



# Arkansas Analytical, Inc.

## Toxicity Test Results

**MAGCOBAR MINE SITE**  
**NPDES PERMIT NUMBER: AR0049794**  
**November 2003**

Fathead Minnow, *Pimephales promelas*, Larval Survival and Growth Test  
Test 1000.0

*Ceriodaphnia dubia*, Survival and Reproduction Test  
Test 1002.0

Prepared for: **Mr. Alan B. Brown**  
**Weston Solutions**  
**Magcobar Mine Site**  
**2000 Darby Lane**  
**Malvern, AR 72104**

Prepared by: Arkansas Analytical, Inc.  
11701 I-30, Bldg 1, Suite 115  
Little Rock, Arkansas 72209  
**Lab Number K311328**

Monday, December 8, 2003

## **Introduction**

This report contains test results for toxicity testing for the Magcobar Mine Site. The NPDES permit number is AR0049794. The facility is located one mile northeast of Magnet Cove in Sections 10, 11, 14, & 15, Township 3 South, Range 17 West in Hot Springs County, Arkansas. The facility discharges into Chamberlain Creek, thence to Cove Creek, thence to Quachita River in Segment 2F of the Ouachita River Basin.

The permit requires chronic biomonitoring testing once per month for both *Ceriodaphnia dubia* and *Pimephales promelas*. The test results in this report represent the testing for November of 2003.

## **Plant Operations**

To be provided by permittee.

## Source of Effluent and Dilution Water

Effluent samples were collected as follows:

Sample Collection:	Date, Time Started	Date, Time Ended
Sample #1:	11-12-03, 1045	11-13-03, 1045
Sample #2:	11-13-03, 1110	11-14-03, 1110
Sample #3:	11-17-03, 0900	11-18-03, 0900

The sample was a composite collected at the final discharge from the Magcobar mine site.

The following information was collected upon immediate receipt of the samples at the laboratory:

Sample Receiving Information:	Date, Time Sample(s) Received	Storage Temperature (°C)
Sample #1:	11-13-03, 1425	4
Sample #2:	11-14-03, 1450	4
Sample #3:	11-18-03, 1530	4

Chain of custody documentation is located in Appendix A.

The permit designates the receiving water to be used as dilution water for the toxicity tests. Synthetic dilution water was substituted either because zero flow conditions existed or due to an earlier characterization of the receiving water as being toxic.

Each sample was analyzed for pH, hardness, total alkalinity, and conductivity. Results are provided in Appendix B.

### Dilution Series

Five dilutions in addition to a control (0% effluent) were used in the toxicity tests. The dilutions, which were made with synthetic water, were 32%, 42%, 56%, 75%, and 100%. The low-flow effluent concentration (**critical dilution**) was defined as **100% effluent**.

## Test Methods

EPA Method 1000.0, Fathead Minnow, *Pimephales promelas*, Larval Survival and Growth Test, was used in this bioassay. Larvae are exposed in a static renewal system for seven days and the results are based on the survival and growth (increase in weight) of the larvae. There were no deviations from the reference method. The test chambers were 500 ml plastic cups, and each chamber contained ten organisms in a test solution volume of 250 mls. The test temperature was 25 degrees Centigrade. Raw data and statistics are provided in Appendix C.

EPA Method 1002.0, Cladoceran, *Ceriodaphnia dubia*, Survival and Reproduction Test, was also used. Neonates are exposed in a static renewal system until at least 60% of the control organisms have produced a third brood. Results are based on the survival and reproduction of the organisms. One neonate was placed in each of ten replicate chambers using a randomizing template. Test chambers were 30 ml plastic cups filled with 15 ml of test solution. The test temperature was 25 degrees Centigrade. Raw data and statistics are provided in Appendix D.

## Test Organisms

The organisms used in Test 1000.0 were < 48 hour old Fathead Minnows, *Pimephales promelas*, which were purchased from Aquatox; a copy of the organism history is provided in Appendix E.

The organisms used in Test 1002.0 were < 24 hour old *Ceriodaphnia dubia* neonates, (all born within the same eight hours), obtained from an in-house culture. An organism history is provided in Appendix E.

## Quality Assurance

### Test Acceptability

#### TEST ACCEPTANCE CRITERIA for *Ceriodaphnia dubia*

Control Criteria	Results	Pass	Fail
Greater than or equal to 80% survival	90%	X	
Average of 15 or more young per surviving female	28.0	X	
At least 60% of surviving females should have produced 3 broods	90%	X	
The percent coefficient of variation between replicates must be 40% or less for the young of surviving females	11.0%	X	

#### TEST ACCEPTANCE CRITERIA for *Pimephales promelas*

Control Criteria	Results	Pass	Fail
Greater than or equal to 80% survival	98%	X	
The percent coefficient of variation between replicates must be 40% or less for survival	4.56%	X	
Minimum of 0.25 mg average dry weight of surviving controls	0.412	X	
The percent coefficient of variation between replicates must be 40% or less for growth	5.52%	X	

### Reference Toxicant

The reference toxicant used was Potassium Chloride prepared in-house. The tests were performed using moderately hard synthetic as dilution water. The results of the reference toxicant were:

#### REFERENCE TOXICANT

<i>Ceriodaphnia dubia</i>		<i>Pimephales promelas</i>	
NOEC Survival:	500 ppm KCl	NOEC Survival:	500 ppm KCl
LOEC Survival:	1000 ppm KCl	LOEC Survival:	1000 ppm KCl
NOEC Reproduction:	250 ppm KCl	NOEC Growth:	500 ppm KCl
LOEC Reproduction:	500 ppm KCl	LOEC Growth:	1000 ppm KCl

Quality Assurance charts are provided in Appendix F.

## Summary of Results Magcobar Mine Site

<i>Ceriodaphnia dubia</i>		<i>Pimephales promelas</i>	
NOEC / LOEC Survival	100% / NA	NOEC / LOEC survival	100% / NA
NOEC / LOEC Reproduction	100% / NA	NOEC / LOEC growth	100% / NA
Mean number of neonates (critical dilution)	22.2	%CV survival (critical dilution)	0%
%CV Reproduction (critical dilution)	26.4%	Mean dry weight (critical dilution) in milligrams	0.649
		%CV growth (critical dilution)	19.6%

### Conclusion

Chronic static renewal larval survival and growth test using fathead minnow, *Pimephales promelas*, (Method 1000.0).

The permit issued to the Magcobar Mine Site, AR0049794, specifies that the **critical dilution is 100% effluent**. The effluent samples did not exhibit lethal effects or sublethal effects at the critical dilution, and, as such, **passed** both portions of the test.

Chronic static renewal survival and reproduction test using *Ceriodaphnia dubia*, (Method 1002.0).

The permit issued to the Magcobar, AR0049794, specifies that the **critical dilution is 100% effluent**. The effluent samples did not exhibit lethal effects or sublethal effects at the critical dilution, and, as such, **passed** both portions of the test.

Biomonitoring Analysts:

  
Melissa Green

  
Andrea Fox

  
Teresa Canfield

  
Wendy Harston

**SUMMARY REPORTING FORMS FOR CHRONIC BIOMONITORING  
FATHEAD MINNOW LARVAE GROWTH AND SURVIVAL  
*PIMEPHALES PROMELAS***

**PERMITTEE: Magcobar Mine Site**

**NPDES #: AR0049794**

Sample Collection:	Date, Time Started	Date, Time Ended
Sample #1:	11-12-03, 1045	11-13-03, 1045
Sample #2:	11-13-03, 1110	11-14-03, 1110
Sample #3:	11-17-03, 0900	11-18-03, 0900

Test initiated (date, time): 11-14-03, 1445    Test terminated (date, time): 11-21-03, 1505

Dilution water used:    Soft Synthetic

**DATA TABLE FOR FATHEAD MINNOW SURVIVAL**

Effluent Conc %	Percent Survival in Replicate Chambers					Mean Percent Survival			
	A	B	C	D	E	24 hours	48 hours	7 days	CV %
0%	100	90	100	100	100	100	100	98	4.56
32%	100	100	100	90	100	100	100	98	
42%	100	100	100	100	100	100	100	100	
56%	100	100	100	100	100	100	100	100	
75%	100	100	100	100	100	100	100	100	
100%	100	100	100	100	100	100	100	100	0.00

**DATA TABLE FOR GROWTH OF FATHEAD MINNOWS**

Effluent Conc %	Average Dry Weight in milligrams in replicate chambers					Mean Dry Weight	CV%
	A	B	C	D	E		
0%	0.449	0.416	0.398	0.390	0.409	0.412	5.52
32%	0.537	0.517	0.419	0.448	0.570	0.498	
42%	0.729	0.701	0.668	0.525	0.518	0.628	
56%	0.756	0.618	0.684	0.732	0.774	0.713	
75%	0.698	0.742	0.660	0.758	0.779	0.727	
100%	0.667	0.708	0.430	0.684	0.756	0.649	19.6

