Arkansas Analytical, Inc.

Toxicity Test Results

MAGCOBAR MINE SITE
NPDES PERMIT NUMBER: AR0049794
August 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 K308578

Tuesday, September 9, 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 August 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:	8-21-03, 1000	8-22-03, 1000
Sample #2:	8-24-03, 0930	8-25-03, 0930
Sample #3:	8-25-03, 0930	8-26-03, 0930

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	Temperature Upon Receipt (°C)
Sample #1:	8-22-03, 1534	Not Taken
Sample #2:	8-25-03, 1525	3
Sample #3:	8-26-03, 1531	5

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 < 24 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	100%	X	
Average of 15 or more young per surviving female	25.4	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	13.8%	X	

TEST ACCEPTANCE CRITERIA for *Pimephales promelas*

Control Criteria	Results	Pass	Fail
Greater than or equal to 80% survival	100%	X	
The percent coefficient of variation between replicates must be 40% or less for survival	0%	X	
Minimum of 0.25 mg average dry weight of surviving controls	0.556	X	
The percent coefficient of variation between replicates must be 40% or less for growth	17.3%	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

Ceriodaphnia dubia		*Pimephales promelas*	
NOEC Survival:	250 ppm KCl	NOEC Survival:	500 ppm KCl
LOEC Survival:	500 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

Ceriodaphnia dubia		*Pimephales promelas*	
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)	20.4	%CV survival (critical dilution)	0%
%CV Reproduction (critical dilution)	27.3%	Mean dry weight (critical dilution) in milligrams	0.693
		%CV growth (critical dilution)	14.7%

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

Amy Daniel

Arkansas Analytical Inc.

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:	8-21-03, 1000	8-22-03, 1000
Sample #2:	8-24-03, 0930	8-25-03, 0930
Sample #3:	8-25-03, 0930	8-26-03, 0930

Test initiated (date, time): 8-22-03, 1600 Test terminated (date, time): 8-29-03, 1600

Dilution water used: Soft Synthetic

DATA TABLE FOR FATHEAD MINNOW SURVIVAL

	Percent Survival in Replicate Chambers						**Mean Percent Survival**	
Effluent Conc %	A	B	C	D	E		Mean Dry Weight	CV%
0%	0.616	0.620	0.390	0.595	0.557		0.556	17.3
32%	0.702	0.780	0.817	0.663	0.700		0.732	
42%	0.643	0.793	0.743	0.599	0.707		0.697	
56%	0.953	0.671	0.703	0.633	0.649		0.722	
75%	0.733	0.803	0.619	0.650	0.675		0.696	
100%	0.712	0.848	0.600	0.602	0.701		0.693	14.7

DATA TABLE FOR GROWTH OF FATHEAD MINNOWS

Average Dry Weight in milligrams in replicate chambers

Effluent Conc %	A	B	C	D	E		Mean Dry Weight	CV%
0%	0.616	0.620	0.390	0.595	0.557		0.556	17.3
32%	0.702	0.780	0.817	0.663	0.700		0.732	
42%	0.643	0.793	0.743	0.599	0.707		0.697	
56%	0.953	0.671	0.703	0.633	0.649		0.722	
75%	0.733	0.803	0.619	0.650	0.675		0.696	
100%	0.712	0.848	0.600	0.602	0.701		0.693	14.7

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)= _____**0**_____%

Arkansas Analytical Inc.

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:	8-21-03, 1000	8-22-03, 1000
Sample #2:	8-24-03, 0930	8-25-03, 0930
Sample #3:	8-25-03, 0930	8-26-03, 0930

Test initiated (date, time): 8-22-03, 1600 Test terminated (date, time): 8-28-03, 0920

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	28	20	24	13	21	11
B	24	30	29	24	23	23
C	25	27	32	33	23	19
D	30	27	30	25	27	17
E	28	24	23	27	24	28
F	21	33	28	23	16	X0
G	22	9	24	25	28	27
H	20	28	27	28	26	X0
I	28	X0	25	25	12	18
J	28	32	33	25	28	20
Mean	25.4	23.0	27.5	24.8	22.8	16.6
Mean/surviving female	25.4	25.6	27.5	24.8	22.8	20.4
CV%*	13.8					27.3

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	100	100	100	100	100	100
Test termination	100	90	100	100	100	80

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)= _____**27.3**_____%

APPENDIX A

Chain of Custody Forms

CHAIN OF CUSTODY RECORD

CLIENT INFORMATION	Project Description	Turnaround Time (CIRCLE ONE)	Preservation Codes:
Weston Solutions		24 hour	1. Cool, 4 degrees Centigrade — 4. Thiosulfate for dechlorination
2000 Darby Lane	Reporting Information	48 hour	2. Sulfuric Acid, pH <2 — 5. Hydrochloric Acid for VOA
Malvern, AR 72104	Telephone:	routine	3. Nitric Acid, pH <2 — 6. Sodium Hydroxide, pH >12
Attn: Alan Brown	FAX:	Preservative Code:	
	Bill to/P.O.	Bottle Type	

Samplers:(Signature/s): Alan B Brown

Samplers:(Printed): Alan B Brown

Field Number	Sample Collection Date/s	Sample Collection Time/s	Grab	Comp	# of Containers	Sample Matrix	SAMPLE IDENTIFICATION/ DESCRIPTION	TEST PARAMETERS: Chrom 13:0	Arkansas Analytical Lab #
FD0822Comp	8/22	10:00		X	5		Facility Discharge	X	1c30857 8A

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

1 Relinquished by:(Signature)	Date/Time	1.Received by:(Signature)
Alan B Brown	8/22/03 15:34	
2.Relinquished by:(Signature)	Date/Time	2.Received by laboratory :(Signature)
	8/22/03 1534	

For completion by laboratory

Condition of samples:	yes	no
A. Containers Correct:?	✓	
B. Preservation Correct:?	✓	
C. Seals Intact:?	✓	

REMARKS

ARKANSAS ANALYTICAL, INC. ** 11701 I-30, Bldg 1, Suite 115**Little Rock, Arkansas 72209**phone(501)455-3233**Fax(501)455-6118

CHAIN OF CUSTODY RECORD

CLIENT INFORMATION	Project Description	Turnaround Time
Weston Solutions, Inc.	MAGCOBAR Mine Site	(CIRCLE ONE)
P.O. Box 699	**Reporting Information**	24 hour
2000 Darby Lane	Telephone: 501/467-8355	48 hour
Malvern, AR 72104	FAX: 501/467-8687	routine
Attn: Alan Brown	Bill to/P.O.	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

Samplers:(Signature/s): Alan B. Brown

Samplers:(Printed): Alan B. Brown

Field Number	Sample Collection Date/s	Time/s	Grab	Comp	# of Containers	Sample Matrix	SAMPLE IDENTIFICATION/ DESCRIPTION	TEST PARAMETERS: Chronic Bio	Bottle type code G=glass;P=HDPE V=septum;A=amber	Arkansas Analytical Lab #
								P		
FD0825COMP	25-Aug	9:30		X	3		Facilty Discharge	X		K308578B

1 Relinquished by:(Signature)	Date/Time	1.Received by:(Signature)
Alan B. Brown	8/25/13 15:25	
2.Relinquished by:(Signature)	Date/Time	2.Received by laboratory :(Signature)
	8.25.13 1525	Sydney James

For completion by laboratory

Condition of samples:	yes	no
A. Containers Correct:?	✓	
B. Preservation Correct:?	✓	
C. Seals Intact:?	NA	

REMARKS

Temp - 3°C

ARKANSAS ANALYTICAL, INC. ** 11701 I-30, Bldg 1, Suite 115**Little Rock, Arkansas 72209**phone(501)455-3233**Fax(501)455-6118

CHAIN OF CUSTODY RECORD

CLIENT INFORMATION	Project Description	Turnaround Time
Weston Solutions, Inc.		(CIRCLE ONE)
P.O Box 699	Reporting Information	24 hour
2000 Darby Lane	Telephone: 501.467.8355	48 hour
Malvern, AR 72104	FAX: 501.467.8687	routine
ATTN: ~~David Passmore~~ Alan Brown	Bill to/P.O.	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

Alan B. Brown — Samplers:(Signature/s)

Alan B. Brown — Samplers:(Printed)

Field Number	Sample Collection Date/s	Sample Collection Time/s	Grab	Comp	# of Containers	Sample Matrix	SAMPLE IDENTIFICATION/ DESCRIPTION	Chronic Biomonitoring - CD, FH	TEST PARAMETERS	Bottle type code G=glass;P=HDPE V=septum;A=amber	Arkansas Analytical Lab #
								1			
								P			
FD0826Comp	08/26	9:30		X		3	Facility Discharge	X			13085780

1.Relinquished by:(Signature)	Date/Time	1.Received by:(Signature)
Alan B. Brown	8/26/03 15:31	
2.Relinquished by:(Signature)	Date/Time	2.Received by laboratory :(Signature)
	8/26/03 1531	

For completion by laboratory

Condition of samples:	yes	no
A. Containers Correct:?	✓	
B. Preservation Correct:?	✓	
C. Seals Intact:?	✓	

Received 5°C

REMARKS

ARKANSAS ANALYTICAL, INC. ** 11701 I-30, Bldg 1, Suite 115**Little Rock, Arkansas 72209**phone(501)455-3233**Fax(501)455-6118

APPENDIX B

Effluent and Dilution Water Data

CHEMICAL DATA SHEET FOR CHRONIC TOXICITY TESTING — Fathead Minnow

Lab # / Sample ID: K308578 — Test Start (Date/Time): 8-22-03/1600

Client: Weston — Test End (Date/Time): 8-29-03/1600

		Day of Test							
		1	2	3	4	5	6	7	notes/remarks
Control		8/22	8-23	8-24	8-25	8/26	8/27	8/28	8/22 SS 69
D.O (mg/L)	INITIAL	7.3	9.1	9.0	8.0	7.4	7.9	7.5	8/26 · SS 70
	FINAL	6.9	8.5	7.0	6.8	6.7	6.8	6.9	
pH(mg/L)	INITIAL	7.2	7.4	7.7	6.1	6.6	6.7	6.5	
	FINAL	6.6	6.9	6.1	6.1	6.0	7.7	7.2	
temp(C)	INITIAL	23.8	21.3	20.9	21.3	21.0	21.7	21.3	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
ALKALINITY(mg/L)		28	→	→	→	22	→	→	
HARDNESS(mg/L)		82	→	→	→	39	→	→	
CONDUCTIVITY(umhos/cm)		160	→	→	→	153	→	→	
CHLORINE(mg/L)		<0.05	→	→	~~<0.05~~	<0.05	→	→	
CONC:		32%	32%	32%	32%	32%	32%	32%	
D.O (mg/L)	INITIAL	7.5	9.8	9.3	7.7	7.7	7.9	7.5	
	FINAL	6.9	8.3	7.1	6.8	6.7	6.7	7.0	
pH(mg/L)	INITIAL	7.1	7.2	7.4	6.5	6.4	6.8	6.7	
	FINAL	6.5	6.8	6.0	6.0	6.0	7.4	7.1	
temp(C)	INITIAL	23.6	21.6	20.9	22.5	21.0	22.0	22.4	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
CONC:		42%	42%	42%	42%	42%	42%	42%	
D.O (mg/L)	INITIAL	7.3	9.8	9.1	7.6	7.5	7.9	7.5	
	FINAL	6.9	8.4	7.0	6.9	6.8	6.7	7.0	
pH(mg/L)	INITIAL	7.2	7.2	7.4	6.6	6.4	6.9	6.8	
	FINAL	6.5	6.8	6.0	6.0	6.0	7.3	7.1	
temp(C)	INITIAL	23.5	21.6	20.9	22.9	22.0	22.2	23.2	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
CONC:		56%	56%	56%	56%	56%	56%	56%	
D.O (mg/L)	INITIAL	7.3	9.9	9.2	7.5	7.6	8.0	7.4	
	FINAL	6.9	8.8	7.0	6.9	6.8	6.7	7.0	
pH(mg/L)	INITIAL	7.2	7.1	7.4	6.7	6.4	6.9	6.9	
	FINAL	6.5	6.8	6.0	6.1	6.1	7.3	7.0	
temp(C)	INITIAL	23.5	21.5	20.9	23.7	21.9	22.5	24.3	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
CONC:		75%	75%	75%	75%	75%	75%	75%	
D.O (mg/L)	INITIAL	7.5	10.0	9.3	7.4	7.6	8.0	7.5	
	FINAL	7.0	8.9	7.9	7.0	6.8	6.8	6.9	
pH(mg/L)	INITIAL	7.2	7.1	7.3	6.8	6.4	6.9	7.0	
	FINAL	6.5	6.8	6.0	6.1	6.1	7.3	7.0	
temp(C)	INITIAL	23.5	21.2	21.1	24.7	21.9	23.4	25.2	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
CONC:		100%	100%	100%	100%	100%	100%	100%	
D.O (mg/L)	INITIAL	7.3	9.6	9.4	7.2	7.7	8.0	7.4	
	FINAL	7.0	8.7	7.0	7.1	6.8	6.9	6.9	
pH(mg/L)	INITIAL	7.3	7.2	7.2	7.0	6.4	7.0	7.1	
	FINAL	6.4	6.7	5.9	6.0	6.1	7.2	7.0	
temp(C)	INITIAL	24.0	22.0	21.1	26.3	21.9	24.3	26.8	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
CONC:	100%	A	A	A	B	B	C	C	
ALKALINITY((mg/L)		11	→	→	12	→	13	→	
HARDNESS(mg/L)		1196	→	→	1368	→	1356	→	
CONDUCTIVITY(umhos/cm)		2220	→	→	2250	→	2230	→	
CHLORINE(mg/L)		<0.05	→	→	<0.05	→	<0.05	→	

