



Tennessee Valley Authority, Post Office Box 2000, Soddy Daisy, Tennessee 37384-2000

June 8, 2017

Chattanooga Environmental Field Office
Division of Water Pollution Control
1301 Riverfront Parkway, #206
Chattanooga, Tennessee 37402-2013

TENNESSEE VALLEY AUTHORITY (TVA) - SEQUOYAH NUCLEAR PLANT (SQN) - NPDES
PERMIT NO. TN0026450 - DISCHARGE MONITORING REPORT (DMR) FOR May 2017

Enclosed is the May 2017 Discharge Monitoring Report for Sequoyah Nuclear Plant. There were no exceedances during the reporting period. The final report for toxicity testing conducted at outfall 101, April 30 - May 5, 2017, is enclosed. No adverse effects were observed. If you have any questions or need additional information, please contact Millicent Garland by email at mrmoore@tva.gov or by phone at (423) 843-6714.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sincerely,

Anthony L. Williams
Site Vice President
Sequoyah Nuclear Plant

Enclosures

cc (Enclosures):
U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

IEZ5
NRR

PERMITTEE NAME/ADDRESS (Include Facility Name/Location if Different)

Name **TVA - SEQUOYAH NUCLEAR PLANT**
 Address **P.O. BOX 2000**
 (INTEROFFICE OPS-5N-SQN)
SODDY - DAISY, TN 37384
 Facility **TVA - SEQUOYAH NUCLEAR PLANT**
 Location **HAMILTON COUNTY**

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
 DISCHARGE MONITORING REPORT (DMR)

MAJOR (SUBR 01)
 F - FINAL
 DIFFUSER DISCHARGE
 EFFLUENT

Form Approved.
 OMB No. 2040-0004

TN0026450 101 G
 PERMIT NUMBER DISCHARGE NUMBER

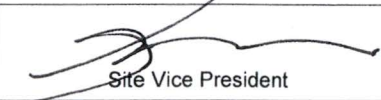
MONITORING PERIOD
 From 17 05 01 To 17 05 31

*** NO DISCHARGE ***

NOTE: Read instructions before completing this form.

ATTN:Millicent Garland

PARAMETER	SAMPLE MEASUREMENT	QUANTITY OR LOADING			QUALITY OR CONCENTRATION			NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE	
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM				UNITS
TEMPERATURE, WATER DEG. CENTIGRADE 00010 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT	*****	*****	**	*****	*****	35.6	04	0	31 / 31	RCORDR
	PERMIT REQUIREMENT	*****	*****	****	*****	*****	Req. Mon. DAILY MAX	DEG. C.		CONTI NUOUS	CALCTD
TEMPERATURE, WATER DEG. CENTIGRADE 00010 Z 0 INSTREAM MONITORING	SAMPLE MEASUREMENT	*****	*****	**	*****	*****	23.4	04	0	31 / 31	MODEL D
	PERMIT REQUIREMENT	*****	*****	****	*****	*****	30.5 DAILY MX	DEG. C.		CONTI NUOUS	CALCTD
TEMP. DIFF. BETWEEN SAMP. & UPSTRM DEG.C 00016 1 S EFFLUENT GROSS	SAMPLE MEASUREMENT	*****	*****	**	*****	*****	1.6	04	0	31 / 31	CALCTD
	PERMIT REQUIREMENT	*****	*****	****	*****	*****	3.0 DAILY MX	DEG. C.		CONTI NUOUS	CALCTD
FLOW, IN CONDUIT OR THRU TREATMENT PLANT 50050 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT	*****	1908	03	*****	*****	*****	**	0	31 / 31	RCORDR
	PERMIT REQUIREMENT	*****	Req. Mon. DAILY MAX	MGD	*****	*****	*****	****		CONTI NUOUS	RCORDR
FLOW, IN CONDUIT OR THRU TREATMENT PLANT 50050 1 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	*****	1433	03	*****	*****	*****	03	0	31 / 31	CALCTD
	PERMIT REQUIREMENT	*****	Req. Mon. MO AVG	MGD	*****	*****	*****	MGD		CONTI NUOUS	CALCTD
CHLORINE, TOTAL RESIDUAL 50060 1 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	*****	*****	**	*****	0.018	0.036	19	0	20 / 31	GRAB
	PERMIT REQUIREMENT	*****	*****	****	*****	0.1 MO AVG	0.1 DAILY MAX	MG/L		FIVE PER WEEK	CALCTD
TEMPERATURE - C, RATE OF CHANGE 82234 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT	*****	0.2	62	*****	*****	*****	**	0	31 / 31	CALCTD
	PERMIT REQUIREMENT	*****	2.0 DAILY MX	DEG C/HR	*****	*****	*****	****		CONTI NUOUS	CALCTD

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER Anthony L. Williams Site Vice President TYPED OR PRINTED	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	 Site Vice President SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE		DATE		
			AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

No closed mode operation. The following injections occurred: Spectrus CT 1300 (max calc. was 0.039 mg/mL, limit 0.05 mg/L), Spectrus BD 1500 (max calc. was 0.046 mg/mL, limit - 2.0 mg/mL).

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SODDY - DAISY, TN 37384
 Facility **TVA - SEQUOYAH NUCLEAR PLANT**
 Location **HAMILTON COUNTY**

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
 DISCHARGE MONITORING REPORT (DMR)

MAJOR

(SUBR 01)

F - FINAL

BIOMONITORING FOR OUTFALL 101

EFFLUENT

Form Approved.

OMB No. 2040-0004

TN0026450 **101 T**
 PERMIT NUMBER DISCHARGE NUMBER

MONITORING PERIOD
 From

YEAR	MO	DAY
17	05	01

 To

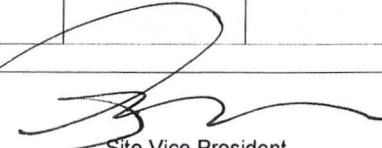
YEAR	MO	DAY
17	05	31

*** NO DISCHARGE ***

NOTE: Read instructions before completing this form.

ATTN:Millicent Garland

PARAMETER	X	QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
IC25 STATRE 7DAY CHR CERIODAPHNIA	SAMPLE MEASUREMENT	*****	*****	**	>100.0	*****	*****	23	0	1 / 180	COMPOS
TRP3B 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	*****	*****	****	42.8 MINIMUM	*****	*****	PERCENT		SEMI ANNUAL	COMPOS
IC25 STATRE 7DAY CHR PIMEPHALES	SAMPLE MEASUREMENT	*****	*****	**	>100.0	*****	*****	23	0	1 / 180	COMPOS
TRP6C 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	*****	*****	****	42.8 MINIMUM	*****	*****	PERCENT		SEMI ANNUAL	COMPOS
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

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			AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

Toxicity was sampled April 30 - May 5, 2017.

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 Location HAMILTON COUNTY

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
 DISCHARGE MONITORING REPORT (DMR)

MAJOR

(SUBR 01)

F - FINAL

LOW VOL. WASTE TREATMENT POND

EFFLUENT

Form Approved.

OMB No. 2040-0004

TN0026450 103 G
 PERMIT NUMBER DISCHARGE NUMBER

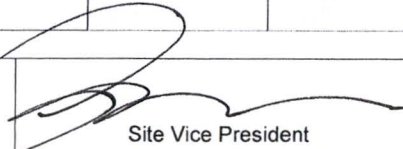
MONITORING PERIOD
 YEAR MO DAY YEAR MO DAY
 From 17 05 01 To 17 05 31

*** NO DISCHARGE ***

NOTE: Read instructions before completing this form.

ATTN:Millicent Garland

PARAMETER	X	QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
PH	SAMPLE MEASUREMENT	*****	*****	**	7.2	*****	7.5	12	0	5 / 31	GRAB
00400 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	*****	*****	**	6.0 MINIMUM	*****	9.0 MAXIMUM	SU		ONCE/ WEEK	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	*****	*****	**	*****	4.5	4.5	19	0	1 / 31	GRAB
00530 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	*****	*****	**	*****	30.0 MO AVG	100.0 DAILY MX	MG/L		ONCE/ MONTH	GRAB
OIL AND GREASE	SAMPLE MEASUREMENT	*****	*****	**	*****	<5.0	<5.0	19	0	1 / 31	GRAB
00556 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	*****	*****	**	*****	15.0 MO AVG	20.0 DAILY MX	MG/L		ONCE/ MONTH	GRAB
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	1.679	1.757	03	*****	*****	*****	**	0	4 / 31	INSTAN
50050 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	Req. Mon. MO AVG	Req. Mon DAILY MX	MGD	*****	*****	*****	**		ONCE/ WEEK	INSTAN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

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			AREA CODE	NUMBER	YEAR	MO	DAY
			423	843-7001	17	06	07

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

PERMITTEE NAME/ADDRESS (Include Facility Name/Location if Different)

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 Location **HAMILTON COUNTY**

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
 DISCHARGE MONITORING REPORT (DMR)

MAJOR (SUBR 01)
 F - FINAL
 RECYCLED COOLING WATER
 EFFLUENT

Form Approved.
 OMB No. 2040-0004

TN0026450
 PERMIT NUMBER

110 G
 DISCHARGE NUMBER

MONITORING PERIOD

YEAR	MO	DAY	YEAR	MO	DAY
17	05	01	17	05	31

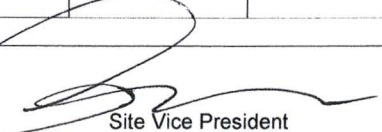
From To

*** NO DISCHARGE ***

ATTN:Millicent Garland

NOTE: Read instructions before completing this form.

PARAMETER	SAMPLE MEASUREMENT / PERMIT REQUIREMENT	QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
TEMPERATURE, WATER DEG. CENTIGRADE 00010 1 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	*****	*****	**	*****	*****		04			
	PERMIT REQUIREMENT	*****	*****	**	*****	*****	REPORT DAILY MX	DEG C		CONTINUOUS	CALCTD
TEMPERATURE, WATER DEG. CENTIGRADE 00010 Z 0 INSTREAM MONITORING	SAMPLE MEASUREMENT	*****	*****	**	*****	*****		04			
	PERMIT REQUIREMENT	*****	*****	**	*****	*****	30.5 DAILY MX	DEG C		CONTINUOUS	CALCTD
TEMP. DIFF. BETWEEN SAMP. & UPSTRM DEG.C 00016 1 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	*****	*****	**	*****	*****		04			
	PERMIT REQUIREMENT	*****	*****	**	*****	*****	5 DAILY MX	DEG C		CONTINUOUS	CALCTD
FLOW, IN CONDUIT OR THRU TREATMENT PLANT 50050 1 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	*****		03	*****	*****	*****	**			
	PERMIT REQUIREMENT	*****	Req. Mon. DAILY MX	MGD	*****	*****	*****	**		CONTINUOUS	RCORDR
CHLORINE, TOTAL RESIDUAL 50060 1 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	*****	*****	**	*****	*****		19			
	PERMIT REQUIREMENT	*****	*****	**	*****	0.1 MO AVG	0.1 DAILY MX	MG/L		Five per Week	CALCTD
TEMPERATURE - C, RATE OF CHANGE 82234 1 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	*****		04	*****	*****	*****	**			
	PERMIT REQUIREMENT	*****	2 DAILY MX	DEG C	*****	*****	*****	**		CONTINUOUS	CALCTD
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

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			AREA CODE	NUMBER	YEAR	MO	DAY
			423	843-7001	17	06	07

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

No Discharge this Period

PERMITTEE NAME/ADDRESS (Include Facility Name/Location if Different)

Name **TVA - SEQUOYAH NUCLEAR PLANT**
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NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
 DISCHARGE MONITORING REPORT (DMR)

MAJOR

(SUBR 01)

F - FINAL

RECYCLED COOLING WATER

EFFLUENT

Form Approved.

OMB No. 2040-0004

TN0026450 **110 T**
 PERMIT NUMBER DISCHARGE NUMBER

MONITORING PERIOD
 From

YEAR	MO	DAY
17	05	01

 To

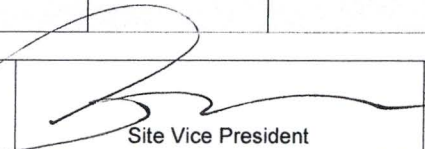
YEAR	MO	DAY
17	05	31

*** NO DISCHARGE ***

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PARAMETER	X	QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
IC25 STATRE 7DAY CHR CERIODAPHNIA	SAMPLE MEASUREMENT	*****	*****	**		*****	*****	23			
TRP3B 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	*****	*****	****	42.8 MINIMUM	*****	*****	PERCENT		SEMI ANNUAL	COMPOS
IC25 STATRE 7DAY CHR PIMEPHALES	SAMPLE MEASUREMENT	*****	*****	**		*****	*****	23			
TRP6C 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	*****	*****	****	42.8 MINIMUM	*****	*****	PERCENT		SEMI ANNUAL	COMPOS
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

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			AREA CODE	NUMBER	YEAR	MO	DAY
			423	843-7001	17	06	07

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

No Discharge this Period

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NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
 DISCHARGE MONITORING REPORT (DMR)

MAJOR
 (SUBR 01)

Form Approved.
 OMB No. 2040-0004

TN0026450 **118 G**
 PERMIT NUMBER DISCHARGE NUMBER

F - FINAL
 WASTEWATER & STORM WATER
 EFFLUENT

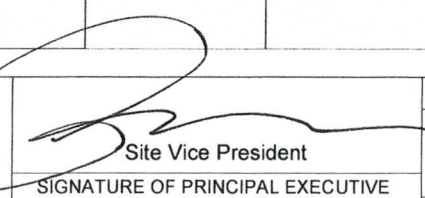
MONITORING PERIOD
 From **17 05 01** To **17 05 31**

*** NO DISCHARGE ***

NOTE: Read instructions before completing this form.

ATTN:Millicent Garland

PARAMETER	X	QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
OXYGEN, DISSOLVED (DO)		*****	*****	**		*****	*****				
00300 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT							19			
	PERMIT REQUIREMENT	*****	*****	****	2	*****	*****	MG/L		TWICE/WEEK	GRAB
					MINIMUM						
SOLIDS, TOTAL SUSPENDED		*****	*****	**	*****	*****		19			
00530 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT	*****	*****	****	*****	*****	100	MG/L		TWICE/WEEK	GRAB
							DAILY MX				
SOLIDS, SETTLEABLE		*****	*****	**	*****	*****		25			
00545 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT	*****	*****	****	*****	*****	1	ML/L		ONCE/MONTH	GRAB
							DAILY MX				
FLOW, IN CONDUIT OR THRU TREATMENT PLANT				03	*****	*****	*****	**			
50050 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT							*		ONCE/BATCH	ESTIMA
	PERMIT REQUIREMENT	Req. Mon. MO AVG	Req. Mon. DAILY MX	MGD	*****	*****	*****				
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

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			423	843-7001	17	06	07

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

During this reporting period, there has been no flow from the Dredge Pond other than that resulting from rainfall. No Discharge this Period

**TENNESSEE VALLEY AUTHORITY
TOXICITY TEST REPORT**

INTRODUCTION / EXECUTIVE SUMMARY

Report Date: May 24, 2017

1. Facility / Discharger: Sequoyah Nuclear Plant / TVA
2. County / State: Hamilton / Tennessee
3. NPDES Permit #: TN0026450
4. Type of Facility: Nuclear-Fueled Electric Generating Plant
5. Design Flow (MGD): 1,579
6. Receiving Stream: Tennessee River (TRM 483.6)
7. 1Q10: 3,491
8. Outfall Tested: 101
9. Dates Sampled: April 30 – May 05, 2017
10. Average Flow on Days Sampled (MGD): 1834, 1834, 1817
11. Pertinent Site Conditions: Production / operation data will be provided upon request.
12. Test Dates: May 02 – 09, 2017
13. Test Type: Short-term Chronic Definitive
14. Test Species: Fathead Minnows (*Pimephales promelas*)
Daphnids (*Ceriodaphnia dubia*)
15. Concentrations Tested (%):
Pimephales promelas: UV treated Outfall 101: 10.7, 21.4, 42.8, 85.6, 100
UV treated Intake: 100

Ceriodaphnia dubia: Non-treated Outfall 101: 10.7, 21.4, 42.8, 85.6, 100
Non-treated Intake: 100
16. Permit Limit Endpoint (%): Outfall 101: IC₂₅ = 42.8%
17. Test Results: Outfall 101: *Pimephales promelas*: IC₂₅ > 100%
Ceriodaphnia dubia: IC₂₅ > 100%

18. Facility Contact: Millicent Garland Phone #: (423) 843-6714

19. Consulting / Testing Lab: Environmental Testing Solutions, Inc.

20. Lab Contact: Jim Sumner Phone #: (828) 350-9364

21. TVA Contact: Donald W. Snodgrass Phone #: (256) 386-2787

22. Notes: Exposures to samples collected April 30 – May 05, 2017 from Outfall 101 resulted in no toxic effects to fathead minnows or daphnids. The resulting IC25 values, for both species, were > 100 percent. Exposure of minnows and daphnids to intake samples resulted in no significant difference from the controls during this study period.

METHODS SUMMARY

Samples:

1. Sampling Point: Outfall 101, Intake
2. Sample Type: Composite
3. Sample Information:

Sample ID	Date (MM-DD-YY) Time (ET) Collected	Date (MM-DD-YY) Time (ET) Received	Arrival Temp. (°C)	Initial TRC* (mg/L)	Date (MM-DD-YY) Time (ET) Last Used By
101	04-30-17 0805 to 05-01-17 0705	05-01-17 1332	4.1, 2.2 [†]	<0.10	05-02-17 0920 05-03-17 0846
Intake	04-30-17 0710 to 05-01-17 0610	05-01-17 1332	1.7	<0.10	05-02-17 0920 05-03-17 0846
101	05-02-17 0705 to 05-03-17 0605	05-03-17 1235	2.1, 1.7 [†]	<0.10	05-04-17 0850 05-05-17 0852
Intake	05-02-17 0730 to 05-03-17 0630	05-03-17 1235	2.2	<0.10	05-04-17 0850 05-05-17 0852
101	05-04-17 0730 to 05-05-17 0630	05-05-17 1230	1.1, 1.3 [†]	<0.10	05-06-17 0930 05-07-17 0952 05-08-17 0833
Intake	05-04-17 0745 to 05-05-17 0645	05-05-17 1230	0.9	<0.10	05-06-17 0930 05-07-17 0952 05-08-17 0833

*TRC = Total Residual Chlorine

[†]Samples were collected in two 2.5 gallon cubitainers. Temperature was measured in each cubitainer upon arrival.

4. Sample Manipulation: Samples from Outfall 101 and intake were warmed to test temperature (25.0 ± 1.0°C) in a warm water bath.

Aliquots of Outfall 101 and Intake samples were UV-treated through a 40-watt Smart[®] UV Sterilizer (manufactured by Emperor Aquatics, Inc.) for 2 minutes.

	<i>Pimephales promelas</i>	<i>Ceriodaphnia dubia</i>
<u>Test Organisms:</u>		
1. Source:	<u>In-house Cultures</u>	<u>In-house Cultures</u>
2. Age:	<u>< 24-hours old</u>	<u>< 24-hours old</u>
<u>Test Method Summary:</u>		
1. Test Conditions:	<u>Static, Renewal</u>	<u>Static, Renewal</u>
2. Test Duration:	<u>7 days</u>	<u>Until at least 60% of control females have 3 broods</u>
3. Control / Dilution Water:	<u>Moderately Hard Synthetic</u>	<u>Moderately Hard Synthetic</u>
4. Number of Replicates:	<u>4</u>	<u>10</u>
5. Organisms per Replicate:	<u>10</u>	<u>1</u>
6. Test Initiation: (Date/Time):	<u>05-02-17 0832 ET</u>	<u>05-02-17 0920 ET</u>
7. Test Termination: (Date/Time):	<u>05-09-17 0857 ET</u>	<u>05-09-17 0827 ET</u>
8. Test Temperature: Outfall 101:	<u>Mean = 24.7°C</u> <u>(24.2 – 25.1°C)</u>	<u>Mean = 24.9°C</u> <u>(24.6 – 25.2°C)</u>
9. Physical / Chemical Measurements:	<u>Alkalinity, hardness, total residual chlorine, and conductivity were measured at the laboratory in each 100% sample. Daily temperatures were measured in one replicate for each test concentration. Pre- and post-exposure test solutions were analyzed daily for pH and dissolved oxygen.</u>	
10. Statistics:	<u>Statistics were performed according to methods prescribed by EPA using ToxCalc version 5.0 statistical software (Tidepool Scientific Software, McKinneyville, CA).</u>	

TOXICITY TEST RESULTS (see Appendix C for Bench Sheets)

1. Results of a *Pimephales promelas* Chronic/ 7-day Toxicity Test.
 (Genus species) (Type / Duration)

Conducted May 02 – 09, 2017 using effluent from Outfall 101.

Test Solutions (% Effluent)	Percent Surviving (time interval used – days)						
	1	2	3	4	5	6	7
Control, UV-treated	100	100	100	100	100	100	100
10.7%	100	100	100	100	100	100	100
21.4%	100	100	100	100	100	100	100
42.8%	100	100	100	100	100	100	100
85.6%	100	100	100	100	100	100	100
100.0%	100	100	100	100	100	100	100
Intake	100	100	100	100	100	100	98
Control, Non-treated	100	100	100	100	100	100	98

Test Solutions (% Effluent)	Mean Dry Weight (mg) (replicate number)				
	1	2	3	4	Mean
Control, UV-treated	0.632	0.723	0.732	0.703	0.698
10.7%	0.700	0.704	0.701	0.677	0.696
21.4%	0.730	0.701	0.689	0.771	0.723
42.8%	0.687	0.642	0.662	0.684	0.669
85.6%	0.633	0.719	0.657	0.666	0.669
100.0%	0.644	0.649	0.627	0.637	0.639
Intake	0.650	0.605	0.596	0.688	0.635
Control, Non-treated	0.632	0.783	0.630	0.669	0.679

IC ₂₅ Value: <u>≥ 100%</u> Permit Limit: <u>42.8%</u> 95% Confidence Limits: Upper Limit: <u>NA</u> Lower Limit: <u>NA</u>	Calculated TU Estimates: <u>< 1.0 TUc*</u> Permit Limit: <u>2.3 TUc</u>
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*TU_a = 100/LC₅₀; TU_c = 100/ IC₂₅

TOXICITY TEST RESULTS (see Appendix C for Bench Sheets)

2. Results of a *Ceriodaphnia dubia* Chronic/ 7-day Toxicity Test.
 (Genus species) (Type / Duration)

Conducted May 02 – 09, 2017 using effluent from Outfall 101.