Coefficient of Variation = standard deviation / mean \* 100

SUMMARY REPORTING FORMS FOR CHRONIC BIOMONITORING  
FATHEAD MINNOW LARVAE GROWTH AND SURVIVAL  
*Pimephales promelas*

1. Dunnett's procedure or Steel's Many-One Rank Test as appropriate:  
Is the mean survival at 7 days significantly different ( $p=0.05$ ) than the control survival for:
  - a) LOW FLOW OR CRITICAL DILUTION, (100%)    YES \_\_\_\_\_    NO   X
  
2. Dunnett's Procedure  
Is the mean dry weight (growth) at 7 days significantly different ( $p=0.05$ ) than the control's dry weight (growth) for:
  - a) LOW FLOW OR CRITICAL DILUTION, (100%)    YES \_\_\_\_\_    NO   X
  
3. If NO was answered to 1.a) enter [0] otherwise enter [1] (parameter TLP6C): \_\_\_\_\_   0
  
4. If NO was answered to 2.a) enter [0] otherwise enter [1] (parameter TGP6C): \_\_\_\_\_   0
  
5. Enter percentage corresponding to each parameter below:
  - a) NOEC survival (parameter TOP6C)= \_\_\_\_\_   100   % effluent
  - b) NOEC growth (parameter TPP6C)= \_\_\_\_\_   100   % effluent
  - c) Coefficient of variation (parameter TQP6C)= \_\_\_\_\_   4.56   %



**SUMMARY REPORTING FORMS FOR CHRONIC BIOMONITORING**  
*Ceriodaphnia dubia* SURVIVAL AND REPRODUCTION

**Permittee: Magcobar Mine Site**

**NPDES #: AR0049794**

Sample Collection:	Date, Time Started	Date, Time Ended
Sample #1:	11-12-03, 1045	11-13-03, 1045
Sample #2:	11-13-03, 1110	11-14-03, 1110
Sample #3:	11-17-03, 0900	11-18-03, 0900

Test initiated (date, time): 11-14-03, 1130    Test terminated (date, time): 11-20-03, 0915

Dilution water used:    Soft Synthetic

*Ceriodaphnia dubia* SURVIVAL AND REPRODUCTION  
 NUMBER OF YOUNG PRODUCED PER FEMALE @ TEST TERMINATION  
 PERCENT EFFLUENT

Replicate	0%	32%	42%	52%	75%	100%
A	X0	35	28	X0	29	31
B	29	31	22	32	32	24
C	29	28	27	26	29	13
D	26	18	20	28	24	25
E	31	29	25	11	24	16
F	32	27	25	29	20	25
G	31	29	28	33	28	16
H	24	32	35	29	31	26
I	24	17	34	35	19	X4
J	26	30	16	32	32	24
Mean	25.2	27.6	26.0	25.5	26.8	20.4
Mean/surviving female	28.0	27.6	26.0	28.3	26.8	22.2
CV%*	11.0					26.4

X= Dead Adult; M= Male (Not considered in statistics)

\*Coefficient of Variation = standard deviation/ mean \* 100; CV% calculation based on young per surviving female

## SUMMARY REPORTING FORMS FOR CHRONIC BIOMONITORING *Ceriodaphnia dubia* SURVIVAL AND REPRODUCTION

Permittee: Magcobar Mine Site

NPDES #: AR0049794

### PERCENT SURVIVAL

PERCENT EFFLUENT	0%	32%	42%	56%	75%	100%
Time of Reading: 24 HOURS	100	100	100	100	100	100
48 HOURS	90	100	100	100	100	100
Test termination	90	100	100	90	100	90

1. Fisher's Exact Test:

Is the mean survival at test termination significantly different (p=0.05) than the control survival for:

a) LOW FLOW OR CRITICAL DILUTION, (100%): YES \_\_\_\_\_ NO   X  

2. Dunnett's Procedure or Steel's Many One Rank Test:

Is the mean number of young produced per female significantly different (p=0.05) than the controls number of young per female for:

a) LOW FLOW OR CRITICAL DILUTION, (100%): YES \_\_\_\_\_ NO   X  

3. If NO was answered to 1.a) enter [0] otherwise enter [1] (parameter TLP3B):   0  

4. If NO was answered to 2.a) enter [0] otherwise enter [1] (parameter TGP3B):   0  

5. Enter percentage corresponding to each parameter below:

a) NOEC survival (parameter TOP3B)=   100   % effluent

b) NOEC reproduction (parameter TPP3B)=   100   % effluent

c) Coefficient of variation (parameter TQP3B)=   26.4   %



## APPENDIX A

### Chain of Custody Forms

# CHAIN OF CUSTODY RECORD

**CLIENT INFORMATION**  
**Weston Solutions, Inc.**  
**P.O. Box 699**  
**2000 Darby Lane**  
**Malvern, AR 72104**  
**Attn: Alan Brown**

**Project Description**  
 MAGCOBAR Mine Site  
**Reporting Information**  
 Telephone: 501/467-8355  
 FAX: 501/467-8687  
 Bill to P.O.

**Turnaround Time (CIRCLE ONE)**  
 24 hour  
 48 hour  
Routine  
 Preservative Code:  
 Bottle Type

**Preservation Codes:**  
 1. Cool, 4 degrees Centigrade  
 2. Sulfuric Acid, pH <2  
 3. Nitric Acid, pH <2  
 4. Thiosulfate for dechlorination  
 5. Hydrochloric Acid for VOA  
 6. Sodium Hydroxide, pH >12

Bottle type code  
 G=glass, P=HDPE  
 V=septum, A=amber

Field Number	Sample Collection		Sample		# of Containers	SAMPLE IDENTIFICATION/ DESCRIPTION		Chronic Bio	Arkansas Analytical Lab #
	Dates	Times	Grab	Comp		Sample Matrix			
FD1118COMP	11/18/2003	9:00	X	X	4		Facility Discharge	X	K311328C

**SAMPLERS: (Printed)**

1. Relinquished by: (Signature)	Date/Time	1. Received by: (Signature)	For completion by laboratory	REMARKS
<i>[Signature]</i>		<i>[Signature]</i>	Condition of samples: A. Containers Correct? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO B. Preservation Correct? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO C. Seals Intact? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
<i>[Signature]</i>	11-18-03, 1530	<i>Sydney James</i>		

**Arkansas Analytical, Inc.**

# CHAIN OF CUSTODY RECORD

CLIENT INFORMATION		Project Description		Turnaround Time (CIRCLE ONE)		Preservation Codes:	
Weston Solutions, Inc. P.O. Box 699 2000 Darby Lane Malvern, AR 72104 Attn: Alan Brown		MAGCOBAR Mine Site Reporting Information Telephone: 501/467-8355 FAX: 501/467-8687 Bill to P.O.		24 hour 48 hour routine		1. Cool, 4 degrees Centigrade 2. Sulfuric Acid, pH <2 3. Nitric Acid, pH <2 4. Thiosulfate for dechlorination 5. Hydrochloric Acid for VOA 6. Sodium Hydroxide, pH >12	
Samplers: (Signatures)		Samplers: (Printed)		Preservative Code: Bottle Type		Bottle type code G=glass, P=HDPE V=septum, A=amber	
Field Number	Sample Collection Date/s	Sample Collection Time/s	# of Containers	Grab	Comp	Sample Matrix	SAMPLE IDENTIFICATION/ DESCRIPTION
FD1114COMP	11/14/03	11:10	4	X			Chronic Bio Facility Discharge Arkansas Analytical Lab # K311328B
1. Relinquished by: (Signature)		Date/Time		1. Received by: (Signature)		For completion by laboratory	
Daniel Scott		11-14-03 1450		[Signature]		Condition of samples: YES NO A. Containers Correct? <input checked="" type="checkbox"/> <input type="checkbox"/> B. Preservation Correct? <input checked="" type="checkbox"/> <input type="checkbox"/> C. Seals Intact? <input type="checkbox"/> NA	
2. Relinquished by: (Signature)		Date/Time		2. Received by: (Signature)		REMARKS	
[Signature]		11-14-03 1450		Sydney James			

**CHAIN OF CUSTODY RECORD**

<b>CLIENT INFORMATION</b>		<b>Project Description</b>		<b>Turnaround Time</b>		<b>Preservation Codes:</b>	
Weston Solutions, Inc.		MAGCOBAR Mine Site		<b>(CIRCLE ONE)</b>		1. Cool, 4 degrees Centigrade	
P.O. Box 699		Reporting Information		24 hour		2. Sulfuric Acid, pH <2	
2000 Darby Lane		Telephone: 601/467-3356		48 hour		3. Nitric Acid, pH <2	
Malvern, AR 72104		FAX: 501/467-3687		<b>FOUR</b>		4. Thiosulfate for dechlorination	
Attn: Alan Brown		Bill to P.O.		Preservative Code:		5. Hydrochloric Acid for YOA	

<i>David Scott</i>		Bottle Type		P		<b>TEST PARAMETERS</b>	
Samplers: (Printed)		Bottle Code:				6. Sodium Hydroxide, pH >12	
		Sample Matrix				Bottle type code	
						G-glass; P-HDPE	
						V-septum; A-amber	
						Arkansas Analytical Lab #	