CHEMICAL DATA SHEET FOR CHRONIC TOXICITY TESTING — Ceriodaphnia dubia

Lab # / Sample ID: K308578 — Test Start (Date/Time): 8-22-03 / 1600

Client: Weston — Test End (Date/Time): 8-28-03 / 0920

		Day of Test								
		1	2	3	4	5	6	7	8	notes/remarks
Control		8-22	8-23	8-24	8-25	8/26	8/27			8-22 SS#69
D.O (mg/L)	INITIAL	7.3	9.1	7.0	8.0	7.4	7.9			8-26 SS#70
	FINAL	7.0	9.3	8.1	8.2	7.7	8.3			
pH	INITIAL	7.2	7.4	7.7	6.1	6.4	6.7			
	FINAL	7.5	7.4	7.1	6.8	6.4	7.9			
temp(C)	INITIAL	23.8	21.3	20.9	21.3	21.0	21.7			
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0			
ALKALINITY(mg/L)		28	→	→	→	22	→	→	→	
HARDNESS(mg/L)		82	→	→	→	39	→	→	→	
CONDUCTIVITY(umhos/cm)		160	→	→	→	153	→	→	→	
CHLORINE(mg/L)		<0.05	→	→	~~<0.05~~	<0.05	→	→	→	
CONC:		32%	32%	32%	32%	32%	32%			
D.O (mg/L)	INITIAL	7.5	9.8	9.3	7.7	7.7	7.9			
	FINAL	7.0	9.2	8.1	8.3	7.7	8.3			
pH	INITIAL	7.8	7.2	7.4	6.5	6.4	6.8			
	FINAL	7.5	7.3	7.1	6.8	6.3	8.1			
temp(C)	INITIAL	23.6	21.6	20.9	22.5	21.0	22.0			
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0			
CONC:		42%	42%	42%	42%	42%	42%			
D.O (mg/L)	INITIAL	7.3	9.8	9.1	7.6	7.5	7.9			
	FINAL	7.0	9.2	8.1	8.3	7.8	8.6			
pH	INITIAL	7.2	7.2	7.4	6.6	6.4	6.9			
	FINAL	7.5	7.4	7.0	6.8	6.3	7.9			
temp(C)	INITIAL	23.5	21.6	20.9	22.9	22.0	22.2			
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0			
CONC:		56%	56%	56%	56%	56%	56%			
D.O (mg/L)	INITIAL	7.3	9.9	9.2	7.5	7.6	8.0			
	FINAL	7.0	9.2	8.1	8.4	7.9	8.6			
pH	INITIAL	7.2	7.1	7.4	6.7	6.4	6.9			
	FINAL	7.4	7.4	7.0	6.7	6.2	7.8			
temp(C)	INITIAL	23.5	21.5	20.9	23.7	21.9	22.5			
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0			
CONC:		75%	75%	75%	75%	75%	75%			
D.O (mg/L)	INITIAL	7.5	10.0	9.3	7.4	7.6	8.0			
	FINAL	7.1	9.3	8.1	8.4	8.0	8.7			
pH	INITIAL	7.2	7.1	7.3	6.8	6.4	6.9			
	FINAL	7.4	7.4	7.0	6.7	6.2	7.8			
temp(C)	INITIAL	23.5	21.2	21.1	24.7	21.9	23.4			
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0			
CONC:		100%	100%	100%	100%	100%	100%			
D.O (mg/L)	INITIAL	7.3	9.6	9.4	7.2	7.7	8.0			
	FINAL	7.1	9.3	8.2	8.4	8.0	8.5			
pH	INITIAL	7.3	7.2	7.2	7.0	6.4	7.0			
	FINAL	7.3	7.2	6.9	6.7	6.1	7.5			
temp(C)	INITIAL	24.0	22.0	21.1	24.3	21.9	24.3			
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0			
CONC:	**100%**	A	A	A	B	B	C			
ALKALINITY((mg/L)		11	→	→	12	→	13	→	→	
HARDNESS(mg/L)		1146	→	→	1368	→	1356	→	→	
CONDUCTIVITY(umhos/cm)		2220	→	→	2250	→	2230	→	→	
CHLORINE(mg/L)		<0.05	→	→	<0.05	→	<0.05	→	→	

APPENDIX C

Fathead Minnow Raw Data and Statistics

SURVIVAL DATA FOR FATHEAD MINNOW LARVAL SURVIVAL AND GROWTH TEST

LAB #/ SAMPLE ID K308578 TEST START DATE 8-22-13 TIME 1600

CLIENT Weston TEST END DATE 8-29 TIME 1600

AGE AND SOURCE OF MINNOWS <24 hrs; Aquatox

		DAY (NUMBER SURVIVING)								SURVIVAL		
	REP #	start	1	2	3	4	5	6	7	%	MEAN %	CV
CONC:	A	10	10	10	10	10	10	10	10	100		
	B	|	10	10	10	10	10	10	10	100		
Control	C	|	10	10	10	10	10	10	10	100	100%	0%
	D	|	10	10	10	10	10	10	10	100		
	E	↓	10	10	10	10	10	10	10	100		
CONC:	A	10	10	10	10	10	10	10	10	100		
	B	|	10	10	10	10	10	10	10	100		
32%	C	|	10	10	10	10	10	10	10	100	100%	
	D	|	10	10	10	10	10	10	10	100		
	E	↓	10	10	10	10	10	10	10	100		
CONC:	A	10	10	10	10	10	10	10	10	100		
	B	|	10	10	10	10	10	10	10	100		
42%	C	|	10	10	10	10	10	10	10	100	98%	
	D	|	10	10	10	10	10	9	9	90		
	E	↓	10	10	10	10	10	10	10	100		
CONC:	A	10	10	10	10	10	10	10	10	100		
	B	|	10	10	10	10	10	10	10	100		
56%	C	|	10	10	10	10	10	10	10	100	100%	
	D	|	10	10	10	10	10	10	10	100		
	E	↓	10	10	10	10	10	10	10	100		
CONC:	A	10	10	10	10	10	10	10	10	100		
	B	|	10	10	10	10	9	9	9	90		
75%	C	|	10	10	10	10	10	10	10	100	96%	
	D	|	10	10	10	10	10	9	9	90		
	E	↓	10	10	10	10	10	10	10	100		
CONC:	A	10	10	10	10	10	10	10	10	100		
	B	|	10	10	10	10	10	10	10	100		
100%	C	|	10	10	10	10	10	10	10	100	100%	0%
	D	|	10	10	10	10	10	10	10	100		
	E	↓	10	10	10	10	10	10	10	100		
ANALYST:		TC	AD	AD	TC	TC	TC	TC	mg			
DATE:		8-22	8-23	8-24	8-25	8-26	8-27	8-28	8-29			
TIME:		1600	1015	1020	1635	1415	1530	1620	1600			

CV = PERCENT COEFFICIENT OF VARIATION: STANDARD DEVIATION/MEAN * 100

Pimephales promelas **FATHEAD MINNOW** **TEST 1000.0**

WEIGHT DATA FOR LARVAL SURVIVAL AND GROWTH TEST

LAB #/#S: K3085-78	TEST DATES (BEGIN/END): 8-21-03/8-28-03
CLIENT: Weston	WEIGHING DATE/TIME:
ANALYST/S: AF, AD, TC, MG	DRYING TEMPERATURE (DEGREES C): 60°C
SAMPLE ID:	DRYING TIME (HOURS): 24hrs.

	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	A65	0.98198	0.97582	0.00616	10	0.616	AVG DRY	
	B66	0.97571	0.96951	0.00620	10	0.620	WEIGHT (mg)	
	C67	0.97899	0.97509	0.00390	10	0.390	0.556	
	D68	0.98555	0.97960	0.00595	10	0.595	CV	
	E69	0.97805	0.97248	0.00557	10	0.557	17.3	
CONC:	A70	0.98806	0.98104	0.00702	10	0.702	AVG DRY	
	B71	0.98162	0.97382	0.00780	10	0.780	WEIGHT(MG)	
32%	C72	0.98221	0.97403	0.00817	10	0.817	~~0.452~~ 0.752	
	D73	0.98515	0.97852	0.00663	10	0.663	CV	
	E74	0.98438	0.97738	0.00700	10	0.700		
CONC:	A75	0.98242	0.97599	0.00643	10	0.643	AVG DRY	
	B76	0.98275	0.97482	0.00793	10	0.793	WEIGHT(MG)	
42%	C77	0.98815	0.98072	0.00743	10	0.743	0.697	
	D78	0.98198	0.97599	0.00599	10	0.599	CV	
	E79	0.98265	0.97558	0.00707	10	0.707		
CONC:	A80	0.98472	0.97519	0.00953	10	0.953	AVG DRY	
	B81	0.98513	0.97842	0.00671	10	0.671	WEIGHT(MG)	
Stet.	C82	0.98715	0.98012	0.00703	10	0.703	0.722	
	D83	0.98926	0.98293	0.00633	10	0.633	CV	
	E84	0.98827	0.98178	0.00649	10	0.649		
CONC:	A85	0.98727	0.98004	0.00733	10	0.733	AVG DRY	
	B86	0.98590	0.97747	0.00803	10	0.803	WEIGHT(MG)	
75%	C87	0.97854	0.97235	0.00619	10	0.619	0.696	
	D88	0.98965	0.98315	0.00650	10	0.650	CV	
	E89	0.98923	0.98248	0.00675	10	0.675		
CONC:	A90	0.99067	0.98355	0.00712	10	0.712	AVG DRY	
	B91	0.98216	0.97368	0.00848	10	0.848	WEIGHT(MG)	
100%	C92	0.97900	0.97300	0.00600	10	0.600	0.693	
	D93	0.97708	0.97106	0.00602	10	0.602	CV	
	E94	0.97894	0.97193	0.00701	10	0.701	14.69	

*CV = (STANDARD DEVIATION/MEAN)*100*

AA# K308578 FATHEAD MINNOW SURVIVAL, 8-21-03
File: K308578S Transform: ARC SINE(SQUARE ROOT(Y))

Shapiro - Wilk's test for normality

D = 0.053

W = 0.714

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# K308578 FATHEAD MINNOW SURVIVAL, 8-21-03
File: K308578S 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# K308578 FATHEAD MINNOW SURVIVAL, 8-21-03
FILE: K308578S
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	1.0000	1.4120
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	1.0000	1.4120
2	32 % EFFLUENT	5	1.0000	1.4120
3	42 % EFLLUENT	1	1.0000	1.4120
3	42 % EFLLUENT	2	1.0000	1.4120
3	42 % EFLLUENT	3	1.0000	1.4120
3	42 % EFLLUENT	4	0.9000	1.2490
3	42 % EFLLUENT	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	0.9000	1.2490
5	75 % EFFLUENT	3	1.0000	1.4120
5	75 % EFFLUENT	4	0.9000	1.2490
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# K308578 FATHEAD MINNOW SURVIVAL, 8-21-03
File: K308578S 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	1.412				
2	32 % EFFLUENT	1.412	27.50	16.00	5.00	
3	42 % EFLLUENT	1.379	25.00	16.00	5.00	
4	56 % EFFLUENT	1.412	27.50	16.00	5.00	
5	75 % EFFLUENT	1.347	22.50	16.00	5.00	
6	100 % EFFLUENT	1.412	27.50	16.00	5.00	

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

AA # K309578, FATHEAD MINNOW GROWTH, 8-21-03
File: K308578G Transform: NO TRANSFORMATION

Shapiro - Wilk's test for normality

D = 0.209

W = 0.971

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 # K309578, FATHEAD MINNOW GROWTH, 8-21-03
File: K308578G Transform: NO TRANSFORMATION

Bartlett's test for homogeneity of variance
Calculated B1 statistic = 2.62

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 # K309578, FATHEAD MINNOW GROWTH, 8-21-03
FILE: K308578G
TRANSFORM: NO TRANSFORMATION NUMBER OF GROUPS: 6

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	CONTROL	1	0.6160	0.6160
1	CONTROL	2	0.6200	0.6200
1	CONTROL	3	0.3900	0.3900
1	CONTROL	4	0.5950	0.5950
1	CONTROL	5	0.5570	0.5570
2	32 % EFFLUENT	1	0.7020	0.7020
2	32 % EFFLUENT	2	0.7800	0.7800
2	32 % EFFLUENT	3	0.8170	0.8170
2	32 % EFFLUENT	4	0.6630	0.6630
2	32 % EFFLUENT	5	0.7000	0.7000
3	42 % EFFLUENT	1	0.6430	0.6430
3	42 % EFFLUENT	2	0.7930	0.7930
3	42 % EFFLUENT	3	0.7430	0.7430
3	42 % EFFLUENT	4	0.5990	0.5990
3	42 % EFFLUENT	5	0.7070	0.7070
4	56 % EFFLUENT	1	0.9530	0.9530
4	56 % EFFLUENT	2	0.6710	0.6710
4	56 % EFFLUENT	3	0.7030	0.7030
4	56 % EFFLUENT	4	0.6330	0.6330
4	56 % EFFLUENT	5	0.6490	0.6490
5	75 % EFFLUENT	1	0.7330	0.7330
5	75 % EFFLUENT	2	0.8030	0.8030
5	75 % EFFLUENT	3	0.6190	0.6190
5	75 % EFFLUENT	4	0.6500	0.6500
5	75 % EFFLUENT	5	0.6750	0.6750
6	100 % EFFLUENT	1	0.7120	0.7120
6	100 % EFFLUENT	2	0.8480	0.8480
6	100 % EFFLUENT	3	0.6000	0.6000
6	100 % EFFLUENT	4	0.6020	0.6020
6	100 % EFFLUENT	5	0.7010	0.7010

AA # K309578, FATHEAD MINNOW GROWTH, 8-21-03
File: K308578G Transform: NO TRANSFORMATION

ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	0.103	0.021	2.367
Within (Error)	24	0.209	0.009	
Total	29	0.312		

Critical F value = 2.62 (0.05,5,24)
Since F < Critical F FAIL TO REJECT Ho: All equal