Test Solutions (% Effluent)	Percent Surviving (time interval used – days)						
	1	2	3	4	5	6	7
Control	100	100	100	100	100	100	100
10.7%	100	100	100	100	100	100	100
21.4%	100	100	100	100	100	100	100
42.8%	100	100	100	100	100	100	100
85.6%	100	100	100	100	100	100	100
100.0%	100	100	100	100	100	100	100

Test Solutions (% Effluent)	Reproduction (#young/female/7 days) Data (replicate number)										
	1	2	3	4	5	6	7	8	9	10	Mean
Control	30	33	28	30	32	35	30	32	30	32	31.2
10.7%	34	36	31	34	33	31	32	35	31	31	32.8
21.4%	37	36	31	33	32	34	31	33	32	37	33.6
42.8%	35	36	37	32	33	33	35	34	36	33	34.4
85.6%	37	35	34	38	32	38	38	36	39	32	35.9
100.0%	38	36	37	36	37	39	39	35	38	33	36.8

IC ₂₅ Value: <u>> 100%</u> Permit Limit: <u>42.8%</u> 95% Confidence Limits: Upper Limit: <u>NA</u> Lower Limit: <u>NA</u>	Calculated TU Estimates: <u>< 1.0 TU_c*</u> Permit Limit: <u>2.3 TU_c</u>
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*TU_a = 100/LC₅₀; TU_c = 100/ IC₂₅

TOXICITY TEST RESULTS (see Appendix C for Bench Sheets)

2. Results of a *Ceriodaphnia dubia* Chronic/ 7-day Toxicity Test.
 (Genus species) (Type / Duration)

Conducted May 02 – 09, 2017 using water from Intake

Test Solutions (% Effluent)	Percent Surviving (time interval used – days)						
	1	2	3	4	5	6	7
Control	100	100	100	100	100	100	100
Intake	100	100	100	100	100	100	100

Test Solutions (% Effluent)	Reproduction (#young/female/7 days) Data (replicate number)										
	1	2	3	4	5	6	7	8	9	10	Mean
Control	33	31	32	34	34	31	28	32	30	31	31.6
Intake	38	34	36	37	35	31	37	32	34	32	34.6

IC ₂₅ Value: <u>> 100%</u> Permit Limit: <u>N/A</u> 95% Confidence Limits: Upper Limit: <u>NA</u> Lower Limit: <u>NA</u>	Calculated TU Estimates: <u>< 1.0 TUc*</u> Permit Limit: <u>N/A</u>
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*TU_a = 100/LC₅₀; TU_c = 100/ IC₂₅

REFERENCE TOXICANT TEST RESULTS (see Appendix A and D)

Species	Date	Time	Duration	Toxicant	Results (IC ₂₅)
<i>Pimephales promelas</i>	May 02 – 09, 2017	0820	7-days	KCl	0.67 g/L
<i>Ceriodaphnia dubia</i>	May 02 – 09, 2017	0911	7-days	NaCl	1.07 g/L

PHYSICAL/CHEMICAL SUMMARY

Water Chemistry Mean Values and Ranges for UV-treated *Pimephales promelas* and Non-treated *Ceriodaphnia dubia*, Sequoyah Nuclear Plant (SQN), Effluent Outfall 101 and Intake performed May 02-09, 2017.

Test	Sample ID	Temperature (°C)		Dissolved Oxygen (mg/L)		pH (S.U.)		Conductance (µmhos/cm)	Alkalinity (mg/L CaCO ₃)	Hardness (mg/L CaCO ₃)	*Total Residual Chlorine (mg/L)	
		Initial	Final	Initial	Final	Initial	Final					
<i>Pimephales promelas</i>	Control, Non-treated	24.7 24.6 - 24.8	24.5 24.3 - 24.8	7.8 7.7 - 7.9	7.0 6.0 - 7.8	8.13 8.08 - 8.21	7.69 7.49 - 7.92	322 317 - 328	62 61 - 63	85 82 - 88	-	-
	Control, UV-treated	24.7 24.6 - 24.8	24.4 24.2 - 24.7	8.0 7.9 - 8.2	7.1 6.2 - 7.7	8.09 8.05 - 8.19	7.72 7.55 - 7.93	320 312 - 326	62 61 - 64	87 86 - 88	-	-
	10.7%	24.8 24.7 - 24.9	24.6 24.4 - 24.9	8.0 7.9 - 8.1	7.1 6.2 - 7.7	8.11 8.06 - 8.18	7.67 7.49 - 7.89	307 295 - 318	-	-	-	-
	21.4%	24.9 24.7 - 25.0	24.5 24.3 - 24.7	8.0 7.9 - 8.2	7.0 6.1 - 7.7	8.11 8.04 - 8.17	7.67 7.48 - 7.87	294 283 - 305	-	-	-	-
	42.8%	24.9 24.8 - 25.0	24.6 24.2 - 24.9	8.0 7.9 - 8.1	6.9 6.0 - 7.7	8.09 7.98 - 8.18	7.67 7.49 - 7.87	259 250 - 267	-	-	-	-
	85.6%	25.0 24.9 - 25.1	24.6 24.2 - 24.9	8.0 7.9 - 8.1	6.9 6.0 - 7.7	8.09 7.99 - 8.19	7.67 7.49 - 7.86	190 186 - 193	-	-	-	-
	100%	25.0 24.9 - 25.1	24.6 24.2 - 24.8	8.0 7.9 - 8.1	6.9 5.9 - 7.7	8.08 8.03 - 8.19	7.65 7.48 - 7.87	165 160 - 169	64 59 - 69	65 64 - 66	< 0.10	< 0.10
	Intake	25.0 24.9 - 25.1	24.6 24.4 - 24.9	8.0 7.9 - 8.1	7.0 5.9 - 7.7	8.09 8.03 - 8.18	7.69 7.48 - 7.91	165 158 - 170	64 61 - 67	67 64 - 70	< 0.10	< 0.10
<i>Ceriodaphnia dubia</i>	Control, Non-treated	24.7 24.6 - 24.8	25.0 24.9 - 25.2	7.8 7.7 - 7.9	7.9 7.8 - 8.0	8.13 8.08 - 8.21	8.03 7.97 - 8.09	322 317 - 328	62 61 - 63	85 82 - 88	-	-
	10.7%	24.8 24.7 - 24.9	25.0 24.7 - 25.2	7.8 7.8 - 7.9	7.9 7.7 - 8.0	8.12 8.06 - 8.18	8.02 7.97 - 8.09	308 298 - 316	-	-	-	-
	21.4%	24.8 24.7 - 24.9	25.0 24.8 - 25.2	7.8 7.8 - 8.0	7.9 7.8 - 8.0	8.13 8.09 - 8.19	8.01 7.97 - 8.08	292 286 - 300	-	-	-	-
	42.8%	24.8 24.7 - 24.9	24.9 24.8 - 25.0	7.9 7.8 - 8.0	7.9 7.8 - 8.0	8.12 8.08 - 8.19	8.02 7.97 - 8.09	258 248 - 265	-	-	-	-
	85.6%	24.9 24.7 - 25.0	24.9 24.8 - 25.1	7.9 7.8 - 8.0	8.0 7.9 - 8.1	8.12 8.08 - 8.19	8.02 7.97 - 8.10	188 182 - 196	-	-	-	-
	100%	24.9 24.7 - 25.0	24.9 24.8 - 25.2	8.0 7.9 - 8.0	8.0 7.9 - 8.2	8.08 7.95 - 8.19	8.01 7.92 - 8.09	164 158 - 171	63 59 - 67	65 62 - 66	< 0.10	< 0.10
	Intake	24.9 24.7 - 25.0	24.9 24.8 - 25.0	8.0 7.9 - 8.1	8.0 7.8 - 8.2	8.09 8.02 - 8.18	8.04 7.98 - 8.11	166 162 - 177	64 59 - 67	66 64 - 68	< 0.10	< 0.10

*Note: Total residual chlorine was performed on non-treated Outfall 101 and Intake samples.

Overall temperature (°C)	Average	Minimum	Maximum
<i>Pimephales promelas</i>	24.7	24.2	25.1
<i>Ceriodaphnia dubia</i>	24.9	24.6	25.2

SUMMARY / CONCLUSIONS

Exposures to samples collected April 30 – May 05, 2017 from Outfall 101 resulted in no toxic effects to fathead minnows or daphnids. The resulting IC25 values, for both species, were > 100 percent. Exposure of minnows and daphnids to intake samples resulted in no significant difference from the controls during this study period.

Appendix A

ADDITIONAL TOXICITY TEST INFORMATION

SUMMARY OF METHODS

1. *Pimephales promelas*

Tests were conducted according to EPA-821-R-02-013 (October 2002) using four replicates, each containing ten test organisms, per treatment. Test vessels consisted of 500-mL plastic disposable cups, each containing 250-mL of test solution.

2. *Ceriodaphnia dubia*

Tests were conducted according to EPA-821-R-02-013 (October 2002) using ten replicates, each containing one test organism, per treatment. Test vessels consisted of 30-mL polypropylene cups, each containing 15-mL of test solution.

DEVIATIONS / MODIFICATIONS TO TEST PROTOCOL

1. *Pimephales promelas*

Samples used in the fathead minnow test were exposed to UV light for two minutes prior to introduction of test organisms. UV treatment is used to control interference of fish pathogens. This treatment method was approved on November 23, 2015 by the State of Tennessee in a letter from Jessica Murphy to Terry Cheek, Senior Manager of TVA Water Permits, Compliance, and Monitoring.

2. *Ceriodaphnia dubia*

None

DEVIATIONS / MODIFICATIONS TO PRETEST CULTURE OR HOLDING OF TEST ORGANISMS

1. *Pimephales promelas*

None

2. *Ceriodaphnia dubia*

None

PHYSICAL AND CHEMICAL METHODS

1. Reagents, Titrants, Buffers, etc.: All chemicals were certified products used before expiration dates (where applicable).
2. Instruments: All identification, service, and calibration information pertaining to laboratory instruments is recorded in calibration and maintenance logbooks.
3. Temperature was measured by SM 2550 B-2010.
4. Dissolved oxygen was measured by SM 4500-O G-2011.
5. The pH was measured by SM 4500-H+ B-2011.
6. Conductance was measured by SM 2510 B-2011.
7. Alkalinity was measured by SM 2320 B-2011.
8. Total hardness was measured by SM 2340 C-2011.
9. Total residual chlorine was measured by ORION 97-70-1977.

QUALITY ASSURANCE

Toxicity Test Methods: All phases of the study including, but not limited to, sample collection, handling and storage, glassware preparation, test organism culturing/acquisition and acclimation, test organism handling during test, and maintaining appropriate test conditions were conducted according to the protocol as described in this report and EPA-821-R-02-013. Any known deviations were noted during the study and are reported herein.

REFERENCE TOXICANT TESTS (See Appendix D for control chart information)

1. Test Type: 7-day chronic tests with results expressed as IC₂₅ values in g/L KCl or NaCl.
2. Standard Toxicant: Potassium Chloride (KCl crystalline) for *Pimephales promelas*.
Sodium Chloride (NaCl crystalline) for *Ceriodaphnia dubia*.
3. Dilution Water Used: Moderately hard synthetic water.
4. Statistics: ToxCalc software Version 5.0 was used for statistical analyses.

REFERENCES

1. NPDES Permit No. TN0026450.
2. USEPA. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, EPA-821-R-02-013 (October 2002).
3. Standard Methods for the Examination of Water and Wastewater, 22nd Edition, 2012.
4. Quality Assurance Program: Standard Operating Procedures, Environmental Testing Solutions, Inc (most current version).

Sequoyah Nuclear Plant Biomonitoring
May 02 – 09, 2017

Appendix B

Diffuser Discharge Concentrations of Total Residual Chlorine,
Diffuser Discharge Concentrations of Chemicals Used to
Control Microbiologically Induced Corrosion and Mollusks
During Toxicity Test Sampling

Table B-1. Sequoyah Nuclear Plant Outfall 101
Diffuser Discharge Concentrations of Chemicals Used to Control Microbiologically
Induced Corrosion and Mollusks, During Toxicity Test Sampling,
February 6, 2005 – May 5, 2017

Date	Sodium Hypochlorite mg/L TRC	Towerbrom mg/L TRC	PCL-222 mg/L Phosphate	PCL-401 mg/L Copolymer	CL-363 mg/L DMAD	Cuprostat-PF mg/L Azole	H-130M mg/L Quat	Nalco 73551 mg/L EO/PO	H-150M mg/L Quat
02/06/2005	-	<0.0042	0.028	0.010	-	-	-	-	-
02/07/2005	-	<0.0116	0.028	0.010	-	-	-	0.007	-
02/08/2005	-	<0.0080	0.028	0.010	-	-	-	-	-
02/09/2005	-	0.0199	0.028	0.010	-	-	-	-	-
02/10/2005	-	<0.0042	0.028	0.010	-	-	-	-	-
02/11/2005	-	0.0155	0.028	0.010	-	-	-	0.007	-
06/05/2005	-	0.0063	-	-	-	-	-	-	-
06/06/2005	-	0.0043	-	-	-	-	-	-	0.037
06/07/2005	-	0.0103	-	-	-	-	-	-	0.037
06/08/2005	-	0.0295	-	-	-	-	-	-	0.037
06/09/2005	-	0.0129	-	-	-	-	-	-	-
06/10/2005	-	0.0184	-	-	-	-	-	-	-
07/17/2005	-	0.0109	0.026	0.009	-	-	-	-	-
07/18/2005	-	0.0150	0.026	0.009	-	-	-	-	0.036
07/19/2005	-	0.0163	0.026	0.009	-	-	-	-	0.036
07/20/2005	-	0.0209	0.026	0.009	-	-	-	0.014	0.036
07/21/2005	-	0.0242	0.026	0.009	-	-	-	-	-
07/22/2005	-	0.0238	0.054	0.018	-	-	-	0.014	-
10/30/2005	-	0.0068	-	-	-	-	-	-	-
10/31/2005	-	0.0112	-	-	-	-	-	-	-
11/01/2005	-	0.0104	-	-	-	-	-	-	0.035
11/02/2005	-	0.0104	-	-	-	-	-	-	0.036
11/03/2005	-	0.0117	-	-	-	-	-	-	0.036
11/04/2005	-	0.0165	-	-	-	-	-	-	0.035
11/14/2005	-	0.0274	-	-	-	-	-	-	-
11/15/2005	-	0.0256	-	-	-	-	-	-	-
11/16/2005	-	0.0234	-	-	-	-	-	-	-
11/17/2005	-	0.0231	-	-	-	-	-	-	-
11/18/2005	-	0.0200	-	-	-	-	-	-	-
11/19/2005	-	0.0116	-	-	-	-	-	-	-

Table B-1. Sequoyah Nuclear Plant Outfall 101
Diffuser Discharge Concentrations of Chemicals Used to Control Microbiologically
Induced Corrosion and Mollusks, During Toxicity Test Sampling,
February 6, 2005 – May 5, 2017

Date	Sodium Hypochlorite mg/L TRC	Towerbrom mg/L TRC	PCL-222 mg/L Phosphate	PCL-401 mg/L Copolymer	CL-363 mg/L DMAD	Cuprostat-PF mg/L Azole	H-130M mg/L Quat	Nalco 73551 mg/L EO/PO	H-150M mg/L Quat	MSW 101 mg/L Phosphate
11/12/2006	-	0.0055	-	-	-	-	-	-	-	-
11/13/2006	-	0.0068	-	-	-	-	-	-	0.037	-
11/14/2006	-	0.0143	-	-	-	-	-	-	0.037	-
11/15/2006	-	0.0068	-	-	-	-	-	-	0.037	-
11/16/2006	-	0.0267	-	-	-	-	-	-	0.037	-
11/17/2006	-	0.0222	-	-	-	-	-	-	-	-
11/26/2006	-	0.0188	-	-	-	-	-	-	-	-
11/27/2006	-	0.0138	-	-	-	-	-	-	-	-
11/28/2006	-	0.0120	-	-	-	-	-	-	-	-
11/29/2006	-	0.0288	-	-	-	-	-	-	-	-
11/30/2006	-	0.0376	-	-	-	-	-	-	-	-
12/01/2006	-	0.0187	-	-	-	-	-	-	-	-
05/28/07	-	-	-	-	-	-	-	-	-	0.015
05/29/07	-	-	-	-	-	-	-	-	0.036	0.015
05/30/07	-	0.0084	-	-	-	-	-	0.017	0.036	0.015
05/31/07	-	0.0103	-	-	-	-	-	-	0.036	0.015
06/01/07	-	0.0164	-	-	-	-	-	0.017	0.036	0.015
06/02/07	-	0.0305	-	-	-	-	-	-	-	0.015
12/02/07	-	0.0241	-	-	-	-	-	-	-	-
12/03/07	-	0.0128	-	-	-	-	-	-	-	-
12/04/07	-	0.0238	-	-	-	-	-	-	-	-
12/05/07	-	0.0158	-	-	-	-	-	-	-	-
12/06/07	-	0.0162	-	-	-	-	-	-	-	-
12/07/07	-	0.0175	-	-	-	-	-	-	-	-
04/13/08	-	0.0039	-	-	-	-	-	-	-	-
04/14/08	-	0.0124	-	-	-	-	-	-	-	-
04/15/08	-	0.0229	-	-	-	-	-	-	-	-
04/16/08	-	0.0143	-	-	-	-	-	-	-	-
04/17/08	-	0.0120	-	-	-	-	-	-	-	-
04/18/08	-	0.0149	-	-	-	-	-	-	-	-
10/26/08	-	0.0260	-	-	-	-	-	-	-	-
10/27/08	-	0.0151	-	-	-	-	-	0.017	-	-
10/28/08	-	0.0172	-	-	-	-	-	-	0.041	-
10/29/08	-	0.0154	-	-	-	-	-	0.018	0.041	0.030
10/30/08	-	-	-	-	-	-	-	-	0.041	0.030
10/31/08	-	0.0086	-	-	-	-	-	-	0.041	0.030

Table B-1. Sequoyah Nuclear Plant Outfall 101
 Diffuser Discharge Concentrations of Chemicals Used to Control Microbiologically
 Induced Corrosion and Mollusks, During Toxicity Test Sampling,
 February 6, 2005 – May 5, 2017

Date	Sodium Hypochlorite mg/L TRC	Towerbrom mg/L TRC	PCL-222 mg/L Phosphate	PCL-401 mg/L Copolymer	CL-363 mg/L DMAD	Cuprostat -PF mg/L Azole	H-130M mg/L Quat	Nalco 73551 mg/L EO/PO	Spectrus CT1300 mg/L Quat	H-150M mg/L Quat	MSW 101 mg/L Phosphate
02/08/09	-	0.0197	-	-	-	-	-	0.017	-	-	-
02/09/09	-	0.0237	-	-	-	-	-	0.017	-	-	-
02/10/09	-	0.0104	-	-	-	-	-	0.021	-	-	-
02/11/09	-	0.0155	-	-	-	-	-	0.017	-	-	-
02/12/09	-	0.0106	-	-	-	-	-	0.017	-	-	-
02/13/09	-	-	-	-	-	-	-	-	-	-	-
05/10/09	-	0.0129	-	-	-	-	-	-	-	-	-
05/11/09	-	0.0415	-	-	-	-	-	-	-	0.0446	-
05/12/09	-	0.0053	-	-	-	-	-	-	-	0.0396	-
05/13/09	-	0.0049	-	-	-	-	-	-	-	0.0396	-
05/14/09	-	<0.0141	-	-	-	-	-	-	-	0.0397	-
05/15/09	-	<0.0160	-	-	-	-	-	-	-	-	-
11/15/09	-	0.025	-	-	-	-	-	-	-	-	-
11/16/09	-	0.0152	-	-	-	-	-	-	-	-	-
11/17/09	-	0.0255	-	-	-	-	-	-	-	-	-
11/18/09	-	0.0306	-	-	-	-	-	-	-	-	-
11/19/09	-	0.0204	-	-	-	-	-	-	-	-	-
11/20/09	-	0.0093	-	-	-	-	-	-	-	-	-
05/09/10	-	0.0192	-	-	-	-	-	-	-	-	-
05/10/10	-	0.0055	-	-	-	-	-	-	-	-	-
05/11/10	-	0.0100	-	-	-	-	-	-	0.039	-	-
05/12/10	-	0.0171	-	-	-	-	-	-	0.039	-	-
05/13/10	-	0.0041	-	-	-	-	-	-	0.039	-	-
05/14/10	-	0.0099	-	-	-	-	-	-	0.039	-	-

Table B-1. Sequoyah Nuclear Plant Outfall 101
Diffuser Discharge Concentrations of Chemicals Used to Control Microbiologically
Induced Corrosion and Mollusks, During Toxicity Test Sampling,
February 6, 2005 – May 5, 2017

Date	Sodium Hypochlorite mg/L TRC	Towerbrom mg/L TRC	PCL-222 mg/L Phosphate	PCL-401 mg/L Copolymer	CL-363 mg/L DMAD	Cuprostat -PF mg/L Azole	H-130M mg/L Quat	Nalco 73551 mg/L EO/PO	Spectrus CT1300 mg/L Quat	H-150M mg/L Quat	MSW 101 mg/L Phosphate	Floguard MS6236 mg/L Phosphate
10/31/10	-	-	-	-	-	-	-	-	-	-	-	-
11/01/10	-	0.0122	-	-	-	-	-	-	-	-	-	-
11/02/10	-	0.0112	-	-	-	-	-	-	-	-	-	-
11/03/10	-	0.0163	-	-	-	-	-	-	-	-	-	-
11/04/10	-	0.0107	-	-	-	-	-	-	-	-	-	-
11/05/10	-	0.0132	-	-	-	-	-	-	-	-	-	-
05/01/2011	-	-	-	-	-	-	-	-	-	-	-	-
05/02/2011	-	-	-	-	-	-	-	-	0.04	-	-	-
05/03/2011	-	-	-	-	-	-	-	-	0.04	-	-	-
05/04/2011	-	0.0155	-	-	-	-	-	-	0.04	-	-	-
05/05/2011	-	0.0179	-	-	-	-	-	-	0.04	-	-	-
05/06/2011	-	0.0089	-	-	-	-	-	-	-	-	-	-
11/06/2011	-	0.0168	-	-	-	-	-	-	-	-	-	-
11/07/2011	-	0.0225	-	-	-	-	-	-	-	-	-	-
11/08/2011	-	0.0141	-	-	-	-	-	-	-	-	-	-
11/09/2011	-	0.0239	-	-	-	-	-	-	-	-	-	-
11/10/2011	-	0.0242	-	-	-	-	-	-	-	-	-	-
11/11/2011	-	0.0231	-	-	-	-	-	-	-	-	-	-
05/06/2012	-	-	-	-	-	-	-	-	-	-	-	-
05/07/2012	-	-	-	-	-	-	-	-	-	-	-	-
05/08/2012	-	-	-	-	-	-	-	-	0.041	-	-	-
05/09/2012	-	0.0145	-	-	-	-	-	-	0.041	-	-	-
05/10/2012	-	0.0298	-	-	-	-	-	-	0.041	-	-	-
05/11/2012	-	0.0174	-	-	-	-	-	-	-	-	-	-
08/12/2012	-	-	-	-	-	-	-	-	-	-	-	0.029
08/13/2012	-	0.0256	-	-	-	-	-	0.028	0.037	-	-	0.029
08/14/2012	-	0.0209	-	-	-	-	-	-	0.037	-	-	0.029
08/15/2012	-	0.0279	-	-	-	-	-	0.028	-	-	-	0.029
08/16/2012	-	0.0076	-	-	-	-	-	-	-	-	-	0.029
08/17/2012	-	0.0446	-	-	-	-	-	-	-	-	-	0.032
05/12/2013	-	0.0099	-	-	-	-	-	-	-	-	-	-
05/13/2013	-	-	-	-	-	-	-	-	-	-	-	0.064
05/14/2013	-	0.0091	-	-	-	-	-	0.039	-	-	-	0.064
05/15/2013	-	0.0096	-	-	-	-	-	0.039	-	-	-	0.064
05/16/2013	-	0.0229	-	-	-	-	-	-	-	-	-	0.032
05/17/2013	-	0.0063	-	-	-	-	-	-	-	-	-	0.032
09/15/2013	-	-	-	-	-	-	-	-	-	-	-	0.03
09/16/2013	-	0.0072	-	-	-	-	-	-	0.0379	-	-	0.03
09/17/2013	-	0.0107	-	-	-	-	-	0.036	0.0379	-	-	0.03
09/18/2013	-	0.0217	-	-	-	-	-	0.036	0.0379	-	-	0.03
09/19/2013	-	0.0172	-	-	-	-	-	-	-	-	-	0.03
09/20/2013	-	0.0173	-	-	-	-	-	-	-	-	-	0.03

