	4	7	12	0	13	10-15											
5	4	7	10	0	16	10-16	3										
4	4	5	10	0	15	10-13											
3	3	6	11	0	14	10-14	10										
2	4	5	11	0	13	10-16											
1	5	7	12	0	8	10-14	9										
Day	4th	5th	6th	7th	8th	9th											

Row B (Brood/Number Young)

10	2	8	11	0	13	15											
9	5	8	13	0	12	10											
8	4	6	0	6	8	8											
7	4	7	13	0	14	10-15	7										
6	3	6	3	0	13	10-12											
5	2	6	11	0	13	10-13											
4	2	8	10	0	14	10-12											
3	4	5	11	0	11	10-15	6										
2	5	7	11	0	12	10-13											
1	3	8	11	0	15	10-12											
Day	4th	5th	6th	7th	8th	9th											

Row C (Brood/Number Young)

10	0	7	10	0	13	10-11											
9	4	7	12	0	12	10-15											
8	4	7	11	0	11	10-14											
7	4	8	12	0	16	10-15											
6	3	6	9	0	10	10-16	5										
5	3	6	12	0	11	10-14	4										
4	3	6	10	0	16	10-11											
3	4	7	12	0	11	10-11											
2	4	7	10	0	14	10-11											
1	4	8	0	12	14	10-12											
Day	4th	5th	6th	7th	8th	9th											

Day	Date	Time	Temp	Mod	Food	Algae	Day	Date	Time	Temp	Mod	Food	Algae
0	7-13-93	11:20	23.5	1382	15-3	15-3	1	7-21	1645	26.3	1399	16-5	16-4
1	7-14	1360	25.2	1392	16-3	16-3	9	7-22	1230	26.3	1399	16-5	16-4
2	7-15	900	25.3	1392	16-3	16-3	10						
3	7-16	940	25.3	1392	16-3	16-3	11						
4	7-17	815	25.0	1393	16-4	16-3	12						
5	7-18	8:30	25.0	1393	16-4	16-4	13						
6	7-19	900	25.2	1395	16-4	16-4	14						
7	7-20	930	25.2	1395	16-4	16-4							

1218
 10-6 = 10:00pm 7-21-93 to 6:00 11:00 7-22-93

Batch ID: 1219
 O Date: 7-13-93
 Tray: #2

GERMOPHILA BROOD RECORD SHEET

Page No. 1 of 1
 Patron(s): 5121 / ORH
 Reviewed By: DRH / SYM

Brood Record
 KKKKKKKKKKK

Row D (Brood/Number Young)

10	4	0	1	10	11	0					
9	2	0	1	12	5	15					
8	4	0	0	12	18	13					
7	0	2	3	6	7	0					
6	4	0	4	12	13	13					
5	4	4	0	10	13	12					
4	5	0	7	11	16	14					
3	0	3	0	10	9	10					
2	3	0	6	11	12	13					
1	4	0	7	11	6	0					
Day	4TH	5TH	6TH	7TH	8TH	9TH					

Row E (Brood/Number Young)

10	5	6	0	9	9	12					
9	5	8	0	10	19	10					
8	5	6	0	11	15	10					
7	3	6	0	11	13	10					
6	4	6	0	11	15	13					
5	0	4	6	0	110	8					
4	2	6	0	10	13	10					
3	4	5	0	10	16	10					
2	0	6	9	13	0	11					
1	4	6	0	11	13	15					
Day	4TH	5TH	6TH	7TH	8TH	9TH					

Row F (Brood/Number Young)

10	4	6	0	10	110	9					
9	3	5	0	11	12	13					
8	4	5	0	10	11	10					
7	4	6	0	11	13	13					
6	4	6	0	11	110	110					
5	2	4	0	7	11	15					
4	3	0	0	9	112	16					
3	4	6	0	10	10	10					
2	4	7	0	9	12	10					
1	4	5	0	9	11	16					
Day	4TH	5TH	6TH	7TH	8TH	9TH					

Day	Date	Time	Temp	Hum	Food	Algae	Day	Date	Time	Temp	Hum	Food	Algae
0	7-13	11:20	23.5	1382	AS-3	AS-3	0	7-21	1045	24.3	1397	AS-5	AS-9
1	7-14	1300	25.2	1342	AS-3	AS-3	9	7-22	1150	13.3	1397	AS-6	AS-4
2	7-15	900	25.3	1392	AS-3	AS-3	10						
3	7-16	940	25.3	1392	AS-3	AS-3	11						
4	7-17	815	25.0	1393	AS-4	AS-3	12						
5	7-18	8:30	25.0	1313	AS-4	AS-4	13						
6	7-19	910	25.2	1345	AS-4	AS-4	14						
7	7-20	930	25.2	1375	AS-4	AS-4							

1219

* O's on 3rd day - (A-F) J

10-6 = 10:00 pm 7-21-93 to 6:00 pm 7-22-93

1 - Young present in brood cup at 3 days or more than one brood present in individual cup at removal.

(00/11)

INITIAL CHEMISTRY

Page 1 of 7Study DOE July 93Date 7/22/93Personnel Therway
S. J. 22Beginning Date 7.22.93Ending Date 7.28.93
08-09-93

By	DH	DH	DH	DH	DH	DH	Cur	Cur	Cur	WTH	Cur
Sample ID	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x1.0
CRM19-50% C		25.4	8.4	7.8	289						
CRM19-50% F		25.1	8.4	7.7	298						
CRM19-100% 2008	3.7	25.2	8.4	7.5	271	7.1	121.4	105	165	20.1	20.1
CRM22-50% C		25.5	8.6 8.3	7.7 7.9	291						
CRM22-50% F		25.1	8.6 8.3	7.6 7.8	298						
CRM22-100% 2010	2.1	25.1	8.6 8.3	7.4 7.7	270	7.3	124.8	108	163	20.1	20.1
TR cerio only	29.9	25.3	7.4	7.7	156	35	59.9	5.3	53		
F-med 1402	22.7	25.3	8.3	8.1	335						
C-med 1399	22.8	25.4	8.3	8.1	320						

NOTES:

PLARC501-252

Reviewed By: DH

INITIAL CHEMISTRY

Study DOE July 93Beginning Date 7-22-93Date 7-23-93Personnel Karanay
EslerEnding Date 7-28-93
02.08.01.93

By	ON	ON	ON	ON	ON	TS	Cur	TS	Cur		
Sample ID	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x1.0
CRM19-50%-C		25.2	8.4	7.9	295						
CRM19-50%-F		25.4	8.4	7.8	302						
CRM19-100% 2008	3.5	25.3	7.6 8.3	7.6 7.7	270						
CRM22-50%-C		25.4	8.4	7.8	294						
CRM22-50%-F		25.5	8.6 8.3	7.7 7.8	301						
CRM22-100% 2010	2.5	25.3	8.7 8.3	7.5 7.6	270						
TR Cerio only	28.9	25.0	7.0	7.6	161	3.5	59.9	5.2	5.0		
F-med 1402	23.1	25.2	8.2	8.2	336						
C-med 1399	22.6	25.4	8.2	8.2	323						

NOTES:

PLARC501-252

Reviewed By: SH

INITIAL CHEMISTRY

Page 3 of 7Study DOE July 93Date 7.24.93Personnel S. S. S.Beginning Date 7.22.93HarawayEnding Date 07.24.93

By	D41	D41	D41	D41	D41	TS	Cue	TS	Cue	TS	Cue
Sample ID	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1.0
CRM19-50% C		25.4	8.3	7.8	296			10.4			
CRM19 50% F		25.4	8.4	7.7	305						
CRM19-100% 2037	2.1	25.4	8.6 8.3	7.5 7.6	268	7.1	121.4	10.4	104	<0.1	40.1
CRM22 50% C		25.5	8.7 8.3	8.0 8.1	294						
CRM22 50% F		25.4	8.4 8.3	8.0 8.1	304						
CRM22 100% 2039	1.7	25.2	8.7 8.3	7.9 8.0	267	7.2	123.1	10.5	105	<0.1	40.1
TR Cerio only	30.4	25.2	6.6	8.0	161	36	61.6	5.4	54	20.1	40.1
F-med 1404	23.4	25.4	8.2	8.3	346						
C-med 1400	23.6	25.5	8.2	8.3	326						

NOTES:

PLARC501-252

Reviewed By: S. S. S.

INITIAL CHEMISTRY

Study DOE July 93Date 7-25-93Personnel DMBeginning Date 7-22-93TSEnding Date 07-29-93

By	DM	DM	DM	DM	DM	TS	DM	TS	DM		
Sample ID	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	Calc x17.1	Alk	Calc x10	TRC	x 1.0
7:55 7:57 CRM19-50%-C		25.5	8.6 8.3	7.8 8.0	294						
7:55 8:00 CRM19-50%-F		25.5	8.7 8.3	7.7 7.9	305						
7:55 8:01 CRM19-100% 2037	3.0	25.4	8.9 8.4	7.5 7.7	270						
7:55 8:01 CRM22-50%-C		25.4	8.6 8.3	8.1 8.1	291						
7:55 8:01 CRM22-50%-F		25.5	8.8 8.3	8.0 8.1	304						
7:55 8:02 CRM22-100% 2039	3.1	25.2	8.9 8.3	7.9 8.0	268						
TR ^{Calc} only	30.7	25.3	7.0	8.2	160	3.5	59.9	5.0	50		
F-med 1404	22.4	25.4	8.3	8.2	347						
C-med 1400	22.6	25.3	8.2	8.3	326						

NOTES:

PLARC501-252

Reviewed By: DM

INITIAL CHEMISTRY

Page 5 of 7Study DOE July 93Date 7-26-93Personnel COLBeginning Date 7-22-93SiskerEnding Date 07-24-93