Field Number	Sample Collection Dates	Sample Collection Times	# of Containers	Samplers: (Printed)		SAMPLE IDENTIFICATION/ DESCRIPTION	REMARKS
				Grab	Comp		
FD1113COMP	11/13/2003	10:45	4	X		Facility Discharge	Chronic Bio X

<b>1. Relinquished by: (Signature)</b> <i>David Scott</i>	<b>Date/Time</b> 11-13-03 14:25	<b>1. Received by: (Signature)</b> <i>[Signature]</i>	<b>For completion by laboratory</b> Condition of samples: A. Containers Correct? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO B. Preservation Correct? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO C. Seals Intact? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
<b>2. Relinquished by: (Signature)</b> <i>[Signature]</i>	<b>Date/Time</b> 11-13-03 1425	<b>2. Received by: (Signature)</b> <i>Sydney James</i>	<b>REMARKS</b> TEMP-10



## APPENDIX B

### Effluent and Dilution Water Data

CHEMICAL DATA SHEET FOR CHRONIC TOXICITY TESTING

Fathead Minnow

Lab # / Sample ID		K311328		Test Start (Date/Time)		11-14-03/1445		notes/remarks	
Client		Weston		Test End (Date/Time)		11-21-03/1505			
		Day of Test							
		1	2	3	4	5	6	7	
<b>Control</b>		11-14	11-15	11-16	11-17	11-18	11-19	11-20	SS 80
D.O (mg/L)	INITIAL	8.5	8.4	8.1	8.3	7.4	8.0	7.9	1/16 SS81
	FINAL	8.2	8.1	7.9	8.1	7.6	7.3	7.0	
pH(mg/L)	INITIAL	6.3	6.7	6.7	7.0	7.5	7.2	7.1	
	FINAL	6.9	7.0	6.9	7.1	7.3	7.5	7.3	
temp(C)	INITIAL	21.0	21.0	20.7	21.2	21.2	21.1	21.0	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
ALKALINITY(mg/L)		25	→	30					
HARDNESS(mg/L)		46	→	42					
CONDUCTIVITY(umhos/cm)		160	→	158					
CHLORINE(mg/L)		40.05	→	40.05					
<b>CONC:</b>		32%	32%	32%	32%	32%	32%	32%	
D.O (mg/L)	INITIAL	8.9	8.5	8.3	8.4	7.6	7.9	7.9	
	FINAL	8.2	8.3	7.7	7.9	7.4	7.3	7.1	
pH(mg/L)	INITIAL	6.6	6.9	7.0	7.0	7.6	7.4	7.4	
	FINAL	6.9	7.0	6.9	6.9	7.0	7.4	7.4	
temp(C)	INITIAL	21.7	21.3	20.9	21.6	21.5	22.0	21.8	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
<b>CONC:</b>		42%	42%	42%	42%	42%	42%	42%	
D.O (mg/L)	INITIAL	9.1	8.5	8.3	8.6	7.9	7.9	8.1	
	FINAL	8.5	8.3	7.7	7.8	7.7	7.4	7.1	
pH(mg/L)	INITIAL	6.7	6.9	7.0	7.1	7.6	7.4	7.4	
	FINAL	6.9	6.9	6.9	7.0	7.0	7.4	7.4	
temp(C)	INITIAL	22.3	21.4	20.9	22.0	21.9	22.3	22.0	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
<b>CONC:</b>		56%	56%	56%	56%	56%	56%	56%	
D.O (mg/L)	INITIAL	9.3	8.4	8.5	8.7	8.6	8.0	8.3	
	FINAL	8.6	8.4	7.6	8.3	7.7	7.6	7.3	
pH(mg/L)	INITIAL	6.8	6.9	6.9	7.1	7.6	7.5	7.4	
	FINAL	6.9	7.0	7.0	7.0	7.0	7.4	7.4	
temp(C)	INITIAL	23.1	21.5	20.9	22.3	22.2	22.5	22.1	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
<b>CONC:</b>		75%	75%	75%	75%	75%	75%	75%	
D.O (mg/L)	INITIAL	9.4	8.6	8.5	8.9	8.2	8.2	8.6	
	FINAL	8.8	8.4	7.6	7.9	7.9	7.6	7.5	
pH(mg/L)	INITIAL	6.9	7.0	6.9	7.2	7.6	7.5	7.4	
	FINAL	7.1	6.9	7.0	6.9	7.0	7.4	7.3	
temp(C)	INITIAL	23.9	21.5	21.2	22.7	22.5	22.7	22.3	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
<b>CONC:</b>		100%	100%	100%	100%	100%	100%	100%	
D.O (mg/L)	INITIAL	9.6	8.7	8.7	9.0	9.0	8.3	8.6	
	FINAL	8.8	8.4	7.5	7.9	7.8	7.7	7.6	
pH(mg/L)	INITIAL	6.9	7.0	7.0	7.2	7.7	7.5	7.4	
	FINAL	7.1	7.0	6.9	6.9	7.0	7.2	7.3	
temp(C)	INITIAL	24.5	21.8	21.3	23.1	23.0	22.8	22.4	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
<b>CONC:</b>		100%	A	A	A	B	B	C	C
ALKALINITY( mg/L)		22	→	→	19	→	20	→	
HARDNESS(mg/L)		1454	→	→	1450	→	1390	→	
CONDUCTIVITY(umhos/cm)		2400	→	→	2420	→	2320	→	
CHLORINE(mg/L)		40.05	→	→	40.05	→	40.05	→	



CHEMICAL DATA SHEET FOR CHRONIC TOXICITY TESTING

Ceriodaphnia dubia

Lab # / Sample ID		K311328		Test Start (Date/Time)		11-14-03/1130		Test End (Date/Time)		11-20-03/0915		notes/remarks
Client		Weston		Day of Test								
		1	2	3	4	5	6	7	8			
<b>Control</b>		11-14	11-15	11-16	11-17	11-18	11-19	11-20		SS 80		
D.O (mg/L)	INITIAL	8.5	8.4	8.1	8.3	7.4	8.0	7.9		11-16 SS81		
	FINAL	7.9	8.0	8.1	8.0	7.8	8.8	NA				
pH	INITIAL	6.3	6.7	6.7	7.0	7.5	7.2	7.1				
	FINAL	7.4	7.5	7.4	8.1	6.9	7.8	NA				
temp(C)	INITIAL	21.0	21.0	20.7	21.2	21.2	21.1	21.0				
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	NA				
ALKALINITY(mg/L)		25	→	30								
HARDNESS(mg/L)		46	→	42								
CONDUCTIVITY(umhos/cm)		1160	→	158								
CHLORINE(mg/L)		40.05	→	40.05								
<b>CONC:</b>		32%	32%	32%	32%	32%	32%	32%				
D.O (mg/L)	INITIAL	8.9	8.5	8.8	8.4	7.6	7.9	7.9				
	FINAL	7.9	8.1	8.1	8.0	7.8	8.5	NA				
pH	INITIAL	6.6	6.9	7.0	7.0	7.6	7.4	7.4				
	FINAL	7.4	7.5	7.4	7.7	7.4	7.8	NA				
temp(C)	INITIAL	21.7	21.3	20.9	21.6	21.5	22.0	21.8				
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	NA				
<b>CONC:</b>		42%	42%	42%	42%	42%	42%	42%				
D.O (mg/L)	INITIAL	9.1	8.5	8.3	8.6	7.9	7.9	8.1				
	FINAL	8.0	8.1	8.1	8.0	7.9	8.5	NA				
pH	INITIAL	6.7	6.9	7.0	7.1	7.6	7.4	7.4				
	FINAL	7.4	7.5	7.4	7.6	7.4	7.8	NA				
temp(C)	INITIAL	22.3	21.4	20.9	22.0	21.9	22.3	22.0				
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	NA				
<b>CONC:</b>		56%	56%	56%	56%	56%	56%	56%				
D.O (mg/L)	INITIAL	9.3	8.6	8.5	8.7	8.0	8.0	8.3				
	FINAL	8.1	8.2	8.0	7.9	8.2	8.7	NA				
pH	INITIAL	6.8	6.9	6.9	7.1	7.6	7.5	7.4				
	FINAL	7.5	7.4	7.4	7.6	7.4	7.7	NA				
temp(C)	INITIAL	23.1	21.5	20.9	22.3	22.2	22.5	22.1				
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	NA				
<b>CONC:</b>		75%	75%	75%	75%	75%	75%	75%				
D.O (mg/L)	INITIAL	9.4	8.6	8.5	8.9	8.2	8.2	8.6				
	FINAL	8.3	8.2	8.0	7.9	8.2	8.7	NA				
pH	INITIAL	6.9	7.0	6.9	7.2	7.6	7.5	7.4				
	FINAL	7.4	7.3	7.4	7.6	7.7	7.7	NA				
temp(C)	INITIAL	23.9	21.5	21.2	22.7	22.5	22.7	22.3				
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	NA				
<b>CONC:</b>		100%	100%	100%	100%	100%	100%	100%				
D.O (mg/L)	INITIAL	9.6	8.7	8.7	9.0	9.0	8.3	8.6				
	FINAL	8.3	8.2	8.0	7.9	8.4	8.7	NA				
pH	INITIAL	6.9	7.0	7.0	7.2	7.7	7.5	7.4				
	FINAL	7.3	7.3	7.4	7.5	7.8	7.5	NA				
temp(C)	INITIAL	24.5	21.8	21.3	23.1	23.0	22.8	22.4				
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	NA				
<b>CONC:</b>		100%	A	A	A	B	b	C	C			
ALKALINITY(mg/L)		22	→	→	19	→	20	→				
HARDNESS(mg/L)		1454	→	→	1450	→	1390	→				
CONDUCTIVITY(umhos/cm)		2400	→	→	2420	→	2320	→				
CHLORINE(mg/L)		40.05	→	→	40.05	→	40.05	→				