Table B-1. Sequoyah Nuclear Plant Outfall 101
 Diffuser Discharge Concentrations of Chemicals Used to Control Microbiologically
 Induced Corrosion and Mollusks, During Toxicity Test Sampling,
 February 6, 2005 – May 5, 2017

Date	Sodium Hypochlorite mg/L TRC	Towerbrom mg/L TRC	PCL-222 mg/L Phosphate	PCL-401 mg/L Copolymer	CL-363 mg/L DMAD	Cuprostat -PF mg/L Azole	H-130M mg/L Quat	Nalco 73551 mg/L EO/PO	Spectrus CT1300 mg/L Quat	H-150M mg/L Quat	MSW 101 mg/L Phosphate	Floguard MS6236 mg/L Phosphate
05/04/2014	-	0.0118	-	-	-	-	-	-	-	-	-	-
05/05/2014	-	0.0112	-	-	-	-	-	-	-	-	-	-
05/06/2014	-	0.0096	-	-	-	-	-	-	-	-	-	-
05/07/2014	-	0.0164	-	-	-	-	-	-	-	-	-	-
05/08/2014	-	0.0235	-	-	-	-	-	-	-	-	-	-
05/09/2014	-	0.0110	-	-	-	-	-	-	-	-	-	-
09/07/2014	-	-	-	-	-	-	-	-	-	-	-	-
09/08/2014	-	-	-	-	-	-	-	-	0.04	-	-	-
09/09/2014	-	-	-	-	-	-	-	-	0.04	-	-	-
09/10/2014	-	-	-	-	-	-	-	-	0.04	-	-	-
09/11/2014	-	0.0070	-	-	-	-	-	-	-	-	-	-
09/12/2014	-	0.0074	-	-	-	-	-	-	-	-	-	-
08/09/2015		-							-			-
08/10/2015		0.0195							0.03			-
08/11/2015		0.0275							0.03			-
08/12/2015		0.0213							-			0.03
08/13/2015		0.0192							-			0.03
08/14/2015		0.0182							-			0.03
10/18/2015		0.0162										
10/19/2015		0.0125										
10/20/2015		0.0120										
10/21/2015		0.0130										
10/22/2015		0.0174										
10/23/2015		0.0156										
05/15/2016		-										
05/16/2016		0.0209										
05/17/2016		0.0210										
05/18/2016		0.0361										
05/19/2016		0.0254										
05/20/2016		0.0261										
07/31/2016		-							-			
08/01/2016		0.0091							0.03			
08/02/2016		0.0093							0.03			
08/03/2016		0.0209							0.03			
08/04/2016		-							-			
08/05/2016		-							-			
04/30/2017		-										
05/01/2017		0.0298										
05/02/2017		0.0218										
05/03/2017		0.0260										
05/04/2017		-										
05/05/2017		-										

Sequoyah Nuclear Plant Biomonitoring
May 02 – 09, 2017

Appendix C

Chain of Custody Records and
Toxicity Test Bench Sheets

BIOMONITORING CHAIN OF CUSTODY RECORD

Page 1 of 1

Client: TVA
 Project Name: Sequoyah NP Toxicity
 ID Number: N/A
 Facility Sampled: Sequoyah NP
 NPDES Number: TN0026450
 Collected By: *Marcus D. Moore* *Andy Papter*
Bryson Dutton *Bryon Belter* *Amy Panton*

Environmental Testing Solution, Inc.
 351 Depot Street.
 Asheville, NC
 28801
 Phone: 828-350-9364
 Fax: 828-350-9368

Delivered By (Circle One):
 FedEx UPS Bus Client
 Other (specify): Sonic Delivery
 General Comments:
 Took samples from 101 sampler @ 0730 on 5-1-17
 Took samples from Ink sampler @ 0710 on 5-1-17
 *Diss. Metals were collected & kept on site

Field Identification / Sample Description	Grab/Comp.	Collection Date/Time		Container Number & Volume Collected	Flow (MGD)	Rain Event? (Mark as Appropriate)				Laboratory Use				
		Start	End			Yes	If Yes, Inches	No	Trace	ETS Log Number	Arrival Temp. (°C)	By	Time ET	Appearance
SQN-101-TOX	Comp	4-30-17 0805 ET	5-1-17 0705 ET	2(2.5gal)	1833.92	X	0.51			1705D1.03	4.1, 2.2°C	J	1332	*
SQN-INT-TOX	Comp	4-30-17 0710 ET	5-1-17 0610 ET	1(2.5 gal)	NA	X	0.51			1705D1.04	1.7°C	J	1332	*

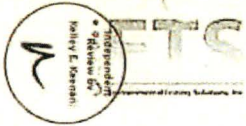
Project # 12332

Sample Custody - Fill In From Top Down

* CUSTOMER SEALS INTACT, SAMPLES RECEIVED IN GOOD CONDITION. TRC ABSENT IN ALL SAMPLES Date/Time

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
<i>Marcus D. Moore</i> / TVA	5-1-17 / 0815 ET	<i>B R Shuler</i> SONIC	05-01-17 / 08:15 ET
<i>B R Shuler</i> SONIC	05-01-17 1332 ET	<i>Jm/</i> ETS	05-01-17 1332 ET

Instructions: Clients should fill in all areas except those in the "Laboratory Use" block. Biomonitoring samples are preserved by storing them at 6°C and shipping them in ice. The hold time for each sample is 36 hours from the time of collection. Therefore, please collect and ship in such a way that the laboratory will receive the samples with ample time to initiate testing within that time frame. Samples shipped overnight on Friday via FedEx or UPS must be marked for Saturday delivery or they will not arrive until the following Monday.



Whole Effluent Sample Receipt Log

*Sample temperature performed using Sample Receiving Thermometer: SN 160928622

Date Received	Time Received	Received by	Received from	*Sample Temp. (°C)	Project number	Sample number	Sample name and description	State	Comments
05-01-17	1245	J. Sumner	L. Keenan	4.1	12330	170501 .01	Jefferson WWTP	NC	
05-01-17	1245	J. Sumner	L. Keenan	4.1	12331	170501 .02	West Jefferson WWTP	NC	
05-01-17	1332	J. Sumner	TVA Courier	4.1/2.2	12332	170501 .03	TVA - Sequoyah Nuclear Plant - 101	TN	
05-01-17	1332	J. Sumner	TVA Courier	1.7	12332	170501 .04	TVA - Sequoyah Nuclear Plant - Intake	TN	

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BIOMONITORING CHAIN OF CUSTODY RECORD

Page 1 of 1

Client: TVA
 Project Name: Sequoyah NP Toxicity
 ID Number: N/A
 Facility Sampled: Sequoyah NP
 NPDES Number: TN0026450
 Collected By: *Marcus D. Moore* *Andy Panter*
Andy Panter

Environmental Testing Solution, Inc.
 351 Depot Street.
 Asheville, NC
 28801
 Phone: 828-350-9364
 Fax: 828-350-9368

Delivered By (Circle One):
 FedEx UPS Bus Client
 Other (specify): *Sonic Delivery*

General Comments:
Took samples from 101 sampler @ 0720 on 5-3-17
Took samples from Ink sampler @ 0700 on 5-3-17
 * Diss. Metals were collected + kept on site

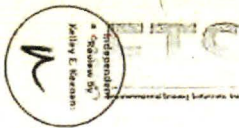
Field Identification / Sample Description	Grab/Comp.	Collection Date/Time		Container Number & Volume Collected	Flow (MGD)	Rain Event? (Mark as Appropriate)				Laboratory Use						
		Start	End			Yes	If Yes, Inches	No	Trace	ETS Log Number	Arrival Temp. (°C)	By	Time ET	Appearance		
										<i>project #12332</i>						
SQN-101-TOX	Comp	<i>5-2-17 0705 ET</i>	<i>5-3-17 0605 ET</i>	2(2.5gal)	1833.76				X			17050335	2.1 1.7°C	J	1235	*
SQN-INT-TOX	Comp	<i>5-2-17 0730 ET</i>	<i>5-3-17 0630 ET</i>	1(2.5 gal)	NA				X			17050336	2.2°C	J	1235	*

Sample Custody – Fill In From Top Down

* CUSTODY SEALS INTACT. SAMPLES
 RECEIVED IN GOOD CONDITION. TAC
 Date/Time ABSENT IN ALL
 SAMPLES. J

Relinquished By (Signature):	Date/Time	Received By (Signature):	
<i>Marcus D. Moore / TVA</i>	<i>5-3-17/0816 ET</i>	<i>B R Skelton</i>	<i>SONIC</i>
<i>BR Skelton</i>	<i>05-03-17 12:35 ET</i>	<i>Jm/</i>	<i>ETS</i>

Instructions: Clients should fill in all areas except those in the "Laboratory Use" block. Biomonitoring samples are preserved by storing them at 6°C and shipping them in ice. The hold time for each sample is 36 hours from the time of collection. Therefore, please collect and ship in such a way that the laboratory will receive the samples with ample time to initiate testing within that time frame. Samples shipped overnight on Friday via FedEx or UPS must be marked for Saturday delivery or they will not arrive until the following Monday.



Whole Effluent Sample Receipt Log

*Sample temperature performed using Sample Receiving Thermometer: SN 160928622

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Date Received	Time Received	Received by	Received from	*Sample Temp. (°C)	Project number	Sample number	Sample name and description	State	Comments
05-03-17	0910	K. Keenan	Fed - Ex	0.7	12346	170503 .01	Rockingham WWTP	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.0	12347	170503 .02	Apex WRF	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.2	12348	170503 .03	Belews Creek SS	NC	
05-03-17	0950	K. Keenan	Fed - Ex	4.1	12349	170503 .04	Daikin Applied Americas	NC	
05-03-17	0950	K. Keenan	Fed - Ex	0.3	12350	170503 .05	Dan River CC	NC	
05-03-17	0950	K. Keenan	Fed - Ex	2.4	12351	170503 .06	Davidson Water WTP	NC	
05-03-17	0950	K. Keenan	Fed - Ex	0.8	12352	170503 .07	Dobson WTP	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.2	12353	170503 .08	James Loughlin WWTP	NC	
05-03-17	0950	K. Keenan	Fed - Ex	0.8	12354	170503 .09	Performance Fibers	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.2	12355	170503 .10	Roseboro WWTP	NC	
05-03-17	0950	K. Keenan	Fed - Ex	0.3	12356	170503 .11	Scarlett Acres MHP	NC	
05-03-17	0950	K. Keenan	Fed - Ex	0.8	12357	170503 .12	Sparks Road WTP	NC	
05-03-17	0950	K. Keenan	Fed - Ex	2.0	12358	170503 .13	Elementis	NC	
05-03-17	0948	K. Keenan	UPS	10.5	12359	170503 .14	Morehead City WWTP	NC	Exceeded Temp. requirement
05-03-17	0950	K. Keenan	Fed - Ex	1.7	12360	170503 .15	AQWA	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.7	12361	170503 .16	Bladen Bluffs WTP	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.7	12362	170503 .17	Buckeye Terminals	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.2	12363	170503 .18	Invisita - 001	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.2	12364	170503 .19	Invisita - 002	NC	
05-03-17	0950	K. Keenan	Fed - Ex	0.1	12365	170503 .20	Manteo WWTP	NC	
05-03-17	0950	K. Keenan	Fed - Ex	0.3	12366	170503 .21	Mayo Stream Electric Plant	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.2	12367	170503 .22	Pender County WTP	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.3	12368	170503 .23	Shearon Harris Plant	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.5	12369	170503 .24	Shearon Harris E&E Center	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.0	12370	170503 .25	Washington WWTP	NC	
05-03-17	0950	K. Keenan	Fed - Ex	1.2	12371	170503 .26	PCS Phosphate, Inc.	NC	
05-03-17	0950	K. Keenan	Fed - Ex	0.3	12372	170503 .27	Woodlake Yacht Club	NC	
05-03-17	0950	K. Keenan	Fed - Ex	0.3	12373	170503 .28	TVA - Allen Fossil Plant - 001	TN	
05-03-17	0950	K. Keenan	Fed - Ex	0.2	12373	170503 .29	TVA - Allen Fossil Plant - Intake	TN	
05-03-17	0950	K. Keenan	Fed - Ex	0.1	12373	170503 .30	TVA - Allen Fossil Plant - Upstream	TN	
05-03-17	0950	K. Keenan	Fed - Ex	1.2	12374	170503 .31	Carolina Beach WWTP	NC	
05-03-17	1152	J. Sumner	Dash Courier	0.3	12375	170503 .32	OWASA - Mason Farms WWTP	NC	
05-03-17	1215	K. Keenan	L. Keenan	4.0	12330	170503 .33	Jefferson WWTP	NC	
05-03-17	1215	K. Keenan	L. Keenan	4.0	12331	170503 .34	West Jefferson WWTP	NC	
05-03-17	1235	J. Sumner	TVA Courier	2.1/1.7	12332	170503 .35	TVA - Sequoyah Nuclear Plant - 101	TN	
05-03-17	1235	J. Sumner	TVA Courier	2.2	12332	170503 .36	TVA - Sequoyah Nuclear Plant - Intake	TN	

BIOMONITORING CHAIN OF CUSTODY RECORD

Client: TVA
 Project Name: Sequoyah NP Toxicity
 P.O. Number: N/A
 Facility Sampled: Sequoyah NP
 NPDES Number: TN0026450
 Collected By: *Margaret Anne Amy Patton*
Board Director

Environmental Testing Solution, Inc.
 351 Depot Street.
 Asheville, NC
 28801
 Phone: 828-350-9364
 Fax: 828-350-9368

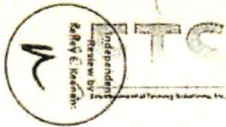
Delivered By (Circle One):
 FedEx UPS Bus Client
 Other (specify): Sonic Delivery
 General Comments:
 Took samples from 1st sampler @ 0730 on 5-5-17
 Took samples from 2nd sampler @ 0730 on 5-5-17
 * Diss Metals were collected & kept on site.

Field Identification / Sample Description	Grab/Comp.	Collection Date/Time		Container Number & Volume Collected	Flow (MGD)	Rain Event? (Mark as Appropriate)				Laboratory Use				
		Start	End			Yes	If Yes, Inches	No	Trace	ETS Log Number	Arrival Temp. (°C)	By	Time ET	Appearance
SON-101-TOX	Comp	5-4-17 0730 ET	5-5-17 0630 ET	2(2.5gal)	1817.24	X	7.74			17050517	1.1, 1.0°C	J	1230	#
SON-INT-TOX	Comp	5-4-17 0745 ET	5-5-17 0645 ET	1(2.5 gal)	NA	X	1.14			17050518	0.9°C	J	1230	#

Sample Custody - Fill In From Top Down * CUSTOM SEALS INTACT. SAMPLES RECEIVED IN GOOD CONDITION. TSS ABOVE DATE/TIME IN ALL SAMPLES

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
<i>M. Patton</i> / TVA	5-5-17 / 0835	<i>BR Shuler</i> / SONIC	5-5-17 / 8:35 ET
<i>BR Shuler</i> / SONIC	^{BRS} 5-5-17 / 1230 ET	<i>Jim</i> / ETS	05-05-17 1230 ET
	5-5-17		
	5-24-17 BRS		

Instructions: Clients should fill in all areas except those in the "Laboratory Use" block. Biomonitoring samples are preserved by storing them at 6°C and shipping them in ice. The hold time for each sample is 36 hours from the time of collection. Therefore, please collect and ship in such a way that the laboratory will receive the samples with ample time to initiate testing within that time frame. Samples shipped overnight on Friday via FedEx or UPS must be marked for Saturday delivery or they will not arrive until the following Monday.



Whole Effluent Sample Receipt Log

*Sample temperature performed using Sample Receiving Thermometer: SN 160928622

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Date Received	Time Received	Received by	Received from	*Sample Temp. (°C)	Project number	Sample number	Sample name and description	State	Comments
05-05-17	0943	K. Keenan	Fed - Ex	0.9	12347	170505 .01	Apex WRF	NC	
05-05-17	0943	K. Keenan	Fed - Ex	0.1	12348	170505 .02	Belews Creek SS	NC	
05-05-17	0943	K. Keenan	Fed - Ex	3.3	12349	170505 .03	Daikin Applied Americas	NC	
05-05-17	0943	K. Keenan	Fed - Ex	0.8	12350	170505 .04	Dan River CC	NC	
05-05-17	0943	K. Keenan	Fed - Ex	2.1	12351	170505 .05	Davidson Water WTP	NC	
05-05-17	0943	K. Keenan	Fed - Ex	0.3	12352	170505 .06	Dobson WTP	NC	
05-05-17	0943	K. Keenan	Fed - Ex	0.9	12353	170505 .07	James Loughlin WWTP	NC	
05-05-17	0943	K. Keenan	Fed - Ex	0.3	12354	170505 .08	Performance Fibers	NC	
05-05-17	0943	K. Keenan	Fed - Ex	0.4	12355	170505 .09	Roseboro WWTP	NC	
05-05-17	0943	K. Keenan	Fed - Ex	0.2	12356	170505 .10	Scarlett Acres MHP	NC	
05-05-17	0943	K. Keenan	Fed - Ex	0.3	12357	170505 .11	Sparks Road WTP	NC	
05-05-17	0943	K. Keenan	Fed - Ex	0.7	12358	170505 .12	Elementis	NC	
05-05-17	1220	K. Keenan	Dash Courier	0.4	12375	170505 .13	OWASA - Mason Farms WWTP	NC	
05-05-17	1220	K. Keenan	Dash Courier	0.7	12346	170505 .14	Rockingham WWTP	NC	
05-05-17	1240	K. Keenan	J. Brewer	1.4	12330	170505 .15	Jefferson WWTP	NC	
05-05-17	1240	K. Keenan	J. Brewer	2.4	12331	170505 .16	West Jefferson WWTP	NC	
05-05-17	1230	J. Sumner	TVA Courier	1.1/1.3	12332	170505 .17	TVA - Sequoyah Nuclear Plant - 101	TN	
05-05-17	1230	J. Sumner	TVA Courier	0.9	12332	170505 .18	TVA - Sequoyah Nuclear Plant - Intake	TN	

Chronic Whole Effluent Toxicity Test (EPA-821-R-02-013 Method 1000.0)

Species: *Pimephales promelas*

Client: Tennessee Valley Authority
 Facility: Sequoyah Nuclear Plant
 NPDES #: TN0026450
 Project #: 17332

County: Hamilton
 Outfall: 101

Dilution preparation information:						Comments: Each concentration was UV-treated for 2 minutes to remove pathogenic Interferences.
Dilution prep (%)	10.7	21.4	42.8	85.6	100	
Effluent volume (mL)	267.5	535	1070	2140	2500	
Diluent volume (mL)	2232.5	1965	1430	360	0	
Total volume (mL)	2500	2500	2500	2500	2500	

Test organism information:		Test information:	
Organism source:	In-house culture	Randomizing template:	PALE YELLOW
Age:	< 24-hours old	Incubator number and shelf location:	7C
Spawn date:	04-27-17	Artemia CHM number:	CHM914
Hatch dates and times:	05-01-17 1700 TO 05-02-17 0605	Drying information for weight determination:	
Transfer vessel information:	pH = 7.86 S.U. Temperature = 24.9 °C	Date / Time in oven:	05-09-17 0930
Average transfer volume:	< 0.25 mL	Initial oven temperature:	60°C
		Date / Time out of oven:	05-10-17 0930
		Final oven temperature:	60°C
		Total drying time:	24 Hours

Daily feeding and renewal information:

Day	Date	Morning feeding		Afternoon feeding		Test initiation, renewal, or termination		Sample numbers used		MHSW batch used
		Time	Analyst	Time	Analyst	Time	Analyst	Outfall 101	Intake	
0	05-02-17	0610	K	1230	K	0832	J	170501.03	170501.04	04-26-17A
1	05-03-17	0600	J	1200	K	0846	J	170501.05	170501.04	04-26-17B
2	05-04-17	0605	K	1205	J	0850	J	170503.35	170503.36	04-26-17B
3	05-05-17	0610	K	1210	J	0852	J	170503.35	170503.36	04-26-17B
4	05-06-17	0715	J	1315	K	0930	J	170505.17	170505.18	05-02-17
5	05-07-17	0740	J	1340	K	0952	J	170505.17	170505.18	05-02-17
6	05-08-17	0615	J	1215	J	0833	K	170505.17	170505.18	05-02-17
7	05-09-17					0857	J			

Control information: UN-CONTROL		Acceptance criteria	Summary of test endpoints:	
% Mortality:	07.	≤ 20%	7-day LC ₅₀	> 1007.
Average weight per initial larvae:	0.698		NOEC	1007.
Average weight per surviving larvae:	0.698	≥ 0.25mg/larvae	LOEC	> 1007.
			ChV	> 1007.
			IC ₂₅	> 1007.