AA # K309578, FATHEAD MINNOW GROWTH, 8-21-03
File: K308578G 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	0.556	0.556		
2	32 % EFFLUENT	0.732	0.732	-2.994	
3	42 % EFFLUENT	0.697	0.697	-2.395	
4	56 % EFFLUENT	0.722	0.722	-2.815	
5	75 % EFFLUENT	0.696	0.696	-2.378	
6	100 % EFFLUENT	0.693	0.693	-2.320	

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

AA # K309578, FATHEAD MINNOW GROWTH, 8-21-03
File: K308578G 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	0.139	25.1	-0.177
3	42 % EFFLUENT	5	0.139	25.1	-0.141
4	56 % EFFLUENT	5	0.139	25.1	-0.166
5	75 % EFFLUENT	5	0.139	25.1	-0.140
6	100 % EFFLUENT	5	0.139	25.1	-0.137

APPENDIX D

Ceriodaphnia dubia Raw Data and Statistics

Ceriodaphnia dubia — **SURVIVAL AND REPRODUCTION TEST**

Discharger: Weston
Location:
Date Sample Collected: See COC

Lab Number/s: K308578

Analyst: mg, AD, TC
Test Start-Date/Time: 8-22-03/1600
Test Stop-Date/Time: 8-28-03/0920

Conc 1 (Control)

%	Day	A	B	C	D	E	F	G	H	I	J	No. of Young	No. of Adults	Young/ Adult	Analyst
	1	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
	2	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
	3	5	0	4	5	5	0	3	6	6	6	40	10	4.0	TC
	4	0	5	0	0	1	5	8	0	10	0	29	10	2.9	TC
	5	10	9	10	12	10	8	0	8	0	11	78	10	7.8	TC
	6	13	10	11	13	12	8	11	6	12	11	107	10	10.7	TC
	7														
	8											90% 3rd brood			
	Total	28	24	25	30	28	21	22	20	28	28	254	$\bar{X}$=25.4	CV=13.8%	

Conc 2 (32)

%	Day	A	B	C	D	E	F	G	H	I	J	No. of Young	No. of Adults	Young/ Adult	Analyst
	1	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
	2	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
	3	4	7	6	0	0	0	0	5	X0	5	27	9	2.7	TC
	4	0	0	0	5	5	7	3	0	–	0	20	9	2.2	TC
	5	8	12	9	9	9	11	5	10	–	12	85	9	9.4	TC
	6	8	11	12	13	10	15	1	13	–	15	98	9	10.9	TC
	7														
	8														
	Total	20	30	27	27	24	33	9	28	X0	32	230			

Conc 3 (42)

%	Day	A	B	C	D	E	F	G	H	I	J	No. of Young	No. of Adults	Young/ Adult	Analyst
	1	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
	2	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
	3	4	6	7	6	0	0	0	6	5	6	40	10	4.0	TC
	4	0	0	0	0	5	5	6	0	0	0	16	10	1.6	TC
	5	7	11	11	12	8	9	9	10	10	13	100	10	10.0	TC
	6	13	12	14	12	10	14	9	11	10	14	119	10	11.9	TC
	7														
	8														
	Total	24	29	32	30	23	28	24	27	25	33	275			

Conc 4 (56)

%	Day	A	B	C	D	E	F	G	H	I	J	No. of Young	No. of Adults	Young/ Adult	Analyst
	1	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
	2	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
	3	0	2	6	5	6	0	0	4	5	4	32	10	3.2	TC
	4	5	0	0	0	0	6	6	0	8	0	25	10	2.5	TC
	5	0	11	12	9	11	8	9	10	0	9	79	10	7.9	TC
	6	8	11	15	11	10	9	10	14	12	12	112	10	11.2	
	7														
	8														
	Total	13	24	33	25	27	23	25	28	25	25	248			

Conc 5 (75)

%	Day	A	B	C	D	E	F	G	H	I	J	No. of Young	No. of Adults	Young/ Adult	Analyst
	1	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
	2	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
	3	4	2	6	0	5	0	0	5	5	5	32	10	3.2	TC
	4	0	3	0	4	0	0	6	0	0	0	13	10	1.3	TC
	5	6	10	7	10	7	8	11	10	7	11	87	10	8.7	TC
	6	11	8	10	13	12	8	11	11	0	12	96	10	9.6	TC
	7														
	8														
	Total	21	23	23	27	24	16	28	26	12	28	228			

Conc 6 (100)

%	Day	A	B	C	D	E	F	G	H	I	J	No. of Young	No. of Adults	Young/ Adult	Analyst
	1	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
	2	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
	3	0	3	0	2	4	X0	0	X3	0	4	16	8	1.6	TC
	4	10	0	3	1	1	–	5	–	6	0	26	8	2.0	TC
	5	15	11	7	7	11	–	10	–	0	6	57	8	7.1	TC
	6	6	9	9	7	12	–	12	–	12	10	77	8	9.6	TC
	7														
	8														
	Total	11	23	19	17	28	X0	27	X0	18	20	1600	$\bar{X}$=20.4	CV=27.3%	

X=DEAD; Y=MALE

FISHER'S EXACT TEST

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

CRITICAL FISHER'S VALUE (10,10,10) (p=0.05) IS 6. b VALUE IS 9.
Since b is greater than 6 there is no significant difference between CONTROL and TREATMENT at the 0.05 level.

FISHER'S EXACT TEST

IDENTIFICATION	NUMBER OF ALIVE	DEAD	TOTAL ANIMALS
CONTROL	10	0	10
42% EFFLUENT	10	0	10
TOTAL	20	0	20

CRITICAL FISHER'S VALUE (10,10,10) (p=0.05) IS 6. b VALUE IS 10.
Since b is greater than 6 there is no significant difference between CONTROL and TREATMENT at the 0.05 level.

FISHER'S EXACT TEST

IDENTIFICATION	NUMBER OF ALIVE	DEAD	TOTAL ANIMALS
CONTROL	10	0	10
56% EFFLUENT	10	0	10

TOTAL	20	0	20

CRITICAL FISHER'S VALUE (10,10,10) (p=0.05) IS 6. b VALUE IS 10.
Since b is greater than 6 there is no significant difference between CONTROL and TREATMENT at the 0.05 level.

FISHER'S EXACT TEST

IDENTIFICATION	NUMBER OF ALIVE	NUMBER OF DEAD	TOTAL ANIMALS
CONTROL	10	0	10
75% EFFLUENT	10	0	10
TOTAL	20	0	20

CRITICAL FISHER'S VALUE (10,10,10) (p=0.05) IS 6. b VALUE IS 10.
Since b is greater than 6 there is no significant difference between CONTROL and TREATMENT at the 0.05 level.

FISHER'S EXACT TEST

IDENTIFICATION	NUMBER OF ALIVE	NUMBER OF DEAD	TOTAL ANIMALS
CONTROL	10	0	10
100%	8	2	10
TOTAL	18	2	20

CRITICAL FISHER'S VALUE (10,10,10) (p=0.05) IS 6. b VALUE IS 8.
Since b is greater than 6 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	0	
1	32% EFFLUENT	10	1	
2	42% EFFLUENT	10	0	
3	56% EFFLUENT	10	0	
4	75% EFFLUENT	10	0	
5	100%	10	2	

AA # K308578, CERIODAPHNIA DUBIA REPRODUCTION, 8-21-03
File: k308578c Transform: NO TRANSFORMATION

Shapiro - Wilk's test for normality

******** 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 # K308578, CERIODAPHNIA DUBIA REPRODUCTION, 8-21-03
File: k308578c Transform: NO TRANSFORMATION

Bartlett's test for homogeneity of variance
Calculated B1 statistic = 21.95

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

Data FAIL B1 homogeneity test at 0.01 level. Try another transformation.

TITLE: AA # K308578, CERIODAPHNIA DUBIA REPRODUCTION, 8-21-03
FILE: k308578c
TRANSFORM: NO TRANSFORMATION NUMBER OF GROUPS: 6

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	CONTROL	1	28.0000	28.0000
1	CONTROL	2	24.0000	24.0000
1	CONTROL	3	25.0000	25.0000
1	CONTROL	4	30.0000	30.0000
1	CONTROL	5	28.0000	28.0000
1	CONTROL	6	21.0000	21.0000
1	CONTROL	7	22.0000	22.0000
1	CONTROL	8	20.0000	20.0000
1	CONTROL	9	28.0000	28.0000
1	CONTROL	10	28.0000	28.0000
2	32 % EFFLUENT	1	20.0000	20.0000
2	32 % EFFLUENT	2	30.0000	30.0000
2	32 % EFFLUENT	3	27.0000	27.0000
2	32 % EFFLUENT	4	27.0000	27.0000
2	32 % EFFLUENT	5	24.0000	24.0000
2	32 % EFFLUENT	6	33.0000	33.0000
2	32 % EFFLUENT	7	9.0000	9.0000
2	32 % EFFLUENT	8	28.0000	28.0000
2	32 % EFFLUENT	9	0.0000	0.0000
2	32 % EFFLUENT	10	32.0000	32.0000
3	42 % EFFLUENT	1	24.0000	24.0000
3	42 % EFFLUENT	2	29.0000	29.0000
3	42 % EFFLUENT	3	32.0000	32.0000
3	42 % EFFLUENT	4	30.0000	30.0000
3	42 % EFFLUENT	5	23.0000	23.0000
3	42 % EFFLUENT	6	28.0000	28.0000
3	42 % EFFLUENT	7	24.0000	24.0000
3	42 % EFFLUENT	8	27.0000	27.0000
3	42 % EFFLUENT	9	25.0000	25.0000
3	42 % EFFLUENT	10	33.0000	33.0000
4	56 % EFFLUENT	1	13.0000	13.0000
4	56 % EFFLUENT	2	24.0000	24.0000
4	56 % EFFLUENT	3	33.0000	33.0000
4	56 % EFFLUENT	4	25.0000	25.0000
4	56 % EFFLUENT	5	27.0000	27.0000
4	56 % EFFLUENT	6	23.0000	23.0000
4	56 % EFFLUENT	7	25.0000	25.0000
4	56 % EFFLUENT	8	28.0000	28.0000
4	56 % EFFLUENT	9	25.0000	25.0000
4	56 % EFFLUENT	10	25.0000	25.0000
5	75 % EFFLUENT	1	21.0000	21.0000
5	75 % EFFLUENT	2	23.0000	23.0000
5	75 % EFFLUENT	3	23.0000	23.0000
5	75 % EFFLUENT	4	27.0000	27.0000
5	75 % EFFLUENT	5	24.0000	24.0000
5	75 % EFFLUENT	6	16.0000	16.0000
5	75 % EFFLUENT	7	28.0000	28.0000
5	75 % EFFLUENT	8	26.0000	26.0000
5	75 % EFFLUENT	9	12.0000	12.0000
5	75 % EFFLUENT	10	28.0000	28.0000

6	100 %	EFFLUENT	1	31.0000	31.0000
6	100 %	EFFLUENT	2	23.0000	23.0000
6	100 %	EFFLUENT	3	19.0000	19.0000
6	100 %	EFFLUENT	4	17.0000	17.0000
6	100 %	EFFLUENT	5	28.0000	28.0000
6	100 %	EFFLUENT	6	0.0000	0.0000
6	100 %	EFFLUENT	7	27.0000	27.0000
6	100 %	EFFLUENT	8	0.0000	0.0000
6	100 %	EFFLUENT	9	18.0000	18.0000
6	100 %	EFFLUENT	10	20.0000	20.0000

AA # K308578, CERIODAPHNIA DUBIA REPRODUCTION, 8-21-03
File: k308578c Transform: NO TRANSFORMATION

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

GROUP	IDENTIFICATION	TRANSFORMED MEAN	RANK SUM	CRIT. VALUE	df	SIG
1	CONTROL	25.400				
2	32 % EFFLUENT	23.000	105.50	75.00	10.00	
3	42 % EFFLUENT	27.500	120.00	75.00	10.00	
4	56 % EFFLUENT	24.800	101.50	75.00	10.00	
5	75 % EFFLUENT	22.800	90.00	75.00	10.00	
6	100 % EFFLUENT	18.300	80.50	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 8-21-03 Arkansas Aquaculture

SPECIES Pimephales promelas

QUANTITY SHIPPED 900+

AGE/LIFE STAGE 48hrs 8/21 1500CST

BROODSTOCK SOURCE Anderson Farms, AR

CULTURE WATER groundwater

ALKALINITY (Mg/l as $CaCO_3$) ≈180

HARDNESS (Mg/l as $CaCO_3$)/Salinity (ppt) ≈160

FEEDING Artemia

COMMENTS

PACKAGED BY

BILL HALL PRINTERS 3171

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:	24 °C	21-24°C
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	112 mg/l	90-124 mg/l
TOTAL ALKALINITY (as $CaCO_3$):	85 mg/l	50-85 mg/l
pH:	8.09	7.68-8.14

Comments:

Facility Supervisor

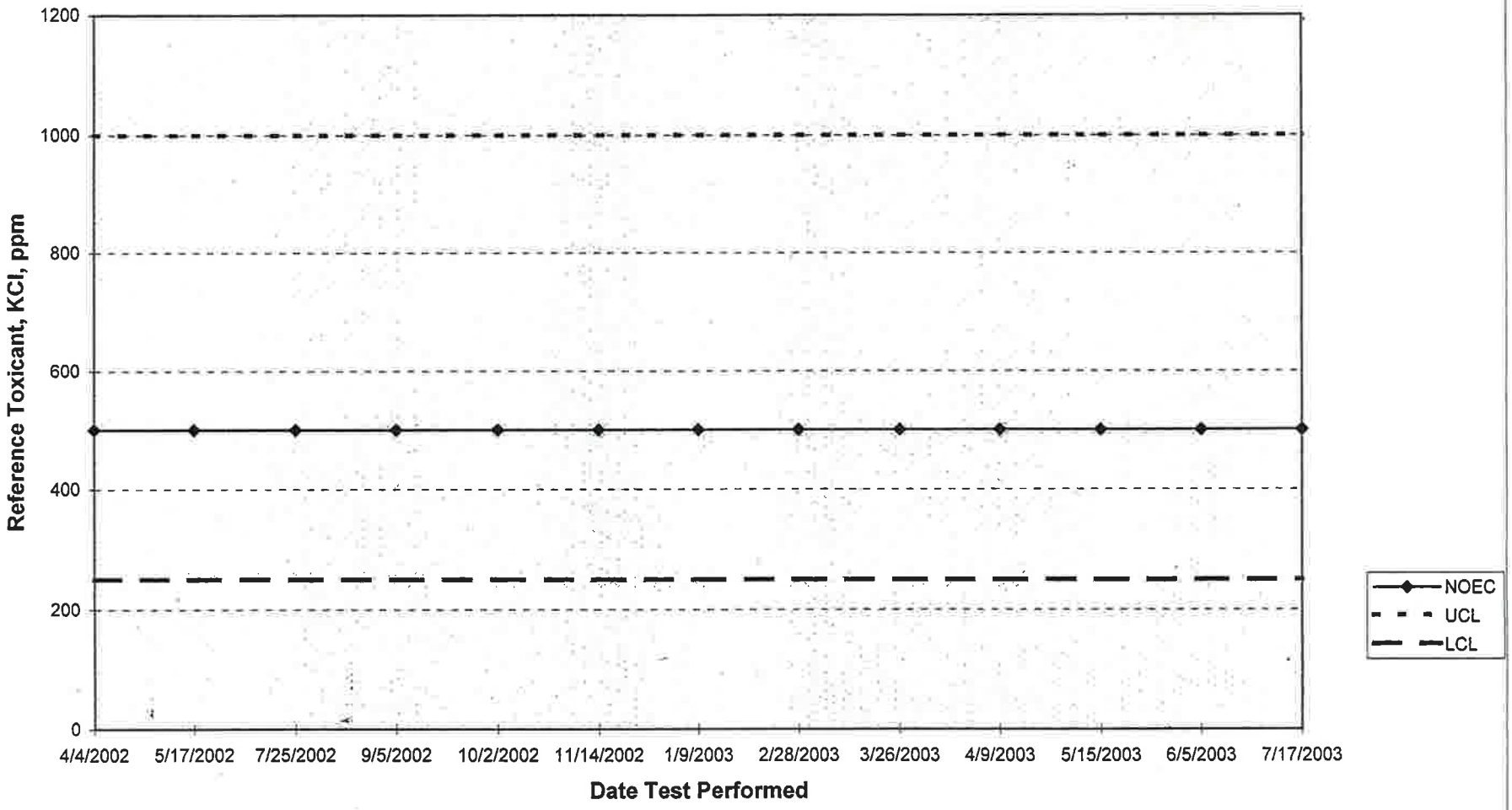
APPENDIX F

Quality Assurance Charts

ARKANSAS ANALYTICAL, INC.

FATHEAD MINNOW SURVIVAL

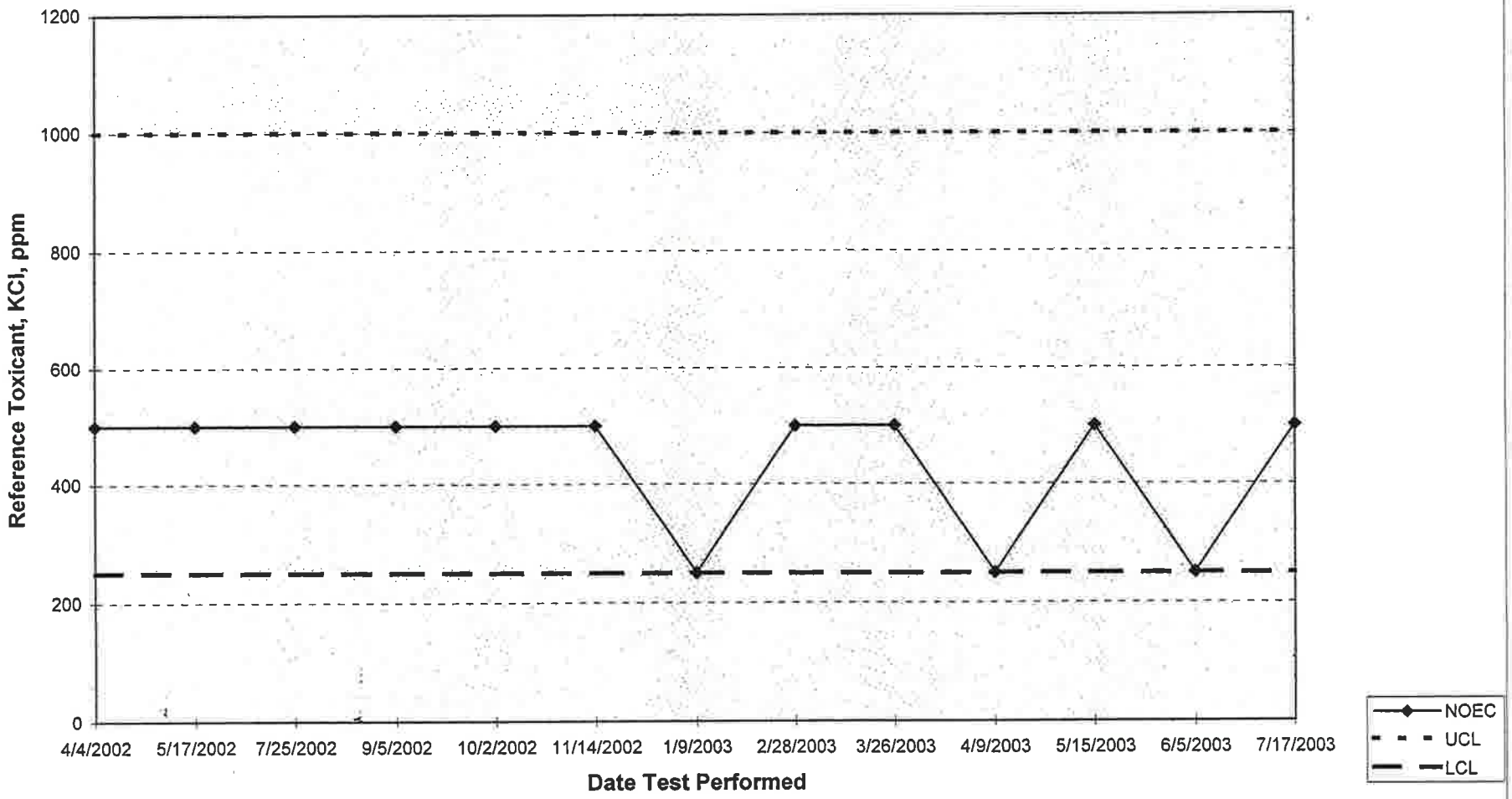
QUALITY ASSURANCE



ARKANSAS ANALYTICAL, INC.

FATHEAD MINNOW GROWTH

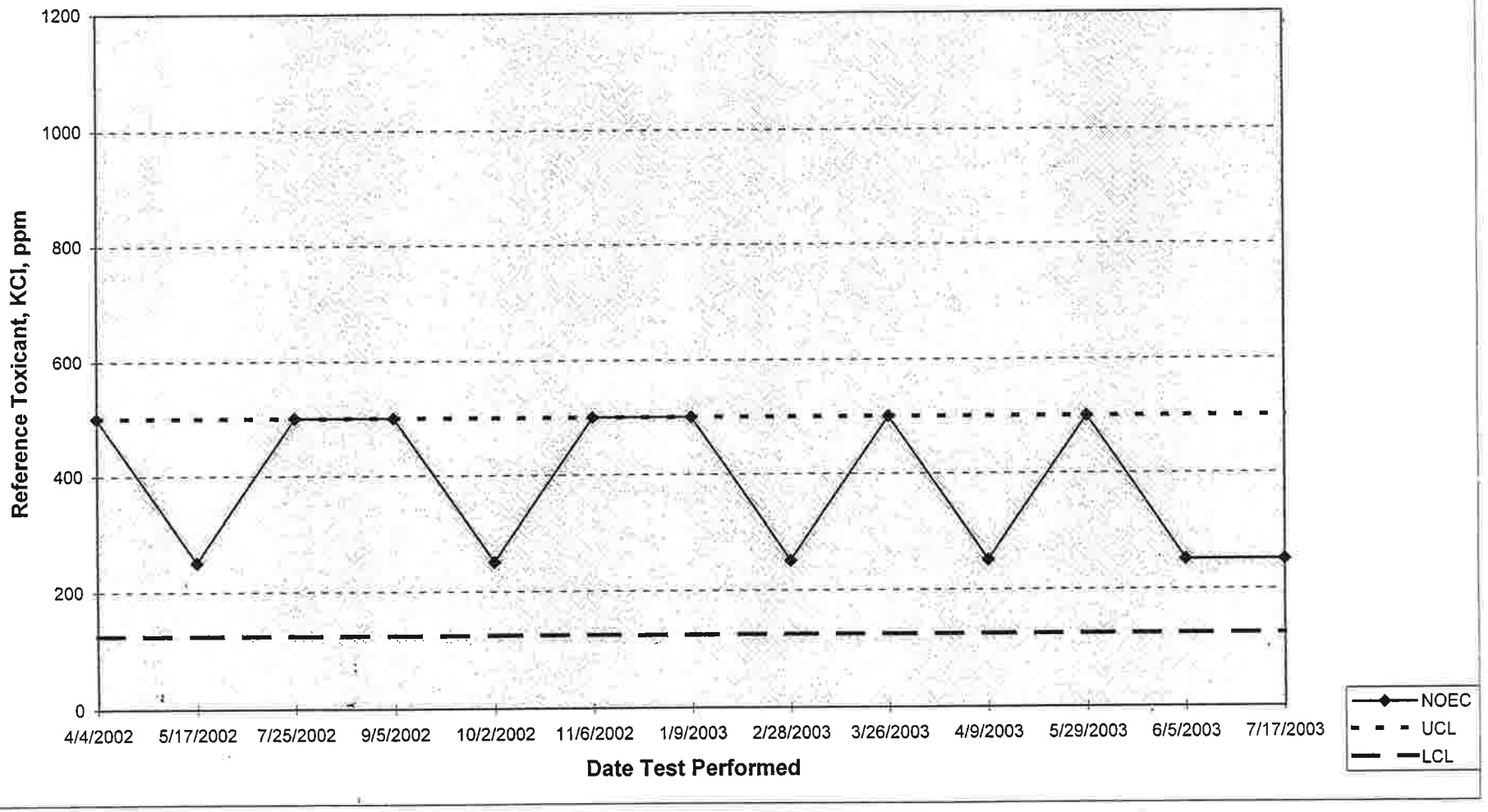
QUALITY ASSURANCE



ARKANSAS ANALYTICAL, INC.

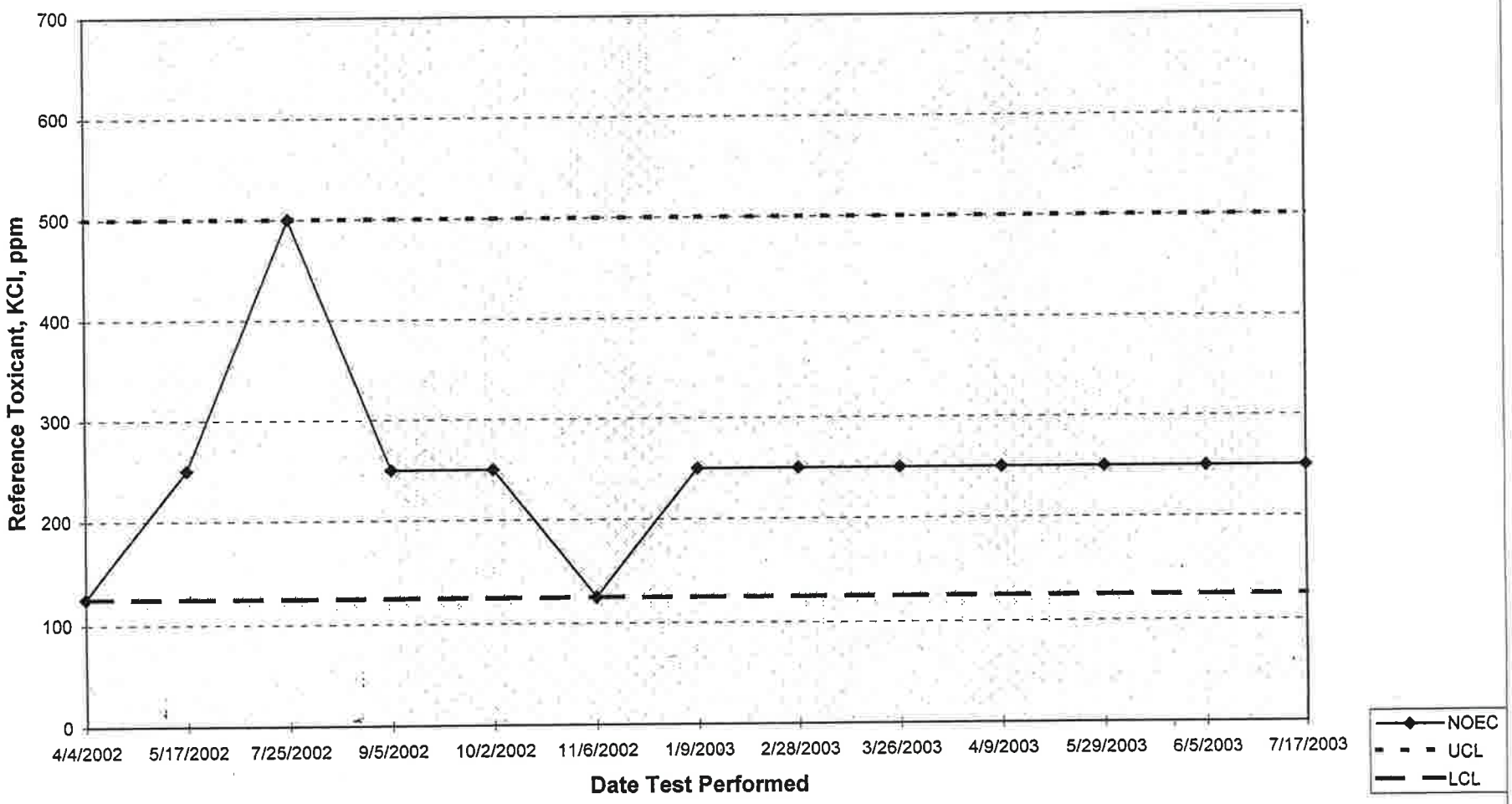
CERIODAPHNIA DUBIA SURVIVAL

QUALITY ASSURANCE



ARKANSAS ANALYTICAL, INC.