By	OH	OH	OH	OH	OH	OH	CHC	SAT	CHC		
Sample ID	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1.0
0757 800 CRM19-50% C		25.4	8.8 8.3	7.8 8.0	296						
0757 803 CRM19-50% F		25.4	9.1 8.4 8.3	7.7 8.0	308						
0757 806 CRM19-100% ²⁰³⁷	42	25.3	9.6 8.3	7.5 7.9	268						
0757 800 CRM22 50% C		25.3	9.0 8.4	8.0 8.1	294						
0757 803 CRM22 50% F		25.2	9.1 8.3	8.0 8.1	304						
0757 806 CRM22 100% ²⁰³⁹	3.7	25.0	9.7 8.3	7.8 8.1	268						
TR Cerio only	30.7	25.2	6.6	7.9	162	3.7	63.3	5.4	5.1		
F-med 1407	22.5	25.2	8.3	8.2	348						
C-med 1400	22.4	25.4	8.3	8.2	328						

NOTES:

PLARC501-252

Reviewed By: COL

INITIAL CHEMISTRY

Page 6 of 7Study DOE July 93Date 7-27-93Personnel HansenBeginning Date 7-22-9310-00Ending Date 01-29-93

By	DH	DH	DO	pH	Cond.	Hard	Cur	DH	Cur	Cur	Cur
Sample ID	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1.0
CRM19-50% C		25.4	8.3	7.9	294						
CRM19 50% F		25.3	8.4	7.3	304						
CRM19 ²⁰⁶⁶ 100% ₂₀₆₆	2.5	25.4	8.4	7.6	270	7.5*	128.3	10.5	10.5	20.1	20.1
CRM22 50% C		25.4	8.4	7.8	294						
CRM22 50% F		25.4	8.4	7.7	303						
CRM22 ²⁰⁶⁸ 100% ₂₀₆₈	2.1	25.2	8.4	7.5	268	7.3	124.8	10.5	10.5	20.1	20.1
TR ceris only	30.2	25.4	6.6	8.1	162	3.9	66.7	5.3	5.3		
F-med 1408	23.0	25.4	8.3	8.2	340						
C-med 1405	22.5	25.3	8.3	8.2	321						

NOTES: *rechecked Cur

PLARC501-252

Reviewed By: WTF

INITIAL CHEMISTRY

Page 7 of 7Study DOE July 93Date 7-28-93Personnel DLT
TSBeginning Date 7-22-93Ending Date 7-29^{DOE}-93

By	DT	DT	DT	DT	DT	IS	Cur	DT	Cur		
Sample ID	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1.0
02/7:54 CRM17-50% C		25.5	8.7/8.3	7.9/8.1	295						
02/7:57 CRM19-50% F		25.3	8.8/8.3	7.8/8.1	305						
2/7:59 CRM19-100% S	2.8	25.3	9.0/8.3	7.6/7.9	276						
02/7:54 CRM22-50% C		25.3	8.7/8.3	7.8/8.1	291						
2/7:57 CRM22-50% F		25.1	8.9/8.3	7.7/8.0	301						
2/7:59 CRM22-100% S	3.2	25.0	9.2/8.3	7.5/7.9	269						
TR Cerio only	29.8	25.4	7.0	8.0	161	3.5	59.9	5.5	55		
F-med 1410	21.8	25.3	8.3	8.2	342						
C-med 1405	21.5	25.5	8.3	8.2	326						

NOTES:

PLARC501-252

Reviewed By: DLT

Study DOE July 93
 Beginning Date 7-22-93
 Ending Date 7-29-93

Date 7-23-93

Personnel Wt

Sample ID	By Rep.	Fish			
		Wt	DO	pH	Cond.
		Temp.	DO	pH	Cond.
CRM 19 50%	1	25.2	6.4	7.8	
	2	25.1	6.2		301
	3	25.1	6.5		
	4	25.1	6.4		
CRM 19 100%	1	25.1	6.4	7.7	
	2	25.1	6.5		273
	3	25.1	6.4		
	4	25.2	6.4		
CRM 22 50%	1	25.0	6.3	7.8	
	2	25.0	6.2		300
	3	25.0	6.3		
	4	25.0	6.5		
CRM 22 100%	1	25.1	6.5	8.0	
	2	25.0	6.4		271
	3	25.2	6.3		
	4	25.0	6.4		
F-med	1	25.0	6.6	7.8	
	2	25.1	6.7		335
	3	25.0	6.6		
	4	25.1	6.7		
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				

NOTES:

Ceriodaphnia			
Wt	Sample ID	DO	pH
Temp.	Sample ID	DO	pH
25.5	CRM 19 50%	7.3	8.1
25.4	CRM 19 100%	7.3	8.2
25.4	CRM 22 50%	7.3	8.1
25.3	CRM 22 100%	7.2	8.2
25.3	T.R.	7.2	7.9
25.4	C-med-	7.3	7.9
25.3			
25.2			
25.2			
25.1			

FINAL CHEMISTRY

Page 2 of 7Study DOE July 93Beginning Date 7-22-93Ending Date 7-29-93Date 7/24/93Personnel S. J. L.
7.5

Sample ID	By Rep.	Fish			
		Temp.	DO	pH	Cond.
CRM 19 50%	1	24.8	7.8	6.1	
	2	24.9	5.8	7.8	
	3	24.8	6.0		304
	4	24.8	6.1		
CRM 19 100%	1	25.0	5.6		
	2	24.9	5.6	7.9	
	3	24.8	5.9		273
	4	24.8	6.0		
CRM 22 50%	1	24.8	6.0		
	2	24.9	5.5	7.7	
	3	24.8	5.7		304
	4	24.8	6.5		
CRM 22 100%	1	24.6	6.2		
	2	24.8	6.2	7.9	
	3	24.9	6.0		272
	4	24.9	5.9		
F-med	1	24.5	6.0		
	2	24.8	6.4	7.8	
	3	24.9	6.3		337
	4	24.8	6.4		
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				

Ceriodaphnia			
Temp.	Sample ID	DO	pH
25.5	CRM 19 50%	7.3	8.2
25.3	CRM 19 100%	7.3	8.3
25.4	CRM 22 50%	7.3	8.2
25.4	CRM 22 100%	7.3	8.3
25.4	7R	7.2	8.0
25.5	C-med	7.3	8.0
25.3			
25.4			
25.3			
25.3			

NOTES:

Reviewed By: S. J. L.
PLARC501-255

Study DOE July 93
 Beginning Date 7-22-93
 Ending Date 07-29-93

Date 7/25/93

Personnel JCS
JH

Sample ID	By	Fish			
		DOH	SM	PH	Cond.
	Rep.	Temp.	DO	pH	Cond.
CRM 19 50%	1	24.8	6.4		
	2	24.8	6.3		
	3	25.0	6.3	7.8	
	4	25.0	6.1		310
CRM 19 100%	1	24.9	6.2		
	2	24.9	6.0		
	3	25.0	6.0	7.9	
	4	25.0	5.9		271
CRM 22 50%	1	24.9	5.8		
	2	24.9	6.2		
	3	25.1	5.5	7.8	
	4	25.0	5.8		310
CRM 22 100%	1	25.0	5.5		
	2	25.1	5.6		
	3	24.9	6.0	8.0	
	4	24.7	6.0		272
F-med	1	24.9	6.0		
	2	24.9	6.2		
	3	24.9	6.4	7.9	
	4	24.8	6.1		34.8
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				

Ceriodaphnia			
DOH	SM	PH	Cond.
Temp.	Sample ID	DO	pH
25.2	CRM 19 50%	7.5	8.2
25.4	CRM 19 100%	7.5	8.3
25.3	CRM 22 50%	7.4	8.2
25.4	CRM 22 100%	7.4	8.4
25.4	TR	7.5	8.1
25.5	C-med-	7.5	8.1
25.6			
25.5			
25.5			
25.4			

NOTES:

Study DOE July 93
 Beginning Date 7-22-93
 Ending Date 07-24-93

Date 7/26/93

Personnel Harvey
Swab

Sample ID	By	Fish			
		Temp.	DO	pH	Cond.
	Rep.				
CRM 19 50%	1	25.1	6.2		308
	2	25.2	5.2		
	3	25.1	6.0		
	4	24.9	6.0	7.8	
CRM 19 100%	1	24.5	6.2		374 T ³
	2	25.1	6.2		275
	3	25.0	6.0		
	4	25.0	5.8	7.8	
CRM 22 50%	1	24.9	6.0		308
	2	25.1	5.7		
	3	24.9	6.0		
	4	25.0	6.1	7.8	
CRM 22 100%	1	25.1	6.1		270
	2	24.8	6.2		
	3	25.0	6.0		
	4	25.1	5.9	7.9	
F-med	1	24.8	6.7		350
	2	24.9	6.5		
	3	24.9	6.4		
	4	24.7	6.4	7.8	
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				

Ceriodaphnia			
Temp.	Sample ID	DO	pH
25.3	CRM 19 50%	7.4	8.1
25.3	CRM 19 100%	7.4	8.3
25.4	CRM 22 50%	7.4	8.2
25.4	CRM 22 100%	7.4	8.3
25.5	T.R.	7.4	8.0
25.4	C-med.	7.4	8.0
25.4			
25.5			
25.4			
25.4			

NOTES:

Study DOE July 93Beginning Date 7-22-93Date 07-27-93Personnel H. C. C. C. C.
Y. C. C. C. C.Ending Date 07-29-93

Sample ID	By Rep.	Fish			
		DI	LI	DI	LI
		Temp.	DO	pH	Cond.
CRM 19 50%	1	24.8	6.0	7.8	
	2	25.1	5.6		310
	3	24.9	5.8		
	4	24.5	6.0		
CRM 19 100%	1	25.1	5.8	7.9	
	2	25.1	5.8		272
	3	24.9	5.6		
	4	24.8	5.6		
CRM 22 50%	1	24.9	5.3	7.7	
	2	25.0	5.4		311
	3	25.0	5.8		
	4	24.8	6.2		
CRM 22 100%	1	25.0	5.9	7.9	
	2	24.9	5.8		271
	3	24.9	5.8		
	4	24.8	6.2		
F-med	1	24.9	6.1	7.8	
	2	24.9	6.1		350
	3	24.6	6.3		
	4	24.7	6.3		
	1				
	2				
	3				
	4				

NOTES:

Ceriodaphnia			
Temp.	Sample ID	DO	pH
25.5	CRM 19 50%	8.74	8.1
25.4	CRM 19 100%	7.4	8.2
25.4	CRM 22 50%	7.4	8.1
25.5	CRM 22 100%	7.4	8.2
25.4	TR	7.4	8.0
25.3	C-med	7.4	8.0
25.4			
25.5			
25.5			
25.4			