Species: *Pimephales promelas*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated

Date: 05-02-17

Survival and Growth Data

Day	CONTROL				10.7%				21.4%			
	A	B	C	D	E	F	G	H	I	J	K	L
0	10	10	10	10	10	10	10	10	10	10	10	10
1	10	10	10	10	10	10	10	10	10	10	10	10
2	10	10	10	10	10	10	10	10	10	10	10	10
3	10	10	10	10	10	10	10	10	10	10	10	10
4	10	10	10	10	10	10	10	10	10	10	10	10
5	10	10	10	10	10	10	10	10	10	10	10	10
6	10	10	10	10	10	10	10	10	10	10	10	10
7	10	10	10	10	10	10	10	10	10	10	10	10
A = Pan weight (mg) Tray color code: <u>TUR 90052</u> Analyst: <u>W</u> Date: <u>04-22-17</u>	⁰⁵⁻⁰²⁻¹⁷ 15.80 15.56	16.90	15.03	15.80	16.50	16.03	15.01	14.14	15.00	14.44	13.65	15.45
B = Pan + Larvae weight (mg) Analyst: <u>W</u> Date: <u>05-11-17</u>	21.88	23.79	22.35	22.83	23.50	23.07	22.02	20.91	22.36	21.45	20.54	23.16
C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>jl</u>	6.32	7.23	7.32	7.03	7.00	7.04	7.01	6.77	7.30	7.01	6.89	7.71
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>jl</u>	0.632	0.723	0.732	0.703	0.700	0.704	0.701	0.677	0.730	0.701	0.689	0.771
Average weight per initial number of larvae (mg)	0.698				0.696		0.37		0.723		-3.67	
Percent reduction from control (%)												

Comment codes: c = clear, d = dead, fg = fungus, k = killed, m = missing, sk = sick, sm = unusually small, lg = unusually large, d&r = decanted and returned, w = wounded.

Comments:



Species: Pimephales promelas

Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated

Date: 05-02-17

Survival and Growth Data

Day	42.8%				85.6%				100%			
	M	N	O	P	Q	R	S	T	U	V	W	X
0	10	10	10	10	10	10	10	10	10	10	10	10
1	10	10	10	10	10	10	10	10	10	10	10	10
2	10	10	10	10	10	10	10	10	10	10	10	10
3	10	10	10	10	10	10	10	10	10	10	10	10
4	10	10	10	10	10	10	10	10	10	10	10	10
5	10	10	10	10	10	10	10	10	10	10	10	10
6	10	10	10	10	10	10	10	10	10	10	10	10
7	10	10	10	10	10	10	10	10	10	10	10	10
A = Pan weight (mg) Tray color code: <u>Turquoise</u> Analyst: <u>W</u> Date: <u>04-22-17</u>	15.76	15.34	16.28	16.03	16.26	15.74	14.89	16.27	14.86	15.17	14.44	15.61
B = Pan + Larvae weight (mg) Analyst: <u>W</u> Date: <u>05-11-17</u>	22.63	21.76	22.90	22.87	22.59	22.93	21.46	22.93	21.30	21.66	20.71	21.98
C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>JL</u>	6.87	6.42	6.62	6.84	6.33	7.19	6.57	6.66	6.44	6.49	6.27	6.37
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>JL</u>	0.687	0.642	0.662	0.684	0.633	0.719	0.657	0.666	0.644	0.649	0.627	0.637
Average weight per initial number of larvae (mg)	0.64		4.17.		0.669		4.17.		0.639		8.47.	
Percent reduction from control (%)												

Comment codes: c = clear, d = dead, fg = fungus, k = killed, m = missing, sk = sick, sm = unusually small, lg = unusually large, d&r = decanted and returned, w = wounded.

Comments:



Species: Pimephales promelas

Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated

Date: 05-02-17

Survival and Growth Data

Day	100% Intake				Control - Non-treated				GG	HH	II	JJ	
	Y	Z	AA	BB	CC	DD	EE	FF					
0	10	10	10	10	10	10	10	10					
1	10	10	10	10	10	10	10	10					
2	10	10	10	10	10	10	10	10					
3	10	10	10	10	10	10	10	10					
4	10	10	10	10	10	10	10	10					
5	10	10	10	10	10	10	10	10					
6	10	10	10	10	10	10	10	10					
7	10	9 ^d	10 SM	10	10	10	9 ^d	10					
A = Pan weight (mg) Tray color code: <u>Turquoise</u> Analyst: <u>K</u> Date: <u>04-22-17</u>		15.99	14.63	15.47	16.05	15.80	15.82	15.86	15.70				
B = Pan + Larvae weight (mg) Analyst: <u>K</u> Date: <u>05-11-17</u>		22.49	20.68	21.43	22.93	22.12	23.65	22.16	22.39				
C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>K</u>		6.50	6.05	5.96	6.88	6.32	7.83	6.30	6.69				
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>K</u>		0.650	0.605	0.596	0.688	0.632	0.783	0.630	0.669				
Average weight per initial number of larvae (mg)	Percent reduction from control (%)	0.635		9.07	0.679		NOT APPLICABLE						

Comment codes: c = clear, d = dead, fg = fungus, k = killed, m = missing, sk = sick, sm = unusually small, lg = unusually large, d&r = decanted and returned, w = wounded.

Comments:





Environmental Testing Solutions, Inc.

TVA / Sequoyah Nuclear Plant, Outfall 101
May 02-09, 2017

Pimephales promelas Chronic Whole Effluent Toxicity Test
EPA-821-R-02-013, Method 1000.0

Quality Control
Verification of Data Entry, Calculations, and Statistical Analyses

Project number: 12532

Concentration (%)	Replicate	Initial number of larvae	Final number of larvae	A = Pan weight (mg)	B = Pan + Larvae weight (mg)	Larvae weight (mg) = B - A	Not for Compliance Assessment, Internal Laboratory QC			Weight / Initial number of larvae (mg)	Mean survival (%)	Mean weight / Initial number of larvae (mg)	Coefficient of variation (Mean weight per surviving number of larvae) (%)	Percent reduction from control (%)
							Weight / Surviving number of larvae (mg)	Mean weight / Surviving number of larvae (mg)	Coefficient of variation (Mean weight per surviving number of larvae) (%)					
Control, Non-treated	CC	10	10	15.80	22.12	6.32	0.632	0.696	9.2	97.5	0.679	10.6	Not applicable	
	DD	10	10	15.82	23.65	7.83	0.783							
	EE	10	9	15.86	22.16	6.30	0.700							
	FF	10	10	15.70	22.39	6.69	0.669							
Control, UV-treated	A	10	10	15.56	21.88	6.32	0.632	0.698	6.5	100.0	0.698	6.5	Not applicable	
	B	10	10	16.56	23.79	7.23	0.723							
	C	10	10	15.03	22.35	7.32	0.732							
	D	10	10	15.80	22.83	7.03	0.703							
10.7%	E	10	10	16.50	23.50	7.00	0.700	0.696	1.8	100.0	0.696	1.8	0.3	
	F	10	10	16.03	23.07	7.04	0.704							
	G	10	10	15.01	22.02	7.01	0.701							
	H	10	10	14.14	20.91	6.77	0.677							
21.4%	I	10	10	15.06	22.36	7.30	0.730	0.723	5.0	100.0	0.723	5.0	-3.6	
	J	10	10	14.44	21.45	7.01	0.701							
	K	10	10	13.65	20.54	6.89	0.689							
	L	10	10	15.45	23.16	7.71	0.771							
42.8%	M	10	10	15.76	22.63	6.87	0.687	0.669	3.1	100.0	0.669	3.1	4.1	
	N	10	10	15.34	21.76	6.42	0.642							
	O	10	10	16.28	22.96	6.62	0.662							
	P	10	10	16.03	22.87	6.84	0.684							
85.6%	Q	10	10	16.26	22.59	6.33	0.633	0.669	5.4	100.0	0.669	5.4	4.1	
	R	10	10	15.74	22.93	7.19	0.719							
	S	10	10	14.89	21.46	6.57	0.657							
	T	10	10	16.27	22.93	6.66	0.666							
100%	U	10	10	14.86	21.30	6.44	0.644	0.639	1.5	100.0	0.639	1.5	8.4	
	V	10	10	15.17	21.66	6.49	0.649							
	W	10	10	14.44	20.71	6.27	0.627							
	X	10	10	15.61	21.98	6.37	0.637							
100% Intake	Y	10	10	15.99	22.45	6.50	0.650	0.652	6.2	97.5	0.635	6.7	9.0	
	Z	10	9	14.63	20.68	6.05	0.672							
	AA	10	10	15.47	21.43	5.96	0.596							
	BB	10	10	16.05	22.93	6.88	0.688							

Outfall 101:
Dunnett's MSD value: 0.0511
PMSD: 7.3

MSD = Minimum Significant Difference
PMSD = Percent Minimum Significant Difference

PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test

Intake:
Dunnett's MSD value: 0.0605
PMSD: 8.7

Lower PMSD bound determined by USEPA (10th percentile) = 12%
Upper PMSD bound determined by USEPA (90th percentile) = 30%

Lower and upper PMSD bounds were determined from the 10th and 90th percentiles, respectively, of PMSD data from EPA's WET Interlaboratory Variability Study (USEPA 2001a; USEPA, 2001b)

Control and Treatment by
OK

TVA / Sequoyah Nuclear Plant, Outfall 101
May 02-09, 2017



Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

Start Date: 5/2/2017 Test ID: PpFRCR Sample ID: TVA / SQN Outfall 101
 End Date: 5/9/2017 Lab ID: ETS-Envir. Testing Sol. Sample Type: DMR-Discharge Monitoring Report
 Sample Date: May 2017 Protocol: FWCHR-EPA-821-R-02-013 Test Species: PP-Pimephales promelas
 Comments: UV-Treated

Conc-%	1	2	3	4
Non-Control	0.6320	0.7830	0.6300	0.6690
UV-Control	0.6320	0.7230	0.7320	0.7030
10.7	0.7000	0.7040	0.7010	0.6770
21.4	0.7300	0.7010	0.6890	0.7710
42.8	0.6870	0.6420	0.6620	0.6840
85.6	0.6330	0.7193	0.6570	0.6660
100	0.6440	0.6490	0.6270	0.6370
Intake	0.6500	0.6050	0.5960	0.6880

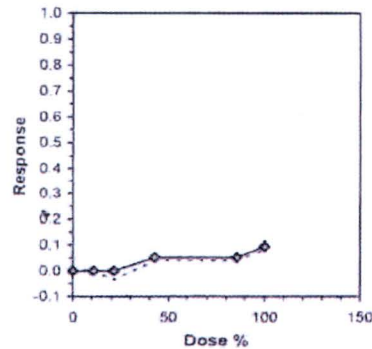
While hypothesis test results indicate a significant difference in growth for the 100% Outfall 101 sample, the PMSD was below the lower bound (12%) established by EPA. Guidance in EPA 833-R-00-003 (June 2000) Section 6.4.2 for determining the NOEC was followed, and it was concluded that the hypothesis test yielded a Type I Error.

Conc-%	Transform: Untransformed						N	1-Tailed			Isotonic	
	Mean	N-Mean	Mean	Min	Max	CV%		t-Stat	Critical	MSD	Mean	N-Mean
Non-Control	0.6785	0.9728	0.6785	0.6300	0.7830	10.602	4				0.7053	1.0000
UV-Control	0.6975	1.0000	0.6975	0.6320	0.7320	6.497	4					
10.7	0.6955	0.9971	0.6955	0.6770	0.7040	1.790	4	0.094	2.410	0.0511	0.7053	1.0000
21.4	0.7228	1.0362	0.7228	0.6890	0.7710	5.048	4	-1.190	2.410	0.0511	0.7053	1.0000
42.8	0.6688	0.9588	0.6688	0.6420	0.6870	3.145	4	1.355	2.410	0.0511	0.6688	0.9483
85.6	0.6688	0.9589	0.6688	0.6330	0.7193	5.445	4	1.352	2.410	0.0511	0.6688	0.9483
*100	0.6393	0.9165	0.6393	0.6270	0.6490	1.492	4	2.746	2.410	0.0511	0.6393	0.9064
Intake	0.6348	0.9100	0.6348	0.5960	0.6880	6.718	4					

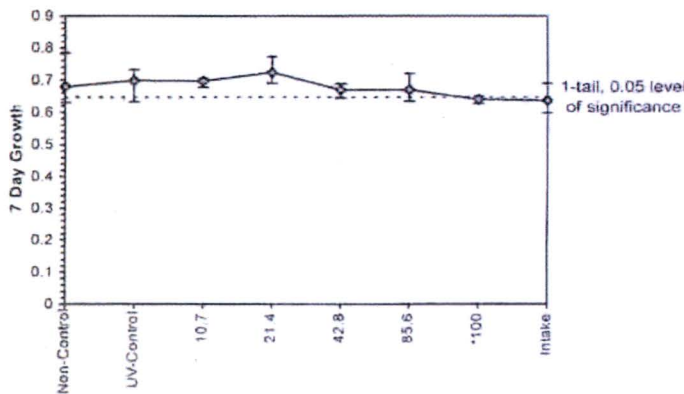
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97487	0.884	-0.2395	0.68461
Bartlett's Test indicates equal variances (p = 0.14)	8.38396	15.0863		
The control means are not significantly different (p = 0.67)	0.44695	2.44691		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnnett's Test	85.6	100	92.5203	1.16822	0.05112	0.07329	0.00341	0.0009	0.01612	5, 18

Point	%	SD	95% CL(Exp)	Skew	
IC05	42.096	24.500	17.808	122.928	0.4432
IC10	>100				
IC15	>100				
IC20	>100				
IC25	>100				
IC40	>100				
IC50	>100				



Dose-Response Plot



Reviewed
 Approved by
 the Sumner



TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
May 02-09, 2017



Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

Start Date: 5/2/2017	Test ID: PpFRCR	Sample ID: TVA / SQN Outfall 101 - Intake
End Date: 5/9/2017	Lab ID: ETS-Envir. Testing Sol.	Sample Type: DMR-Discharge Monitoring Report
Sample Date: May 2017	Protocol: FWCHR-EPA-821-R-02-013	Test Species: PP-Pimephales promelas

Comments: UV-Treated

Conc-%	1	2	3	4
Non-Control	0.5320	0.7830	0.6300	0.6690
UV-Control	0.5320	0.7230	0.7320	0.7030
10.7	0.7000	0.7040	0.7010	0.6770
21.4	0.7300	0.7010	0.6890	0.7710
42.8	0.5870	0.6420	0.6620	0.6840
85.6	0.5330	0.7190	0.6570	0.6660
100	0.5440	0.6490	0.6270	0.6370
Intake	0.5500	0.6050	0.5960	0.6880

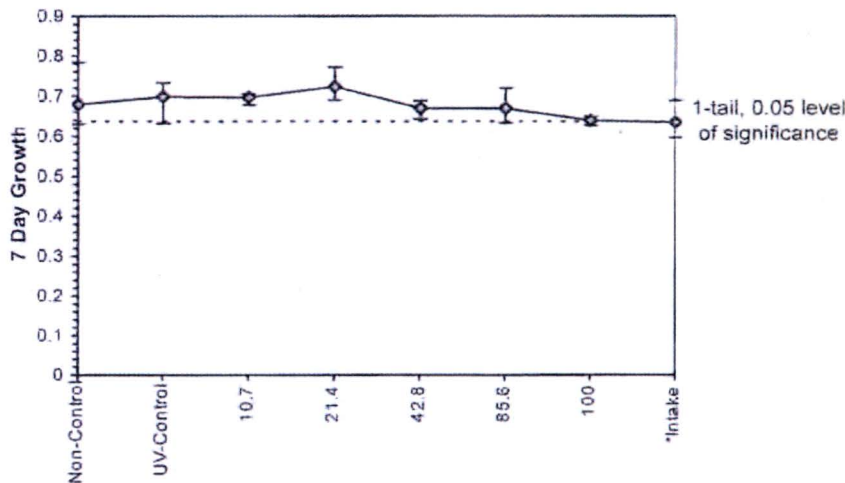
While hypothesis test results indicate a significant difference in growth for the intake sample, the PMSD was below the lower bound (12%) established by EPA. Guidance in EPA 833-R-00-003 (June 2000) Section 6.4.2 for determining the NOEC was followed, and it was concluded that the hypothesis test yielded a Type I Error.

Conc-%	Transform: Untransformed						1-Tailed			
	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Non-Control	0.6785	0.9728	0.6785	0.6300	0.7830	10.602	4			
UV-Control	0.6975	1.0000	0.6975	0.6320	0.7320	6.497	4			
10.7	0.6955	0.9971	0.6955	0.6770	0.7040	1.790	4			
21.4	0.7228	1.0362	0.7228	0.6890	0.7710	5.048	4			
42.8	0.6688	0.9588	0.6688	0.6420	0.6870	3.145	4			
85.6	0.6688	0.9588	0.6688	0.6330	0.7190	5.425	4			
100	0.6393	0.9165	0.6393	0.6270	0.6490	1.492	4			
*Intake	0.6348	0.9100	0.6348	0.5960	0.6880	6.718	4	2.017	1.943	0.0605

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test: indicates normal distribution (p > 0.01)	0.95314	0.749	-0.4316	-0.9929
F-Test indicates equal variances (p = 0.92)	1.12947	47.4683		
The control means are not significantly different (p = 0.67)	0.44695	2.44691		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Homoscedastic t Test indicates significant differences Treatments vs UV-Control	0.06046	0.08668	0.00788	0.00194	0.09029	1, 6

Dose-Response Plot



Entered and Reviewed by



Species: *Pimephales promelas*

Date: 05-02-17

Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated

Daily Chemistry:

Concentration		Parameter		Day					
				(Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
				0		1		2	
Analyst		u	u	u	u	u	u		
CONTROL UV-treated	pH (S.U.)	8.19	7.93	8.06	7.65	8.06	7.69		
	DO (mg/L)	7.9	7.0	7.9	6.8	7.9	7.2		
	Conductivity (µmhos/cm)	322		325		319			
	*Alkalinity (mg CaCO ₃ /L)	61		64					
	*Hardness (mg CaCO ₃ /L)	88		86					
	*Temperature (°C)	24.7	24.6	24.6	24.7	24.8	24.2		
10.7%	pH (S.U.)	8.18	7.89	8.09	7.61	8.07	7.58		
	DO (mg/L)	7.9	7.0	7.9	6.7	7.9	7.1		
	Conductivity (µmhos/cm)	309		318		306			
	*Temperature (°C)	24.8	24.9	24.7	24.7	24.9	24.4		
21.4%	pH (S.U.)	8.16	7.87	8.10	7.61	8.08	7.57		
	DO (mg/L)	7.9	7.0	7.9	6.7	7.9	6.6		
	Conductivity (µmhos/cm)	291		305		292			
	*Temperature (°C)	24.8	24.7	24.7	24.7	25.0	24.4		
42.8%	pH (S.U.)	8.14	7.87	8.10	7.61	8.08	7.57		
	DO (mg/L)	7.9	7.5	7.9	6.1	8.0	6.5		
	Conductivity (µmhos/cm)	260		247		250			
	*Temperature (°C)	24.8	24.9	24.8	24.5	25.0	24.6		
85.6%	pH (S.U.)	8.13	7.85	8.11	7.59	8.09	7.57		
	DO (mg/L)	8.0	7.5	7.9	6.2	8.0	6.7		
	Conductivity (µmhos/cm)	186		191		186			
	*Temperature (°C)	24.9	24.9	24.9	24.7	25.0	24.6		
100%	pH (S.U.)	8.15	7.84	8.05	7.51	8.04	7.50		
	DO (mg/L)	8.0	7.5	7.9	6.2	8.0	6.8		
	Conductivity (µmhos/cm)	140		145		160			
	*Alkalinity (mg CaCO ₃ /L)	59				65			
	*Hardness (mg CaCO ₃ /L)	64				66			
	*TR chlorine (mg/L)	<0.10				<0.10			
	*Temperature (°C)	25.0	24.8	24.9	24.8	25.1	24.6		
100% Intake	pH (S.U.)	8.17	7.85	8.05	7.64	8.03	7.53		
	DO (mg/L)	8.1	7.6	8.0	6.9	8.0	6.9		
	Conductivity (µmhos/cm)	163		165		168			
	*Alkalinity (mg CaCO ₃ /L)	61				65			
	*Hardness (mg CaCO ₃ /L)	64				66			
	*TR chlorine (mg/L)	<0.10				<0.10			
	*Temperature (°C)	24.9	24.9	24.9	24.5	25.1	24.4		
		Initial	Final	Initial	Final	Initial	Final		

Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1. Alkalinity, hardness and total residual chlorine performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet. Total residual chlorine was performed on non-treated Outfall 101 and Intake samples.

Independent Review
Kelley E. Kelly
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Species: *Pimephales promelas*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated

Date: 05-02-17

Analyst		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)							
		3		4		5		6	
		u	Bell	Pell	u	u	u	u	u
Concentration	Parameter								
CONTROL UV-treated	pH (S.U.)	8.05	7.81	8.10	7.55	8.06	7.83	8.14	7.57
	DO (mg/L)	8.0	7.7	8.2	6.5	7.9	7.5	7.9	6.2
	Conductivity (µmhos/cm)	326		312		317		321	
	*Alkalinity (mg CaCO ₃ /L)	85.117		62		85.117		85.117	
	*Hardness (mg CaCO ₃ /L)	85.117		86		85.117		85.117	
	*Temperature (°C)	24.8	24.2	24.8	24.4	24.7	24.4	24.8	24.2
10.7%	pH (S.U.)	8.06	7.74	8.12	7.91	8.09	7.84	8.16	7.49
	DO (mg/L)	8.0	7.7	8.1	6.6	8.0	7.5	7.9	6.2
	Conductivity (µmhos/cm)	310		295		304		305	
	*Temperature (°C)	24.9	24.5	24.9	24.6	24.6	24.4	24.9	24.4
21.4%	pH (S.U.)	8.04	7.77	8.11	7.56	8.08	7.83	8.17	7.48
	DO (mg/L)	8.0	7.7	8.2	6.7	8.0	7.6	7.9	6.1
	Conductivity (µmhos/cm)	296		283		297		293	
	*Temperature (°C)	25.0	24.5	25.0	24.6	24.9	24.3	25.0	24.4
42.8%	pH (S.U.)	7.98	7.77	8.09	7.54	8.09	7.84	8.18	7.49
	DO (mg/L)	8.0	7.7	8.1	6.8	8.0	7.6	7.9	6.0
	Conductivity (µmhos/cm)	261		250		263		256	
	*Temperature (°C)	25.0	24.6	25.0	24.6	24.9	24.5	25.0	24.2
85.6%	pH (S.U.)	7.99	7.77	8.10	7.58	8.04	7.86	8.19	7.48
	DO (mg/L)	8.0	7.7	8.1	6.6	8.1	7.6	7.9	6.0
	Conductivity (µmhos/cm)	193		187		193		191	
	*Temperature (°C)	25.1	24.6	25.0	24.7	24.9	24.2	25.0	24.2
100%	pH (S.U.)	8.03	7.76	8.04	7.58	8.06	7.87	8.19	7.48
	DO (mg/L)	8.0	7.7	8.1	6.7	8.0	7.6	8.0	5.9
	Conductivity (µmhos/cm)	167		165		169		166	
	*Alkalinity (mg CaCO ₃ /L)			69					
	*Hardness (mg CaCO ₃ /L)			66					
	*TR chlorine (mg/L)			20.10					
	*Temperature (°C)	25.1	24.5	25.1	24.5	25.0	24.2	25.1	24.6
100% Intake	pH (S.U.)	8.05	7.78	8.07	7.62	8.07	7.91	8.18	7.48
	DO (mg/L)	8.0	7.6	7.9	6.4	8.0	7.7	7.9	5.9
	Conductivity (µmhos/cm)	168		161		170		167	
	*Alkalinity (mg CaCO ₃ /L)			67					
	*Hardness (mg CaCO ₃ /L)			70					
	*TR chlorine (mg/L)			20.10					
	*Temperature (°C)	25.0	24.6	25.1	24.7	25.0	24.5	25.1	24.5
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

Independent Review by
Kellee E. Kelley
by: *[Signature]*

Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1.
Alkalinity, hardness and total residual chlorine performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet.
Total residual chlorine was performed on non-treated Outfall 101 and Intake samples.