CERIODAPHNIA DUBIA REPRODUCTION
QUALITY ASSURANCE



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

May 14, 2003 to October 30, 2003

Laboratory ID # 60-1754 **Certificate # 03-031-1**

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		

May 15, 2003
Date

J A Lemberski
Quality Assurance Officer

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

Laboratory Control Number: K308578 Date: 9-9-03

Client: Weston Sample ID: effluent

	Pass	Fail
Fathead Minnow Survival Test	✓	
Fathead Minnow Growth Test	✓	
Ceriodaphnia dubia Survival Test	✓	
Ceriodaphnia dubia Reproduction Test	✓	

Analyst Initials MY

Arkansas Analytical, Inc.

Toxicity Test Results

MAGCOBAR MINE SITE
NPDES PERMIT NUMBER: AR0049794
August 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 K308578

Tuesday, September 9, 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 August 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:	8-21-03, 1000	8-22-03, 1000
Sample #2:	8-24-03, 0930	8-25-03, 0930
Sample #3:	8-25-03, 0930	8-26-03, 0930

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	Temperature Upon Receipt (°C)
Sample #1:	8-22-03, 1534	Not Taken
Sample #2:	8-25-03, 1525	3
Sample #3:	8-26-03, 1531	5

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 < 24 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	100%	X	
Average of 15 or more young per surviving female	25.4	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	13.8%	X	

TEST ACCEPTANCE CRITERIA for *Pimephales promelas*

Control Criteria	Results	Pass	Fail
Greater than or equal to 80% survival	100%	X	
The percent coefficient of variation between replicates must be 40% or less for survival	0%	X	
Minimum of 0.25 mg average dry weight of surviving controls	0.556	X	
The percent coefficient of variation between replicates must be 40% or less for growth	17.3%	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

Ceriodaphnia dubia		*Pimephales promelas*	
NOEC Survival:	250 ppm KCl	NOEC Survival:	500 ppm KCl
LOEC Survival:	500 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

Ceriodaphnia dubia		*Pimephales promelas*	
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)	20.4	%CV survival (critical dilution)	0%
%CV Reproduction (critical dilution)	27.3%	Mean dry weight (critical dilution) in milligrams	0.693
		%CV growth (critical dilution)	14.7%

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
Melissa Green

Andrea Fox
Andrea Fox

Teresa Canfield
Teresa Canfield

Amy Daniel
Amy Daniel

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:	8-21-03, 1000	8-22-03, 1000
Sample #2:	8-24-03, 0930	8-25-03, 0930
Sample #3:	8-25-03, 0930	8-26-03, 0930

Test initiated (date, time): 8-22-03, 1600 Test terminated (date, time): 8-29-03, 1600

Dilution water used: Soft Synthetic

DATA TABLE FOR FATHEAD MINNOW SURVIVAL

	Percent Survival in Replicate Chambers						Mean Percent Survival	
Effluent Conc %	A	B	C	D	E		Mean Dry Weight	CV%
0%	0.616	0.620	0.390	0.595	0.557		0.556	17.3
32%	0.702	0.780	0.817	0.663	0.700		0.732	
42%	0.643	0.793	0.743	0.599	0.707		0.697	
56%	0.953	0.671	0.703	0.633	0.649		0.722	
75%	0.733	0.803	0.619	0.650	0.675		0.696	
100%	0.712	0.848	0.600	0.602	0.701		0.693	14.7

DATA TABLE FOR GROWTH OF FATHEAD MINNOWS

	Average Dry Weight in milligrams in replicate chambers							
Effluent Conc %	A	B	C	D	E		Mean Dry Weight	CV%
0%	0.616	0.620	0.390	0.595	0.557		0.556	17.3
32%	0.702	0.780	0.817	0.663	0.700		0.732	
42%	0.643	0.793	0.743	0.599	0.707		0.697	
56%	0.953	0.671	0.703	0.633	0.649		0.722	
75%	0.733	0.803	0.619	0.650	0.675		0.696	
100%	0.712	0.848	0.600	0.602	0.701		0.693	14.7

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)= _____**0**_____%

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:	8-21-03, 1000	8-22-03, 1000
Sample #2:	8-24-03, 0930	8-25-03, 0930
Sample #3:	8-25-03, 0930	8-26-03, 0930

Test initiated (date, time): 8-22-03, 1600 Test terminated (date, time): 8-28-03, 0920

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	28	20	24	13	21	11
B	24	30	29	24	23	23
C	25	27	32	33	23	19
D	30	27	30	25	27	17
E	28	24	23	27	24	28
F	21	33	28	23	16	X0
G	22	9	24	25	28	27
H	20	28	27	28	26	X0
I	28	X0	25	25	12	18
J	28	32	33	25	28	20
Mean	25.4	23.0	27.5	24.8	22.8	16.6
Mean/surviving female	25.4	25.6	27.5	24.8	22.8	20.4
CV%*	13.8					27.3

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	100	100	100	100	100	100
Test termination	100	90	100	100	100	80

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)= _____**27.3**_____%

APPENDIX A

Chain of Custody Forms

CHAIN OF CUSTODY RECORD

CLIENT INFORMATION	Project Description	Turnaround Time (CIRCLE ONE)
Weston Solutions		24 hour
2000 Darby Lane	Reporting Information	48 hour
Malvern, AR 72104	Telephone:	routine
Attn: Alan Brown	FAX:	Preservative Code:
	Bill to/P.O.	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

Samplers:(Signature/s): Alan B Brown

Samplers:(Printed): Alan B. Brown

Field Number	Sample Collection Date/s	Sample Collection Time/s	Grab	Comp	# of Containers	Sample Matrix	SAMPLE IDENTIFICATION/ DESCRIPTION	Charge 13.0	TEST PARAMETERS	Arkansas Analytical Lab #
FDDB22Wm1	8/22	10:00		X	5		Facility Discharge	X		1c30857 8A

1.Relinquished by:(Signature)	Date/Time	1.Received by:(Signature)
Alan B Brown	8/22/03 15:34	
2.Relinquished by:(Signature)	Date/Time	2.Received by laboratory :(Signature)
	8/22/03 1534	

For completion by laboratory

Condition of samples:	yes	no
A. Containers Correct:?	✓	
B. Preservation Correct:?	✓	
C. Seals Intact:?	✓	

REMARKS

CHAIN OF CUSTODY RECORD

CLIENT INFORMATION	Project Description	Turnaround Time
Weston Solutions, Inc.	MAGCOBAR Mine Site	(CIRCLE ONE)
P.O. Box 699	Reporting Information	24 hour
2000 Darby Lane	Telephone: 501/467-8365	48 hour
Malvern, AR 72104	FAX: 501/467-8687	routine
Attn: Alan Brown	Bill to/P.O.	Preservative Code:
		Bottle Type: P

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

Samplers:(Signature/s): Alan B. Brown

Samplers:(Printed): Alan B. Brown

Field Number	Sample Collection Date/s	Sample Collection Time/s	Grab	Comp	# of Containers	Sample Matrix	SAMPLE IDENTIFICATION/ DESCRIPTION	Chronic Bio	TEST PARAMETERS	Arkansas Analytical Lab #
FD0825COMP	25-Aug	9:30		X	3		Facility Discharge	X		K3085788

Bottle type code (G=glass;P=HDPE V=septum;A=amber)

1 Relinquished by:(Signature)	Date/Time	1.Received by:(Signature)
Alan B. Brown	8/25/13 15:25	
2.Relinquished by:(Signature)	Date/Time	2.Received by laboratory :(Signature)
	8-25-13 1525	Sydney James

For completion by laboratory

Condition of samples:	yes	no
A. Containers Correct:?	✓	
B. Preservation Correct:?	✓	
C. Seals Intact:?	N/A	

REMARKS

Temp - 3°C

ARKANSAS ANALYTICAL, INC. ** 11701 I-30, Bldg 1, Suite 115**Little Rock, Arkansas 72209**phone(501)455-3233***Fax(501)455-6118

CHAIN OF CUSTODY RECORD

CLIENT INFORMATION	Project Description	Turnaround Time (CIRCLE ONE)
Weston Solutions, Inc.		24 hour
P.O Box 699	Reporting Information	48 hour
2000 Darby Lane	Telephone: 501.467.8355	routine
Malvern, AR 72104	FAX: 501.467.8687	Preservative Code:
ATTN: ~~David Passmore~~ Alan Brown	Bill to/P.O.	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

Alan B. Brown — Samplers:(Signature/s)

Alan B. Brown — Samplers:(Printed)

Field Number	Sample Collection Date/s	Sample Collection Time/s	Grab	Comp	# of Containers	Sample Matrix	SAMPLE IDENTIFICATION/ DESCRIPTION	Chronic Biomonitoring - CD, FH	TEST PARAMETERS	Arkansas Analytical Lab #
						1				
						P				Bottle type code G=glass;P=HDPE V=septum;A=amber
FD0826Comp	08/26	9:30		X		3	Facility Discharge	X		130578C

1.Relinquished by:(Signature)	Date/Time	1.Received by:(Signature)
	8/26/03 15:31	
2.Relinquished by:(Signature)	Date/Time	2.Received by laboratory :(Signature)
	8/26/03 1531	

For completion by laboratory

Condition of samples:	yes	no
A. Containers Correct:?	✓	
B. Preservation Correct:?	✓	
C. Seals intact:?	✓	

Received 5°C

REMARKS

APPENDIX B

Effluent and Dilution Water Data

CHEMICAL DATA SHEET FOR CHRONIC TOXICITY TESTING — Fathead Minnow

Lab # / Sample ID: K308578 — Test Start (Date/Time): 8-22-03/1600

Client: Weston — Test End (Date/Time): 8-29-03/1600

		Day of Test							
		1	2	3	4	5	6	7	notes/remarks
Control		8/22	8-23	8-24	8-25	8/26	8/27	8/28	8/22 SS 69
D.O (mg/L)	INITIAL	7.3	9.1	9.0	8.6	7.4	7.9	7.5	8/26 · SS 70
	FINAL	6.9	8.5	7.0	6.8	6.7	6.8	6.9	
pH(mg/L)	INITIAL	7.2	7.4	7.7	6.1	6.6	6.7	6.5	
	FINAL	6.6	6.9	6.1	6.1	6.0	7.7	7.2	
temp(C)	INITIAL	23.8	21.3	20.9	21.3	21.0	21.7	21.3	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
ALKALINITY(mg/L)		28			→	22		→	
HARDNESS(mg/L)		82			→	39		→	
CONDUCTIVITY(umhos/cm)		160			→	153		→	
CHLORINE(mg/L)		<0.05			<0.05	<0.05		→	
CONC:		32%	32%	32%	32%	32%	32%	32%	
D.O (mg/L)	INITIAL	7.5	9.8	9.3	7.7	7.1	7.9	7.5	
	FINAL	6.9	8.3	7.1	6.8	6.7	6.7	7.0	
pH(mg/L)	INITIAL	7.1	7.2	7.4	6.5	6.4	6.8	6.7	
	FINAL	6.5	6.8	6.0	6.0	6.0	7.4	7.1	
temp(C)	INITIAL	23.6	21.6	20.9	22.5	21.0	22.0	22.4	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
CONC:		42%	42%	42%	42%	42%	42%	42%	
D.O (mg/L)	INITIAL	7.3	9.8	9.1	7.6	7.5	7.9	7.5	
	FINAL	6.9	8.4	7.0	6.9	6.8	6.7	7.0	
pH(mg/L)	INITIAL	7.2	7.2	7.4	6.6	6.4	6.9	6.8	
	FINAL	6.5	6.8	6.0	6.0	6.0	7.3	7.1	
temp(C)	INITIAL	23.5	21.6	20.9	22.9	22.0	22.2	23.2	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
CONC:		56%	56%	56%	56%	56%	56%	56%	
D.O (mg/L)	INITIAL	7.3	9.9	9.2	7.5	7.6	8.0	7.4	
	FINAL	6.9	8.8	7.0	6.9	6.8	6.7	7.0	
pH(mg/L)	INITIAL	7.2	7.1	7.4	6.7	6.4	6.9	6.9	
	FINAL	6.5	6.8	6.0	6.1	6.1	7.3	7.0	
temp(C)	INITIAL	23.5	21.5	20.9	23.7	21.9	22.5	24.3	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
CONC:		75%	75%	75%	75%	75%	75%	75%	
D.O (mg/L)	INITIAL	7.5	10.0	9.3	7.4	7.6	8.0	7.5	
	FINAL	7.0	8.9	7.0	7.0	6.8	6.8	6.9	
pH(mg/L)	INITIAL	7.2	7.1	7.3	6.8	6.4	6.9	7.0	
	FINAL	6.5	6.8	6.0	6.1	6.1	7.3	7.0	
temp(C)	INITIAL	23.5	21.2	21.1	24.7	21.9	23.4	25.2	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
CONC:		100%	100%	100%	100%	100%	100%	100%	
D.O (mg/L)	INITIAL	7.3	9.6	9.4	7.2	7.7	8.6	7.4	
	FINAL	7.0	8.7	7.0	7.1	6.8	6.9	6.9	
pH(mg/L)	INITIAL	7.3	7.2	7.2	7.0	6.4	7.0	7.1	
	FINAL	6.4	6.7	5.9	6.0	6.1	7.2	7.0	
temp(C)	INITIAL	24.0	22.0	21.1	26.3	21.9	24.3	26.8	
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
CONC: 100%		A	A	A	B	B	C	C	
ALKALINITY((mg/L)		11	→	→	12	→	13	→	
HARDNESS(mg/L)		1146	→	→	1368	→	1356	→	
CONDUCTIVITY(umhos/cm)		2220		↘	2250	↘	2230	↘	