FINAL CHEMISTRY

Page 6 of 7

Study DOE July 93
Beginning Date 7-22-93
Ending Date 07-29-93

Date 7/28/93

Personnel JTB
755

Sample ID	By	Fish			
		Temp.	DO	pH	Cond.
CRM 19 50%	1	25.1	5.5		
	2	25.0	5.5	7.7	
	3	24.8	5.9		305
	4	24.9	5.8		
CRM 19 100%	1	25.0	5.9		
	2	24.9	5.9	7.9	
	3	24.9	6.0		270
	4	24.9	6.0		
CRM 22 50%	1	24.8	5.9		
	2	24.9	5.8	7.8	
	3	24.9	5.9		306
	4	24.9	5.8		
CRM 22 100%	1	25.0	5.6		
	2	24.9	6.0	7.9	
	3	24.8	5.6		273
	4	24.9	6.1		
F-med	1	24.9	5.9		
	2	24.7	6.1	7.8	
	3	24.7	6.1		346
	4	24.8	6.1		
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				

Ceriodaphnia			
Temp.	Sample ID	DO	pH
25.1	CRM 19 50%	7.5	8.1
25.1	CRM 19 100%	7.5	8.2
25.3	CRM 22 50%	7.4	8.2
25.2	CRM 22 100%	7.4	8.2
25.2	TR.	7.4	7.9
25.4	C-med-	7.4	8.0
25.3			
25.3			
25.2			
25.1			

NOTES:

Reviewed By: JTB
PLARC501-255

FINAL CHEMISTRY

Page 7 of 7

Study DOE July 93
 Beginning Date 7-22-93
 Ending Date 7-29-93

Date 7-29-93

Personnel E. H.
C. R.

Sample ID	By	Fish			
		DH	DH	DH	DH
	Rep.	Temp.	DO	pH	Cond.
CRM 19 50%	1	25.0	6.2		
	2	24.6	6.2		
	3	24.7	6.2	7.9	
	4	24.7	6.3		312
CRM 19 100%	1	24.9	6.0		
	2	24.7	6.1		
	3	24.9	6.0	7.9	
	4	24.9	5.8		280
CRM 22 50%	1	24.9	6.2		
	2	25.0	6.3		
	3	24.9	6.1	7.8	
	4	24.8	6.4		305
CRM 22 100%	1	24.9	6.3		
	2	24.8	6.5		
	3	24.9	6.4	8.0	
	4	24.8	6.4		271
F-med	1	24.8	6.3		
	2	24.7	6.4		
	3	24.7	6.6	7.8	
	4	24.7	6.7		345
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				

Ceriodaphnia			
DH	DH	DH	DH
Temp.	Sample ID	DO	pH
25.1	CRM 19 50%	7.4	8.1
25.1	CRM 19 100%	7.4	8.2
25.3	CRM 22 50%	7.4	8.1
25.4	CRM 22 100%	7.4	8.2
25.4	TR	7.4	7.9
25.5	C-med	7.4	8.0
25.4			
25.3			
25.2			
25.1			

NOTES:

Reviewed By: E. H.
 PLARC501-255

DOE - 07/91 -- JULY 22-29, 1993 -- INITIAL AND FINAL CHEMISTRY

INITIAL CHEMISTRY

MEDIUM (FISH)

DAY	INITIAL TEMP	WARMED TEMP	DO	pH	COND	HARD	ALK	CHLORINE
0	22.7	25.3	8.3	8.1	335	---	---	---
1	23.1	25.2	8.2	8.2	336	---	---	---
2	21.4	25.4	8.2	8.3	346	---	---	---
3	22.4	25.4	8.3	8.2	347	---	---	---
4	22.5	25.2	8.3	8.2	348	---	---	---
5	23.0	25.4	8.3	8.2	340	---	---	---
6	21.8	25.3	8.3	8.2	342	---	---	---
MEAN	22.7	25.3	8.3	8.2	342	0.0	---	---
MIN	21.4	25.2	8.2	8.1	335	0.0	---	---
MAX	23.4	25.4	8.3	8.3	348	0.0	---	---

CRM 22.0 100% W/F-MEDIUM

DAY	INITIAL TEMP	WARMED TEMP	DO	pH	COND	HARD	ALK	CHLORINE
0	2.1	25.1	8.3	7.7	---	---	---	---
1	2.5	25.3	8.3	7.8	---	---	---	---
2	1.7	25.2	8.3	7.9	---	---	---	---
3	3.1	25.2	8.3	8.0	---	---	---	---
4	3.7	25.0	8.3	8.1	---	---	---	---
5	2.1	25.2	8.4	7.5	---	---	---	---
6	1.2	25.0	8.3	7.9	---	---	---	---
MEAN	2.6	25.1	8.3	7.8	---	---	---	---
MIN	1.7	25.0	8.3	7.5	---	---	---	---
MAX	3.7	25.3	8.4	8.1	---	---	---	---

CRM 19.0 50% W/F-MEDIUM

DAY	INITIAL TEMP	WARMED TEMP	DO	pH	COND	HARD	ALK	CHLORINE
0	---	25.1	8.4	7.7	298	---	---	---
1	---	25.4	8.4	7.8	302	---	---	---
2	---	25.4	8.4	7.7	305	---	---	---
3	---	25.5	8.3	7.9	305	---	---	---
4	---	25.4	8.3	8.0	308	---	---	---
5	---	25.3	8.4	7.8	304	---	---	---
6	---	25.3	8.3	8.1	305	---	---	---
MEAN	0.0	25.3	8.4	7.9	304	0.0	---	---
MIN	0.0	25.1	8.3	7.7	298	0.0	---	---
MAX	0.0	25.5	8.4	8.1	308	0.0	---	---

MEDIUM (CRIO)

DAY	INITIAL TEMP	WARMED TEMP	DO	pH	COND	HARD	ALK	CHLORINE
0	22.8	25.4	8.3	8.1	---	---	---	---
1	22.6	25.4	8.2	8.2	---	---	---	---
2	23.6	25.5	8.2	8.3	---	---	---	---
3	22.6	25.3	8.2	8.3	---	---	---	---
4	22.4	25.4	8.3	8.2	---	---	---	---
5	22.5	25.3	8.3	8.2	---	---	---	---
6	21.5	25.5	8.3	8.2	---	---	---	---
MEAN	22.6	25.4	8.3	8.2	---	---	---	---
MIN	21.5	25.3	8.2	8.1	---	---	---	---
MAX	23.6	25.5	8.3	8.3	---	---	---	---

CRM 19.0 100% W/F-MEDIUM

DAY	INITIAL TEMP	WARMED TEMP	DO	pH	COND	HARD	ALK	CHLORINE
0	3.7	25.2	8.4	7.5	271	121.4	105	<0.1
1	3.5	25.3	8.3	7.7	270	---	---	---
2	2.1	25.4	8.3	7.6	268	121.4	104	<0.1
3	7.0	25.4	8.4	7.7	270	---	---	---
4	4.2	25.3	8.3	7.9	268	---	---	---
5	2.5	25.4	8.4	7.6	270	128.3	105	<0.1
6	2.0	25.3	8.3	7.9	276	---	---	---
MEAN	3.1	25.3	8.3	7.7	270	123.7	105	<0.1
MIN	2.1	25.2	8.3	7.5	268	121.4	104	<0.1
MAX	4.2	25.4	8.4	7.9	276	128.3	105	<0.1

CRM 19.0 50% W/C-MEDIUM

DAY	INITIAL TEMP	WARMED TEMP	DO	pH	COND	HARD	ALK	CHLORINE
0	---	25.4	8.4	7.8	---	---	---	---
1	---	25.2	8.4	7.9	---	---	---	---
2	---	25.4	8.3	7.9	---	---	---	---
3	---	25.5	8.3	8.0	---	---	---	---
4	---	25.4	8.3	8.0	---	---	---	---
5	---	25.4	8.3	7.9	---	---	---	---
6	---	25.5	8.3	8.1	---	---	---	---
MEAN	0.0	25.4	8.3	7.9	---	---	---	---
MIN	0.0	25.2	8.3	7.8	---	---	---	---
MAX	0.0	25.5	8.4	8.1	---	---	---	---

CRM 22.0 50% W/F-MEDIUM

DAY	INITIAL TEMP	WARMED TEMP	DO	pH	COND	HARD	ALK	CHLORINE
0	---	25.1	8.3	7.8	298	---	---	---
1	---	25.5	8.3	7.8	301	---	---	---
2	---	25.4	8.3	8.1	304	---	---	---
3	---	25.5	8.3	8.1	306	---	---	---
4	---	25.2	8.3	8.1	304	---	---	---
5	---	25.4	8.4	7.7	303	---	---	---
6	---	25.1	8.3	8.0	301	---	---	---
MEAN	0.0	25.3	8.3	7.9	302	0.0	---	---
MIN	0.0	25.1	8.3	7.7	298	0.0	---	---
MAX	0.0	25.5	8.4	8.1	306	0.0	---	---

CRM 22.0 50% W/C-MEDIUM

DAY	INITIAL TEMP	WARMED TEMP	DO	pH	COND	HARD	ALK	CHLORINE
0	---	25.5	8.3	7.9	291	---	---	---
1	---	25.4	8.4	7.9	291	---	---	---
2	---	25.5	8.3	8.1	291	---	---	---
3	---	25.4	8.3	8.1	291	---	---	---
4	---	25.3	8.4	8.1	291	---	---	---
5	---	25.4	8.4	7.8	291	---	---	---
6	---	25.3	8.3	8.1	291	---	---	---
MEAN	0.0	25.4	8.3	8.0	291	---	---	---
MIN	0.0	25.3	8.3	7.8	291	---	---	---
MAX	0.0	25.5	8.4	8.1	291	---	---	---