Species: Pimephales promelas
Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated

Date: 05-02-17

Daily Chemistry:

		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
		0		1		2	
		Analyst	u	u	u	u	u
Concentration	Parameter						
Control Non-treated	pH (S.U.)	0.21	7.92	0.10	7.66	0.08	7.52
	DO (mg/L)	7.9	7.5	7.7	7.2	7.7	6.6
	Conductivity (µmhos/cm)	321		320		319	
	*Alkalinity (mg CaCO ₃ /L)	61		62		61	
	*Hardness (mg CaCO ₃ /L)	88		82			
	*Temperature (°C)	24.7	24.8	24.7	24.5	24.7	24.6
		Initial	Final	Initial	Final	Initial	Final

		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)							
		3		4		5		6	
		Analyst	u	u BSL	u BSL	u	u	u	u
Concentration	Parameter								
Control Non-treated	pH (S.U.)	0.13	7.83	7.98	7.54	0.15	7.04	0.19	7.49
	DO (mg/L)	7.7	7.8	7.8	6.4	7.7	7.0	7.0	6.0
	Conductivity (µmhos/cm)	320		317		324		320	
	*Alkalinity (mg CaCO ₃ /L)	61		63		61		61	
	*Hardness (mg CaCO ₃ /L)			86					
	*Temperature (°C)	24.6	24.4	24.6	24.3	24.7	24.5	24.8	24.4
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1. Alkalinity, hardness and total residual chlorine performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: JK





TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated
May 02-09, 2017

Pimephales promelas Chronic Whole Effluent Toxicity Test
EPA-821-R-02-013, Method 1000.0

Daily Chemical Analyses

Project number: 12332

Concentration	Parameter	Day 0		Day 1		Day 2		Day 3		Day 4		Day 5		Day 6	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Control, Non-treated	pH (SU)	8.21	7.92	8.10	7.66	8.08	7.52	8.13	7.83	8.08	7.54	8.15	7.84	8.19	7.49
	DO (mg/L)	7.9	7.5	7.7	7.2	7.7	6.6	7.7	7.8	7.8	6.4	7.7	7.6	7.8	6.0
	Conductivity (µmhos/cm)	321		328		319		326		317		324		320	
	Alkalinity (mg/L CaCO ₃)	61		62						63					
	Hardness (mg/L CaCO ₃)	88		82						86					
	Temperature (°C)	24.7	24.8	24.7	24.5	24.7	24.6	24.6	24.4	24.6	24.3	24.7	24.5	24.8	24.4
Control, UV-treated	pH (SU)	8.19	7.93	8.06	7.65	8.06	7.69	8.05	7.81	8.10	7.55	8.06	7.83	8.14	7.57
	DO (mg/L)	7.9	7.6	7.9	6.8	7.9	7.2	8.0	7.7	8.2	6.5	7.9	7.5	7.9	6.2
	Conductivity (µmhos/cm)	322		325		319		326		312		317		321	
	Alkalinity (mg/L CaCO ₃)	61		64						62					
	Hardness (mg/L CaCO ₃)	88		86						86					
	Temperature (°C)	24.7	24.6	24.6	24.7	24.8	24.2	24.8	24.2	24.8	24.4	24.7	24.4	24.8	24.2
10.7%	pH (SU)	8.18	7.89	8.09	7.61	8.07	7.58	8.06	7.74	8.12	7.54	8.09	7.84	8.16	7.49
	DO (mg/L)	7.9	7.6	7.9	6.7	7.9	7.1	8.0	7.7	8.1	6.6	8.0	7.5	7.9	6.2
	Conductivity (µmhos/cm)	309		318		306		310		295		304		305	
	Temperature (°C)	24.8	24.9	24.7	24.7	24.9	24.4	24.9	24.5	24.9	24.6	24.8	24.4	24.9	24.4
21.4%	pH (SU)	8.16	7.87	8.10	7.61	8.08	7.57	8.04	7.77	8.11	7.56	8.08	7.83	8.17	7.48
	DO (mg/L)	7.9	7.6	7.9	6.7	7.9	6.6	8.0	7.7	8.2	6.7	8.0	7.6	7.9	6.1
	Conductivity (µmhos/cm)	291		305		292		296		283		297		293	
	Temperature (°C)	24.8	24.7	24.7	24.7	25.0	24.4	25.0	24.5	25.0	24.6	24.9	24.3	25.0	24.4
42.8%	pH (SU)	8.14	7.87	8.10	7.61	8.08	7.57	7.98	7.77	8.09	7.54	8.09	7.84	8.18	7.49
	DO (mg/L)	7.9	7.5	7.9	6.1	8.0	6.5	8.0	7.7	8.1	6.8	8.0	7.6	7.9	6.0
	Conductivity (µmhos/cm)	260		267		256		261		250		263		256	
	Temperature (°C)	24.8	24.9	24.8	24.5	25.0	24.6	25.0	24.6	25.0	24.6	24.9	24.5	25.0	24.2
85.6%	pH (SU)	8.13	7.85	8.11	7.59	8.09	7.57	7.99	7.77	8.10	7.58	8.04	7.86	8.19	7.49
	DO (mg/L)	8.0	7.5	7.9	6.2	8.0	6.7	8.0	7.7	8.1	6.6	8.1	7.6	7.9	6.0
	Conductivity (µmhos/cm)	186		191		186		193		187		193		191	
	Temperature (°C)	24.9	24.9	24.9	24.7	25.0	24.6	25.1	24.6	25.0	24.7	24.9	24.2	25.0	24.2
100%	pH (SU)	8.15	7.84	8.05	7.51	8.04	7.56	8.03	7.76	8.04	7.56	8.06	7.87	8.19	7.48
	DO (mg/L)	8.0	7.5	7.9	6.2	8.0	6.8	8.0	7.7	8.1	6.7	8.0	7.6	8.0	5.9
	Conductivity (µmhos/cm)	160		165		160		167		165		169		166	
	Alkalinity (mg/L CaCO ₃)	59				65				69					
	Hardness (mg/L CaCO ₃)	64				66				66					
	*Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	25.0	24.8	24.9	24.8	25.1	24.6	25.1	24.5	25.1	24.5	25.0	24.2	25.1	24.6
100% Intake	pH (SU)	8.17	7.85	8.05	7.64	8.03	7.53	8.05	7.78	8.07	7.62	8.07	7.91	8.18	7.48
	DO (mg/L)	8.1	7.6	8.0	6.9	8.0	6.9	8.0	7.6	7.9	6.6	8.0	7.7	7.9	3.9
	Conductivity (µmhos/cm)	163		165		158		168		161		170		167	
	Alkalinity (mg/L CaCO ₃)	61				65				67					
	Hardness (mg/L CaCO ₃)	64				66				70					
	*Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
Temperature (°C)	24.9	24.9	24.9	24.5	25.1	24.4	25.0	24.6	25.1	24.7	25.0	24.5	25.1	24.5	

*Note: Total residual chlorine was performed on non-treated Outfall 101 and Intake samples

Species: *Ceriodaphnia dubia*

Client: TVA / Sequovah Nuclear Plant, Outfall 101

Date: 05-02-17

CONTROL-1

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	4	6	4	5	5	5	4	5	3	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	11	10	12	12	13	10	10	13	11
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	16	16	14	13	15	17	16	17	14	16
Total young produced		30	33	28	30	32	35	30	32	30	32
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3 rd Broods		X	X	X	X	X	X	X	X	X	X

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer)

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	31.2

CONC: 10.7%

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	5	4	5	5	3	4	4	4	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	14	12	11	13	14	12	12	11	12
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	17	18	14	18	17	13	16	19	15	14
Total young produced		34	36	31	34	33	31	35	31	31	
Final Adult Mortality		L	L	L	L	L	L	L	L	L	

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer)

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	32.8
% Reduction from Control-1:	-5.1%



Species: *Ceriodaphnia dubia*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 05-02-17

CONC: 21.4%

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	5	6	4	4	4	5	4	4	4	6
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	13	12	13	10	13	12	10	11	14
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	19	17	15	16	18	16	15	19	17	17
Total young produced		37	36	31	33	32	34	31	33	32	37
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	33.6
% Reduction from Control-1:	-7.72

CONC: 42.8%

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	4	5	5	5	4	4	5	6	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	13	12	12	14	10	14	13	12	13
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	19	18	20	15	15	19	16	15	19	15
Total young produced		35	36	37	32	33	33	35	34	36	33
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	34.4
% Reduction from Control-1:	-10.37.



Species: *Ceriodaphnia dubia*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 05-02-17

CONC: 85.6%

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	6	5	5	6	4	6	5	5	5	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	12	14	13	11	13	13	13	14	11
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	18	18	15	19	17	19	20	18	20	17
Total young produced		37	35	34	38	32	38	38	36	39	32
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer)

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	35.9
% Reduction from Control-1:	-15.17.

CONC: 100%

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	4	5	5	6	5	6	6	5	6	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	14	14	12	14	13	14	11	12	12
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	21	17	18	18	18	20	19	19	20	17
Total young produced		38	36	37	36	37	39	39	35	38	33
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer)

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	36.8
% Reduction from Control-1:	-17.97.



Species: *Ceriodaphnia dubia*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 05-02-17

CONTROL-2

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	4	4	4	6	5	4	4	4	5	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	12	13	13	11	12	10	10	10	11
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	17	15	15	15	18	15	14	18	15	16
Total young produced		33	31	32	34	34	31	28	32	30	31
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3 rd Broods		X	X	X	X	X	X	X	X	X	X

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	31.6

CONC: 100% Intake

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	6	6	5	6	4	4	4	5	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	11	14	12	12	12	14	12	13	11
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	19	17	17	19	15	15	19	15	16	16
Total young produced		38	34	36	37	35	31	37	32	34	32
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	34.6
% Reduction from Control-2:	-9.57.





TVA / Sequoyah Nuclear Plant, Outfall 101
May 02-09, 2017



Verification of *Ceriodaphnia* Reproduction Totals

Control-1

Day	Replicate number										Total	
	1	2	3	4	5	6	7	8	9	10		
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	4	6	4	5	5	5	4	5	3	5		46
5	10	11	10	12	12	13	10	10	13	11		112
6	0	0	0	0	0	0	0	0	0	0		0
7	16	16	14	13	15	17	16	17	14	16		154
Total	30	33	28	30	32	35	30	32	30	32		312

85.6%

Day	Replicate number										Total	
	1	2	3	4	5	6	7	8	9	10		
1	0	0	0	0	0	0	0	0	0	0		0
2	0	0	0	0	0	0	0	0	0	0		0
3	0	0	0	0	0	0	0	0	0	0		0
4	6	5	5	6	4	6	5	5	5	4		51
5	13	12	14	13	11	13	13	13	14	11		127
6	0	0	0	0	0	0	0	0	0	0		0
7	18	18	15	19	17	19	20	18	20	17		181
Total	37	35	34	38	32	38	38	36	39	32		359

10.7%

Day	Replicate number										Total	
	1	2	3	4	5	6	7	8	9	10		
1	0	0	0	0	0	0	0	0	0	0		0
2	0	0	0	0	0	0	0	0	0	0		0
3	0	0	0	0	0	0	0	0	0	0		0
4	5	4	5	5	3	4	4	4	5	5		44
5	12	14	12	11	13	14	12	2	11	12		123
6	0	0	0	0	0	0	0	0	0	0		0
7	17	18	14	18	17	13	16	9	15	14		161
Total	34	36	31	34	33	31	32	35	31	31		328

100%

Day	Replicate number										Total	
	1	2	3	4	5	6	7	8	9	10		
1	0	0	0	0	0	0	0	0	0	0		0
2	0	0	0	0	0	0	0	0	0	0		0
3	0	0	0	0	0	0	0	0	0	0		0
4	4	5	5	6	5	6	6	5	6	4		52
5	13	14	14	12	14	13	14	11	12	12		129
6	0	0	0	0	0	0	0	0	0	0		0
7	21	17	18	18	18	20	19	19	20	17		187
Total	38	36	37	36	37	39	39	35	38	33		368

21.4%

Day	Replicate number										Total	
	1	2	3	4	5	6	7	8	9	10		
1	0	0	0	0	0	0	0	0	0	0		0
2	0	0	0	0	0	0	0	0	0	0		0
3	0	0	0	0	0	0	0	0	0	0		0
4	5	6	4	4	4	5	4	4	4	6		46
5	13	13	12	13	10	13	12	10	11	14		121
6	0	0	0	0	0	0	0	0	0	0		0
7	19	17	15	16	18	16	15	19	17	17		169
Total	37	36	31	33	32	34	31	33	32	37		336

Control-2

Day	Replicate number										Total	
	1	2	3	4	5	6	7	8	9	10		
1	0	0	0	0	0	0	0	0	0	0		0
2	0	0	0	0	0	0	0	0	0	0		0
3	0	0	0	0	0	0	0	0	0	0		0
4	4	4	4	4	6	5	4	4	4	5		44
5	12	12	13	13	11	12	10	10	10	11		114
6	0	0	0	0	0	0	0	0	0	0		0
7	17	15	15	15	18	15	14	18	15	16		158
Total	33	31	32	34	34	31	28	32	30	31		316

42.8%

Day	Replicate number										Total	
	1	2	3	4	5	6	7	8	9	10		
1	0	0	0	0	0	0	0	0	0	0		0
2	0	0	0	0	0	0	0	0	0	0		0
3	0	0	0	0	0	0	0	0	0	0		0
4	4	5	5	5	4	4	5	6	5	5		48
5	12	13	12	12	14	10	14	13	12	13		125
6	0	0	0	0	0	0	0	0	0	0		0
7	19	18	20	15	15	19	16	15	19	15		171
Total	35	36	37	32	33	33	35	34	36	33		344

100% Intake

Day	Replicate number										Total	
	1	2	3	4	5	6	7	8	9	10		
1	0	0	0	0	0	0	0	0	0	0		0
2	0	0	0	0	0	0	0	0	0	0		0
3	0	0	0	0	0	0	0	0	0	0		0
4	6	6	5	6	4	4	4	5	5	5		50
5	13	11	14	12	12	12	14	12	13	11		124
6	0	0	0	0	0	0	0	0	0	0		0
7	19	17	17	19	19	15	19	15	16	16		172
Total	38	34	36	37	35	31	37	32	34	32		346

✓
Controlled and
Reviewed by
[Signature]



Environmental Testing Solutions, Inc.

TVA / Sequoyah Nuclear Plant, Outfall 101

May 02-09, 2017

Chronic Whole Effluent Toxicity Test (EPA-821-R-02-013, Method 1002.0)

***Ceriodaphnia dubia* Chronic Whole Effluent Toxicity Test**

EPA-821-R-02-013, Method 1002.0

Quality Control

Verification of Data Entry, Calculations, and Statistical Analyses

Project number: 12332

Concentration (%)	Replicate number										Survival (%)	Average reproduction (offspring/female)	Coefficient of variation (%)	Percent reduction from pooled controls (%)
	1	2	3	4	5	6	7	8	9	10				
Control - 1	30	33	28	30	32	35	30	32	30	32	100	31.2	6.4	Not applicable
10.7%	34	36	31	34	33	31	32	35	31	31	100	32.8	5.7	-5.1
21.4%	37	36	31	33	32	34	31	33	32	37	100	33.6	6.9	-7.7
42.8%	35	36	37	32	33	33	35	34	36	33	100	34.4	4.8	-10.3
85.6%	37	35	34	38	32	38	38	36	39	32	100	35.9	7.1	-15.1
100%	38	36	37	36	37	39	39	35	38	33	100	36.8	5.1	-17.9
Control - 2	33	31	32	34	34	31	28	32	30	31	100	31.6	5.8	Not applicable
100% Intake	38	34	36	37	35	31	37	32	34	32	100	34.6	7.0	-9.5

Outfall 101:

Dunnett's MSD value: 2.113
 PMSD: 6.8

MSD = Minimum Significant Difference

PMSD = Percent Minimum Significant Difference

PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.

Intake:

Dunnett's MSD value: 1.663
 PMSD: 5.3

Lower PMSD bound determined by USEPA (10th percentile) = 13%

Upper PMSD bound determined by USEPA (90th percentile) = 47%

Lower and upper PMSD bounds were determined from the 10th and 90th percentile, respectively, of PMSD data from EPA's WET Interlaboratory Variability Study (USEPA, 2001a; USEPA, 2001b)

USEPA, 2001a, 2001b. Final Report: Interlaboratory Variability Study of EPA Short-term Chronic and Acute Whole Effluent Toxicity Test Methods, Volumes 1 and 2-Appendix. EPA-821-B-01-004 and EPA-821-B-01-005. US Environmental Protection Agency, Cincinnati, OH.

Checked and Reviewed by

TVA / Sequoyah Nuclear Plant, Outfall 101
May 02-09, 2017



Statistical Analyses

Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date: 5/2/2017 Test ID: CdFRCR Sample ID: TVA / SQN Outfall 101
End Date: 5/9/2017 Lab ID: ETS-Envir. Testing Sol. Sample Type: DMR-Discharge Monitoring Report
Sample Date: May 2017 Protocol: FWCHR-EPA-821-R-02-013 Test Species: CD-Ceriodaphnia dubia
Comments: Non-treated

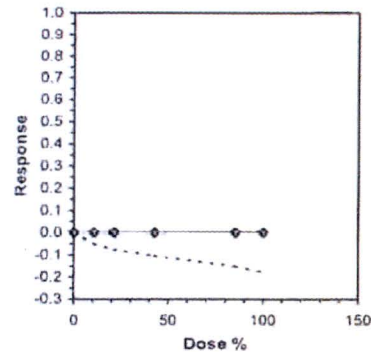
Conc-%	1	2	3	4	5	6	7	8	9	10
Control-1	30.000	33.000	28.000	30.000	32.000	35.000	30.000	32.000	30.000	32.000
Control-2	33.000	31.000	32.000	34.000	34.000	31.000	28.000	32.000	30.000	31.000
10.7	34.000	36.000	31.000	34.000	33.000	31.000	32.000	35.000	31.000	31.000
21.4	37.000	36.000	31.000	33.000	32.000	34.000	31.000	33.000	32.000	37.000
42.8	35.000	36.000	37.000	32.000	33.000	33.000	35.000	34.000	36.000	33.000
85.6	37.000	35.000	34.000	38.000	32.000	38.000	38.000	36.000	39.000	32.000
100	38.000	36.000	37.000	36.000	37.000	39.000	39.000	35.000	38.000	33.000
Intake	38.000	34.000	36.000	37.000	35.000	31.000	37.000	32.000	34.000	32.000

Conc-%	Transform: Untransformed							1-Tailed			Isotonic	
	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
Control-1	31.200	0.9873	31.200	26.000	35.000	6.375	10	*			34.117	1.0000
Control-2	31.600	1.0000	31.600	26.000	34.000	5.816	10					
10.7	32.800	1.0380	32.800	31.000	36.000	5.713	10	-1.732	2.287	2.113	34.117	1.0000
21.4	33.600	1.0633	33.600	31.000	37.000	6.902	10	-2.598	2.287	2.113	34.117	1.0000
42.8	34.400	1.0886	34.400	32.000	37.000	4.786	10	-3.463	2.287	2.113	34.117	1.0000
85.6	35.900	1.1361	35.900	32.000	39.000	7.126	10	-5.087	2.287	2.113	34.117	1.0000
100	36.800	1.1646	36.800	33.000	39.000	5.092	10	-6.061	2.287	2.113	34.117	1.0000
Intake	34.600	1.0949	34.600	31.000	38.000	6.974	10					

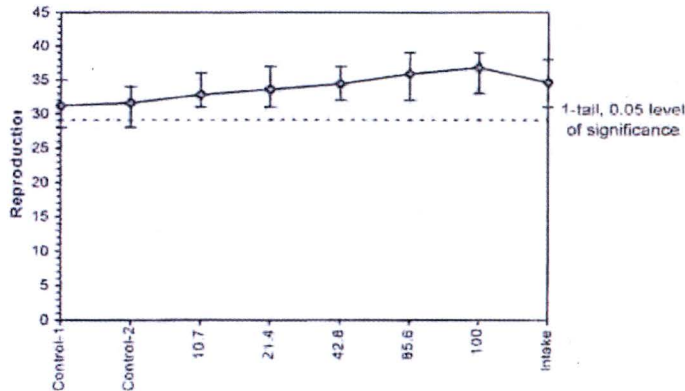
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.74361	1.035	-0.0134	-0.8025
Bartlett's Test indicates equal variances (p = 0.81)	2.26348	15.0863		
The control means are not significantly different (p = 0.65)	0.4671	2.10092		
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Dunnnett's Test	100	>100		1
Treatments vs Control-1	MSDu	MSDp	MSB	MSE
	2.11279	0.06772	41.9367	4.26852
	F-Prob	df		
	1.0E-06	5, 54		

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL	Skew
IC05	>100			
IC10	>100			
IC15	>100			
IC20	>100			
IC25	>100			
IC40	>100			
IC50	>100			



Dose-Response Plot



Checked and Reviewed by Jim Sumner
JL



TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake

May 02-09, 2017



Statistical Analyses

Environmental Testing Solutions, Inc.