## APPENDIX C

### Fathead Minnow Raw Data and Statistics

FATHEAD MINNOW, *Pimephales promelas*, Larval Survival and Growth test, Method 1000.0\*

SURVIVAL DATA FOR LARVAE

Lab #/s: 1311328      TEST START DATE 11-14 TIME 1445  
Weston      TEST END DATE 11-21 TIME 1505  
 AGE AND SOURCE OF MINNOWS 248 hrs; Aquatex

CONC:	REP #	start	DAY (NUMBER SURVIVING)							SURVIVAL		MEAN %	
			1	2	3	4	5	6	7	%			
Control	A	10	10	10	10	10	10	10	10	10	100	98%	4.56%
	B	↓	10	10	10	10	9	9	9	90			
	C	↓	10	10	10	10	10	10	10	100			
	D	↓	10	10	10	10	10	10	10	100			
	E	↓	10	10	10	10	10	10	10	100			
32%	A	10	10	10	10	10	10	10	10	100	98%		
	B	↓	10	10	10	10	10	10	10	100			
	C	↓	10	10	10	10	10	10	10	100			
	D	↓	10	10	10	10	10	9	9	90			
	E	↓	10	10	10	10	10	10	10	100			
42%	A	10	10	10	10	10	10	10	10	100	100%		
	B	↓	10	10	10	10	10	10	10	100			
	C	↓	10	10	10	10	10	10	10	100			
	D	↓	10	10	10	10	10	10	10	100			
	E	↓	10	10	10	10	10	10	10	100			
56%	A	10	10	10	10	10	10	10	10	100	100%		
	B	↓	10	10	10	10	10	10	10	100			
	C	↓	10	10	10	10	10	10	10	100			
	D	↓	10	10	10	10	10	10	10	100			
	E	↓	10	10	10	10	10	10	10	100			
75%	A	10	10	10	10	10	10	10	10	100	100%		
	B	↓	10	10	10	10	10	10	10	100			
	C	↓	10	10	10	10	10	10	10	100			
	D	↓	10	10	10	10	10	10	10	100			
	E	↓	10	10	10	10	10	10	10	100			
100%	A	10	10	10	10	10	10	10	10	100	100%	0%	
	B	↓	10	10	10	10	10	10	10	100			
	C	↓	10	10	10	10	10	10	10	100			
	D	↓	10	10	10	10	10	10	10	100			
	E	↓	10	10	10	10	10	10	10	100			
ANALYST:		mg	AF	AF	mg	WH	TC	TC	TC				
DATE:		11-14	11-15	11-16	11-17	11-18	11-19	11-20	11-21				
TIME:		1445	1345	1430	1400	1530	1205	1505	1505				

\*EPA 600/4-89/001, March 1989.

*Pimephales promelas*

FATHEAD MINNOW

TEST 1000.0

WEIGHT DATA FOR LARVAL SURVIVAL AND GROWTH TEST

LAB #/S: <u>K311328</u>	TEST DATES (BEGIN/END): <u>11-14-03/11-21-03</u>
CLIENT: <u>Weston</u>	WEIGHING DATE/TIME:
ANALYST/S: <u>mg, TC</u>	DRYING TEMPERATURE (DEGREES C): <u>60°C</u>
SAMPLE ID:	DRYING TIME (HOURS): <u>24hrs</u>

	REP #	FINAL DRY WEIGHT TIN+LARVAE (g)	INITIAL WEIGHT TIN (g)	TOTAL DRY WEIGHT OF LARVAE (g)	NUMBER OF LARVAE	DRY WEIGHT OF LARVA (mg)		REMARKS
CONTROL	A50	0.97856	0.97407	0.00449	10	0.449	AVG DRY	
	B51	0.98055	0.97639	0.00416	10	0.416	WEIGHT (MG)	
	C52	0.98031	0.97633	0.00398	10	0.398		0.412
	D53	0.98571	0.98181	0.00390	10	0.390	CV	
	E54	0.98164	0.97755	0.00409	10	0.409		5.52%
32%	A55	0.98369	0.97832	0.00537	10	0.537	AVG DRY	
	B56	0.98224	0.97707	0.00517	10	0.517	WEIGHT(MG)	
	C57	0.97886	0.97467	0.00419	10	0.419		0.498
	D58	0.97464	0.97016	0.00448	10	0.448	CV	
	E59	0.97631	0.97061	0.00570	10	0.570		
42%	A60	0.98500	0.97771	0.00729	10	0.729	AVG DRY	
	B61	1.00165	0.99464	0.00701	10	0.701	WEIGHT(MG)	
	C62	0.99630	0.98962	0.00668	10	0.668		0.628
	D63	0.99575	0.99050	0.00525	10	0.525	CV	
	E64	0.99945	0.99427	0.00518	10	0.518		
56%	A65	0.99687	0.98931	0.00756	10	0.756	AVG DRY	
	B66	0.99691	0.99073	0.00618	10	0.618	WEIGHT(MG)	
	C67	0.99903	0.99219	0.00684	10	0.684		0.713
	D68	1.00222	0.99490	0.00732	10	0.732	CV	
	E69	1.00080	0.99306	0.00774	10	0.774		
75%	A70	1.00672	0.99974	0.00698	10	0.698	AVG DRY	
	B71	1.00860	1.00118	0.00742	10	0.742	WEIGHT(MG)	
	C72	1.00687	1.00027	0.00660	10	0.660		0.727
	D73	1.00323	0.99565	0.00758	10	0.758	CV	
	E74	1.00119	0.99340	0.00779	10	0.779		
100%	A75	1.00052	0.99385	0.00667	10	0.667	AVG DRY	
	B76	1.00250	0.99542	0.00708	10	0.708	WEIGHT(MG)	
	C77	1.00078	0.99648	0.00430	10	0.430		0.649
	D78	0.99781	0.99097	0.00684	10	0.684	CV	
	E79	1.00187	0.99431	0.00756	10	0.756		19.6%

CV = (STANDARD DEVIATION/MEAN)\*100

AA# K311328 FATHEAD MINNOW SURVIVAL, 11-14-03  
File: k311328s Transform: ARC SINE(SQUARE ROOT(Y))

Shapiro - Wilk's test for normality

---

D = 0.042

W = 0.547

Critical W (P = 0.05) (n = 30) = 0.927

Critical W (P = 0.01) (n = 30) = 0.900

---

Data FAIL normality test. Try another transformation.

Warning - The first three homogeneity tests are sensitive to non-normal data and should not be performed.

AA# K311328 FATHEAD MINNOW SURVIVAL, 11-14-03  
File: k311328s Transform: ARC SINE(SQUARE ROOT(Y))

Hartley's test for homogeneity of variance

Bartlett's test for homogeneity of variance

---

These two tests can not be performed because at least one group has zero variance.

Data FAIL to meet homogeneity of variance assumption.  
Additional transformations are useless.

---

TITLE: AA# K311328 FATHEAD MINNOW SURVIVAL, 11-14-03  
FILE: k311328s  
TRANSFORM: ARC SINE(SQUARE ROOT(Y))

NUMBER OF GROUPS: 6

---

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	CONTROL	1	1.0000	1.4120
1	CONTROL	2	0.9000	1.2490
1	CONTROL	3	1.0000	1.4120
1	CONTROL	4	1.0000	1.4120
1	CONTROL	5	1.0000	1.4120
2	32 % EFFLUENT	1	1.0000	1.4120
2	32 % EFFLUENT	2	1.0000	1.4120
2	32 % EFFLUENT	3	1.0000	1.4120
2	32 % EFFLUENT	4	0.9000	1.2490
2	32 % EFFLUENT	5	1.0000	1.4120
3	42 % EFFLUENT	1	1.0000	1.4120
3	42 % EFFLUENT	2	1.0000	1.4120
3	42 % EFFLUENT	3	1.0000	1.4120
3	42 % EFFLUENT	4	1.0000	1.4120
3	42 % EFFLUENT	5	1.0000	1.4120
4	56 % EFFLUENT	1	1.0000	1.4120
4	56 % EFFLUENT	2	1.0000	1.4120
4	56 % EFFLUENT	3	1.0000	1.4120
4	56 % EFFLUENT	4	1.0000	1.4120
4	56 % EFFLUENT	5	1.0000	1.4120
5	75 % EFFLUENT	1	1.0000	1.4120
5	75 % EFFLUENT	2	1.0000	1.4120
5	75 % EFFLUENT	3	1.0000	1.4120
5	75 % EFFLUENT	4	1.0000	1.4120
5	75 % EFFLUENT	5	1.0000	1.4120
6	100 % EFFLUENT	1	1.0000	1.4120
6	100 % EFFLUENT	2	1.0000	1.4120
6	100 % EFFLUENT	3	1.0000	1.4120
6	100 % EFFLUENT	4	1.0000	1.4120
6	100 % EFFLUENT	5	1.0000	1.4120