TR

INITIAL		WARMED							
DAY	TEMP	DO	pH	COND	HARD	AL	W/F	W/F	W/F
0	29.9	25.1	7.4	7.7	156	59.9	5.1	5.1	5.1
1	28.9	25.0	7.0	7.6	161	59.9	5.2	5.2	5.2
2	30.4	25.2	6.6	8.0	161	61.6	5.4	5.4	5.4
3	30.7	25.3	7.0	8.2	160	59.9	5.4	5.4	5.4
4	30.7	25.2	6.6	7.9	162	63.3	5.4	5.4	5.4
5	30.2	25.4	6.6	8.1	162	66.7	5.4	5.4	5.4
6	29.8	25.4	7.0	8.0	161	59.9	5.4	5.4	5.4
MEAN	30.1	25.3	6.9	7.9	160	61.6	5.4	5.4	5.4
MIN	28.9	25.0	6.6	7.6	156	59.9	5.0	5.0	5.0
MAX	30.7	25.4	7.4	8.2	162	66.7	5.5	5.5	5.5

P I S H F I N A L

CRM 19.0 50% W/F-MEDIUM

DAY	TEMP	DO	pH	COND
1	25.1	6.4	7.8	101
2	24.8	6.1	7.8	304
3	24.8	6.4	7.8	310
4	25.1	6.2	7.8	309
5	24.8	6.0	7.8	310
6	24.8	5.5	7.7	305
7	24.7	6.2	7.9	312
MEAN	24.9	6.0	7.8	307
MIN	24.5	5.2	7.7	301
MAX	25.2	6.5	7.9	312

CRM 19.0 100%

DAY	TEMP	DO	pH	COND
1	25.1	6.4	7.9	273
2	24.8	6.1	7.9	271
3	24.8	6.2	7.9	271
4	24.8	6.2	7.9	275
5	24.8	5.8	7.8	272
6	24.8	5.5	7.9	270
7	24.7	6.2	7.9	280
MEAN	24.9	6.0	7.9	273
MIN	24.5	5.5	7.8	270
MAX	25.2	6.5	7.9	280

CRM 22.0 50% W/F-MEDIUM

DAY	TEMP	DO	pH	COND
1	25.0	6.4	7.8	335
2	24.8	6.1	7.8	337
3	24.8	6.2	7.8	348
4	24.8	6.2	7.8	350
5	24.8	5.8	7.8	350
6	24.8	5.5	7.8	350
7	24.8	6.2	7.8	350
MEAN	24.9	6.0	7.8	348
MIN	24.8	5.5	7.8	348
MAX	25.1	6.5	7.9	350

CRM 22.0 100%

DAY	TEMP	DO	pH	COND
1	25.1	6.5	8.0	271
2	24.6	6.2	7.9	272
3	24.8	6.0	8.0	272
4	24.7	6.1	7.9	271
5	24.8	6.2	7.9	271

MEDIUM

DAY	TEMP	DO	pH	COND
1	25.0	6.6	7.8	335
2	24.5	6.6	7.8	337
3	24.8	6.1	7.9	348
4	24.8	6.2	7.8	350
5	24.7	6.2	7.8	350

Project Instrument Record Sheet

Project Study DOE July 93

Beginning Date 7-22-93

Ending Date 7-29-93

DO Meter

Model YSI Model 57

TVA Tag 557673

Calibration Date 4-28-93

pH Meter(s)

Model ORION SA250

TVA Tag SN 8147

Calibration Date 4-30-93

Model ORION 407A

TVA Tag 557674

Calibration Date 4-14-93

Conductivity Meter

Model YSI Model 32

TVA Tag 543389

Calibration Date 2-8-93

Thermometer(s)

Model Ertco SAMM CT-40

TVA Tag M-205 / 3331

Calibration Date 5-20-93

Model Ertco SAMM CT-40

TVA Tag M-254 SN-4516

Calibration Date 12-8-92

PROJECT REAGENT RECORD SHEET

Project/Study: DOE July 93
 Personnel: OH

Beginning Date: 7-22-93
 Ending Date: 7-29-93

WINKLER TITRATION METHOD

Alkaline-Iodide-Azide:

Brand Fisher
 Lot # 910067-24
 Exp. Feb 93

Manganous Sulfate:

Brand Fisher
 Lot # 910067-24
 Exp. April 93

Sodium Thiosulfate:

Brand RICCA
 Lot # H267
 Exp. April 94

Sulfuric Acid:

Brand Fisher
 Lot # 854507
 Exp. Indef.

Thyodene:

Brand Fisher
 Lot # 912254
 Exp. Indef.

pH BUFFER SOLUTIONS

pH 4:

Brand Spectrum
 Lot # HH150
 Exp. Sept 93

pH 7:

Brand Mallinckrodt
 Lot # 0098 K14W
 Exp. 6-94

pH 10:

Brand Mallinckrodt
 Lot # 0097 K5XJ
 Exp. 12-93

pH _____:

Brand N/A
 Lot # _____
 Exp. _____

CONDUCTIVITY STANDARD SOLUTIONS

200 μ hos:

Brand Beapham
 Lot # J32C
 Exp. 11-94

720 μ hos:

Brand Beapham
 Lot # E052H
 Exp. 5-94

_____ μ hos:

Brand N/A
 Lot # _____
 Exp. _____

ALKALINITY TITRATION

Sulfuric Acid Solution N/50:

Brand Mallinckrodt
 Lot # H366 KHKJ
 Exp. Indef.

HARDNESS TITRATION

Hardness Titrating Solution:

Brand Calgon
 Lot # R2037200
 Exp. Indef.

Hardness Indicator:

Brand Calgon
 Lot # 012913
 Exp. Indef.

Hardness Buffer Solution:

Brand Calgon
 Lot # 2605-63
 Exp. Indef.

CHLORINE TITRATION

DPD Powder Pillows:

Brand Aach
 Lot # 03CM
 Exp. Indef.

Potassium Iodide:

Brand Fisher
 Lot # 863484A
 Exp. Indef.

FAS:

Brand RICCA
 Lot # E238
 Exp. 8-20-93

ATTACHMENT III

CR-ERP AMBIENT WATER TOXICITY STUDY
Reference Toxicant Test Information

Chronic Reference Toxicant Test

Fathead Minnows - ARL

Test #	Date	Survival		Growth		IC25	Corrective Action Taken
		LOEC	NOEC	LOEC	NOEC		
1	01/18/90	0.05	0.02	<0.008	0.008		
2	02/08/90	0.02	0.008	<0.008	0.008		
3	02/21/90	0.125	0.05	0.02	0.008		
4	03/07/90	0.05	0.02	0.008	0.003		
5	03/28/90	0.05	0.02	0.008	0.003		
6	04/23/90	0.05	0.02	0.02	0.008		
7	05/10/90	0.05	0.02	0.02	0.008		
8	06/06/90	0.05	0.02	0.02	0.008		
9	07/09/90	0.05	0.02	0.02	0.008		
10	08/02/90	0.05	0.02	0.008	0.003		
11	09/06/90	0.05	0.02	0.02	0.008		
12	10/10/90	0.05	0.02	0.008	0.003		
13	10/31/90	0.02	0.008	0.008	0.003		
14	11/27/90	0.05	0.02	0.02	0.008		
15	01/03/91	0.05	0.02	0.008	0.003		
16	02/06/91	0.125	0.05	0.02	0.008		
17	02/28/91	0.05	0.02	0.008	0.003		
18	03/25/91	0.05	0.02	0.008	0.003		
19	05/02/91	0.02	0.008	0.008	0.003		
20	05/30/91	0.02	0.008	0.008	0.003		
21	07/12/91	0.05	0.02	0.008	0.003		
22	08/02/91	0.05	0.02	0.008	0.003		
23	09/03/91	0.05	0.02	0.008	0.003		
24	10/02/91	0.02	0.008	0.008	0.003		
25	10/30/91	<0.05	0.05	0.008	0.003		
26	12/02/91	0.05	0.02	0.008	0.003		
27	01/09/92	0.05	0.02	0.02	0.008	0.0109	
28	01/29/92	0.05	0.02	0.008	0.003	0.0089	
29	02/27/92	0.05	0.02	0.008	0.003	0.0067	
30	04/06/92	0.02	0.008	0.008	0.003	0.0059	
31	04/30/92	0.02	0.008	0.008	0.003	0.0085	
32	05/27/92	0.05	0.02	0.02	0.008	0.01	*0.003 was significant
33	07/07/92	0.02	0.008	0.008	0.003	0.0059	
34	07/28/92	0.05	0.02	0.008	0.003	0.0078	
35	08/27/92	0.02	0.008	0.008	0.003	0.0061	
36	09/29/92*	0.02	0.008	0.008	0.003	0.0061	* started using less than
37	10/27/92*	0.02	0.008	0.008	0.003	0.006	24hr old fish
38	12/01/92*	0.05	0.02	0.008	0.003	0.0068	
39	01/05/93*	0.02	0.008	0.008	0.003	0.0056	
40	01/26/93*	0.008	0.003	0.008	0.003	0.0039	
41	02/24/93*	0.02	0.008	0.008	0.003	0.0052	
42	03/23/93*	0.05	0.02	0.008	0.003	0.0056	
43	04/26/93*	0.02	0.008	0.008	0.003	0.0055	
44	06/01/93*	0.05	0.02	0.008	0.003	0.0074	
45	07/06/93**	0.05	0.02	0.02	0.008	0.0119	**fish were 24hrs & 53mins
Mean=		0.04	0.018	Mean=	0.011	0.004	0.0071

Chronic Reference Toxicant Record Sheet

Study July Rella #45

Test Organism Fathead

Beginning Date/Time 07-06-93 / 1653

Ending Date/Time 07-13-93 / 1000

Personnel King, Russell

Toxicant Cu

Source EPA

Lot # 188

Concentration 50 mg/mL

Stock Concentration(s) Control, 0.3, 0.9, 24, 6.0, 15.0 mg/L

Test Concentrations Control, 0.001, 0.003, 0.008, 0.02, 0.05

Dilution Water Fish medium

Spawn Date:

Tile #

Hatch Date

07-01-93

18, 19, 21, 22, 10, 11

07-05-93 At 1000, Bet 0700 on 07-06-93

07-01-93

12, 14

"

Test # 45

NOEC 0.008

LOEC 0.02

Notes:

fish used were 24 hr 53 mins old.