Ceriodaphnia Survival and Reproduction Test-Reproduction

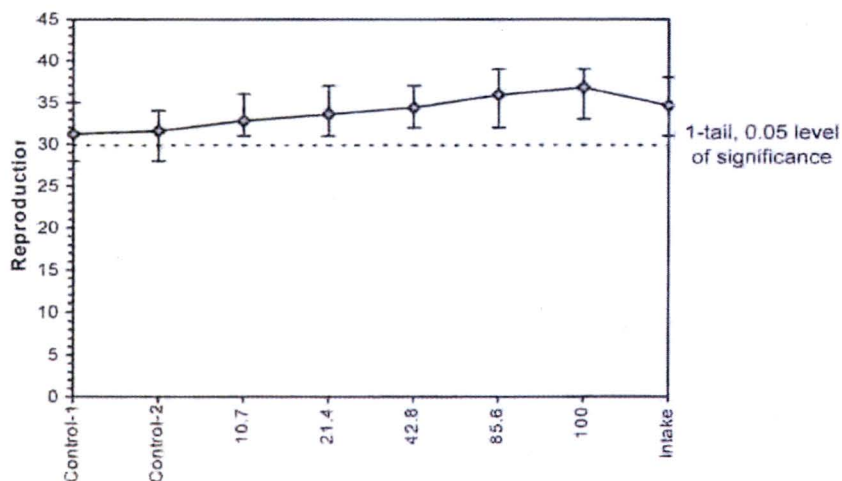
Start Date: 5/2/2017	Test ID: CdFRCR	Sample ID: TVA / SQN Outfall 101 - Intake
End Date: 5/9/2017	Lab ID: ETS-Envir. Testing Sol.	Sample Type: DMR-Discharge Monitoring Report
Sample Date: May 2017	Protocol: FWCHR-EPA-821-R-02-013	Test Species: CD-Ceriodaphnia dubia
Comments: Non-treated		

Conc-%	1	2	3	4	5	6	7	8	9	10
Control-1	30.000	33.000	28.000	30.000	32.000	35.000	30.000	32.000	30.000	32.000
Control-2	33.000	31.000	32.000	34.000	34.000	31.000	28.000	32.000	30.000	31.000
10.7	34.000	36.000	31.000	34.000	33.000	31.000	32.000	35.000	31.000	31.000
21.4	37.000	36.000	31.000	33.000	32.000	34.000	31.000	33.000	32.000	37.000
42.8	35.000	36.000	37.000	32.000	33.000	33.000	35.000	34.000	36.000	33.000
85.6	37.000	35.000	34.000	38.000	32.000	38.000	38.000	36.000	39.000	32.000
100	38.000	36.000	37.000	36.000	37.000	39.000	39.000	35.000	38.000	33.000
Intake	38.000	34.000	36.000	37.000	35.000	31.000	37.000	32.000	34.000	32.000

Conc-%	Transform: Untransformed							1-Tailed		
	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control-1	31.200	0.9873	31.200	28.000	35.000	6.375	10			
Control-2	31.600	1.0000	31.600	28.000	34.000	5.816	10			
10.7	32.800	1.0380	32.800	31.000	36.000	5.713	10			
21.4	33.600	1.0633	33.600	31.000	37.000	6.902	10			
42.8	34.400	1.0886	34.400	32.000	37.000	4.786	10			
85.6	35.900	1.1361	35.900	32.000	39.000	7.126	10			
100	36.800	1.1646	36.800	33.000	39.000	5.092	10			
Intake	34.600	1.0949	34.600	31.000	38.000	6.974	10	-3.128	1.734	1.663

Auxiliary Tests	Statistic	Critical	Skew	Kurt		
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.94304	0.868	-0.2144	-0.8437		
F-Test indicates equal variances (p = 0.43)	1.72368	6.54109				
The control means are not significantly different (p = 0.65)	0.4671	2.10092				
Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences	1.66325	0.05263	45	4.6	0.00582	1, 18
Treatments vs Control-2						

Dose-Response Plot



Entered and Reviewed by
 Jim Sumner



Species: Ceriodaphnia dubia

Date: 05-02-17

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Daily Chemistry:

Analyst		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
		0		1		2	
		K	L	M	N	O	P
Concentration	Parameter						
CONTROL	pH (S.U.)	8.21	8.02	8.10	8.00	8.00	7.97
	DO (mg/L)	7.9	7.0	7.7	7.9	7.7	7.0
	Conductivity (µmhos/cm)	321		320		319	
	*Alkalinity (mg CaCO ₃ /L)	61		62		60	
	*Hardness (mg CaCO ₃ /L)	88		82			
	*Temperature (°C)	24.6	25.0	24.7	24.9	24.8	25.1
10.7%	pH (S.U.)	8.18	8.01	8.11	8.00	8.08	7.97
	DO (mg/L)	7.8	7.9	7.8	7.9	7.0	7.7
	Conductivity (µmhos/cm)	309		314		304	
	*Temperature (°C)	24.7	25.1	24.7	24.7	24.9	25.2
21.4%	pH (S.U.)	8.19	8.01	8.12	7.99	8.10	7.97
	DO (mg/L)	7.8	7.9	7.8	7.9	7.8	7.8
	Conductivity (µmhos/cm)	291		293		290	
	*Temperature (°C)	24.7	24.8	24.7	24.9	24.9	25.2
42.8%	pH (S.U.)	8.18	8.00	8.12	8.00	8.08	7.98
	DO (mg/L)	7.9	7.9	7.8	7.9	7.8	7.8
	Conductivity (µmhos/cm)	257		265		250	
	*Temperature (°C)	24.7	24.8	24.8	24.8	24.9	25.0
85.6%	pH (S.U.)	8.17	8.00	8.10	8.02	8.08	7.98
	DO (mg/L)	7.9	7.9	7.9	7.9	7.8	7.9
	Conductivity (µmhos/cm)	186		188		187	
	*Temperature (°C)	24.7	24.8	24.9	24.8	24.9	24.9
100%	pH (S.U.)	8.12	7.99	8.09	8.01	8.05	7.98
	DO (mg/L)	8.0	7.9	8.0	7.9	7.9	8.0
	Conductivity (µmhos/cm)	158		163		167	
	*Alkalinity (mg CaCO ₃ /L)	59				63	
	*Hardness (mg CaCO ₃ /L)	62				66	
	*TR chlorine (mg/L)	<0.10				<0.10	
	*Temperature (°C)	24.7	25.1	24.9	24.9	25.0	24.9
100% Intake	pH (S.U.)	8.02	7.99	8.08	8.01	8.06	7.98
	DO (mg/L)	8.1	7.9	8.0	7.8	7.9	7.8
	Conductivity (µmhos/cm)	163		165		162	
	*Alkalinity (mg CaCO ₃ /L)	59				67	
	*Hardness (mg CaCO ₃ /L)	64				66	
	*TR chlorine (mg/L)	<0.10				<0.10	
	*Temperature (°C)	24.7	24.9	24.8	24.9	25.0	25.0
		Initial	Final	Initial	Final	Initial	Final

*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1. Alkalinity, hardness and total residual chlorine performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: JK



Species: *Ceriodaphnia dubia*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 05-02-17

Concentration		Parameter	Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)							
			3		4		5		6	
			Analyst	u	BSL u	BSC u	u	u	u	u
CONTROL	pH (S.U.)	0.13	8.04	8.08	7.98	8.15	8.09	8.19	8.09	
	DO (mg/L)	7.7	7.9	7.8	8.0	7.7	8.0	7.8	7.9	
	Conductivity (µmhos/cm)	320		317		324		320		
	*Alkalinity (mg CaCO ₃ /L)	64		63		64		64		
	*Hardness (mg CaCO ₃ /L)			86						
	*Temperature (°C)	24.8	24.9	24.8	24.9	24.7	25.1	24.8	25.2	
10.7%	pH (S.U.)	8.06	8.04	8.12	7.97	8.10	8.08	8.17	8.09	
	DO (mg/L)	7.8	7.9	7.9	8.0	7.8	8.0	7.9	7.9	
	Conductivity (µmhos/cm)	310		328 (298)		310		303		
	*Temperature (°C)	24.9	25.1	24.9	25.2	24.8	24.9	24.9	25.0	
21.4%	pH (S.U.)	8.09	8.04	8.12	7.97	8.10	8.08	8.18	8.04	
	DO (mg/L)	7.8	8.0	8.2	8.0	7.8	8.0	7.9	8.0	
	Conductivity (µmhos/cm)	292		280		300		290		
	*Temperature (°C)	24.9	25.2	24.9	25.0	24.8	24.9	24.9	24.9	
42.8%	pH (S.U.)	8.08	8.04	8.11	7.97	8.10	8.09	8.19	8.05	
	DO (mg/L)	7.9	8.0	8.0	8.0	7.9	8.0	7.9	8.0	
	Conductivity (µmhos/cm)	261		248		263		257		
	*Temperature (°C)	24.9	24.8	24.9	25.0	24.8	25.0	24.9	24.9	
85.6%	pH (S.U.)	8.08	8.03	8.12	7.97	8.10	8.10	8.19	8.06	
	DO (mg/L)	7.9	8.1	8.2	8.0	8.0	8.0	8.0	8.0	
	Conductivity (µmhos/cm)	191		182		190		187		
	*Temperature (°C)	24.9	24.8	25.0	25.1	24.8	25.0	25.0	25.1	
100%	pH (S.U.)	7.95	8.05	8.07	7.92	8.09	8.09	8.19	8.01	
	DO (mg/L)	7.9	8.2	8.0	8.1	8.0	8.0	8.0	8.0	
	Conductivity (µmhos/cm)	105		158		171		163		
	*Alkalinity (mg CaCO ₃ /L)			67						
	*Hardness (mg CaCO ₃ /L)			66						
	*TR chlorine (mg/L)			<0.10						
	*Temperature (°C)	25.0	24.8	25.0	24.8	24.9	25.2	25.0	24.8	
100% Intake	pH (S.U.)	8.05	8.05	8.11	8.00	8.10	8.11	8.18	8.11	
	DO (mg/L)	7.9	8.2	7.9	8.0	8.0	8.0	8.1	8.1	
	Conductivity (µmhos/cm)	103		165		177		160		
	*Alkalinity (mg CaCO ₃ /L)			65						
	*Hardness (mg CaCO ₃ /L)			68						
	*TR chlorine (mg/L)			<0.10						
	*Temperature (°C)	25.0	24.9	24.9	25.0	24.8	25.0	25.0	24.8	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	

*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1. Alkalinity, hardness and total residual chlorine performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: *[Signature]*

SOP AT11 - Exhibit AT11.2, revision 11-01-14





TVA / Sequoyah Nuclear Plant, Outfall 101, Non-treated
May 02-09, 2017

Ceriodaphnia dubia Chronic Whole Effluent Toxicity Test
EPA-821-R-02-013, Method 1002.0

Daily Chemical Analyses

Project number: 12332

Concentration	Parameter	Day 0		Day 1		Day 2		Day 3		Day 4		Day 5		Day 6	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Control	pH (SU)	8.21	8.02	8.10	8.00	8.08	7.97	8.13	8.04	8.08	7.98	8.15	8.09	8.19	8.09
	DO (mg/L)	7.9	7.8	7.7	7.9	7.7	7.8	7.7	7.9	7.8	8.0	7.7	8.0	7.8	7.9
	Conductivity (µmhos/cm)	321		328		319		326		317		324		320	
	Alkalinity (mg/L CaCO ₃)	61		62						63					
	Hardness (mg/L CaCO ₃)	88		82						86					
	Temperature (°C)	24.6	25.0	24.7	24.9	24.8	25.1	24.8	24.9	24.8	24.9	24.7	25.1	24.8	25.2
10.7%	pH (SU)	8.18	8.01	8.11	8.00	8.08	7.97	8.06	8.04	8.12	7.97	8.10	8.08	8.17	8.09
	DO (mg/L)	7.8	7.9	7.8	7.9	7.8	7.7	7.8	7.9	7.9	8.0	7.8	8.0	7.9	7.9
	Conductivity (µmhos/cm)	309		314		304		310		298		316		303	
	Temperature (°C)	24.7	25.1	24.7	24.7	24.9	25.2	24.9	25.1	24.9	25.2	24.8	24.9	24.9	25.0
21.4%	pH (SU)	8.19	8.01	8.12	7.99	8.10	7.97	8.09	8.04	8.12	7.97	8.10	8.08	8.18	8.04
	DO (mg/L)	7.8	7.9	7.8	7.9	7.8	7.8	7.8	8.0	8.0	8.0	7.8	8.0	7.9	8.0
	Conductivity (µmhos/cm)	291		293		290		292		286		300		290	
	Temperature (°C)	24.7	24.8	24.7	24.9	24.9	25.2	24.9	25.2	24.9	25.0	24.8	24.9	24.9	24.9
42.8%	pH (SU)	8.18	8.00	8.12	8.00	8.08	7.98	8.08	8.04	8.11	7.97	8.10	8.09	8.19	8.05
	DO (mg/L)	7.9	7.9	7.8	7.9	7.8	7.8	7.9	8.0	8.0	8.0	7.9	8.0	7.9	8.0
	Conductivity (µmhos/cm)	257		265		256		261		248		263		257	
	Temperature (°C)	24.7	24.8	24.8	24.8	24.9	25.0	24.9	24.8	24.9	25.0	24.8	25.0	24.9	24.9
85.6%	pH (SU)	8.17	8.00	8.10	8.02	8.08	7.98	8.08	8.03	8.12	7.97	8.10	8.10	8.19	8.06
	DO (mg/L)	7.9	7.9	7.9	7.9	7.8	7.9	7.9	8.1	8.0	8.0	8.0	8.0	8.0	8.0
	Conductivity (µmhos/cm)	186		188		187		191		182		196		187	
	Temperature (°C)	24.7	24.8	24.9	24.8	24.9	24.9	24.9	24.8	25.0	25.1	24.8	25.0	25.0	25.1
100%	pH (SU)	8.12	7.99	8.09	8.01	8.05	7.98	7.95	8.05	8.07	7.92	8.09	8.09	8.19	8.01
	DO (mg/L)	8.0	7.9	8.0	7.9	7.9	8.0	7.9	8.2	8.0	8.1	8.0	8.0	8.0	8.0
	Conductivity (µmhos/cm)	158		163		167		165		158		171		163	
	Alkalinity (mg/L CaCO ₃)	59				63				67					
	Hardness (mg/L CaCO ₃)	62				66				65					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	24.7	25.1	24.9	24.9	25.0	24.9	25.0	24.8	25.0	24.8	24.9	25.2	25.0	24.8
100% Intake	pH (SU)	8.02	7.99	8.08	8.01	8.06	7.98	8.05	8.05	8.11	8.06	8.10	8.11	8.18	8.11
	DO (mg/L)	8.1	7.9	8.0	7.8	7.9	7.8	7.9	8.2	7.9	8.0	8.0	8.0	8.1	8.1
	Conductivity (µmhos/cm)	163		165		162		163		165		177		166	
	Alkalinity (mg/L CaCO ₃)	59				67				65					
	Hardness (mg/L CaCO ₃)	64				66				68					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	24.7	24.9	24.8	24.9	25.0	25.0	25.0	24.9	24.9	25.0	24.8	25.0	25.0	24.8



Total Residual Chlorine (ORION-1977)

Matrix: Water, RL = 0.10 mg/L

Meter: Accumet Model AB250 pH/mV/Ion Meter

Analyst MS
Date analyzed 05-02-17

Iodide reagent: INR 799
Acid reagent: INR 798

Calibration:

	0.10 mg/L	1.00 mg/L	mV Change (suggested range = 26 to 30 mV)
Reference standard number	<u>INSS 1478</u>	<u>INSS 1478</u>	
Millivolts (mV)	<u>561.9</u>	<u>591.6</u>	<u>29.7</u>

Note: For samples with a residual chlorine of > 1.0 mg/L, the samples must be diluted to be within the calibration range.

Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS 1478</u>	<u>0.50</u>	<u>0.546</u>	<u>109.2%</u>

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = $\frac{(S - D)}{((S+D)/2)} \times 100$ (acceptable range = ± 10%)
<u>170502.04</u>	<u>Apex</u>	<u>Pale tan, clear</u>	<u>S 20.006</u>	
<u>J</u>	<u>Duplicate</u>		<u>D 20.004</u>	<u>MS</u> <u>05/02/17</u>

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	<u>Reagent Blank</u>		<u>20.007</u>
<u>170501.01</u>	<u>JEFFERSON</u>	<u>Pale tan, clear</u>	<u>0.002</u>
<u>170501.02</u>	<u>WEST JEFFERSON</u>	<u>Pale tan, clear</u>	<u>20.003</u>
<u>170501.03</u>	<u>TVA / SQN 101</u>	<u>Pale tan, clear</u>	<u>0.001</u>
<u>170501.04</u>	<u>↓ INTAKE</u>	<u>Pale tan, clear</u>	<u>0.001</u>
<u>170502.05</u>	<u>BOGUE BANKS</u>	<u>Pale yellow, clear</u>	<u>20.002</u>
<u>170502.06</u>	<u>ENGELHARD</u>	<u>yellow, clear</u>	<u>20.001</u>
<u>170502.07</u>	<u>PASQUOTANK</u>	<u>Pale yellow, clear</u>	<u>20.001</u>
<u>170502.14</u>	<u>TVA / PCC 001</u> <u>AMSAMPLE</u>	<u>Pale tan, clear</u>	<u>20.001</u>
<u>170502.15</u>	<u>↓ INTAKE</u> <u>↓</u>	<u>Pale tan, clear</u>	<u>20.001</u>

Note: All samples were analyzed in excess of EPA recommended holding time (15 minutes) unless otherwise noted.

Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS 1478</u>	<u>0.50</u>	<u>0.513</u>	<u>102.6%</u>

Reviewed by J
Date reviewed 05-02-17



Total Residual Chlorine (ORION-1977)

Matrix: Water, RL = 0.10 mg/L

Meter: Accumet Model AB250 pH/mV/Ion Meter

Analyst MS
 Date analyzed 05.02.17

Iodide reagent: MS 050217
 Acid reagent: MS 050217

Calibration:

	0.10 mg/L	1.00 mg/L	mV Change (suggested range = 26 to 30 mV)
Reference standard number			
Millivolts (mV)			

Note: For samples with a residual chlorine of > 1.0 mg/L, the samples must be diluted to be within the calibration range.

Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
	0.50		

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = $\frac{ S - D }{(S+D)/2} \times 100$ (acceptable range = ± 10%)
170502.12	TVA/PCC 001 PH SAMPLE	Pale tan, clear	S 20.014	
↓	Duplicate		D 20.012	MS 050217

Sample measurements:

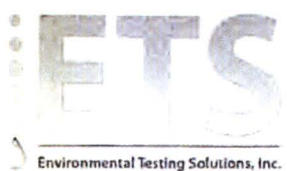
Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	Reagent Blank		MS 050217
170502.13	TVA/PCC INTAKE PH SAMPLE	Pale tan, clear	0.006
MS 050217			

Note: All samples were analyzed in excess of EPA recommended holding time (15 minutes) unless otherwise noted.

Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
MS 1778	0.50	0.486	97.2%

Reviewed by W
 Date reviewed 05.02.17



Total Residual Chlorine (ORION-1977)

Matrix: Water, RL = 0.10 mg/L

Meter: Accumet Model AB250 pH/mV/Ion Meter

Analyst MS
Date analyzed 05-04-17

Iodide reagent: INR 799
Acid reagent: INR 798

Calibration:

	0.10 mg/L	1.00 mg/L	mV Change (suggested range = 26 to 30 mV)
Reference standard number	<u>INS 1478</u>	<u>INS 1478</u>	
Millivolts (mV)	<u>572.4</u>	<u>601.2</u>	<u>28.8</u>

Note: For samples with a residual chlorine of > 1.0 mg/L, the samples must be diluted to be within the calibration range.

Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INS 1478</u>	<u>0.50</u>	<u>0.503</u>	<u>100.6%</u>

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = $\frac{(S - D)}{((S+D)/2)} \times 100$ (acceptable range = ± 10%)
<u>170504.01</u>	<u>Apex</u>	<u>Pale yellow, clear</u>	<u>S 0.006</u>	
<u>↓</u>	<u>Duplicate</u>		<u>D 0.005</u>	<u>MS 050417</u>

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	<u>Reagent Blank</u>		<u>0.007</u>
<u>170505.33</u>	<u>JEFFERSON</u>	<u>Pale yellow, clear</u>	<u>0.004</u>
<u>170503.34</u>	<u>WEST JEFFERSON</u>	<u>Pale yellow, clear</u>	<u>0.002</u>
<u>170503.35</u>	<u>TVA SAN 101</u>	<u>Pale tan, clear</u>	<u>0.003</u>
<u>170503.36</u>	<u>↓ INTAKE</u>	<u>Pale tan, clear</u>	<u>0.002</u>
<u>170504.06</u>	<u>SUTTON 001</u>	<u>Pale yellow, clear</u>	<u>0.002</u>
<u>170504.07</u>	<u>↓ 008</u>	<u>Pale tan, clear</u>	<u>0.017</u>
<u>170504.02</u>	<u>BOGUE BANKS</u>	<u>Pale yellow, clear</u>	<u>0.002</u>
<u>170504.03</u>	<u>ENGLHARD</u>	<u>Yellow, clear</u>	<u>0.001</u>
<u>170504.04</u>	<u>PASQUOTANK</u>	<u>Pale tan, clear</u>	<u>0.001</u>

Note: All samples were analyzed in excess of EPA recommended holding time (15 minutes) unless otherwise noted.

Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INS 1478</u>	<u>0.50</u>	<u>0.487</u>	<u>97.4%</u>

Reviewed by MS
Date reviewed 05-04-17



Total Residual Chlorine (ORION-1977)

Matrix: Water, RL = 0.10 mg/L

Meter: Accumet Model AB250 pH/mV/Ion Meter

Analyst MS
Date analyzed 05-04-17

Iodide reagent: ~~MS 05-04-17~~
Acid reagent: ~~MS 05-04-17~~

Calibration:

	0.10 mg/L	1.00 mg/L	mV Change (suggested range = 26 to 30 mV)
Reference standard number			
Millivolts (mV)			

Note: For samples with a residual chlorine of > 1.0 mg/L, the samples must be diluted to be within the calibration range.

Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
	0.50		

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = $\frac{ S - D }{(S+D)/2} \times 100$ (acceptable range = ± 10%)
170504.05	CHEMTRIDE	pale brn, clear, particles	S 0.128	1.6%
↓	Duplicate		D 0.126	

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	Reagent Blank		
170504.08	Morehead	pale yellow, clear	0.006
MS 05-04-17			

Note: All samples were analyzed in excess of EPA recommended holding time (15 minutes) unless otherwise noted.

Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
MS 1478	0.50	0.481	96.2%

Reviewed by MS
Date reviewed 05-04-17



Total Residual Chlorine (ORION-1977)

Matrix: Water, RL = 0.10 mg/L

Meter: Accumet Model AB250 pH/mV/Ion Meter

Analyst W / BSL
Date analyzed 05.06.17

Iodide reagent: INR799
Acid reagent: INR798

Calibration:

	0.10 mg/L	1.00 mg/L	mV Change (suggested range = 26 to 30 mV)
Reference standard number	<u>INSS1470</u>	<u>INSS1470</u>	
Millivolts (mV)	<u>572.7</u>	<u>602.7</u>	<u>30.00</u>

Note: For samples with a residual chlorine of > 1.0 mg/L, the samples must be diluted to be within the calibration range.

Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS1470</u>	<u>0.50</u>	<u>0.494</u>	<u>98.8%</u>

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = $\frac{ S - D }{(S+D /2)} \times 100$ (acceptable range = ± 10%)
<u>170506.01</u>	<u>Apex</u>	<u>pale tan / clear</u>	<u>S < 0.010</u>	
<u>↓</u>	<u>Duplicate</u>		<u>D < 0.007</u>	<u>BSL 05-06-17</u>

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	<u>Reagent Blank</u>		<u>< 0.016</u>
<u>170505.15</u>	<u>JEFFERSON</u>	<u>no color / clear</u>	<u>< 0.004</u>
<u>170505.16</u>	<u>WEST JEFFERSON</u>	<u>pale tan / clear</u>	<u>0.003</u>
<u>170505.17</u>	<u>TVA / SQN 101</u>	<u>no color / clear</u>	<u>0.002</u>
<u>170505.18</u>	<u>↓ INTAKE</u>	<u>pale tan / slightly cloudy</u>	<u>0.007</u>
<u>170506.02</u>	<u>BOGUE BANKS</u>	<u>pale tan / clear</u>	<u>0.001</u>
<u>170506.03</u>	<u>ENGELHARD</u>	<u>yellow / clear</u>	<u>< 0.001</u>
<u>170506.03</u>	<u>PASQUOTANK</u>	<u>no color / clear</u>	<u>< 0.001</u>
<u>05-06-17</u>			

Note: All samples were analyzed in excess of EPA recommended holding time (15 minutes) unless otherwise noted.

Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS1470</u>	<u>0.50</u>	<u>0.468</u>	<u>93.6%</u>

Reviewed by J
Date reviewed 05-06-17

Alkalinity (SM 2320 B-1997)
Matrix: Water, RL = 1.0 mg CaCO₃/L

Analyst W
Date analyzed 04.28.17

Time initiated 1105
Time completed 1122

Titrate samples to
pH = 4.5 S.U.

Titrant normality and multiplier determination:

pH of Deionized water = 4.5 S.U.	Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of H ₂ SO ₄ = (5 ml Na ₂ CO ₃ x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000)/ 100 ml sample = N x 500
5.7	1N2704	1N551584	0.2	12.4	12.2	0.0205	10.2

Bill connect - 0.0 - 0.2 = 0.2 ml

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
1N551553	100	100	12.4	22.6	10.2	10.2	104	104.0

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO ₃ /L)	%RPD = ((S - D) / ((S+D)/2)) x 100 (acceptable range = ± 10%)
04.23.17	SSW	100	22.6	26.0	3.4	10.2	^S 35	
J	Duplicate (B)	J	26.0	29.4	3.4	J	^D 35	~042017

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg CaCO ₃ /L)
1N551553	50	100	26.0	34.4	8.4	10.2	84

Sample alkalinity (B) (mg CaCO ₃ /L)	Measured spike value (MV) (mg CaCO ₃ /L) MV = A - B	% R = MV / SV x 100 (acceptable range = 75 to 125%)
35	49	98.0

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO ₃ /L)
04.27.17	SSW	100	34.4	37.8	3.4	10.2	35
04.16.17	MHSW		37.8	44.1	6.3		64
04.19.17A			1.8	8.1	6.3		64
04.19.17B			8.1	14.1	6.0		61
04.26.17A			14.1	20.1	6.0		61
04.26.17B			20.1	26.2	6.1		62
04.26.17A	Saltsw		26.2	35.0	8.8		90
04.26.17B	J		35.0	44.0	9.0		92

Reviewed by: JL

Date reviewed: 05-01-17

Alkalinity (SM 2320 B-1997)
 Matrix: Water, RL = 1.0 mg CaCO₃/L

Analyst BSL
 Date analyzed 05-07-17

Time initiated 1323
 Time completed 1650

Titrant samples to
 pH = 4.5 S.U.

Titrant normality and multiplier determination:

pH of Deionized water = 4.5 S.U.	Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of H ₂ SO ₄ = (5 ml Na ₂ CO ₃ x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000)/ 100 ml sample = N x 500
8.2	INE 764	JN55 1584	0.4	12.8	12.4	0.0202	10.1

Bik Correct: 10 → 0.4 = 0.4mls
 Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
JN55 1553	100	100	12.8	22.8	10.0	10.1	101.0	101.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO ₃ /L)	%RPD = $\frac{ (S-D) }{((S+D)/2)} \times 100$ (acceptable range = ± 10%)
05-04-17	SSW	100	22.8	26.1	3.3	10.1	^S 33	
↓	Duplicate (B)	↓	26.1	29.4	3.3	↓	^D 33	BSL 05-07-17

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg CaCO ₃ /L)
JN55 1533	50 100 05-07-17	100	26.1	39.3	13.2	10.1	130

Sample alkalinity (B) (mg CaCO ₃ /L)	Measured spike value (MV) (mg CaCO ₃ /L) MV = A - B	% R = MV / SV x 100 (acceptable range = 75 to 125%)
33	97	97.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO ₃ /L)
05-02-17	MHSW	100	39.3	45.5	6.2	10.1	63
05-04-17	↓	↓	0.0	6.0	6.0	↓	61
05-05-17	↓	↓	6.0	12.0	6.0	↓	61
04-26-17A	MHSW UV 1	200 25	0.0	1.6	1.6	10.1 (4)	61
04-26-17B	↓ 2	100	24.9	31.2	6.3	↓	64
05-02-17	↓ 3	↓	31.2	37.3	6.1	↓	62
170501-02	W. Jetter Sam 1	50	37.3	40.7	3.4	(2)	69
170503-31	↓ 2	↓	40.7	44.0	3.3	(2)	67
170505-16	↓ 3	↓	1.6	4.8	3.1	(2)	63

Reviewed by: BSL

Date reviewed: 05-07-17

Alkalinity (SM 2320 B-1997)
 Matrix: Water, RL = 1.0 mg CaCO₃/L

Analyst BSC
 Date analyzed 05-07-17

Time initiated 6:20 PM
 Time completed 6:20 PM

**Titrate samples to
 pH = 4.5 S.U.**

Titrant normality and multiplier determination:

pH of Deionized water = 4.5 S.U.	Titration reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of H ₂ SO ₄ = (5 ml Na ₂ CO ₃ x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 100 ml sample = N x 500
							<u>10.5067</u>

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>JWSS 1553</u>	<u>100</u>	<u>100</u>	<u>4.7</u>	<u>148</u>	<u>10.1</u>	<u>10.1</u>	<u>102</u>	<u>102.0%</u>

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO ₃ /L)	%RPD = ((S - D) / ((S+D)/2)) x 100 (acceptable range = ± 10%)
<u>170501.01</u>	<u>Jetterson 1</u>	<u>100</u>	<u>14.8</u>	<u>18.7</u>	<u>3.9</u>	<u>10.1</u>	<u>S 39</u>	
<u>↓</u>	<u>Duplicate (B)</u>	<u>↓</u>	<u>18.7</u>	<u>22.6</u>	<u>3.9</u>	<u>↓</u>	<u>D 39</u>	<u>—— BSC 05-07-17</u>

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg CaCO ₃ /L)
	<u>50</u>	<u>100</u>	<u>18.7</u>	<u>27.7</u>	<u>9.0</u>	<u>10.1</u>	<u>91</u>

Sample alkalinity (B) (mg CaCO ₃ /L)	Measured spike value (MV) MV = A - B (mg CaCO ₃ /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>39</u>	<u>52</u>	<u>104.0%</u>

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO ₃ /L)
<u>170505.33</u>	<u>Jetterson 2</u>	<u>100</u>	<u>27.7</u>	<u>30.8</u>	<u>3.1</u>	<u>10.1</u>	<u>31</u>
<u>170505.15</u>	<u>↓ 3</u>	<u>↓</u>	<u>30.8</u>	<u>34.0</u>	<u>3.2</u>		<u>32</u>
<u>170502.04</u>	<u>Aperu 1</u>	<u>25</u>	<u>34.0</u>	<u>35.1</u>	<u>1.1</u>	<u>(4)</u>	<u>44</u>
<u>170504.01</u>	<u>↓ 2</u>	<u>↓</u>	<u>35.1</u>	<u>36.4</u>	<u>1.3</u>	<u>(4)</u>	<u>52</u>
<u>170506.01</u>	<u>↓ 3</u>	<u>↓</u>	<u>36.4</u>	<u>37.6</u>	<u>1.2</u>	<u>(4)</u>	<u>48</u>
<u>170502.14</u>	<u>TVA PCL 001 Am</u>	<u>25</u>	<u>37.6</u>	<u>40.5</u>	<u>2.9</u>	<u>(4)</u>	<u>120-117</u>
<u>170502.15</u>	<u>↓ AmWT</u>	<u>↓</u>	<u>40.5</u>	<u>43.7</u>	<u>3.2</u>	<u>(4)</u>	<u>130-129</u>
<u>170502.12</u>	<u>↓ Pm</u>	<u>↓</u>	<u>43.7</u>	<u>46.6</u>	<u>2.9</u>	<u>(4)</u>	<u>120-117</u>
<u>170502.13</u>	<u>↓ PmWT</u>	<u>↓</u>	<u>0.0</u>	<u>3.1</u>	<u>3.1</u>	<u>(4)</u>	<u>130-120-125</u>

Reviewed by: JL

Date reviewed: 05-07-17

Alkalinity (SM 2320 B-1997)
Matrix: Water, RL = 1.0 mg CaCO₃/L

Analyst BSL
Date analyzed 05.07.17

Time initiated 05:017
Time completed

Titrant samples to
pH = 4.5 S.U.

Titrant normality and multiplier determination:

pH of Deionized water = 4.5 S.U.	Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of H ₂ SO ₄ = (5 ml Na ₂ CO ₃ x 0.05)/E = 0.25/E (acceptable range 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000)/ 100 ml sample = N x 500
							<u>10.1</u>

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS 1553</u>	<u>100</u>	<u>100</u>	<u>3.1</u>	<u>13.2</u>	<u>10.1</u>	<u>10.1</u>	<u>102</u>	<u>102.0%</u>

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO ₃ /L)	%RPD = {(S - D) / [(S+D)/2]} x 100 (acceptable range = ± 10%)
<u>170503.28</u>	<u>TVA ALF 001</u>	<u>50</u>	<u>13.2</u>	<u>21.0</u>	<u>7.8</u>	<u>(2) 10.1</u>	<u>S 160-158</u>	
<u>↓</u>	<u>Duplicate (B)</u>	<u>↓</u>	<u>21.0</u>	<u>29.0</u>	<u>8.0</u>	<u>(2) ↓</u>	<u>D 160</u>	<u>BSL 05.07.17</u>

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg CaCO ₃ /L)
<u>INSS 1553</u>	<u>50</u>	<u>50</u>	<u>21.0</u>	<u>34.0</u>	<u>13.0</u>	<u>(2) 10.1</u>	<u>260</u>

Sample alkalinity (B) (mg CaCO ₃ /L)	Measured spike value (MV) (mg CaCO ₃ /L) MV = A - B	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>160</u>	<u>100</u>	<u>100.0%</u>

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO ₃ /L)
<u>170503.30</u>	<u>TVA ALF UP</u>	<u>50</u>	<u>34.5</u>	<u>38.3</u>	<u>1.8</u>	<u>(2) 10.1</u>	<u>36</u>
<u>170503.29</u>	<u>↓ INT</u>	<u>1</u>	<u>38.3</u>	<u>44.1</u>	<u>5.8</u>	<u>(2)</u>	<u>120-117</u>
<u>170503.20</u>	<u>Manteo</u>	<u>25</u>	<u>0.0</u>	<u>3.9</u>	<u>3.9</u>	<u>(4)</u>	<u>160</u>
<u>170504.05</u>	<u>Chemtrace</u>	<u>50</u>	<u>3.9</u>	<u>7.0</u>	<u>3.1</u>	<u>(2)</u>	<u>63</u>
<u>170501.03</u>	<u>TVA SQN 101</u>	<u>1</u>	<u>7.0</u>	<u>9.9</u>	<u>2.9</u>	<u>(2)</u>	<u>58 59 05.08.17</u>
<u>170503.35</u>	<u>↓</u>	<u>2</u>	<u>7.9</u>	<u>13.0</u>	<u>3.1</u>	<u>(2)</u>	<u>63</u>
<u>170505.17</u>	<u>↓</u>	<u>3</u>	<u>13.0</u>	<u>16.3</u>	<u>3.3</u>	<u>(2)</u>	<u>67</u>
<u>170501.04</u>	<u>TVA SQN 101 INT 1</u>	<u>1</u>	<u>11.3</u>	<u>19.2</u>	<u>7.9</u>	<u>(2)</u>	<u>58 59 05.08.17</u>
<u>170503.36</u>	<u>↓</u>	<u>2</u>	<u>19.2</u>	<u>22.5</u>	<u>3.3</u>	<u>(2)</u>	<u>67</u>

Reviewed by: yl Date reviewed: 05-07-17

Alkalinity (SM 2320 B-1997)
Matrix: Water, RL = 1.0 mg CaCO₃/L

Analyst BSL
Date analyzed 05-07-17

Time initiated 05/07
Time completed 05/07

Titrate samples to
pH = 4.5 S.U.

Titrant normality and multiplier determination:

pH of Deionized water = 4.5 S.U.	Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of H ₂ SO ₄ = (5 ml Na ₂ CO ₃ x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 100 ml sample = N x 500
							<u>10.1</u>

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>JN55 1553</u>	<u>100</u>	<u>100</u>	<u>22.5</u>	<u>32.4</u>	<u>9.9</u>	<u>10.1</u>	<u>100</u>	<u>100.0%</u>

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO ₃ /L)	%RPD = ((S - D) / ((S + D) / 2)) x 100 (acceptable range = ± 10%)
<u>170505.18</u>	<u>TVASAN101INT3</u>	<u>50</u>	<u>32.4</u>	<u>35.6</u>	<u>3.2</u>	<u>(2) 10.1</u>	<u>65</u>	
<u>↓</u>	<u>Duplicate (B)</u>	<u>↓</u>	<u>35.6</u>	<u>38.8</u>	<u>3.2</u>	<u>(2) ↓</u>	<u>65</u>	<u>BSL 05-07-17</u>

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg CaCO ₃ /L)
<u>JN55 1553</u>	<u>100</u>	<u>50</u>	<u>35.4</u>	<u>43.8</u>	<u>8.2</u>	<u>(2) 10.1</u>	<u>170</u>

Sample alkalinity (B) (mg CaCO ₃ /L)	Measured spike value (MV) MV = A - B (mg CaCO ₃ /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>65</u>	<u>105</u>	<u>95.0%</u>

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO ₃ /L)
<u>170501.03</u>	<u>TVASAN101UUI</u>	<u>50</u>	<u>0.0</u>	<u>2.9</u>	<u>2.9</u>	<u>(2) 10.1</u>	<u>59</u>
<u>170503.35</u>	<u>↓ 2</u>	<u>↓</u>	<u>2.9</u>	<u>6.1</u>	<u>3.2</u>	<u>(2)</u>	<u>65</u>
<u>170505.17</u>	<u>↓ 3</u>	<u>↓</u>	<u>6.1</u>	<u>9.5</u>	<u>3.4</u>	<u>(2)</u>	<u>69</u>
<u>170501.04</u>	<u>TVASAN101UUI</u>	<u>↓</u>	<u>9.5</u>	<u>11.5</u>	<u>2.0</u>	<u>(2)</u>	<u>40</u>
<u>170503.36</u>	<u>↓ 2</u>	<u>↓</u>	<u>11.5</u>	<u>21.7</u>	<u>3.2</u>	<u>(2)</u>	<u>65</u>
<u>170505.18</u>	<u>↓ 3</u>	<u>↓</u>	<u>21.7</u>	<u>25.0</u>	<u>3.3</u>	<u>(2)</u>	<u>67</u>
<u>170502.05</u>	<u>Bogue 1</u>	<u>2</u>	<u>9.5</u>	<u>11.5</u>	<u>2.0</u>	<u>(50)</u>	<u>1000</u>
<u>170504.02</u>	<u>↓ 2</u>	<u>↓</u>	<u>11.5</u>	<u>13.6</u>	<u>2.1</u>	<u>(50)</u>	<u>1100</u>
<u>170506.02</u>	<u>↓ 3</u>	<u>↓</u>	<u>13.6</u>	<u>15.5</u>	<u>1.9</u>	<u>(50)</u>	<u>1000</u>

Reviewed by: [Signature] Date reviewed: 05-07-17

Alkalinity (SM 2320 B-1997)
 Matrix: Water, RL = 1.0 mg CaCO₃/L

Analyst BSV
 Date analyzed 05-07-17

Time initiated 050617
 Time completed _____

Titrate samples to
 pH = 4.5 S.U.

Titrant normality and multiplier determination:

pH of Deionized water = 4.5 S.U.	Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of H ₂ SO ₄ = (5 ml Na ₂ CO ₃ x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 100 ml sample = N x 500
							<u>050617</u>

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
JNSS 1553	100	100	25.0	35.0	10.0	10.1	101	101.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO ₃ /L)	%RPD = {(S - D) / [(S+D)/2]} x 100 (acceptable range = ± 10%)
170502.06	Engelhard 1	2	35.0	41.4	6.4	(50) 10.1	^S 3200	
↓	Duplicate (B)	↓	0.0	6.5	6.5	(50) ↓	^D 3300	3.1% 8/33 = (32-33)/33

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg CaCO ₃ /L)
JNSS 1553	2500	2	0.0	11.5	11.5	(50) 10.1	5800

Sample alkalinity (B) (mg CaCO ₃ /L)	Measured spike value (MV) (mg CaCO ₃ /L) MV = A - B	% R = MV / SV x 100 (acceptable range = 75 to 125%)
3300	2500	100.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO ₃ /L)
170504.03	Engelhard 2	2	11.5	17.9	6.4	(50) 10.1	3200
170506.04	↓ 3		17.9	24.3	6.4	(50) ↓	3200
170502.07	PASAD-TANK 1		24.3	28.3	4.0	(50) ↓	2000
170504.03	↓ 2		28.3	32.3	4.0	(50) ↓	2000
170506.03	↓ 3		32.3	36.3	4.0	(50) ↓	2000
050417	SALT SW	100	36.3	46.5	10.2	↓	100
							BSL 050717

Reviewed by: jl Date reviewed: 05-07-17

Hardness (SM 2340 C-1997)

RL = 1.0 mg CaCO₃/L

Analyst W
Date analyzed 04.28.17

Time initiated 1016
Time completed 1050

Titrant normality and multiplier determination:

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
1N2753	1N551446	0.0	10.0	10.0	0.0200	20.0

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
1N551407	40	50	10.0	12.0	2.0	20.0	40	100.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)	%RPD = ((S - D) / ((S + D) / 2)) x 100
04.28.17	SSW	50	12.0	14.0	2.0	20.0	^S 40	
↓	Duplicate (B)	↓	14.0	16.0	2.0	↓	^D 40	-0.4207

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO ₃ /L)
1N551407	40	50	14.0	18.0	4.0	20.0	80

Sample hardness (B) (mg CaCO ₃ /L)	Measured spike value (MV) (mg CaCO ₃ /L) MV = A - B	% R = MV / SV x 100 (acceptable range = 75 to 125%)
40	40	100.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)
TV = ND	Blank (should be = 0 mg CaCO ₃ /L)	50	0.0	0.0	0.0	20.0	ND
04.27.17	SSW		10.0	20.0	2.0		40
04.16.17	MHSW		20.0	24.0	4.0		92
04.19.17A			24.0	29.1	4.5		90
04.19.17B			29.1	33.5	4.4		88
04.20.17A			33.5	37.9	4.4		88
04.26.17B			37.9	42.0	4.1		82
	Quartry A		42.0	42.8	0.8		16
	↓ B		42.8	43.4	0.6		12
	↓ C		43.4	44.0	0.6		12

Note: If >15ml of titrant is used, sample must be diluted.

Reviewed by: [Signature]

Date reviewed 05-01-17

Hardness (SM 2340 C-1997)
RL = 1.0 mg CaCO₃/L

Analyst W
Date analyzed 04.28.17

Time initiated 04:28P
Time completed ✓

Titrant normality and multiplier determination:

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
						<u>20</u>

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>1NSS1407</u>	<u>40</u>	<u>50</u>	<u>44.0</u>	<u>46.0</u>	<u>2.0</u>	<u>20.0</u>	<u>40</u>	<u>100.0%</u>

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)	%RPD = ((S - D) / ((S+D)/2)) x 100
	<u>Quantity D</u>	<u>50</u>	<u>13.1</u>	<u>14.1</u>	<u>1.0</u>	<u>20.0</u>	<u>S 20</u>	
	<u>Duplicate (D)</u>	<u>50</u>	<u>14.1</u>	<u>15.1</u>	<u>1.0</u>	<u>20.0</u>	<u>D 20</u>	<u>0.4287</u>

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO ₃ /L)
<u>1NSS1407</u>	<u>40</u>	<u>50</u>	<u>14.1</u>	<u>17.0</u>	<u>2.9</u>	<u>20.0</u>	<u>50</u>

Sample hardness (B) (mg CaCO ₃ /L)	Measured spike value (MV) (mg CaCO ₃ /L) MV = A - B	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>20</u>	<u>30</u>	<u>95.0%</u>

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)
TV = ND	Blank (should be = 0 mg CaCO ₃ /L)						<u>0</u>
	<u>Quantity E</u>	<u>50</u>	<u>17.0</u>	<u>17.9</u>	<u>0.9</u>	<u>20.0</u>	<u>10</u>
	<u>F</u>		<u>17.9</u>	<u>19.3</u>	<u>1.4</u>		<u>20</u>
	<u>G</u>		<u>19.3</u>	<u>21.1</u>	<u>1.8</u>		<u>30</u>
	<u>H</u>		<u>21.1</u>	<u>22.7</u>	<u>1.6</u>		<u>32</u>
	<u>I</u>		<u>22.7</u>	<u>24.1</u>	<u>1.4</u>		<u>28</u>
	<u>J</u>		<u>24.1</u>	<u>27.5</u>	<u>3.4</u>		<u>60</u>
	<u>K</u>		<u>27.5</u>	<u>31.5</u>	<u>4.0</u>		<u>80</u>
	<u>L</u>		<u>31.5</u>	<u>33.4</u>	<u>1.9</u>		<u>30</u>
	<u>M</u>		<u>33.4</u>	<u>32.9</u>	<u>0.5</u>		<u>10</u>

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: W Date reviewed 05-01-17

Hardness (SM 2340 C-1997)
RL = 1.0 mg CaCO₃/L

Analyst W
Date analyzed 04.28.17

Time initiated 64207
Time completed W

Titrant normality and multiplier determination:

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
						<u>204207</u>

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>1N551407</u>	<u>40</u>	<u>50</u>	<u>33.9</u>	<u>35.9</u>	<u>2.0</u>	<u>20.0</u>	<u>40</u>	<u>100.0</u>

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)	% RPD = ((S - D) / ((S+D)/2)) x 100
	<u>Quantity N</u>	<u>50</u>	<u>35.9</u>	<u>37.7</u>	<u>1.8</u>	<u>20.0</u>	<u>S 36</u>	
	Duplicate (D)	<u>↓</u>	<u>37.7</u>	<u>39.5</u>	<u>1.8</u>	<u>↓</u>	<u>D 30</u>	<u>→ 04207</u>

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO ₃ /L)
<u>1N551407</u>	<u>40</u>	<u>50</u>	<u>37.7</u>	<u>41.5</u>	<u>3.8</u>	<u>20.0</u>	<u>70</u>

Sample hardness (B) (mg CaCO ₃ /L)	Measured spike value (MV) MV = A - B (mg CaCO ₃ /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>30</u>	<u>40</u>	<u>100.0</u>

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)
<u>TV = ND</u>	<u>Blank</u> (should be = 0 mg CaCO ₃ /L)						<u>04207</u>
	<u>Quantity</u>	<u>0</u>	<u>20.5</u>	<u>21.4</u>	<u>0.9</u>	<u>20.0</u>	<u>10</u>
	<u>P</u>		<u>21.4</u>	<u>22.6</u>	<u>0.6</u>		<u>12</u>
	<u>Q</u>		<u>22.0</u>	<u>22.2</u>	<u>0.2</u>		<u>4.0</u>
	<u>R</u>		<u>22.7</u>	<u>22.9</u>	<u>0.7</u>		<u>14</u>
	<u>S</u>		<u>22.9</u>	<u>23.2</u>	<u>0.3</u>		<u>6.0</u>
	<u>T</u>		<u>23.2</u>	<u>24.0</u>	<u>0.8</u>		<u>16</u>
	<u>U</u>		<u>24.0</u>	<u>25.4</u>	<u>1.4</u>		<u>20</u>
	<u>V</u>		<u>25.4</u>	<u>25.5</u>	<u>0.1</u>		<u>2.0</u>
	<u>W</u>		<u>25.5</u>	<u>25.7</u>	<u>0.2</u>		<u>40</u>
	<u>X</u>		<u>25.7</u>	<u>26.8</u>	<u>1.1</u>		<u>22</u>

Note: If >15ml of titrant is used, sample must be diluted.