---

AA# K311328 FATHEAD MINNOW SURVIVAL, 11-14-03  
 File: k311328s Transform: ARC SINE(SQUARE ROOT(Y))

STEEL'S MANY-ONE RANK TEST - Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	RANK SUM	CRIT. VALUE	df	SIG
1	CONTROL	1.379				
2	32 % EFFLUENT	1.379	27.50	16.00	5.00	
3	42 % EFFLUENT	1.412	30.00	16.00	5.00	
4	56 % EFFLUENT	1.412	30.00	16.00	5.00	
5	75 % EFFLUENT	1.412	30.00	16.00	5.00	
6	100 % EFFLUENT	1.412	30.00	16.00	5.00	

Critical values use  $k = 5$ , are 1 tailed, and  $\alpha = 0.05$

AA # K311328, FATHEAD MINNOW GROWTH, 11-14-03  
File: k311328g Transform: NO TRANSFORMATION

Shapiro - Wilk's test for normality

---

D = 0.147

W = 0.928

Critical W (P = 0.05) (n = 30) = 0.927

Critical W (P = 0.01) (n = 30) = 0.900

---

Data PASS normality test at P=0.01 level. Continue analysis.

AA # K311328, FATHEAD MINNOW GROWTH, 11-14-03  
File: k311328g Transform: NO TRANSFORMATION

---

Bartlett's test for homogeneity of variance

Calculated B1 statistic = 10.49

---

Table Chi-square value = 15.09 (alpha = 0.01, df = 5)

Table Chi-square value = 11.07 (alpha = 0.05, df = 5)

---

Data PASS B1 homogeneity test at 0.01 level. Continue analysis.



TITLE: AA # K311328, FATHEAD MINNOW GROWTH, 11-14-03  
FILE: k311328g  
TRANSFORM: NO TRANSFORMATION

NUMBER OF GROUPS: 6

---

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	CONTROL	1	0.4490	0.4490
1	CONTROL	2	0.4160	0.4160
1	CONTROL	3	0.3980	0.3980
1	CONTROL	4	0.3900	0.3900
1	CONTROL	5	0.4090	0.4090
2	32 % EFFLUENT	1	0.5370	0.5370
2	32 % EFFLUENT	2	0.5170	0.5170
2	32 % EFFLUENT	3	0.4190	0.4190
2	32 % EFFLUENT	4	0.4480	0.4480
2	32 % EFFLUENT	5	0.5700	0.5700
3	42 % EFFLUENT	1	0.7290	0.7290
3	42 % EFFLUENT	2	0.7010	0.7010
3	42 % EFFLUENT	3	0.6680	0.6680
3	42 % EFFLUENT	4	0.5250	0.5250
3	42 % EFFLUENT	5	0.5180	0.5180
4	56 % EFFLUENT	1	0.7560	0.7560
4	56 % EFFLUENT	2	0.6180	0.6180
4	56 % EFFLUENT	3	0.6840	0.6840
4	56 % EFFLUENT	4	0.7320	0.7320
4	56 % EFFLUENT	5	0.7740	0.7740
5	75 % EFFLUENT	1	0.6980	0.6980
5	75 % EFFLUENT	2	0.7420	0.7420
5	75 % EFFLUENT	3	0.6600	0.6600
5	75 % EFFLUENT	4	0.7580	0.7580
5	75 % EFFLUENT	5	0.7790	0.7790
6	100 % EFFLUENT	1	0.6670	0.6670
6	100 % EFFLUENT	2	0.7080	0.7080
6	100 % EFFLUENT	3	0.4300	0.4300
6	100 % EFFLUENT	4	0.6840	0.6840
6	100 % EFFLUENT	5	0.7560	0.7560

---

AA # K311328, FATHEAD MINNOW GROWTH, 11-14-03  
File: k311328g Transform: NO TRANSFORMATION

ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	0.388	0.078	12.651
Within (Error)	24	0.147	0.006	
Total	29	0.535		

Critical F value = 2.62 (0.05,5,24)  
Since  $F > \text{Critical } F$  REJECT  $H_0$ : All equal

AA # K311328, FATHEAD MINNOW GROWTH, 11-14-03  
 File: k311328g Transform: NO TRANSFORMATION

DUNNETT'S TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	CONTROL	0.412	0.412		
2	32 % EFFLUENT	0.498	0.498	-1.732	
3	42 % EFFLUENT	0.628	0.628	-4.357	
4	56 % EFFLUENT	0.713	0.713	-6.065	
5	75 % EFFLUENT	0.727	0.727	-6.360	
6	100 % EFFLUENT	0.649	0.649	-4.777	

Dunnett table value = 2.36 (1 Tailed Value, P=0.05, df=24,5)

AA # K311328, FATHEAD MINNOW GROWTH, 11-14-03  
 File: k311328g Transform: NO TRANSFORMATION

DUNNETT'S TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	CONTROL	5			
2	32 % EFFLUENT	5	0.117	28.3	-0.086
3	42 % EFFLUENT	5	0.117	28.3	-0.216
4	56 % EFFLUENT	5	0.117	28.3	-0.300
5	75 % EFFLUENT	5	0.117	28.3	-0.315
6	100 % EFFLUENT	5	0.117	28.3	-0.237

APPENDIX D

*Ceriodaphnia dubia* Raw Data and Statistics

*Ceriodaphnia dubia*

**SURVIVAL AND REPRODUCTION TEST**

Discharger: Worston Analyst: MG, AF, TC  
 Location: 1331328 Test Start-Date/Time: 11-14-03/1130  
 Date Sample Collected: See COC Test Stop-Date/Time: 11-20-03/0915

Conc 1	Replicate													No. of Young Adults	Young/Adult	Analyst
	Day	A	B	C	D	E	F	G	H	I	J	J				
%	1	0	0	0	0	0	0	0	0	0	0	0	0	10	0	AF
Control	2	X	0	0	0	0	0	0	0	0	0	0	0	9	0	AF
	3	-	5	4	4	0	7	5	3	4	4	3	4	9	4.0	TC
	4	-	10	10	7	2	12	10	10	0	9	7	0	9	7.8	MG
	5	-	0	0	15	14	13	0	0	10	0	5	2	9	5.8	MG
	6	-	14	15	0	15	0	16	11	10	13	9	4	9	10.4	MG
	7															
	8															
	Total	X	0	29	29	26	31	32	31	24	24	24	25	2	252	
													90%	351	100%	
													V=280	CV=11.0%		

Conc 2	Replicate													No. of Young Adults	Young/Adult	Analyst
	Day	A	B	C	D	E	F	G	H	I	J	J				
%	1	0	0	0	0	0	0	0	0	0	0	0	0	10	0	AF
32	2	0	0	0	0	0	0	0	0	0	0	0	0	10	0	AF
	3	6	3	4	3	4	6	5	5	0	5	0	8	10	4.5	TC
	4	0	8	10	4	0	0	0	8	6	8	4	4	10	4.4	MG
	5	12	1	15	0	9	9	11	2	11	1	7	1	10	7.1	MG
	6	17	16	0	10	14	13	13	17	0	16	11	6	10	11.6	MG
	7															
	8															
	Total	35	31	28	18	29	29	27	29	32	17	30	27	6	276	

Conc 3	Replicate													No. of Young Adults	Young/Adult	Analyst
	Day	A	B	C	D	E	F	G	H	I	J	J				
%	1	0	0	0	0	0	0	0	0	0	0	0	0	10	0	AF
42	2	0	0	0	0	0	0	0	0	0	0	0	0	10	0	AF
	3	5	5	4	3	6	5	5	5	0	7	5	9	10	4.3	TC
	4	10	7	7	8	10	0	9	1	0	7	5	9	10	5.9	MG
	5	0	0	0	8	12	10	14	13	11	8	7	6	10	7.6	MG
	6	13	10	15	0	0	9	0	16	18	1	8	2	10	8.2	MG
	7															
	8															
	Total	28	22	27	20	25	25	28	35	34	16	26	0	260		

X=DEAD; Y=MALE

CV=26.4%

FISHER'S EXACT TEST

IDENTIFICATION	NUMBER OF		
	DEAD	ALIVE	TOTAL ANIMALS
CONTROL	1	9	10
32% effluent	0	10	10
TOTAL	1	19	20

CRITICAL FISHER'S VALUE (10,10,1) ( $p=0.05$ ) IS LESS THAN 0. b VALUE IS 0.  
NO SIGNIFICANT DIFFERENCE

FISHER'S EXACT TEST

IDENTIFICATION	NUMBER OF		
	DEAD	ALIVE	TOTAL ANIMALS
CONTROL	1	9	10
42% effluent	0	10	10
TOTAL	1	19	20

CRITICAL FISHER'S VALUE (10,10,1) ( $p=0.05$ ) IS LESS THAN 0. b VALUE IS 0.  
NO SIGNIFICANT DIFFERENCE

FISHER'S EXACT TEST

IDENTIFICATION	NUMBER OF		
	ALIVE	DEAD	TOTAL ANIMALS
CONTROL	9	1	10
56% effluent	8	2	10

TOTAL 17 3 20

CRITICAL FISHER'S VALUE (10,10,9) (p=0.05) IS 4. b VALUE IS 8.  
 Since b is greater than 4 there is no significant difference  
 between CONTROL and TREATMENT at the 0.05 level.