Cu
07-06-93

$IC_{25} = 0.0119$

7/5 AF 1000
BF 0700 7/6

7/1 #18, 19

7/1 #21, 22

7/1 #10, 11

7/1 #12, 14

FATHEAD MINNOW LARVAL SURVIVAL AND GROWTH TEST

Page 1 of 1

Study Reflex #45

Personnel

Beginning Date/Time 07-06-93/1053

Ending Date/Time 07-13-93/1000

Kinard
Russell

— Number Alive —

Treatment	Rep	- Day -						
		1	2	3	4	5	6	7
<u>Control</u>	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	4	10	10	10	10	10	10	10
	By:	CUR	CUR	CUR	CUR	CUR	CUR	CUR
<u>0.001</u>	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	4	10	10	10	10	10	10	10
	By:	CUR	CUR	CUR	CUR	CUR	CUR	CUR
<u>0.003</u>	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	4	10	10	10	10	10	10	10
	By:	GK/CUR	GKK	CUR	CUR	CUR	CUR	CUR
<u>0.008</u>	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	4	10	10	10	10	10	10	10
	By:	GKK	GKK	CUR	GKK	GKK	GKK	GKK
<u>0.02</u>	1	10	10	10	10	8	8	8
	2	10	10	10	10	10	10	10
	3	10	10	10	10	9	8	8
	4	10	10	10	10	10	10	10
	By:	GKK	GKK	FM	GKK	GKK	GKK	GKK
<u>0.05</u>	1	9	8	7	7	7	7	6
	2	10	10	9	8	8	8	8
	3	10	10	10	9	7	5	5
	4	10	10	10	9	9	8	7
	By:	GKK	GKK	FM	GKK	GKK	GKK	GKK

Notes:

Fed- Time/By:

0 1 2 3 4 5 6
0618/CUR 0618/CUR 0620/CUR 0640/CUR 0645/CUR 0622/CUR
1107/GKK 1130/GKK 1150/GKK 1120/FS 1100/GKK 1100/GKK
1507/CUR 1507/FS 1530/DH 1550/DH 1530/DH

Dilution Water ID: 1373 1377 1373-1377 1379 1379 1385 1385
 (PLARC501-257) Reviewed By: CUR CUR CUR CUR CUR CUR CUR

Analysis of Survival

REFTOX #45
Starting Date: 07/06/93

Survival (%) Data

Treatment	Replicate										Mean
	1	2	3	4	5	6	7	8	9	10	
CONTROL	1.00	1.00	1.00	1.00	.	.	.	.	.	.	1.00
0.001	1.00	1.00	1.00	1.00	.	.	.	.	.	.	1.00
0.003	1.00	1.00	1.00	1.00	.	.	.	.	.	.	1.00
0.008	1.00	1.00	1.00	1.00	.	.	.	.	.	.	1.00
0.02	0.80	1.00	0.80	1.00	.	.	.	.	.	.	0.90
0.05	0.60	0.80	0.50	0.70	.	.	.	.	.	.	0.65

Steel's Many-One Rank Test

Treatment	No. of Replicates	Critical Rank Sum	Rank Sum*
0.001	4	10	18
0.003	4	10	18
0.008	4	10	18
0.02	4	10	14
0.05	4	10	10 *

* Values less than Critical Rank Sum significantly less than the control (CONTROL).

Analysis of 7-day Larval Growth Test

REFTOX #45
Starting Date: 07/06/93

Analysis of Dry Weight (mg) Data Dunnett's Test

No transformation applied before data analysis.

For this set of data, the minimum significant difference is 0.03

This represents a 8.00 % reduction in Dry Weight (mg).

T = 2.36 ALPHA = 0.05

Dry Weight (mg) Data

TREATMENT	Replicate										MEAN	S
	1	2	3	4	5	6	7	8	9	10		
1 CONTROL	0.45	0.40	0.42	0.41	.	.	.	.	.	.	0.42	
2 0.001	0.48	0.47	0.49	0.46	.	.	.	.	.	.	0.47	
3 0.003	0.49	0.49	0.52	0.54	.	.	.	.	.	.	0.51	
4 0.008	0.43	0.45	0.42	0.47	.	.	.	.	.	.	0.44	
5 0.02	0.18	0.15	0.15	0.14	.	.	.	.	.	.	0.16	*

Asterisk (*) indicates values significantly less than control (CONTROL).

Analysis of Variance

Source	DF	Sum OF Sq.	Mean Sq.	Calc F	F(0.05)
Among	4	0.320	0.080	197.420	0.0001
Within	15	0.006	0.000		
Total	19	0.000			

THE NUMBER OF RESAMPLES IS 80

*** LISTING OF GROUP CONCENTRATIONS (% EFF.) AND RESPONSE MEANS ***

CONC. (%EFF)	RESPONSE MEAN	MEAN AFTER POOLING
-----	-----	-----
.000	.421	.468
.001	.474	.468
.003	.508	.468
.008	.444	.444
.020	.154	.154
.050	.087	.087

THE LINEAR INTERPOLATION ESTIMATE OF THE TOTAL IMPACT CONCENTRATION
FROM THE INPUT SAMPLE IS .0119.-

.050	.087	.087
------	------	------

THE LINEAR INTERPOLATION ESTIMATE OF THE TOTAL IMPACT CONCENTRATION
FROM THE INPUT SAMPLE IS .0119.

* BOOTSTRAP PROCEDURE TO ESTIMATE VARIABILITY *
* OF THE ESTIMATED ICp *

THE MEAN OF THE BOOTSTRAP ESTIMATES IS .0118.

THE STANDARD DEVIATION OF THE BOOTSTRAP ESTIMATES IS .0003.

AN EMPIRICAL 95.0% CONFIDENCE INTERVAL FOR THE
BOOTSTRAP ESTIMATE IS (.0112, .0124).

C:\BOOTSTRP>

Chronic Reference Toxicant Test

Cerio - ARL

Test #	Date	Survival		Reproduction		IC25	Corrective Action Taken
		LOEC	NOEC	LOEC	NOEC		
1	01/24/90	0.02	0.008	>0.008	0.008		
2	03/23/90	0.05	0.02	0.05	0.02		
3	03/29/90	0.05	0.02	0.05	0.02		
4	05/05/90	void					
5	05/10/90	0.05	0.02	0.05	0.02		
		void					
6	06/11/90	void					
7	07/06/90	void					
8	07/17/90	0.05	0.02	0.008	0.02		
9	08/01/90	0.05	0.02	0.02	0.008		
10	09/06/90	0.02	0.008	0.008	0.003		
11	11/06/90	0.05	0.02	0.05	0.02		
12	11/27/90	0.05	0.02	0.02	0.008		
13	01/10/91	0.05	0.02	0.02	0.008		
14	02/8/91	0.05	0.02	0.02	0.008		
15	03/16/91	0.05	0.02	0.02	0.008		
16	03/27/91	0.05	0.02	0.05	0.02		
17	05/02/91	0.05	0.02	0.05	0.02		
18	05/31/91	0.05	0.02	0.02	0.008		
19	07/12/91	0.05	0.02	0.02	0.008		
20	08/01/91	0.05	0.02	0.02	0.008		
21	09/04/91	0.05	0.02	0.02	0.008		
22	10/03/91	0.05	0.02	0.02	0.008		
23	10/30/91	0.05	0.02	0.02	0.008		
24	12/03/91	0.05	0.02	0.05	0.02		
25	01/09/92	0.05	0.02	0.02	0.008	0.0157	
26	01/29/92	0.05	0.02	0.02	0.008	0.0119	
27	02/27/92	0.05	0.02	0.02	0.008	0.0107	
28	04/07/92	0.05	0.02	0.02	0.02	0.022	
29	05/01/92	0.05	0.02	0.008	0.003	0.0185	
30	05/28/92	0.05	0.02	0.02	0.008	0.0111	
31	07/07/92	0.05	0.02	0.05	0.02	0.0254	
32	07/31/92	0.05	0.02	0.05	0.02	0.0275	
33	08/27/92	0.05	0.02	0.05	0.02	0.0275	
34	09/30/92	0.05	0.02	0.05	0.02	0.0272	
35	10/27/92	0.05	0.02	0.05	0.02	0.0229	
36	12/01/92	0.05	0.02	0.05	0.02	0.0284	
37	01/05/93	0.05	0.02	0.02	0.008	0.0116	
38	01/26/93	0.05	0.02	0.02	0.008	0.0187	
39	02/24/93	0.05	0.02	0.05	0.02	0.0258	
40	03/23/93	0.05	0.02	0.02	0.008	0.0123	
41	04/27/93	>0.05	0.05	0.02	0.008	0.0141	
42	06/01/93	0.05	0.02	0.05	0.02	0.0297	
43	07/12/93	0.05	0.02	0.05	0.02	0.0255	
Mean=		0.05	0.02	Mean=	0.03	0.01	0.0203

Chronic Reference Toxicant Record Sheet

Study Cerio Reflex ⁴³ 42 Restant (Aq. H₂O. Fort)

Test Organism Cerio

Beginning Date/Time 07-12-93 / 0935

Ending Date/Time 07-13-93 / 1028

Personnel Russell

Toxicant Cu

Source EPA

Lot # 188

Concentration 50 mg/l

Stock Concentration(s) Control, 0.3, 0.9, 2.4, 6.0, 15.0 mg/L Cu

Test Concentrations Control, 0.001, 0.003, 0.008, 0.02, 0.05

Dilution Water Enriched Cerio medium w/ 10% TR & Se

Released From

Date

Time

To

Date

Time

07-11-93

1300

07-12-93

0700

Test # ^{012 07-11-93} 42 43

NOEC 0.02

LOEC 0.05

Notes:

IC₂₅ = 0.0255

Number of Young/Day

Treatment	By Rep.	1	2	3	4	5	6	7	8	Total Young
(1) Control	1	0	0	0	4	6	12			22
	2				3	6	9			18
	3				3	5	2			10
	4				4	6	11			21
	5				5	6	0			11
	6				2	3	4			9
	7				3	5	0			8
	8				4	6	7			17
	9				4	8	10			22
	10				4	7	8			19
(2) 0.001	1	4	0	0	4	8	11			23
	2				4	3	0			7
	3				2	4	4			17
	4				4	8	10			22
	5				0	6	0			6
	6				3	6	6			15
	7				0	0	3			3
	8				4	6	7			17
	9				3	6	10			19
	10				4	7	6			17
(3) 0.003	1	0	0	0	4	8	9			21
	2				0	4	6			10
	3				4	8	9			21
	4				2	6	8			16
	5				4	6	0			10
	6				3	6	9			18
	7				3	7	8			18
	8				0	7	8			15
	9				3	7	8			18
	10				2	7	13			22
(4) 0.008	1	0	0	0	2	4	6			12
	2				3	5	0			8
	3				4	7	11			22
	4				3	6	0			9
	5				4	6	0			10
	6				4	6	8			18
	7				3	6	8			17
	8				4	6	8			18
	9				4	7	8			19
	10				3	0	11			14

0 1 2 3 4 5 6 7 8

Chow ID#: A₂Sta^{#2} A₆Sta^{#2} A₉Sta^{#3} A₁₂Sta^{#3} A₁₅Sta^{#4} A₁₈Sta^{#4}

Algae ID#: A₂Sta^{#2} A₆Sta^{#2} A₉Sta^{#3} A₁₂Sta^{#3} A₁₅Sta^{#4} A₁₈Sta^{#4}

Dilution Water ID#: 1350 1380 1382 1382 1392 1392

Reviewed By: C₁₂ C₁₂ C₁₂ C₁₂ C₁₂ C₁₂

Notes:

PIARC501-310

--- Number of Young/Day ---

Treatment	By Rep.	C1	C2	C3	C4	C5	C6	C7	C8	Total Young
		1	2	3	4	5	6	7	8	
0.02	1	0	0	0	3	5	8			16
	2				0	2	0			2
	3				4	7	9			20
	4				4	7	0			11
	5				3	6	0			9
	6				2	4	0			6
	7				5	6	8			19
	8				4	7	9			20
	9				4	7	8			19
	10	1	1	1	3	6	9			18
0.05	1	0/0								0
	2	0/0								0
	3	0/0								0
	4		0	0	0/0					0
	5		0	0	0	0/0				0
	6		0	0	0	4	5			9
	7		0/0			0/0				0
	8		0	0	0	0/0				0
	9		0/0							0
	10		0	0	3	7	0			10
	1	0/0								
	2	07-13-93								
	3									
	4									
	5									
	6									
	7									
	8									
	9									
	10									
	1									
	2									
	3									
	4									
	5									
	6									
	7									
	8									
	9									
	10									

0 1 2 3 4 5 6 7 8

Chow ID#: Ag Star #2 Ag Star #2 Ag Star #3 Ag Star #3 Ag Star #4 Ag Star #4

Algae ID#: Ag Star #2 Ag Star #2 Ag Star #3 Ag Star #3 Ag Star #4 Ag Star #4

Dilution Water ID#: 1380 1380 1382 1382 1392 1392

Reviewed By: C1 C2 C3 C4 C5 C6 C7 C8

Notes:

PLARC501-310

Analysis of Reproduction (# young/female/6 days)

REFTOX #43
Starting Date: 07/12/93

Reproduction (# young/female/6 days) Data

Treatment	Replicate										Mean
	1	2	3	4	5	6	7	8	9	10	
1 CONTROL	22.0	18.0	10.0	21.0	11.0	9.0	8.0	17.0	22.0	19.0	15.70
2 0.001	23.0	7.0	17.0	22.0	6.0	15.0	3.0	17.0	19.0	11.0	14.00
3 0.003	21.0	10.0	21.0	16.0	10.0	17.0	18.0	15.0	18.0	22.0	16.80
4 0.008	12.0	8.0	22.0	9.0	10.0	18.0	17.0	18.0	19.0	14.0	14.70
5 0.02	16.0	2.0	20.0	11.0	9.0	6.0	19.0	20.0	19.0	18.0	14.00

Steel's Many-One Rank Test

Treatment	No. of Replicates	Critical Rank Sum	Rank Sum*
0.001	10	76	97.0
0.003	10	76	107.5
0.008	10	76	98.5
0.02	10	76	96.5

* Values less than Critical Rank Sum significantly less than the control (CONTROL).

THE NUMBER OF RESAMPLES IS 80

*** LISTING OF GROUP CONCENTRATIONS (% EFF.) AND RESPONSE MEANS ***

CONC. (%EFF)	RESPONSE MEAN	MEAN AFTER POOLING
.000	15.700	15.700
.001	14.000	15.400
.003	16.800	15.400
.008	14.700	14.700
.020	14.000	14.000
.050	1.900	1.900

THE LINEAR INTERPOLATION ESTIMATE OF THE TOTAL IMPACT CONCENTRATION
FROM THE INPUT SAMPLE IS .0255.

.050	1.900	1.900
------	-------	-------

THE LINEAR INTERPOLATION ESTIMATE OF THE TOTAL IMPACT CONCENTRATION
FROM THE INPUT SAMPLE IS .0255.

* BOOTSTRAP PROCEDURE TO ESTIMATE VARIABILITY *
* OF THE ESTIMATED IC_p *

THE MEAN OF THE BOOTSTRAP ESTIMATES IS .0234.

THE STANDARD DEVIATION OF THE BOOTSTRAP ESTIMATES IS .0044.

AN EMPIRICAL 95.0% CONFIDENCE INTERVAL FOR THE
BOOTSTRAP ESTIMATE IS (.0130, .0288).

C:\BOOTSTRP>

INITIAL CHEMISTRY

Study 3, 61 FishPersonnel K. W. L.Beginning Date 11/12/93 FieldDate 01-06-93RevisedEnding Date 01-12-93 Field

By	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1.0
Control #											
0.001											
0.003											
0.008											
0.02											
0.05											
Control # 1/2	24.4	24.9	8.2	7.1	347	5.3	90.6	5.0	50		
0.001		24.9	8.1	7.1	347	5.4	92.3	5.0	50		
0.003		24.8	8.1	7.1	347						
0.008		24.8	8.1	7.2	347						
0.02		24.8	8.2	7.1	345						
0.05		24.8	8.2	7.1	345	5.4	92.3	5.0	50		

NOTES:

PLARC501-252

Reviewed By: ack/GKK

INITIAL CHEMISTRY

Study Dr. G.L. P. (1) (1)Personnel KingardBeginning Date 01/12/03Date 01/12/03RussellEnding Date 01/12/03

By	GL Cup	GLK Cup	GLL Cup	GLH Cup	GLR Cup	GLV Cup	Cup	GLK Cup	Cup		
Sample ID	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1,0
Control ^u 13.1	22.7	25.2	8.2	7.2	331	5.8	99.2	5.1	51		
0.001		25.1	8.2	7.1	33.2	5.5	94.1	5.0	50		
0.003		25.1	8.2	7.1	33.1						
0.008		25.1	8.2	7.1	33.0						
0.02		25.0	8.2	7.1	33.1						
0.05		25.1	8.2	7.1	33.1	5.4	92.3	5.0	50		
Control ^u 13.1	24.0	25.2	8.0	7.0	34.0	5.2	33.9	4.9	49		
0.001		25.1	8.0	7.0	34.0	5.3	40.6	4.9	44		
0.003		25.0	8.0	7.1	34.0						
0.008		25.0	8.0	7.1	34.0						
0.02		25.0	8.0	7.1	34.1						
0.05		25.1	8.0	7.0	34.0	5.5	44.1	4.9	44		
Med ^u 13.1		25.0	8.0	7.2	33.2	5.5	94.1	6.4	64		

NOTES:

PLARC501-252

Reviewed By: GLK

INITIAL CHEMISTRY

Page 1 of 1Study Subl. Pol. Inc.Personnel KingBeginning Date 11/11/92Date 11/11/92RussellEnding Date 11/12/92

By	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1.0
Control #1	22.4		8.2	7.1	328	5.3	90.6	5.0	50		
0.001			8.2	7.1	321	5.2	88.9	5.0	50		
0.003			8.2	7.1	320						
0.008			8.2	7.1	321						
0.02			8.2	7.1	321						
0.05			8.2	7.1	321	5.2	88.9	5.0	50		
Control #2	21.2	25.2	8.4	7.1	342	5.4	92.3	5.2	52		
0.001		24.4	8.4	7.1	342	5.3	90.6	5.1	51		
0.003		25.1	8.4	7.1	342						
0.008		25.1	8.4	7.1	342						
0.02		25.1	8.4	7.1	341						
0.05		25.1	8.4	7.1	341	5.4	92.3	5.1	51		

NOTES:

PLARC501-252

Reviewed By: King

INITIAL CHEMISTRY

Study 1.01. P.1.1.1.Personnel KingBeginning Date 1.1.93 FishDate 1.1.93RussellEnding Date 1.1.93 Fish

By	Temp.	Temp.	DO	pH	Cond.	Hard	Calc	Alk	Calc	TRC	x 1.0
Sample ID	Initial	Warmed					x17.1		x10		
Control ^u	23.3	24.4	8.1	7.1	328	5.1	87.2	5.1	51		
O.C.01		25.0	8.1	7.1	321	5.2	88.9	5.0	50		
O.C.03		24.9	8.1	7.2	327						
O.C.08		24.4	8.1	7.2	328						
O.C.02		24.9	8.1	7.2	321						
O.C.05		25.0	8.1	7.1	321	5.1	81.2	5.0	50		
Control ^u	23.3	25.2	8.0	7.1	343	5.4	92.3	5.2	52		
O.C.01		25.0	8.0	7.1	341	5.3	90.6	5.1	52		
O.C.03		25.0	8.0	7.1	344						
O.C.08		25.0	8.1	7.1	344						
O.C.02		25.0	8.1	7.1	344	5.3					
O.C.05		25.1	8.1	7.1	343	5.4	91.8	5.2	52		

NOTES:

PLARC501-252

Reviewed By: King

Personnel King

Date 6-1-11

Russell

Ending Date 6/15/93 Fish

Fish {

PLARC501-252

Reviewed By: Cxk / Gkk

INITIAL CHEMISTRY

Page 1 of 1

Study Sub. P. (A)