CHEMICAL DATA SHEET FOR CHRONIC TOXICITY TESTING — Ceriodaphnia dubia

Lab # / Sample ID: K308578 — Test Start (Date/Time): 8-22-03 / 11.00

Client: Weston — Test End (Date/Time): 8-28-03 / 0920

		Day of Test								
		1	2	3	4	5	6	7	8	notes/remarks
Control		8-22	8-23	8-24	8-25	8/26	8/27			8-22 SS#69
D.O (mg/L)	INITIAL	7.3	9.1	9.0	8.0	7.4	7.9			8-26 SS#70
	FINAL	7.0	9.3	8.1	8.2	7.7	8.3			
pH	INITIAL	7.2	7.4	7.7	6.1	6.6	6.7			
	FINAL	7.5	7.4	7.1	6.8	6.4	7.9			
temp(C)	INITIAL	23.8	21.3	20.9	21.3	21.0	21.7			
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0			
ALKALINITY(mg/L)		28			→	22	→			
HARDNESS(mg/L)		82			→	39	→			
CONDUCTIVITY(umhos/cm)		160			→	153	→			
CHLORINE(mg/L)		<0.05			~~<0.05~~	<0.05	→			
CONC:		32%	32%	32%	32%	32%	32%			
D.O (mg/L)	INITIAL	7.5	9.8	9.3	7.7	7.7	7.9			
	FINAL	7.0	9.2	8.1	8.3	7.7	8.3			
pH	INITIAL	7.8	7.2	7.4	6.5	6.4	6.8			
	FINAL	7.5	7.3	7.1	6.8	6.3	8.1			
temp(C)	INITIAL	23.6	21.6	20.9	22.5	21.0	22.0			
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0			
CONC:		42%	42%	42%	42%	42%	42%			
D.O (mg/L)	INITIAL	7.3	9.8	9.1	7.6	7.5	7.9			
	FINAL	7.0	9.2	8.1	8.3	7.8	8.6			
pH	INITIAL	7.2	7.2	7.4	6.6	6.4	6.9			
	FINAL	7.5	7.4	7.0	6.8	6.3	7.9			
temp(C)	INITIAL	23.5	21.6	20.9	22.9	22.0	22.2			
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0			
CONC:		56%	56%	56%	56%	56%	56%			
D.O (mg/L)	INITIAL	7.3	9.9	9.2	7.5	7.6	8.0			
	FINAL	7.0	9.2	8.1	8.4	7.9	8.6			
pH	INITIAL	7.2	7.1	7.4	6.7	6.4	6.9			
	FINAL	7.4	7.4	7.0	6.7	6.2	7.8			
temp(C)	INITIAL	23.5	21.5	20.9	23.7	21.9	22.5			
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0			
CONC:		75%	75%	75%	75%	75%	75%			
D.O (mg/L)	INITIAL	7.5	10.0	9.3	7.4	7.6	8.0			
	FINAL	7.1	9.3	8.1	8.4	8.0	8.7			
pH	INITIAL	7.2	7.1	7.3	6.8	6.4	6.9			
	FINAL	7.4	7.4	7.0	6.7	6.2	7.8			
temp(C)	INITIAL	23.5	21.2	21.1	24.7	21.9	23.4			
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0			
CONC:		100%	100%	100%	100%	100%	100%			
D.O (mg/L)	INITIAL	7.3	10.6	9.4	7.2	7.7	8.0			
	FINAL	7.1	9.3	8.2	8.4	8.0	8.5			
pH	INITIAL	7.3	7.2	7.2	7.0	6.4	7.0			
	FINAL	7.3	7.2	6.9	6.7	6.1	7.5			
temp(C)	INITIAL	24.0	22.0	21.1	24.3	21.9	24.3			
	FINAL	25.0	25.0	25.0	25.0	25.0	25.0			
CONC:	**100%**	A	A	A	B	B	C			
ALKALINITY((mg/L)		11		→	12	→	13			
HARDNESS(mg/L)		1146		→	1368	→	1356			
CONDUCTIVITY(umhos/cm)		2220		→	2250	→	2230			
CHLORINE(mg/L)		<0.05		→	<0.05	→	<0.05			

APPENDIX C

Fathead Minnow Raw Data and Statistics

SURVIVAL DATA FOR FATHEAD MINNOW LARVAL SURVIVAL AND GROWTH TEST

LAB #/ SAMPLE ID K308578 TEST START DATE 8-22 TIME 1600

CLIENT Weston TEST END DATE 8-29 TIME 1600

AGE AND SOURCE OF MINNOWS <24 hrs; Aquatox

		DAY (NUMBER SURVIVING)								SURVIVAL		
	REP #	start	1	2	3	4	5	6	7	%	MEAN %	CV
CONC: Control	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		
CONC: 32%	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		
CONC: 42%	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		
CONC: 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		
CONC: 75%	A	10	10	10	10	10	10	10	10	100	96%	
	B		10	10	10	10	9	9	9	90		
	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		
CONC: 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:		TC	AD	AD	TC	TC	TC	TC	mg			
DATE:		8-22	8-23	8-24	8-25	8-26	8-27	8-28	8-29			
TIME:		1600	1015	1020	1035	1415	1530	1620	1600			

CV = PERCENT COEFFICIENT OF VARIATION: STANDARD DEVIATION/MEAN * 100

Pimephales promelas **FATHEAD MINNOW** **TEST 1000.0**

WEIGHT DATA FOR LARVAL SURVIVAL AND GROWTH TEST

LAB #/#S: K3085-78	TEST DATES (BEGIN/END): 821-03/8-28-03
CLIENT: Weston	WEIGHING DATE/TIME:
ANALYST/S: AF, AD, TC, MG	DRYING TEMPERATURE (DEGREES C): 60°C
SAMPLE ID:	DRYING TIME (HOURS): 24hrs.

	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	A65	0.98198	0.97582	0.00616	10	0.616	AVG DRY	
	B66	0.97571	0.96951	0.00620	10	0.620	WEIGHT (mg)	
	C67	0.97899	0.97509	0.00390	10	0.390	0.556	
	D68	0.98555	0.97960	0.00595	10	0.595	CV	
	E69	0.97805	0.97248	0.00557	10	0.557	17.3	
CONC:	A70	0.98806	0.98104	0.00702	10	0.702	AVG DRY	
	B71	0.98162	0.97382	0.00780	10	0.780	WEIGHT(MG)	
32%	C72	0.98221	0.97403	0.00817	10	0.817	0.752	
	D73	0.98515	0.97852	0.00663	10	0.663	CV	
	E74	0.98438	0.97738	0.00700	10	0.700		
CONC:	A75	0.98242	0.97599	0.00643	10	0.643	AVG DRY	
	B76	0.98275	0.97482	0.00793	10	0.793	WEIGHT(MG)	
42%	C77	0.98815	0.98072	0.00743	10	0.743	0.697	
	D78	0.98189	0.97599	0.00599	10	0.599	CV	
	E79	0.98265	0.97558	0.00707	10	0.707		
CONC:	A80	0.98472	0.97519	0.00953	10	0.953	AVG DRY	
	B81	0.98513	0.97842	0.00671	10	0.671	WEIGHT(MG)	
56%	C82	0.98715	0.98012	0.00703	10	0.703	0.722	
	D83	0.98926	0.98293	0.00633	10	0.633	CV	
	E84	0.98827	0.98178	0.00649	10	0.649		
CONC:	A85	0.98737	0.98004	0.00733	10	0.733	AVG DRY	
	B86	0.98590	0.97747	0.00803	10	0.803	WEIGHT(MG)	
75%	C87	0.97854	0.97235	0.00619	10	0.619	0.696	
	D88	0.98965	0.98315	0.00650	10	0.650	CV	
	E89	0.98923	0.98248	0.00675	10	0.675		
CONC:	A90	0.99067	0.98355	0.00712	10	0.712	AVG DRY	
	B91	0.98216	0.97368	0.00848	10	0.848	WEIGHT(MG)	
100%	C92	0.97900	0.97300	0.00600	10	0.600	0.693	
	D93	0.97708	0.97106	0.00602	10	0.602	CV	
	E94	0.97894	0.97193	0.00701	10	0.701	14.69	

*CV = (STANDARD DEVIATION/MEAN)*100*

AA# K308578 FATHEAD MINNOW SURVIVAL, 8-21-03
File: K308578S Transform: ARC SINE(SQUARE ROOT(Y))

Shapiro - Wilk's test for normality

D = 0.053

W = 0.714

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# K308578 FATHEAD MINNOW SURVIVAL, 8-21-03
File: K308578S 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# K308578 FATHEAD MINNOW SURVIVAL, 8-21-03
FILE: K308578S
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	1.0000	1.4120
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	1.0000	1.4120
2	32 % EFFLUENT	5	1.0000	1.4120
3	42 % EFLLUENT	1	1.0000	1.4120
3	42 % EFLLUENT	2	1.0000	1.4120
3	42 % EFLLUENT	3	1.0000	1.4120
3	42 % EFLLUENT	4	0.9000	1.2490
3	42 % EFLLUENT	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	0.9000	1.2490
5	75 % EFFLUENT	3	1.0000	1.4120
5	75 % EFFLUENT	4	0.9000	1.2490
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

A# K308578 FATHEAD MINNOW SURVIVAL, 8-21-03
ile: K308578S 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	1.412				
2	32 % EFFLUENT	1.412	27.50	16.00	5.00	
3	42 % EFLLUENT	1.379	25.00	16.00	5.00	
4	56 % EFFLUENT	1.412	27.50	16.00	5.00	
5	75 % EFFLUENT	1.347	22.50	16.00	5.00	
6	100 % EFFLUENT	1.412	27.50	16.00	5.00	

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

AA # K309578, FATHEAD MINNOW GROWTH, 8-21-03
File: K308578G Transform: NO TRANSFORMATION

Shapiro - Wilk's test for normality

D = 0.209

W = 0.971

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 # K309578, FATHEAD MINNOW GROWTH, 8-21-03
File: K308578G Transform: NO TRANSFORMATION

Bartlett's test for homogeneity of variance
Calculated B1 statistic = 2.62

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 # K309578, FATHEAD MINNOW GROWTH, 8-21-03
FILE: K308578G
TRANSFORM: NO TRANSFORMATION NUMBER OF GROUPS: 6

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	CONTROL	1	0.6160	0.6160
1	CONTROL	2	0.6200	0.6200
1	CONTROL	3	0.3900	0.3900
1	CONTROL	4	0.5950	0.5950
1	CONTROL	5	0.5570	0.5570
2	32 % EFFLUENT	1	0.7020	0.7020
2	32 % EFFLUENT	2	0.7800	0.7800
2	32 % EFFLUENT	3	0.8170	0.8170
2	32 % EFFLUENT	4	0.6630	0.6630
2	32 % EFFLUENT	5	0.7000	0.7000
3	42 % EFFLUENT	1	0.6430	0.6430
3	42 % EFFLUENT	2	0.7930	0.7930
3	42 % EFFLUENT	3	0.7430	0.7430
3	42 % EFFLUENT	4	0.5990	0.5990
3	42 % EFFLUENT	5	0.7070	0.7070
4	56 % EFFLUENT	1	0.9530	0.9530
4	56 % EFFLUENT	2	0.6710	0.6710
4	56 % EFFLUENT	3	0.7030	0.7030
4	56 % EFFLUENT	4	0.6330	0.6330
4	56 % EFFLUENT	5	0.6490	0.6490
5	75 % EFFLUENT	1	0.7330	0.7330
5	75 % EFFLUENT	2	0.8030	0.8030
5	75 % EFFLUENT	3	0.6190	0.6190
5	75 % EFFLUENT	4	0.6500	0.6500
5	75 % EFFLUENT	5	0.6750	0.6750
6	100 % EFFLUENT	1	0.7120	0.7120
6	100 % EFFLUENT	2	0.8480	0.8480
6	100 % EFFLUENT	3	0.6000	0.6000
6	100 % EFFLUENT	4	0.6020	0.6020
6	100 % EFFLUENT	5	0.7010	0.7010

AA # K309578, FATHEAD MINNOW GROWTH, 8-21-03
File: K308578G Transform: NO TRANSFORMATION

ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	5	0.103	0.021	2.367
Within (Error)	24	0.209	0.009	
Total	29	0.312		

Critical F value = 2.62 (0.05,5,24)
Since F < Critical F FAIL TO REJECT Ho: All equal

AA # K309578, FATHEAD MINNOW GROWTH, 8-21-03
File: K308578G 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	0.556	0.556		
2	32 % EFFLUENT	0.732	0.732	-2.994	
3	42 % EFFLUENT	0.697	0.697	-2.395	
4	56 % EFFLUENT	0.722	0.722	-2.815	
5	75 % EFFLUENT	0.696	0.696	-2.378	
6	100 % EFFLUENT	0.693	0.693	-2.320	

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

AA # K309578, FATHEAD MINNOW GROWTH, 8-21-03
File: K308578G 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	0.139	25.1	-0.177
3	42 % EFFLUENT	5	0.139	25.1	-0.141
4	56 % EFFLUENT	5	0.139	25.1	-0.166
5	75 % EFFLUENT	5	0.139	25.1	-0.140
6	100 % EFFLUENT	5	0.139	25.1	-0.137