FISHER'S EXACT TEST

IDENTIFICATION	NUMBER OF		
	DEAD	ALIVE	TOTAL ANIMALS
CONTROL	1	9	10
75% effluent	0	10	10
TOTAL	1	19	20

CRITICAL FISHER'S VALUE (10,10,1) (p=0.05) IS LESS THAN 0. b VALUE IS 0.  
 NO SIGNIFICANT DIFFERENCE

FISHER'S EXACT TEST

IDENTIFICATION	NUMBER OF		
	ALIVE	DEAD	TOTAL ANIMALS
CONTROL	9	1	10
100% effluent	9	1	10
TOTAL	18	2	20

CRITICAL FISHER'S VALUE (10,10,9) (p=0.05) IS 4. b VALUE IS 9.  
 Since b is greater than 4 there is no significant difference  
 between CONTROL and TREATMENT at the 0.05 level.

SUMMARY OF FISHER'S EXACT TESTS

GROUP	IDENTIFICATION	NUMBER EXPOSED	NUMBER DEAD	SIG (P=.05)
-------	----------------	----------------	-------------	-------------

	CONTROL	10	1
1	32% effluent	10	0
2	42% effluent	10	0
3	56% effluent	10	2
4	75% effluent	10	0
5	100% effluent	10	1

---



AA# K311328, CERIODAPHNIA REPRODUCTION, 11-14-03  
File: k311328c Transform: NO TRANSFORMATION

Shapiro - Wilk's test for normality

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\*\*\*\*\* Shapiro - Wilk's Test is aborted \*\*\*\*\*

This test can not be performed because total number of replicates  
is greater than 50.

Total number of replicates = 60

---

AA# K311328, CERIODAPHNIA REPRODUCTION, 11-14-03  
File: k311328c Transform: NO TRANSFORMATION

---

Bartlett's test for homogeneity of variance  
Calculated B1 statistic = 9.03

---

Table Chi-square value = 15.09 (alpha = 0.01, df = 5)  
Table Chi-square value = 11.07 (alpha = 0.05, df = 5)

Data PASS B1 homogeneity test at 0.01 level. Continue analysis.

TITLE: AA# K311328, CERIODAPHNIA REPRODUCTION, 11-14-03  
 FILE: k311328c  
 TRANSFORM: NO TRANSFORMATION

NUMBER OF GROUPS: 6

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	CONTROL	1	0.0000	0.0000
1	CONTROL	2	29.0000	29.0000
1	CONTROL	3	29.0000	29.0000
1	CONTROL	4	26.0000	26.0000
1	CONTROL	5	31.0000	31.0000
1	CONTROL	6	32.0000	32.0000
1	CONTROL	7	31.0000	31.0000
1	CONTROL	8	24.0000	24.0000
1	CONTROL	9	24.0000	24.0000
1	CONTROL	10	26.0000	26.0000
2	32 % EFFLUENT	1	35.0000	35.0000
2	32 % EFFLUENT	2	31.0000	31.0000
2	32 % EFFLUENT	3	28.0000	28.0000
2	32 % EFFLUENT	4	18.0000	18.0000
2	32 % EFFLUENT	5	29.0000	29.0000
2	32 % EFFLUENT	6	27.0000	27.0000
2	32 % EFFLUENT	7	29.0000	29.0000
2	32 % EFFLUENT	8	32.0000	32.0000
2	32 % EFFLUENT	9	17.0000	17.0000
2	32 % EFFLUENT	10	30.0000	30.0000
3	42 % EFFLUENT	1	28.0000	28.0000
3	42 % EFFLUENT	2	22.0000	22.0000
3	42 % EFFLUENT	3	27.0000	27.0000
3	42 % EFFLUENT	4	20.0000	20.0000
3	42 % EFFLUENT	5	25.0000	25.0000
3	42 % EFFLUENT	6	25.0000	25.0000
3	42 % EFFLUENT	7	28.0000	28.0000
3	42 % EFFLUENT	8	35.0000	35.0000
3	42 % EFFLUENT	9	34.0000	34.0000
3	42 % EFFLUENT	10	16.0000	16.0000
4	56 % EFFLUENT	1	0.0000	0.0000
4	56 % EFFLUENT	2	32.0000	32.0000
4	56 % EFFLUENT	3	26.0000	26.0000
4	56 % EFFLUENT	4	28.0000	28.0000
4	56 % EFFLUENT	5	11.0000	11.0000
4	56 % EFFLUENT	6	29.0000	29.0000
4	56 % EFFLUENT	7	33.0000	33.0000
4	56 % EFFLUENT	8	29.0000	29.0000
4	56 % EFFLUENT	9	35.0000	35.0000
4	56 % EFFLUENT	10	32.0000	32.0000
5	75 % EFFLUENT	1	29.0000	29.0000
5	75 % EFFLUENT	2	32.0000	32.0000
5	75 % EFFLUENT	3	29.0000	29.0000
5	75 % EFFLUENT	4	24.0000	24.0000
5	75 % EFFLUENT	5	24.0000	24.0000
5	75 % EFFLUENT	6	20.0000	20.0000
5	75 % EFFLUENT	7	28.0000	28.0000
5	75 % EFFLUENT	8	31.0000	31.0000
5	75 % EFFLUENT	9	19.0000	19.0000
5	75 % EFFLUENT	10	32.0000	32.0000

6	100	%	EFFLUENT	1	31.0000	31.0000
6	100	%	EFFLUENT	2	24.0000	24.0000
6	100	%	EFFLUENT	3	13.0000	13.0000
6	100	%	EFFLUENT	4	25.0000	25.0000
6	100	%	EFFLUENT	5	16.0000	16.0000
6	100	%	EFFLUENT	6	25.0000	25.0000
6	100	%	EFFLUENT	7	16.0000	16.0000
6	100	%	EFFLUENT	8	26.0000	26.0000
6	100	%	EFFLUENT	9	4.0000	4.0000
6	100	%	EFFLUENT	10	24.0000	24.0000

---

AA# K311328, CERIODAPHNIA REPRODUCTION, 11-14-03  
 File: k311328c Transform: NO TRANSFORMATION

STEEL'S MANY-ONE RANK TEST

- Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	RANK SUM	CRIT. VALUE	df	SIG
1	CONTROL	25.200				
2	32 % EFFLUENT	27.600	113.50	75.00	10.00	
3	42 % EFFLUENT	26.000	99.00	75.00	10.00	
4	56 % EFFLUENT	25.500	116.50	75.00	10.00	
5	75 % EFFLUENT	26.800	105.00	75.00	10.00	
6	100 % EFFLUENT	20.400	81.00	75.00	10.00	

Critical values use k = 5, are 1 tailed, and alpha = 0.05



## APPENDIX E

### Organism History

# AQUATOX, INC.

100 Springwood Drive #15  
Hot Springs, Arkansas 71913  
(501) 767-9120

## TEST ORGANISM HISTORY

DATE SHIPPED 11-13-03 Ark Analytical

SPECIES Pinnaphales pinnacles

QUANTITY SHIPPED 1,000

AGE/LIFE STAGE 224 hrs 11/13 1500 LT

BROODSTOCK SOURCE Anderson Farms, AR

CULTURE WATER G. woodruff

ALKALINITY (Mg/l as CaCO<sub>3</sub>) = 180

HARDNESS (Mg/l as CaCO<sub>3</sub>)/Salinity (ppt) = 160

FEEDING Artemia

COMMENTS \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PACKAGED BY UM

1300 Blue Spruce Drive, Suite C  
Fort Collins, Colorado 80524



Toll Free: 800/331-5916  
Tel: 970/484-5091 Fax: 970/484-2514

### ORGANISM HISTORY

DATE: 1/17/01

SPECIES: Ceriodaphnia dubia

AGE: Variable

LIFE STAGE: Adult

HATCH DATE: Variable

BEGAN FEEDING: Immediately

FOOD: YTC, Selenastrum

### Water Chemistry Record:

	Mean	Range
TEMPERATURE:	<u>24 °C</u>	<u>21-24°C</u>
SALINITY/CONDUCTIVITY:	<u>--</u>	<u>--</u>
TOTAL HARDNESS (as CaCO <sub>3</sub> ):	<u>112 mg/l</u>	<u>90-124 mg/l</u>
TOTAL ALKALINITY (as CaCO <sub>3</sub> ):	<u>85 mg/l</u>	<u>50-85 mg/l</u>
pH:	<u>8.09</u>	<u>7.68-8.14</u>