Personnel Kincaid

Beginning Date 12-13-73

Date 01-12-74

Russell

Ending Date 12-13-73

Water
Control

By	Cap.	Cap.	Cap.	Cap.	Cap.	Cap.	Cap.	Cap.	Cap.		
Sample ID	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1.0
Control "1300"	21.9	25.0	8.2	7.1	327	5.2 25.0	88.9	5.2	5.2		
0.001	1	25.0	8.2	7.2	328	5.3	90.6	5.0	5.0		
0.003	1	24.8	8.2	7.2	328						
0.008	1	25.2	8.3	7.2	328						
0.02		25.3	8.2	7.2	328						
0.05	"	25.3	8.3	7.1	328	5.3	90.6	5.1	5.1		
Control "1300"	22.1	25.2	8.2	7.1	330						
0.001	1	25.1	8.3	7.1	331						
0.003	1	25.2	8.2	7.1	330						
0.008	1	25.1	8.3	7.1	331						
0.02	1	25.4	8.3	7.1	330						
0.05	"	25.1	8.3	7.1	331						

Fish

NOTES:

PLARC501-252

Reviewed By: CK/GKK

INITIAL CHEMISTRY

Study Cedar Point PostcardPersonnel RussellBeginning Date 01-12-95Date 01-13-95Ending Date 01-13-95

By	Ca ²⁺	Mg ²⁺	Ca ²⁺	Ca ²⁺	Ca ²⁺						
Sample ID	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1.0
Control # 1556	22.9	25.2	8.1	7.2	332						
O.C.1		25.2	8.1	7.2	332						
O.C.2		25.3	8.1	7.2	333						
O.C.3		25.2	8.1	7.2	333						
O.C.4		25.3	8.1	7.2	333						
O.C.5		25.1	8.1	7.2	333						

NOTES:

PLARC501-252

Reviewed By: Ca²⁺

INITIAL CHEMISTRY

Page 1 of 1

Study Cerco Rollox Resistor

Personnel Bussnell

Beginning Date 07-12-93

Date 07-17-93

Ending Date 07-18-93

By	C ₁₂	C ₁₂	C ₁₂	C ₁₂	C ₁₂	C ₁₂	C ₁₂	C ₁₂	C ₁₂		
Sample ID	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1.0
Control # 1532	21.1	25.4	8.2	7.1	337	5.3	90.6	5.5	55		
0.001		24.4	8.2	7.1	336	5.4	92.3	5.5	55		
0.003		14.3	8.2	7.2	345						
0.008		13.0	8.2	7.2	350						
0.02		12.0	8.3	7.2	350						
0.05		11.4	8.2	7.1	350	5.4	92.3	5.4	54		

NOTES:

PLARC501-252

Reviewed By: CRC

INITIAL CHEMISTRY

Page 1 of 1Study Cenio Rollox ResistentPersonnel RussellBeginning Date 07-12-93Date 07-15-93K. RussellEnding Date 07-15-93

By	Temp.	Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1.0
Sample ID	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1.0
Control #1501	24.1	25.3	8.3	7.1	338						
0.001		25.4	8.3	7.2	338						
0.003		25.4	8.3	7.2	340						
0.008		25.2	8.3	7.2	340						
0.02		25.2	8.3	7.2	341						
0.05		25.3	8.3	7.2	342						

NOTES:

PLARC501-252

Reviewed By: CR

Ending Date 6 / 15 / 73

By	Initial Temp.	Warmed Temp.	DO	pH	Cond.	Hard	x17.1	Alk	x10	TRC	x 1.0
Control # 134 C	25.1	25.1	8.3	7.2	333	5.0	85.5 50 67-68	5.2	52		
0.001		25.2	8.3	7.2	334	5.0	85.5 50 67-68	5.2	52		
0.003		25.3	8.3	7.2	334						
0.008		25.3	8.3	7.2	335						
0.02		25.4	8.3	7.2	334						
0.05		25.1	8.3	7.2	334	5.0	85.5	5.1	51		

NOTES:

PLARC501-252

Reviewed By: CWK / GKK

Personnel Bureau

Date 07-17-43

Ending Date 6-18-83

[illegible]

PLARC501-252

Reviewed By: Cup

Study July Rel 100
 Beginning Date 07-07-93 Cello
01-06-93 Fish
 Ending Date 07-12-93 Cello Tissue
07-13-93 Fish

Date 7-7-93

Personnel Kinard
Russell

Sample ID	By Rep.	Fish			
		Temp.	DO	pH	Cond.
Control	1	25.0	6.2	7.5	
	2	24.8	6.4		35.2
	3	25.2	6.1		
	4	25.3	6.2		
0.001	1	25.1	6.1	7.5	
	2	24.8	6.0		35.2
	3	25.5	6.0		
	4	25.5	6.5		
0.003	1	24.8	6.4	7.5	
	2	24.8	6.4		35.1
	3	24.9	5.8		
	4	24.9	6.4		
0.008	1	24.7	6.3	7.5	
	2	24.8	6.6		35.3
	3	24.8	6.5		
	4	24.9	6.4		
0.02	1	25.0	6.6	7.5	
	2	25.0	6.5		34.8
	3	24.8	6.5		
	4	25.0	6.4		
0.05	1	25.1	6.7	7.5	
	2	25.1	6.8		35.0
	3	25.1	6.6		
	4	24.9	6.8		
	1				
	2				
	3				
	4				

Ceriodaphnia			
Temp.	Sample ID	DO	pH
	Control		
	0.001		
	0.003		
	0.008		
	0.02		
	0.05		

NOTES:

FINAL CHEMISTRY

Page 1 of 1Study July Rel. low

Beginning Date

07-07-93 Curo

Date 7-8-93Personnel King

Ending Date

07-12-93 Curo Temp. Int

07-13-93 Fish

Russell

Sample ID	By	Fish			
		GRK/	Temp.	DO	pH
		Rep.	Cond.		
Control	1		24.7	5.4	
	2		24.0	5.8	7.4
	3		24.3	5.8	
	4		24.3	5.8	345
0.001	1		24.0	5.6	
	2		24.5	5.6	7.4
	3		24.0	5.9	
	4		24.4	5.5	347
0.003	1		24.0	5.5	
	2		24.5	5.5	7.4
	3		24.3	5.7	
	4		24.5	5.3	347
0.008	1		24.5	5.9	
	2		24.1	5.8	7.4
	3		23.9	6.1	
	4		24.0	6.0	347
0.02	1		24.6	6.2	
	2		24.5	5.8	7.4
	3		24.4	5.8	
	4		23.9	6.5	347
0.05	1		24.7	6.2	
	2		24.2	6.6	7.5
	3		24.5	5.9	
	4		24.0	6.9	347
	1				
	2				
	3				
	4				

Ceriodaphnia			
Temp.	Sample ID	DO	pH
25.5	Control	15	7.8
25.5	0.001	15	7.8
25.5	0.003	16	7.8
25.5	0.008	7.8	7.8
25.7	0.02	11	7.8
25.4	0.05	11	7.8
25.4			
25.4			
25.4			
25.7			

NOTES:

Reviewed By: Cure
PLARC501-255

Study July Rel IonBeginning Date 07-07-93 Cerio
07-06-93 Fish
Ending Date 07-12-93 Cerio Terminated
07-13-93 FishDate 07-09-93Personnel KingardRussell

Sample ID	By	Fish				
		Rep.	Temp.	DO	pH	Cond.
Control	1		24.7	6.1		
	2		24.7	5.2		
	3		24.4	6.7	7.4	
	4		24.4	5.8		352
0.001	1		24.6	4.7		
	2		24.7	5.5		
	3		25.0	5.0	7.4	
	4		24.6	5.6		353
0.003	1		25.1	5.7		
	2		25.2	4.6		
	3		24.5	5.8	7.5	
	4		24.8	5.2		353
0.008	1		24.7	5.8		
	2		24.8	5.7		
	3		24.6	5.9	7.5	
	4		24.7	5.6		352
0.02	1		24.4	5.9		
	2		24.4	6.0		
	3		24.9	4.9	7.4	End of test 12
	4		25.0	5.3		349
0.05	1		24.7	6.3		
	2		24.3	5.7		
	3		24.8	6.3	7.5	
	4		24.8	6.0		350
	1					
	2					
	3					
	4					

Ceriodaphnia			
Temp.	Sample ID	DO	pH
25.7	Control ①	7.6	7.8
25.4	0.001 ②	7.7	7.8
25.3	0.003 ③	7.7	7.8
25.2	0.008 ④	7.7	7.8
25.4	0.02 ⑤	7.4	7.8
25.2	0.05 ⑥	7.7	7.8
25.2			
25.4			
25.5			
25.7			

NOTES:

Reviewed By: CLP
PLARC501-255

FINAL CHEMISTRY

Page 1 of 1

Study July Rel 1000
 Beginning Date 07-06-93 Fish
07-07-93 Cerio
 Ending Date 07-12-93 Cerio Terminated
07-13-93 Fish

Date 07-10-93

Personnel Kincaid
Russell

Sample ID	By	Fish				
		Cer	Cer	Cer	Cer	
		Rep.	Temp.	DO	pH	Cond.
Control	1		24.9	6.0		348
	2		24.7	6.2		
	3		25.0	6.2		
	4		24.6	6.3	7.5	
0.001	1		24.9	6.1		348
	2		24.9	6.5		
	3		24.5 25.5	6.3		
	4		24.4 24.4	6.5	7.6	
0.003	1		24.4	6.6		349
	2		24.9	6.1		
	3		24.5	6.3		
	4		24.7	6.0	7.6	
0.005	1		24.9	6.4		351
	2		24.8	6.2		
	3		24.7	6.3		
	4		24.8	6.3	7.6	
0.02	1		24.9	6.1		347
	2		25.2	5.9		
	3		24.7	6.5		
	4		24.6	6.5	7.6	
0.05	1		24.7	6.6		344
	2		24.5	6.4		
	3		25.0	6.4		
	4		24.4	6.1	7.5	
	1					
	2					
	3					
	4					