APPENDIX D

Ceriodaphnia dubia Raw Data and Statistics

Ceriodaphnia dubia **SURVIVAL AND REPRODUCTION TEST**

Discharger: Weston
Location:
Date Sample Collected: See COC

Lab Number/s
K308578

Analyst: mg, AD, TC
Test Start-Date/Time: 8-22-03 / 1600
Test Stop-Date/Time: 8-28-03 / 0920

Conc 1 (Control)

Day	A	B	C	D	E	F	G	H	I	J	No. of Young	No. of Adults	Young/ Adult	Analyst
1	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
2	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
3	5	0	4	5	5	0	3	6	6	6	40	10	4.0	TC
4	0	5	0	0	1	5	8	0	10	0	29	10	2.9	TC
5	10	9	10	12	10	8	0	8	0	11	78	10	7.8	TC
6	13	10	11	13	12	8	11	6	12	11	107	10	10.7	TC
7														
8											90% 3rd brood			
Total	28	24	25	30	28	21	22	20	28	28	254	$\bar{X}$=25.4	CV=13.8%	

Conc 2 (32)

Day	A	B	C	D	E	F	G	H	I	J	No. of Young	No. of Adults	Young/ Adult	Analyst
1	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
2	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
3	4	7	6	0	0	0	0	5	X	5	27	9	2.7	TC
4	0	0	0	5	5	7	3	0	–	0	20	9	2.2	TC
5	8	12	9	9	9	11	5	10	–	12	85	9	9.4	TC
6	8	11	12	13	10	15	1	13	–	15	98	9	10.9	TC
7														
8														
Total	20	30	27	27	24	33	9	28	X	32	230			

Conc 3 (42)

Day	A	B	C	D	E	F	G	H	I	J	No. of Young	No. of Adults	Young/ Adult	Analyst
1	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
2	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
3	4	6	7	6	0	0	0	6	5	6	40	10	4.0	TC
4	0	0	0	0	5	5	6	0	0	0	16	10	1.6	TC
5	7	11	11	12	8	9	9	10	10	13	100	10	10.0	TC
6	13	12	14	12	10	14	9	11	10	14	119	10	11.9	TC
7														
8														
Total	24	29	32	30	23	28	24	27	25	33	275			

Conc 4 (56)

Day	A	B	C	D	E	F	G	H	I	J	No. of Young	No. of Adults	Young/ Adult	Analyst
1	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
2	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
3	0	2	6	5	6	0	0	4	5	4	32	10	3.2	TC
4	5	0	0	0	0	6	6	0	8	0	25	10	2.5	TC
5	0	11	12	9	11	8	9	10	0	9	79	10	7.9	TC
6	8	11	15	11	10	9	10	14	12	12	112	10	11.2	
7														
8														
Total	13	24	33	25	27	23	25	28	25	25	248			

Conc 5 (75)

Day	A	B	C	D	E	F	G	H	I	J	No. of Young	No. of Adults	Young/ Adult	Analyst
1	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
2	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
3	4	2	6	0	5	0	0	5	5	5	32	10	3.2	TC
4	0	3	0	4	0	0	6	0	0	0	13	10	1.3	TC
5	6	10	7	10	7	8	11	10	7	11	87	10	8.7	TC
6	11	8	10	13	12	8	11	11	0	12	96	10	9.6	TC
7														
8														
Total	21	23	23	27	24	16	28	26	12	28	228			

Conc 6 (100)

Day	A	B	C	D	E	F	G	H	I	J	No. of Young	No. of Adults	Young/ Adult	Analyst
1	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
2	0	0	0	0	0	0	0	0	0	0	0	10	0	AD
3	0	3	0	2	4	X	0	X	0	4	16	8	1.6	TC
4	10	0	3	1	1	–	5	–	6	0	26	8	2.0	TC
5	15	11	7	7	11	–	10	–	0	6	57	8	7.1	TC
6	6	9	9	7	12	–	12	–	12	10	77	8	9.6	TC
7														
8														
Total	11	23	19	17	28	X	27	X	18	20	1100	$\bar{X}$=20.4	CV=27.3%	

X=DEAD; Y=MALE

FISHER'S EXACT TEST

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

CRITICAL FISHER'S VALUE (10,10,10) (p=0.05) IS 6. b VALUE IS 9.
Since b is greater than 6 there is no significant difference
between CONTROL and TREATMENT at the 0.05 level.

FISHER'S EXACT TEST

IDENTIFICATION	NUMBER OF ALIVE	DEAD	TOTAL ANIMALS
CONTROL	10	0	10
42% EFFLUENT	10	0	10
TOTAL	20	0	20

CRITICAL FISHER'S VALUE (10,10,10) (p=0.05) IS 6. b VALUE IS 10.
Since b is greater than 6 there is no significant difference
between CONTROL and TREATMENT at the 0.05 level.

FISHER'S EXACT TEST

IDENTIFICATION	NUMBER OF ALIVE	DEAD	TOTAL ANIMALS
CONTROL	10	0	10
56% EFFLUENT	10	0	10

TOTAL	20	0	20

CRITICAL FISHER'S VALUE (10,10,10) (p=0.05) IS 6. b VALUE IS 10.
Since b is greater than 6 there is no significant difference
between CONTROL and TREATMENT at the 0.05 level.

FISHER'S EXACT TEST

	NUMBER OF		
IDENTIFICATION	ALIVE	DEAD	TOTAL ANIMALS
CONTROL	10	0	10
75% EFFLUENT	10	0	10
TOTAL	20	0	20

CRITICAL FISHER'S VALUE (10,10,10) (p=0.05) IS 6. b VALUE IS 10.
Since b is greater than 6 there is no significant difference
between CONTROL and TREATMENT at the 0.05 level.

FISHER'S EXACT TEST

	NUMBER OF		
IDENTIFICATION	ALIVE	DEAD	TOTAL ANIMALS
CONTROL	10	0	10
100%	8	2	10
TOTAL	18	2	20

CRITICAL FISHER'S VALUE (10,10,10) (p=0.05) IS 6. b VALUE IS 8.
Since b is greater than 6 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	0	
1	32% EFFLUENT	10	1	
2	42% EFFLUENT	10	0	
3	56% EFFLUENT	10	0	
4	75% EFFLUENT	10	0	
5	100%	10	2	

AA # K308578, CERIODAPHNIA DUBIA REPRODUCTION, 8-21-03
File: k308578c Transform: NO TRANSFORMATION

Shapiro - Wilk's test for normality

******** 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 # K308578, CERIODAPHNIA DUBIA REPRODUCTION, 8-21-03
File: k308578c Transform: NO TRANSFORMATION

Bartlett's test for homogeneity of variance
Calculated B1 statistic = 21.95

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

Data FAIL B1 homogeneity test at 0.01 level. Try another transformation.

TITLE: AA # K308578, CERIODAPHNIA DUBIA REPRODUCTION, 8-21-03
FILE: k308578c
TRANSFORM: NO TRANSFORMATION NUMBER OF GROUPS: 6

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	CONTROL	1	28.0000	28.0000
1	CONTROL	2	24.0000	24.0000
1	CONTROL	3	25.0000	25.0000
1	CONTROL	4	30.0000	30.0000
1	CONTROL	5	28.0000	28.0000
1	CONTROL	6	21.0000	21.0000
1	CONTROL	7	22.0000	22.0000
1	CONTROL	8	20.0000	20.0000
1	CONTROL	9	28.0000	28.0000
1	CONTROL	10	28.0000	28.0000
2	32 % EFFLUENT	1	20.0000	20.0000
2	32 % EFFLUENT	2	30.0000	30.0000
2	32 % EFFLUENT	3	27.0000	27.0000
2	32 % EFFLUENT	4	27.0000	27.0000
2	32 % EFFLUENT	5	24.0000	24.0000
2	32 % EFFLUENT	6	33.0000	33.0000
2	32 % EFFLUENT	7	9.0000	9.0000
2	32 % EFFLUENT	8	28.0000	28.0000
2	32 % EFFLUENT	9	0.0000	0.0000
2	32 % EFFLUENT	10	32.0000	32.0000
3	42 % EFFLUENT	1	24.0000	24.0000
3	42 % EFFLUENT	2	29.0000	29.0000
3	42 % EFFLUENT	3	32.0000	32.0000
3	42 % EFFLUENT	4	30.0000	30.0000
3	42 % EFFLUENT	5	23.0000	23.0000
3	42 % EFFLUENT	6	28.0000	28.0000
3	42 % EFFLUENT	7	24.0000	24.0000
3	42 % EFFLUENT	8	27.0000	27.0000
3	42 % EFFLUENT	9	25.0000	25.0000
3	42 % EFFLUENT	10	33.0000	33.0000
4	56 % EFFLUENT	1	13.0000	13.0000
4	56 % EFFLUENT	2	24.0000	24.0000
4	56 % EFFLUENT	3	33.0000	33.0000
4	56 % EFFLUENT	4	25.0000	25.0000
4	56 % EFFLUENT	5	27.0000	27.0000
4	56 % EFFLUENT	6	23.0000	23.0000
4	56 % EFFLUENT	7	25.0000	25.0000
4	56 % EFFLUENT	8	28.0000	28.0000
4	56 % EFFLUENT	9	25.0000	25.0000
4	56 % EFFLUENT	10	25.0000	25.0000
5	75 % EFFLUENT	1	21.0000	21.0000
5	75 % EFFLUENT	2	23.0000	23.0000
5	75 % EFFLUENT	3	23.0000	23.0000
5	75 % EFFLUENT	4	27.0000	27.0000
5	75 % EFFLUENT	5	24.0000	24.0000
5	75 % EFFLUENT	6	16.0000	16.0000
5	75 % EFFLUENT	7	28.0000	28.0000
5	75 % EFFLUENT	8	26.0000	26.0000
5	75 % EFFLUENT	9	12.0000	12.0000
5	75 % EFFLUENT	10	28.0000	28.0000

6	100 % EFFLUENT	1	31.0000	31.0000
6	100 % EFFLUENT	2	23.0000	23.0000
6	100 % EFFLUENT	3	19.0000	19.0000
6	100 % EFFLUENT	4	17.0000	17.0000
6	100 % EFFLUENT	5	28.0000	28.0000
6	100 % EFFLUENT	6	0.0000	0.0000
6	100 % EFFLUENT	7	27.0000	27.0000
6	100 % EFFLUENT	8	0.0000	0.0000
6	100 % EFFLUENT	9	18.0000	18.0000
6	100 % EFFLUENT	10	20.0000	20.0000

AA # K308578, CERIODAPHNIA DUBIA REPRODUCTION, 8-21-03
File: k308578c Transform: NO TRANSFORMATION

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

GROUP	IDENTIFICATION	TRANSFORMED MEAN	RANK SUM	CRIT. VALUE	df	SIG
1	CONTROL	25.400				
2	32 % EFFLUENT	23.000	105.50	75.00	10.00	
3	42 % EFFLUENT	27.500	120.00	75.00	10.00	
4	56 % EFFLUENT	24.800	101.50	75.00	10.00	
5	75 % EFFLUENT	22.800	90.00	75.00	10.00	
6	100 % EFFLUENT	18.300	80.50	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 8-21-03 Arkansas Animal Hospital

SPECIES Pimephales promelas

QUANTITY SHIPPED 900+

AGE/LIFE STAGE 24hrs 8/21 1500CST

BROODSTOCK SOURCE Anderson Farms, AR

CULTURE WATER groundwater

ALKALINITY (Mg/l as $CaCO_3$) ≈180

HARDNESS (Mg/l as $CaCO_3$)/Salinity (ppt) ≈160

FEEDING Artemia

COMMENTS

PACKAGED BY

BILL HALL PRINTERS 3171

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:	24 °C	21-24°C
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	112 mg/l	90-124 mg/l
TOTAL ALKALINITY (as $CaCO_3$):	85 mg/l	50-85 mg/l
pH:	8.09	7.68-8.14

Comments:

Facility Supervisor

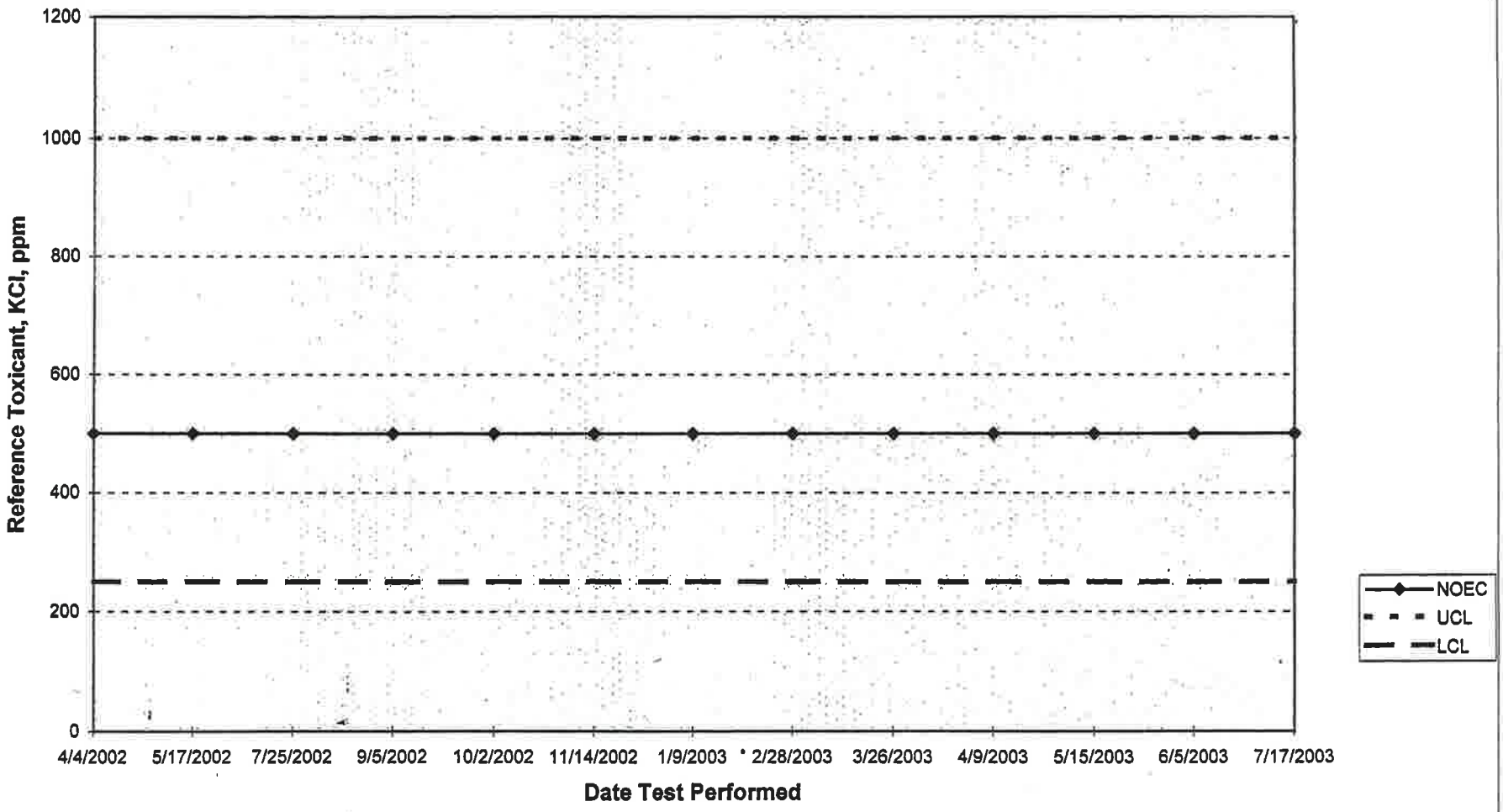
APPENDIX F

Quality Assurance Charts

ARKANSAS ANALYTICAL, INC.