### Comments:

  
\_\_\_\_\_  
*Facility Supervisor*

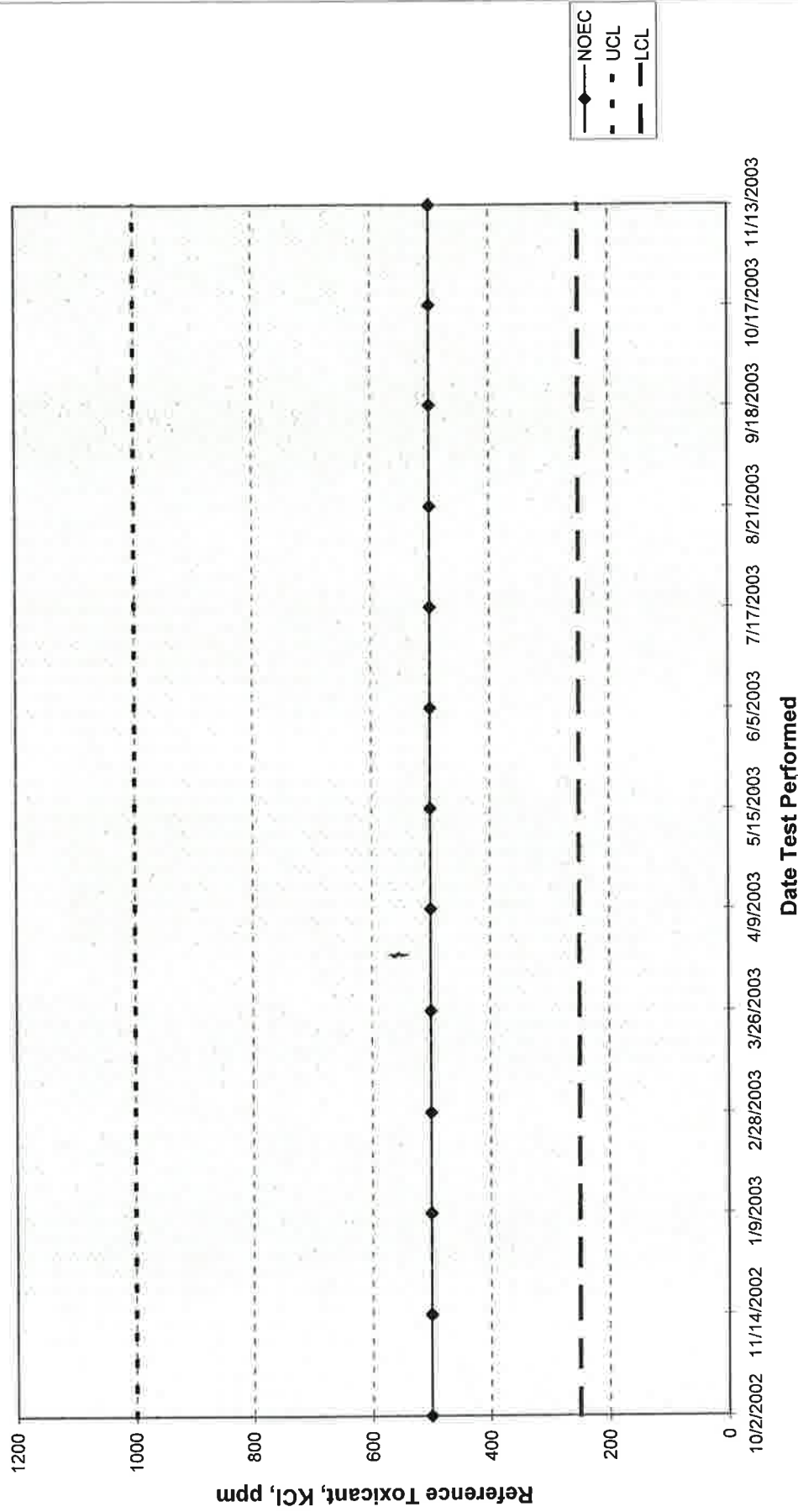


## APPENDIX F

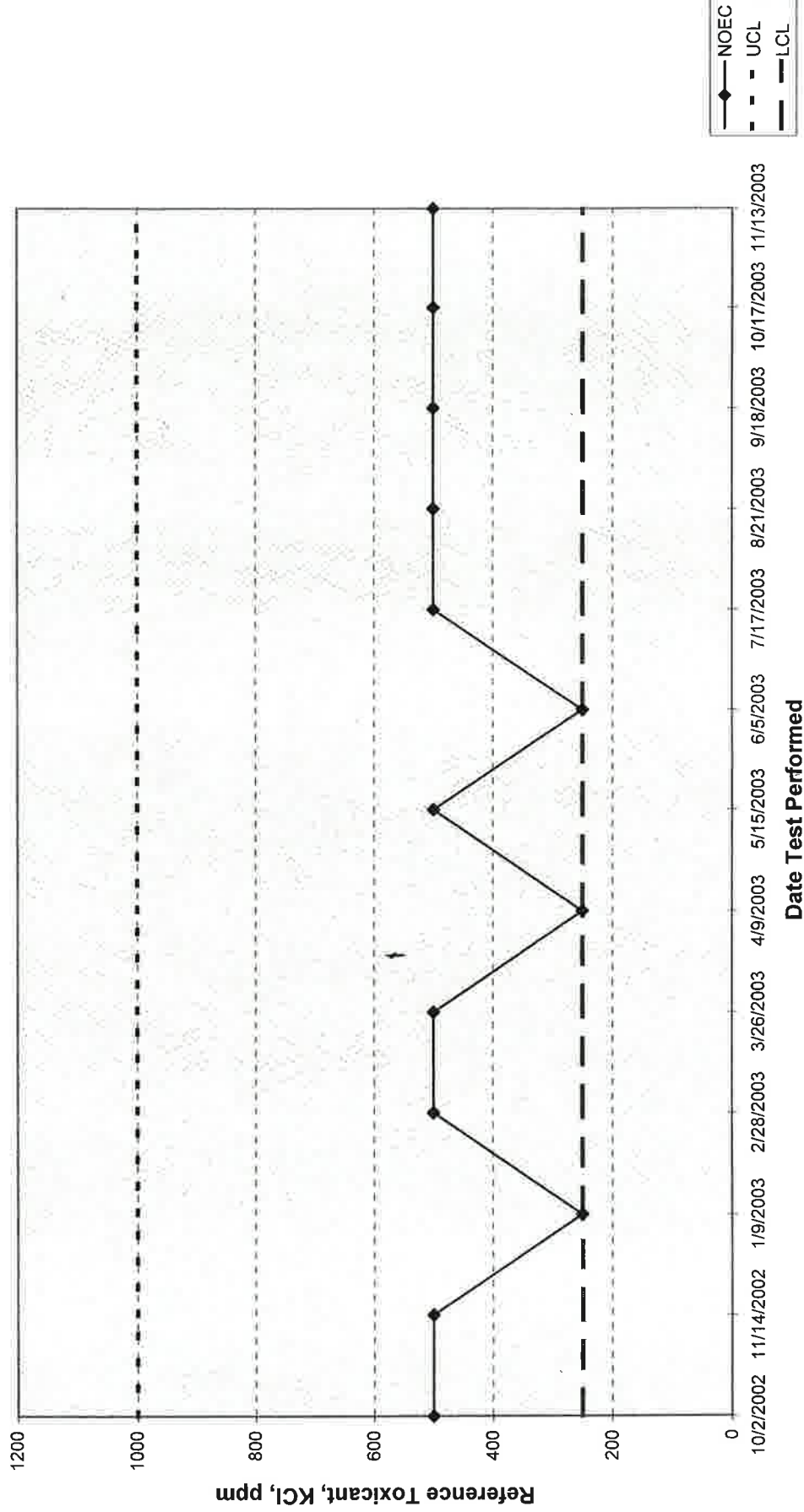
### Quality Assurance Charts



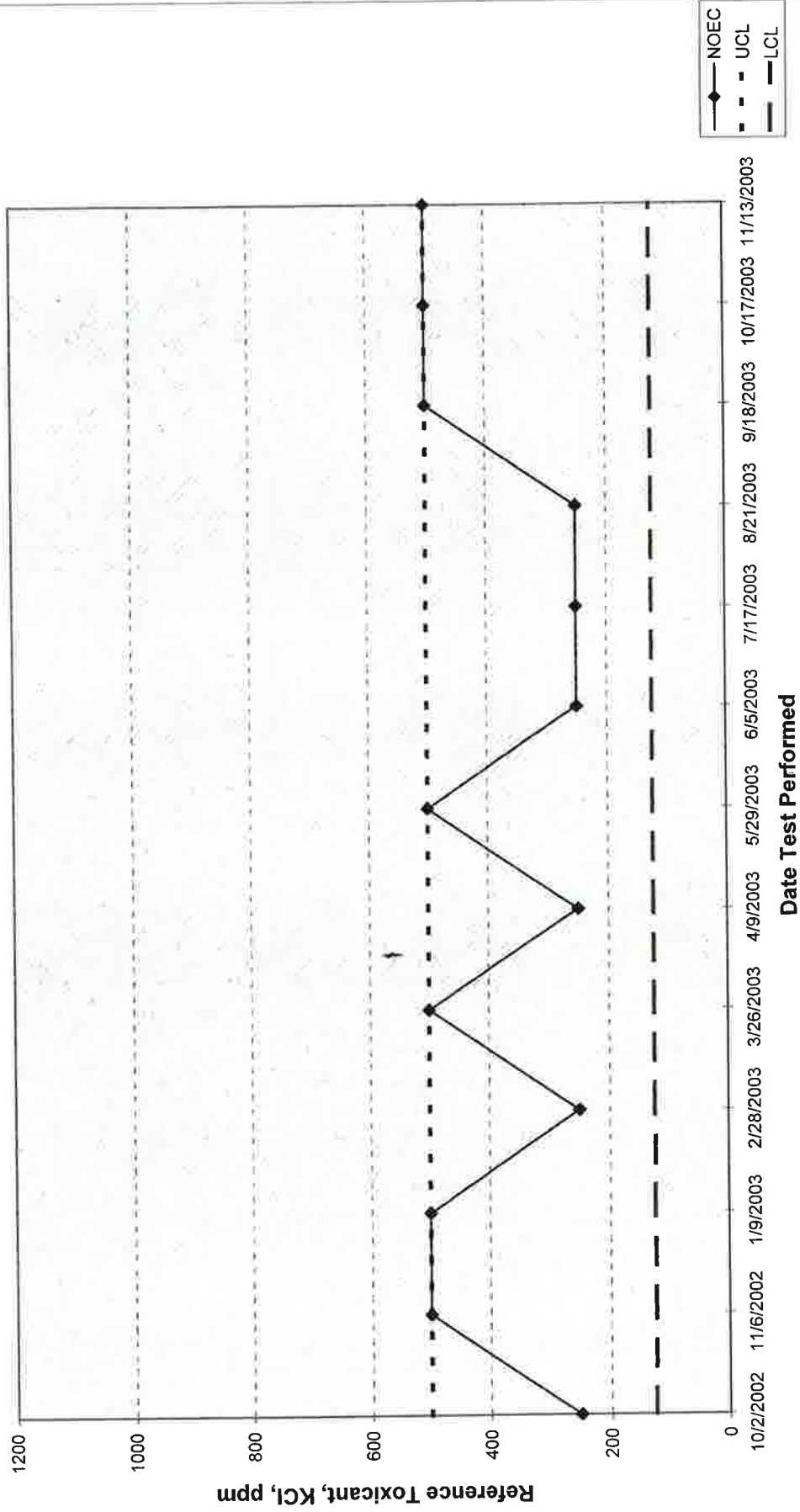
**ARKANSAS ANALYTICAL, INC.**  
**FATHEAD MINNOW SURVIVAL**  
**QUALITY ASSURANCE**



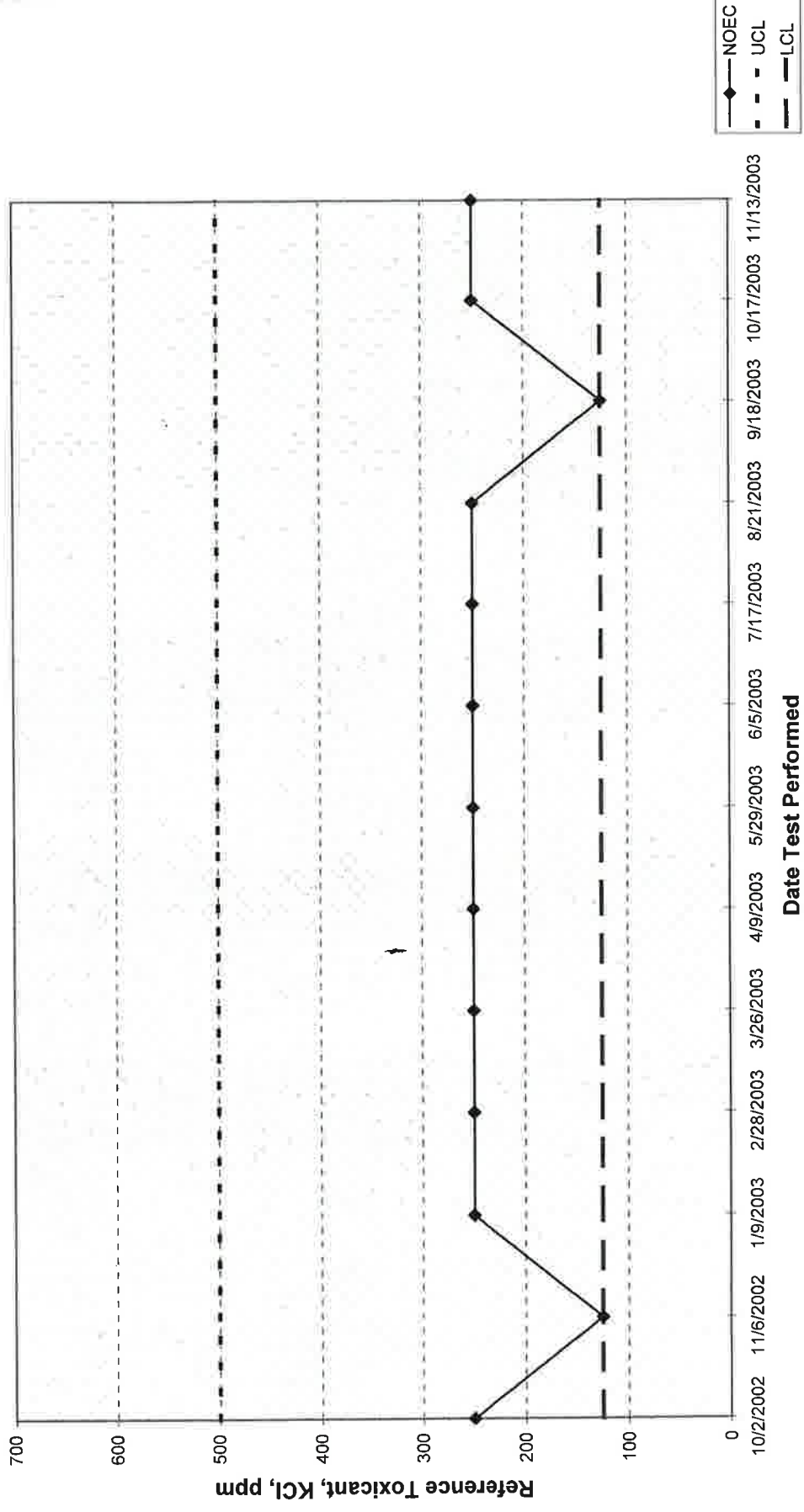
**ARKANSAS ANALYTICAL, INC.**  
**FATHEAD MINNOW GROWTH**  
**QUALITY ASSURANCE**



**ARKANSAS ANALYTICAL, INC.**  
**CERIODAPHNIA DUBIA SURVIVAL**  
**QUALITY ASSURANCE**



**ARKANSAS ANALYTICAL, INC.**  
**CERIODAPHNIA DUBIA REPRODUCTION**  
**QUALITY ASSURANCE**



—◆— NOEC  
- - - UCL  
- - - LCL



APPENDIX G

Lab Certification



State of Arkansas

# Department of Environmental Quality Laboratory Certification Program



Be it known that **Arkansas Analytical, Inc**  
**Little Rock, Arkansas**  
has earned certification by this Department for the period of

**October 30, 2003 to October 30, 2004**

**Laboratory ID # 60-1754**

**Certificate # 03-079-0**

The following parameters are certified:

Alkalinity	Oil & Grease	Turbidity	Lead	Tin
Ammonia	Orthophosphate	Aluminum	Magnesium	Titanium
BOD	Perchlorate	Antimony	Manganese	Vanadium
Bromide	pH	Arsenic	Mercury	Zinc
CBOD	Phenol	Barium	Molybdenum	Herbicides
Chloride	Sulfate	Beryllium	Nickel	Pesticides & PCBs
Chlorine	Sulfide	Boron	Potassium	Semi-volatiles
COD	Surfactants	Cadmium	Selenium	TPHC
Conductivity	TDS	Calcium	Silver	Volatile Organics
Cyanide	TKN	Chromium	Sodium	Fecal Coliform
Fluoride	TOC	Cobalt	Strontium	Acute Toxicity
Hardness	Total Phosphorus	Copper	Thallium	Chronic Toxicity
Nitrate	Total Solids	Hex. Chromium		
Nitrite	TSS	Iron		

*J. B. Lembrski*  
Quality Assurance Officer

*October 24, 2003*  
Date

ARKANSAS ANALYTICAL, INCORPORATED

11701 I-30, BUILDING 1, SUITE 115  
LITTLE ROCK, AR 72209

Laboratory Control Number: K311328 Date: 12-8-08

Client: WILSON Sample ID: Facility discharge

Pass          Fail         

Fathead Minnow Survival Test ✓         

Fathead Minnow Growth Test ✓         

*Ceriodaphnia dubia* Survival Test ✓         

*Ceriodaphnia dubia* Reproduction Test ✓          Analyst Initials MAJ