Ceriodaphnia			
Cer		Cer	Cer
Temp.	Sample ID	DO	pH
25.3	Control ①	7.7	7.9
25.3	0.001 ②	7.1	8.0
25.3	0.003 ③	7.7	7.9
25.2	0.008 ④	7.7	7.9
25.3	0.02 ⑤	7.7	7.9
25.0	0.05 ⑥	7.7	7.9
25.0			
25.2			
25.1			
25.6			

NOTES:

Reviewed By: Cer
 PLARC501-255

FINAL CHEMISTRY

Page 1 of 1

Study 0.01, 0.02, 0.03, 0.05

Beginning Date 07.06.93 Fish

Date 07.11.93

Personnel K. Russell

Ending Date 07.12.93 Control Temp. 12.5

Russell

Sample ID	By	Fish			
		Temp.	DO	pH	Cond.
	Rep.				
Control	1	24.9	6.4	7.5	
	2	25.0	6.4		352
	3	24.4	6.4		
	4	24.0	6.4		
0.001	1	24.3	6.4	7.4	
	2	24.4	6.4		332
	3	24.5	6.5		
	4	24.6	6.6		
0.002	1	24.0	6.5	7.1	
	2	25.1	6.5		344
	3	25.0	6.7		
	4	24.5	6.6		
0.003	1	24.2	6.5	7.1	
	2	24.4	6.6		351
	3	24.5	6.5		
	4	24.9	6.7		
0.004	1	24.3	7.1	7.7	
	2	24.5	6.6		319
	3	24.8	7.0		
	4	24.6	6.9		
0.05	1	24.6	7.0	7.7	
	2	24.4	7.0		350
	3	24.5	7.1		
	4	24.6	7.1		
	1				
	2				
	3				
	4				

Ceriodaphnia			
Temp.	Sample ID	DO	pH
25.2	Control	7.3	7.9
25.1	0.001 (2)	7.1	7.9
25.1	0.003 (3)	7.1	7.9
25.0	0.008 (4)	7.1	7.9
25.1	0.02 (5)	7.0	7.9
24.9	0.05 (6)	7.3	7.9
25.0			
25.1			
25.2			
25.1			

NOTES:

Reviewed By: C.K.
PLARC501-255

Date 07 11 93

Personnel King

Kassel

Sample ID	By	Fish				
		Rep.	Temp.	DO	pH	Cond.
Control	1		25.1	6.2		
	2		25.2	6.3	7.5	
	3		24.7	6.2		35.1
	4		24.6	6.2		
0.001	1		24.3	7.0		
	2		24.5	6.5	7.5	
	3		25.0	6.2		35.5
	4		24.7	6.4		
0.003	1		24.6	6.5		
	2		24.5	6.5	7.5	
	3		24.7			35.0
	4		24.8	6.7		
0.005	1		25.1	6.5		
	2		25.0	6.2	7.5	
	3		24.7	6.6		35.8
	4		24.7	6.4		
0.01	1		25.1	6.2		
	2		25.2	6.5	7.5	
	3		25.2	6.6		35.0
	4		25.1	6.5		
0.05	1		24.3	6.8		
	2		25.0	6.5	7.5	
	3		25.1	6.5		35.2
	4		25.1	6.5		
	1					
	2					
	3					
	4					

NOTES:

Ceriodaphnia			
Temp.	Sample ID	DO	pH
	(1) Control		
	(2) 0.001		
	(3) 0.003		
	(4) 0.008		
	(5) 0.02		
	(6) 0.05		
Turn	Control	100	-
	0.05	100	100
	0.05	100	100

Reviewed By: PLARC501-255

Study July 801 1000Beginning Date 11-13-93Date 07-13-94Personnel 1000Ending Date 07-13-93 Fish1000

Sample ID	By Rep.	Fish				
		Temp.	DO	pH	Cond.	
Control	1	25.6	6.5			
	2	25.2	6.5			
	3	25.3	6.5	7.5		
	4	25.1	6.5		30.5	
0.001	1	25.5	6.5			
	2	25.0	6.5			
	3	25.3	6.5	7.5		
	4	24.9	6.5		30.5	
0.003	1	25.2	6.5			
	2	24.7	6.5			
	3	25.5	6.5	7.5		
	4	25.5	6.5		30.1	
0.005	1	25.0	6.5			
	2	25.3	6.5			
	3	24.6	6.5			
	4	25.2	6.5	7.5	30.1	
0.02	1	25.5	6.5			
	2	25.7	6.5			
	3	24.4	6.5			
	4	25.2	6.5	7.7	30.5	
0.05	1	25.7	6.5			
	2	24.8	6.5			
	3	24.4	6.5			
	4	25.1	6.5	7.7	30.1	
	1					
	2					
	3					
	4					

Ceriodaphnia			
Temp.	Sample ID	DO	pH
	Control		
	0.001		
	0.003		
	0.005		
	0.02		
	0.05		

NOTES:

FINAL CHEMISTRY

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Study Ceriodaphnia Resistant

Beginning Date 07-12-93

Ending Date 07-18-93

Date 07-18-93

Personnel PLARC 255

Sample ID	Fish				
	By				
	Rep.	Temp.	DO	pH	Cond.
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				

Ceriodaphnia			
Temp.	Sample ID	DO	pH
25.2	C. dubia	7.5	7.9
25.2	C. dubia	7.4	7.9
25.3	C. dubia	7.5	7.9
25.3	C. dubia	7.4	7.9
25.3	C. dubia	7.4	7.9
25.3	C. dubia	7.4	7.9
25.1	C. dubia	7.4	7.9
25.3			
25.2			
25.2			
25.1			

NOTES:

Reviewed By: PLARC 255

FINAL CHEMISTRY

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Study Ceriodaphnia Resistant

Beginning Date 07-12-93

Date 01-14-93

Personnel P. J. J. J. J.

Ending Date 01-18-93

Sample ID	By	Fish				
		Rep.	Temp.	DO	pH	Cond.
	1					
	2					
	3					
	4					
	1					
	2					
	3					
	4					
	1					
	2					
	3					
	4					
	1					
	2					
	3					
	4					
	1					
	2					
	3					
	4					
	1					
	2					
	3					
	4					
	1					
	2					
	3					
	4					

Ceriodaphnia			
Temp.	Sample ID	DO	pH
25.0	1	7.3	8.1
25.2	2	7.3	8.1
25.2	3	7.9	8.1
25.2	4	7.9	8.1
25.2	5	7.3	8.1
25.0	6	7.3	8.1
25.0	7		
25.0	8		
25.2	9		
24.6	10		

NOTES:

Reviewed By: P. J. J. J.
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FINAL CHEMISTRY

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Study Ceriodaphnia Resistant

Beginning Date 07-12-93

Ending Date 07-18-93

Date 07-15-93

Personnel PLARC501

Sample ID	Fish				
	By	Temp.	DO	pH	Cond.
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				

Ceriodaphnia			
Temp.	Sample ID	DO	pH
25.3	Ceriodaphnia	1.1	7.8
25.3	O.C.C. 1	1.3	7.8
25.2	O.C.C. 2	1.2	7.8
25.1	O.C.C. 3	1.1	7.8
25.1	O.C.C. 4	1.0	7.7
25.2	O.C.C. 5	1.0	7.8
25.2			
25.2			
25.2			
25.2			

NOTES:

Reviewed By: PLARC501
PLARC501 255

Personnel 11,000,000

Date 11-16-73

Ending Date 01-18-93

Sample ID	Fish				
	By				
	Rep.	Temp.	DO	pH	Cond.
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				

NOTES:

Ceriodaphnia ¹¹			
Conc.		Conc.	
Temp.	Sample ID	DO	pH
25.4	C. G. 1.1 ⁶¹	1.1	7.8
25.4	C. G. 1.1 ⁶²	1.1	7.8
25.4	C. G. 1.1 ⁶³	1.1	7.8
25.4	C. G. 1.1 ⁶⁴	1.1	7.8
25.4	C. G. 1.1 ⁶⁵	1.1	7.8
25.4	C. G. 1.1 ⁶⁶	1.1	7.8
25.4	C. G. 1.1 ⁶⁷	1.1	7.8
25.4	C. G. 1.1 ⁶⁸	1.1	7.8
25.4	C. G. 1.1 ⁶⁹	1.1	7.8
25.4	C. G. 1.1 ⁷⁰	1.1	7.8
25.4	C. G. 1.1 ⁷¹	1.1	7.8
25.4	C. G. 1.1 ⁷²	1.1	7.8
25.4	C. G. 1.1 ⁷³	1.1	7.8
25.4	C. G. 1.1 ⁷⁴	1.1	7.8
25.4	C. G. 1.1 ⁷⁵	1.1	7.8
25.4	C. G. 1.1 ⁷⁶	1.1	7.8
25.4	C. G. 1.1 ⁷⁷	1.1	7.8
25.4	C. G. 1.1 ⁷⁸	1.1	7.8
25.4	C. G. 1.1 ⁷⁹	1.1	7.8
25.4	C. G. 1.1 ⁸⁰	1.1	7.8

Reviewed By: PLARC501.255

FINAL CHEMISTRY

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Study Ceriodaphnia Resistant

Beginning Date 07-12-93

Ending Date 07-18-93

Date 07/17/93

Personnel PLARC501

Sample ID	By	Fish			
		Rep.	Temp.	DO	pH
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				

Ceriodaphnia			
Temp.	Sample ID	DO	pH
24.6	0.001	7.4	7.6
25.8	0.001	7.1	7.7
25.8	0.001	7.1	7.7
25.7	0.001	7.1	7.7
25.8	0.001	7.1	7.7
25.6	0.001	7.1	7.7
25.6			
25.6			
25.6			
25.6			

NOTES:

Reviewed By: PLARC501 255

Personnel :

Ending Date 6-13-92

Sample ID	By Rep.	Fish			
		Temp.	DO	pH	Cond.
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				
	1				
	2				
	3				
	4				

Ceriodaphnia			
Date		Cat	Cat2
Temp.	Sample ID	DO	pH
25.0	6-1-1	7.1	7.3
24.9	6-1-2	7.1	7.3
24.8	6-1-3	7.1	7.3
24.7	6-1-4	7.1	7.3
24.6	6-1-5	7.1	7.3
24.5	6-1-6	7.1	7.3
24.4			
24.3			
24.2			
24.1			

NOTES:

Reviewed By: _____
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