FATHEAD MINNOW SURVIVAL

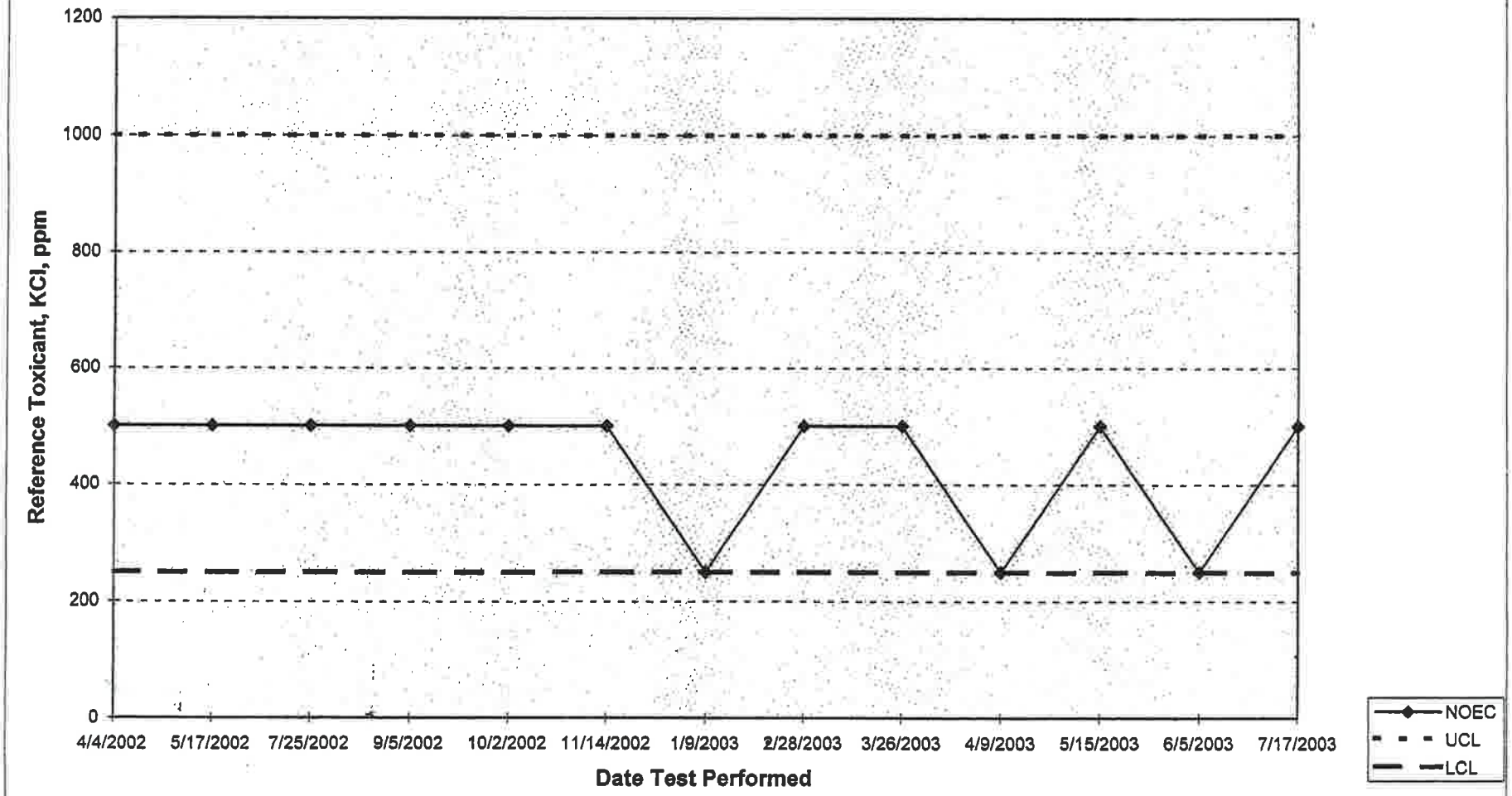
QUALITY ASSURANCE



ARKANSAS ANALYTICAL, INC.

FATHEAD MINNOW GROWTH

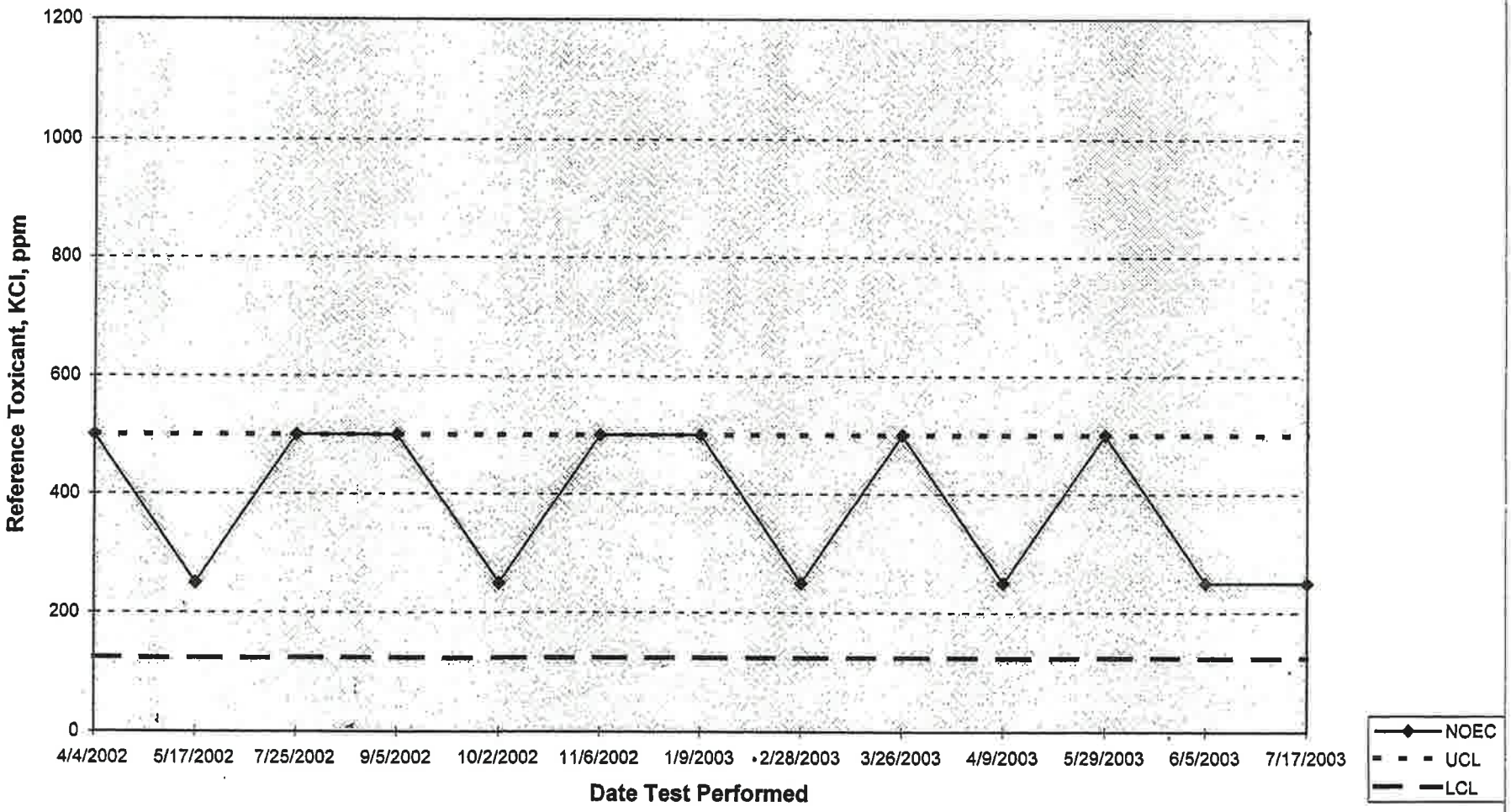
QUALITY ASSURANCE



ARKANSAS ANALYTICAL, INC.

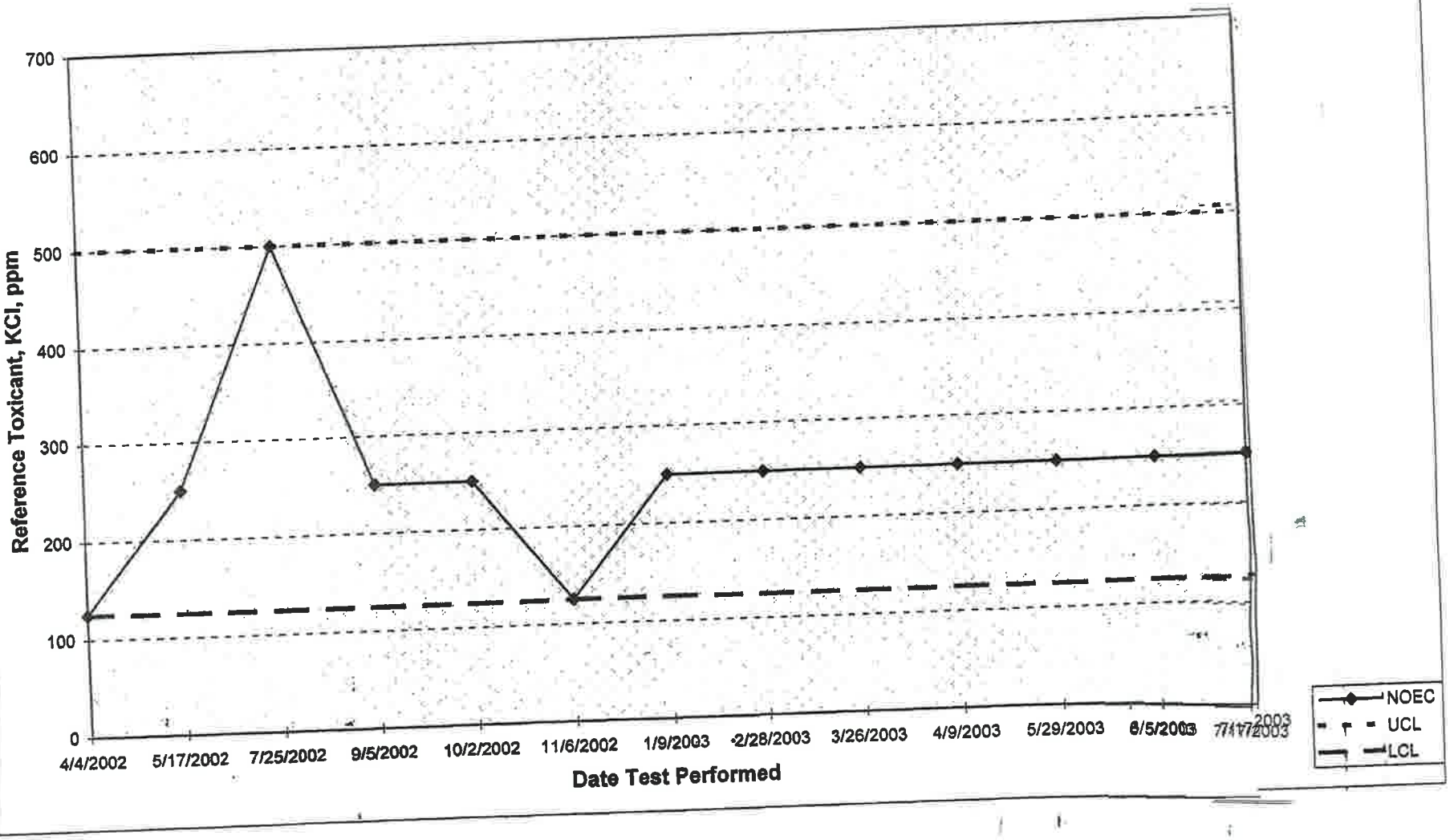
CERIODAPHNIA DUBIA SURVIVAL

QUALITY ASSURANCE



ARKANSAS ANALYTICAL, INC.

CERIODAPHNIA DUBIA REPRODUCTION
QUALITY ASSURANCE



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

May 14, 2003 to October 30, 2003

Laboratory ID # 60-1754 **Certificate # 03-031-1**

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		

May 15, 2003
Date

J A Lemberski
Quality Assurance Officer