Reviewed by: W

Date reviewed 05-01-17

Hardness (SM 2340 C-1997)

RL = 1.0 mg CaCO₃/L

Analyst W Jess
Date analyzed 05.06.17

Time initiated 1220
Time completed 1447

Titrant normality and multiplier determination:

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
JN2753	JN55 1446	0.0	10.0	10.0	0.0200	20.0

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
JN55 1487	40	50	10.0	11.8	1.8	20.0	30.0	90.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)	%RPD = ((S - D) / ((S+D)/2)) x 100
05.04.17	SSW	50	11.8	13.7	1.9	20.0	^S 38	
↓	Duplicate (B)	↓	13.7	15.6	1.9	↓	^D 38	85% 05-04-17

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO ₃ /L)
JN55 1487	40	50	13.7	17.6	3.9	20.0	78

Sample hardness (B) (mg CaCO ₃ /L)	Measured spike value (MV) (mg CaCO ₃ /L) MV = A - B (acceptable range = 75 to 125%)	% R = MV / SV x 100
38	78 - 40	100.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)
TV = ND	Blank (should be = 0 mg CaCO ₃ /L)	50	0.0	0.0	0.0	20.0	ND
05.02.17	MHSW	↓	20.3	24.6	4.3	↓	86
05.04.17	↓		24.6	28.7	4.1		82
05.05.17	↓		28.7	33.1	4.4		88
04-26-17A	MHSW WV 1		33.1	37.5	4.4		88
04-26-17B	↓ 2		37.5	41.8	4.3		86
05.02.17	↓ 3		41.8	46.1	4.3		86
170501.01	Jeherson 1		0.0	2.9	2.9		58
170503.33	↓ 2		2.9	5.6	2.7		54
170505.15	↓ 3		5.6	8.4	2.8		56

Note: If >15ml of titrant is used, sample must be diluted.

Reviewed by: JK

Date reviewed 05-06-17

Hardness (SM 2340 C-1997)

RL = 1.0 mg CaCO₃/L

Analyst: BSC W
Date analyzed: 05.06.17

Time initiated: 050017
Time completed:

Titrant normality and multiplier determination:

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
						<u>050017</u>

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS1487</u>	<u>40</u>	<u>50</u>	<u>8.4</u>	<u>10.4</u>	<u>2.0</u>	<u>20.0</u>	<u>40</u>	<u>100.0%</u>

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)	%RPD = ((S - D) / ((S+D)/2)) x 100
<u>170501.02</u>	<u>WJetterson 1</u>	<u>50</u>	<u>10.4</u>	<u>14.9</u>	<u>4.5</u>	<u>20.0</u>	<u>90</u>	
<u>↓</u>	<u>Duplicate (B)</u>	<u>↓</u>	<u>14.9</u>	<u>19.4</u>	<u>4.5</u>	<u>↓</u>	<u>90</u>	<u>BSC 05.06.17</u>

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO ₃ /L)
<u>INSS1487</u>	<u>40</u>	<u>50</u>	<u>14.9</u>	<u>21.4</u>	<u>6.5</u>	<u>20.0</u>	<u>130</u>

Sample hardness (B) (mg CaCO ₃ /L)	Measured spike value (MV) MV = A - B (mg CaCO ₃ /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>90</u>	<u>40</u>	<u>100.0%</u>

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)
<u>TV = ND</u>	<u>Blank</u> (should be = 0 mg CaCO ₃ /L)						<u>050017</u>
<u>170503.34</u>	<u>WJetterson 2</u>	<u>50</u> <u>20.0 05.06.17</u>	<u>21.4</u>	<u>25.4</u>	<u>4.0</u>	<u>20.0</u>	<u>80</u>
<u>170505.16</u>	<u>↓ 3</u>	<u>↓</u>	<u>25.4</u>	<u>30.0</u>	<u>4.6</u>		<u>92</u>
<u>170502.04</u>	<u>Aperx 1</u>	<u>50</u>	<u>30.0</u>	<u>32.3</u>	<u>2.3</u>		<u>46</u>
<u>170504.01</u>	<u>↓ 2</u>	<u>↓</u>	<u>32.3</u>	<u>35.1</u>	<u>2.8</u>		<u>56</u>
<u>170506.01</u>	<u>↓ 3</u>	<u>↓</u>	<u>35.1</u>	<u>37.5</u>	<u>2.4</u>		<u>48</u>
<u>170502.14</u>	<u>PCC001 Am</u>	<u>10</u>	<u>37.5</u>	<u>44.5</u>	<u>7.0</u>	<u>5</u> <u>(10) BSC 050017</u>	<u>140</u> <u>700 BSC 050017</u>
<u>170502.5</u>	<u>int Am</u>	<u>25</u>	<u>0.0</u>	<u>3.5</u>	<u>3.5</u>	<u>(2)</u>	<u>140</u>
<u>170502.13</u>	<u>Pm</u>	<u>10</u>	<u>3.5</u>	<u>10.6</u>	<u>7.1</u>	<u>5</u> <u>(10) BSC 050017</u>	<u>140</u> <u>710 BSC 050017</u>
<u>170502.13</u>	<u>int Pm</u>	<u>25</u>	<u>10.6</u>	<u>14.1</u>	<u>3.5</u>	<u>(2)</u>	<u>140</u>

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: Date reviewed: 05.06.17

Hardness (SM 2340 C-1997)

RL = 1.0 mg CaCO₃/L

Analyst BSL W
Date analyzed 05.06.17

Time initiated 050617
Time completed

Titrant normality and multiplier determination:

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0186 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
						<u>1000</u>

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS 1487</u>	<u>40</u>	<u>50</u>	<u>14.1</u>	<u>16.0</u>	<u>1.9</u>	<u>20.0</u>	<u>38</u>	<u>95.0%</u>

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)	%RPD = [(S - D) / ((S + D) / 2)] x 100
<u>170503-28</u>	<u>TVA ALF 001</u>	<u>25</u>	<u>16.0</u>	<u>21.7</u>	<u>5.7</u>	<u>(2) 20.0</u>	<u>S² 228 = 230</u>	
<u>↓</u>	<u>Duplicate (B)</u>	<u>↓</u>	<u>21.7</u>	<u>24.5</u>	<u>5.8</u>	<u>(2) ↓</u>	<u>D² 232 = 230</u>	<u>1.7% BSL 05.06.17</u>

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO ₃ /L)
<u>INSS 1487</u>	<u>80</u>	<u>25</u>	<u>21.7</u>	<u>29.5</u>	<u>2.0</u>	<u>(2) 20.0</u>	<u>80</u>

Sample hardness (B) (mg CaCO ₃ /L)	Measured spike value (MV) (mg CaCO ₃ /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>232</u>	<u>80</u>	<u>100.0%</u>

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)
<u>TV = ND</u>	<u>Blank</u> (should be = 0 mg CaCO ₃ /L)						<u>050617</u>
<u>170503-30</u>	<u>TVA ALF UP</u>	<u>25</u>	<u>29.5</u>	<u>30.4</u>	<u>1.1</u>	<u>(2) 20.0</u>	<u>44</u>
<u>170503-29</u>	<u>1 INT</u>	<u>↓</u>	<u>30.6</u>	<u>34.2</u>	<u>3.6</u>	<u>(2)</u>	<u>140-144</u>
<u>170503-20</u>	<u>Manteo</u>	<u>5</u>	<u>35.7</u>	<u>36.8</u>	<u>1.1</u>	<u>(10)</u>	<u>220</u>
<u>170504.05</u>	<u>Chem trade</u>	<u>25</u>	<u>36.8</u>	<u>40.9</u>	<u>4.1</u>		<u>82</u>
<u>* 170501.01</u>	<u>1</u>	<u>25</u>	<u>40.9</u>	<u>42.3</u>	<u>1.4</u>	<u>(2)</u>	<u>56</u>
<u>* 170501.02</u>	<u>2</u>		<u>42.3</u>	<u>43.9</u>	<u>1.6</u>	<u>(2)</u>	<u>64</u>
<u>* 170501.03</u>	<u>3</u>		<u>43.9</u>	<u>45.0</u>	<u>1.1</u>	<u>(2)</u>	<u>44</u>
<u>170501.04</u>	<u>TVA SAN 101 INT 1</u>	<u>50</u>	<u>0.0</u>	<u>3.2</u>	<u>3.2</u>		<u>64</u>
<u>170503-36</u>	<u>↓ 2</u>	<u>↓</u>	<u>3.2</u>	<u>6.5</u>	<u>3.3</u>		<u>66</u>

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: Date reviewed 05-06-17

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Hardness (SM 2340 C-1997)

RL = 1.0 mg CaCO₃/L

Analyst BSL W
Date analyzed 05-06-17

Time initiated 050017
Time completed 050017

Titrant normality and multiplier determination:

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
						<u>0.02017</u>

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>JN55 1487</u>	<u>40</u>	<u>50</u>	<u>6.5</u>	<u>8.4</u>	<u>1.9</u>	<u>20.0</u>	<u>38</u>	<u>95.0%</u>

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)	%RPD = ((S - D) / ((S+D)/2)) x 100
<u>170505.18</u>	<u>TVA SQW 101 INT 3</u>	<u>50</u>	<u>8.4</u>	<u>11.8</u>	<u>3.4</u>	<u>20.0</u>	<u>68</u>	
<u>↓</u>	<u>Duplicate (B)</u>	<u>↓</u>	<u>11.8</u>	<u>15.2</u>	<u>3.4</u>	<u>↓</u>	<u>68</u>	<u>BSL 05-06-17</u>

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO ₃ /L)
<u>JN55 1487</u>	<u>40</u>	<u>50</u>	<u>11.8</u>	<u>17.1</u>	<u>5.3</u>	<u>20.0</u>	<u>106 - 110</u>

Sample hardness (B) (mg CaCO ₃ /L)	Measured spike value (MV) MV = A - B (mg CaCO ₃ /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>68</u>	<u>38 (42)</u>	<u>95.0% (105.0%)</u>

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)
<u>TV = ND</u>	<u>Blank (should be = 0 mg CaCO₃/L)</u>						<u>0.050617</u>
<u>170501.03</u>	<u>TVA SQW 101 INT 1</u>	<u>50</u>	<u>17.1</u>	<u>20.3</u>	<u>3.2</u>	<u>20.0</u>	<u>64</u>
<u>170503.35</u>	<u>↓ 2</u>			<u>20.3</u>	<u>23.6</u>	<u>3.3</u>	<u>66</u>
<u>170505.17</u>	<u>↓ 3</u>			<u>23.6</u>	<u>26.9</u>	<u>3.3</u>	<u>66</u>
<u>170501.04</u>	<u>TVA SQW 101 INT 1</u>			<u>26.9</u>	<u>30.1</u>	<u>3.2</u>	<u>64</u>
<u>170503.36</u>	<u>↓ 2</u>			<u>30.1</u>	<u>33.4</u>	<u>3.3</u>	<u>66</u>
<u>170505.18</u>	<u>↓ 3</u>			<u>33.4</u>	<u>36.9</u>	<u>3.5</u>	<u>70</u>
							<u>BSL 05-06-17</u>

Note: If >15ml of titrant is used, sample must be diluted.

Reviewed by: JL

Date reviewed 05-06-17

Hardness (SM 2340 C-1997)

RL = 1.0 mg CaCO₃/L

Analyst W
Date analyzed 05.07.17

Time initiated 0902
Time completed 0908

Titrant normality and multiplier determination:

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
1N02753	1N551440	9.5	19.5	10.0	0.0200	20.0

Laboratory control standard:

Reference standard number	True value (TV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO ₃ /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
1N551407	40	50	19.5	21.5	2.0	20.0	40	100%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)	%RPD = ((S - D) / ((S+D)/2)) x 100
							S	
	Duplicate (B)						D	

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg CaCO ₃ /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO ₃ /L)

Sample hardness (B) (mg CaCO ₃ /L)	Measured spike value (MV) MV = A - B (mg CaCO ₃ /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
		<u>105%</u>

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO ₃ /L)
TV = ND	Blank (should be = 0 mg CaCO ₃ /L)	50	9.5	9.5	0.0	20.0	ND
170501.03	SAN 101	1	50	21.5	24.6	3.1	62
170503.35	1	2	1	24.6	27.9	3.3	66
170505.17	1	3	1	27.9	31.2	3.3	66

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: JH Date reviewed 05-07-17

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recheck w/o dilution

Sequoyah Nuclear Plant Biomonitoring
May 02 – 09, 2017

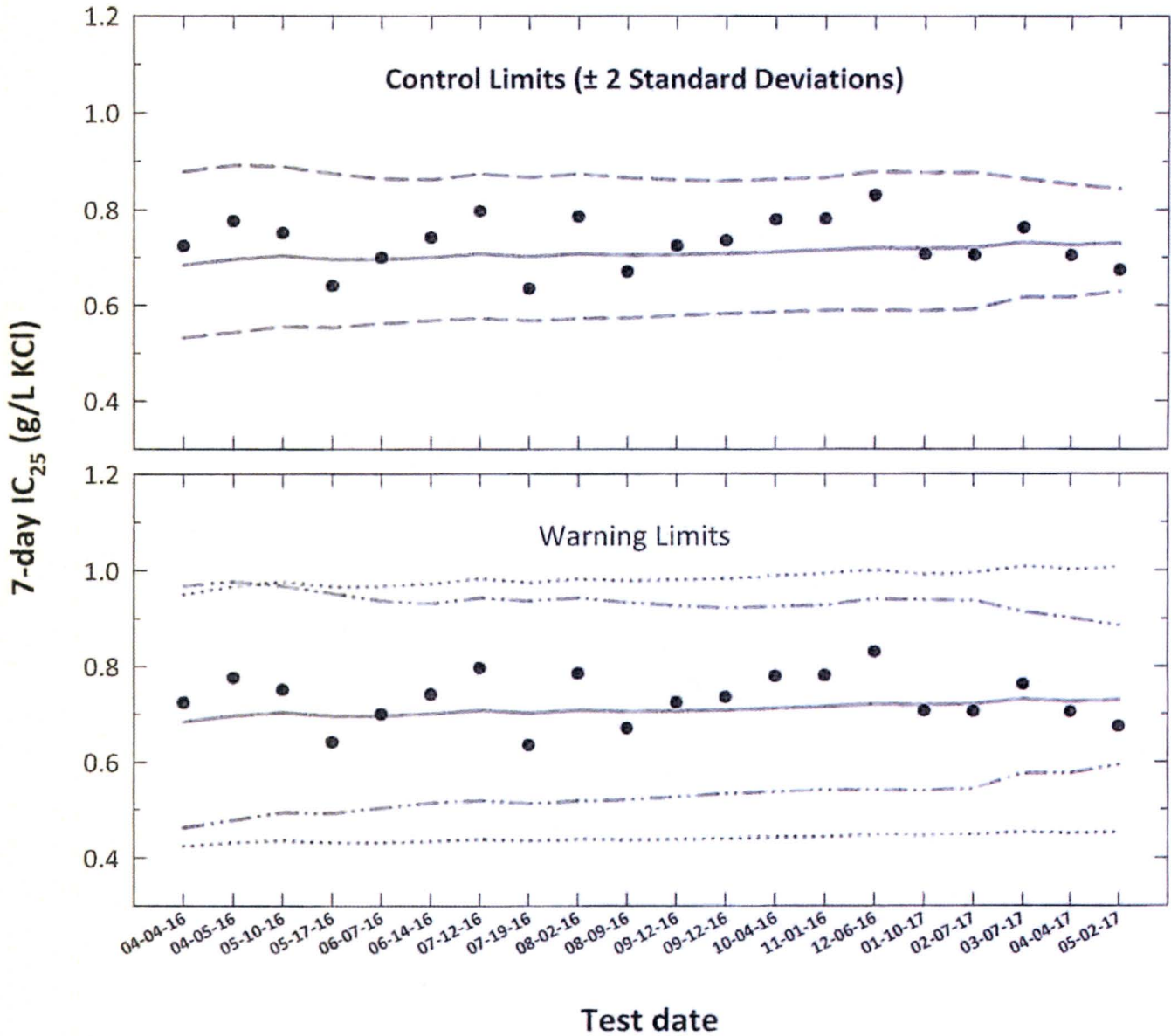
Appendix D

Reference Toxicant Test and
Control Chart

Pimephales promelas

Chronic Reference Toxicant Control Chart

Source: In-house Culture



- 7-day IC_{25} = 25% inhibition concentration. An estimation of the potassium chloride concentration which would cause a 25% reduction in *Pimephales* growth (calculated using ToxCalc).
- Central Tendency (mean logarithmic IC_{25} converted to anti-logarithmic values)
- - - Control Limits (mean logarithmic $IC_{25} \pm 2$ standard deviations converted to anti-logarithmic values)
- · - · - Laboratory Warning Limits (mean logarithmic $IC_{25} \pm 2$ coefficient of variations converted to anti-logarithmic values)
- · · · · USEPA Warning Limits (mean logarithmic $IC_{25} \pm S_{A,75}$ converted to anti-logarithmic values, $S_{A,75}$ = 75th percentile of CVs reported nationally by USEPA)

Independent Review by
Kelley E. Keenan:

Entered and Reviewed by
Jim Sumner

Pimephales promelas
Chronic Reference Toxicant Control Chart
Source: In-house Culture

Test number	Test date	7-day IC ₂₅ ToxCal Determination (g/L KCl)	Log ₁₀ Conversion			Anti-logarithmic Values (g/L KCl)						
			7-day IC ₂₅	CT	S	CT	Control Limits		Laboratory Calculated CV Warning Limits		75th Percentile CV Warning Limits	
							CT - 2S	CT + 2S	CT - 2CV	CT + 2CV	CT - S _{A,75}	CT + S _{A,75}
1	04-04-16	0.7240	-0.1402	-0.1647	0.0544	0.6844	0.5328	0.8791	0.4629	0.9689	0.4243	0.9506
2	04-05-16	0.7762	-0.1100	-0.1569	0.0538	0.6968	0.5440	0.8925	0.4775	0.9777	0.4320	0.9679
3	05-10-16	0.7510	-0.1244	-0.1528	0.0511	0.7034	0.5559	0.8899	0.4937	0.9685	0.4361	0.9770
4	05-17-16	0.6409	-0.1932	-0.1573	0.0496	0.6961	0.5539	0.8749	0.4918	0.9530	0.4316	0.9669
5	06-07-16	0.6998	-0.1550	-0.1571	0.0468	0.6965	0.5614	0.8640	0.5026	0.9370	0.4318	0.9674
6	06-14-16	0.7412	-0.1301	-0.1546	0.0451	0.7004	0.5690	0.8623	0.5127	0.9315	0.4343	0.9729
7	07-12-16	0.7965	-0.0988	-0.1500	0.0460	0.7080	0.5729	0.8749	0.5172	0.9437	0.4389	0.9834
8	07-19-16	0.6348	-0.1974	-0.1536	0.0459	0.7021	0.5682	0.8674	0.5114	0.9376	0.4353	0.9752
9	08-02-16	0.7850	-0.1051	-0.1502	0.0460	0.7077	0.5726	0.8746	0.5168	0.9436	0.4388	0.9830
10	08-09-16	0.6703	-0.1737	-0.1517	0.0447	0.7051	0.5739	0.8664	0.5190	0.9339	0.4372	0.9794
11	09-12-16	0.7241	-0.1402	-0.1510	0.0433	0.7063	0.5786	0.8622	0.5255	0.9270	0.4379	0.9810
12	09-12-16	0.7351	-0.1336	-0.1500	0.0421	0.7080	0.5831	0.8596	0.5315	0.9222	0.4389	0.9834
13	10-04-16	0.7791	-0.1084	-0.1477	0.0420	0.7117	0.5864	0.8638	0.5357	0.9254	0.4413	0.9886
14	11-01-16	0.7808	-0.1074	-0.1456	0.0419	0.7152	0.5897	0.8674	0.5398	0.9280	0.4434	0.9934
15	12-06-16	0.8303	-0.0808	-0.1423	0.0433	0.7206	0.5904	0.8795	0.5399	0.9411	0.4468	1.0009
16	01-10-17	0.7066	-0.1508	-0.1433	0.0432	0.7189	0.5892	0.8773	0.5384	0.9392	0.4457	0.9921
17	02-07-17	0.7052	-0.1517	-0.1421	0.0426	0.7209	0.5924	0.8772	0.5426	0.9378	0.4469	0.9948
18	03-07-17	0.7620	-0.1181	-0.1362	0.0365	0.7308	0.6178	0.8646	0.5761	0.9139	0.4531	1.0086
19	04-04-17	0.7043	-0.1523	-0.1392	0.0351	0.7258	0.6174	0.8531	0.5765	0.9012	0.4500	1.0015
20	05-02-17	0.6740	-0.1714	-0.1371	0.0316	0.7292	0.6305	0.8434	0.5939	0.8858	0.4521	1.0063

Note: 7-day IC₂₅ = 25% inhibition concentration. An estimation of the potassium chloride concentration that would cause a 25% reduction in *Pimephales* growth (calculated using ToxCal).

CT = Central tendency of the IC₂₅ values.

S = Standard deviation of the IC₂₅ values.

Control Limits = Mean logarithmic IC₂₅ ± 2 standard deviations converted to anti-logarithmic values.

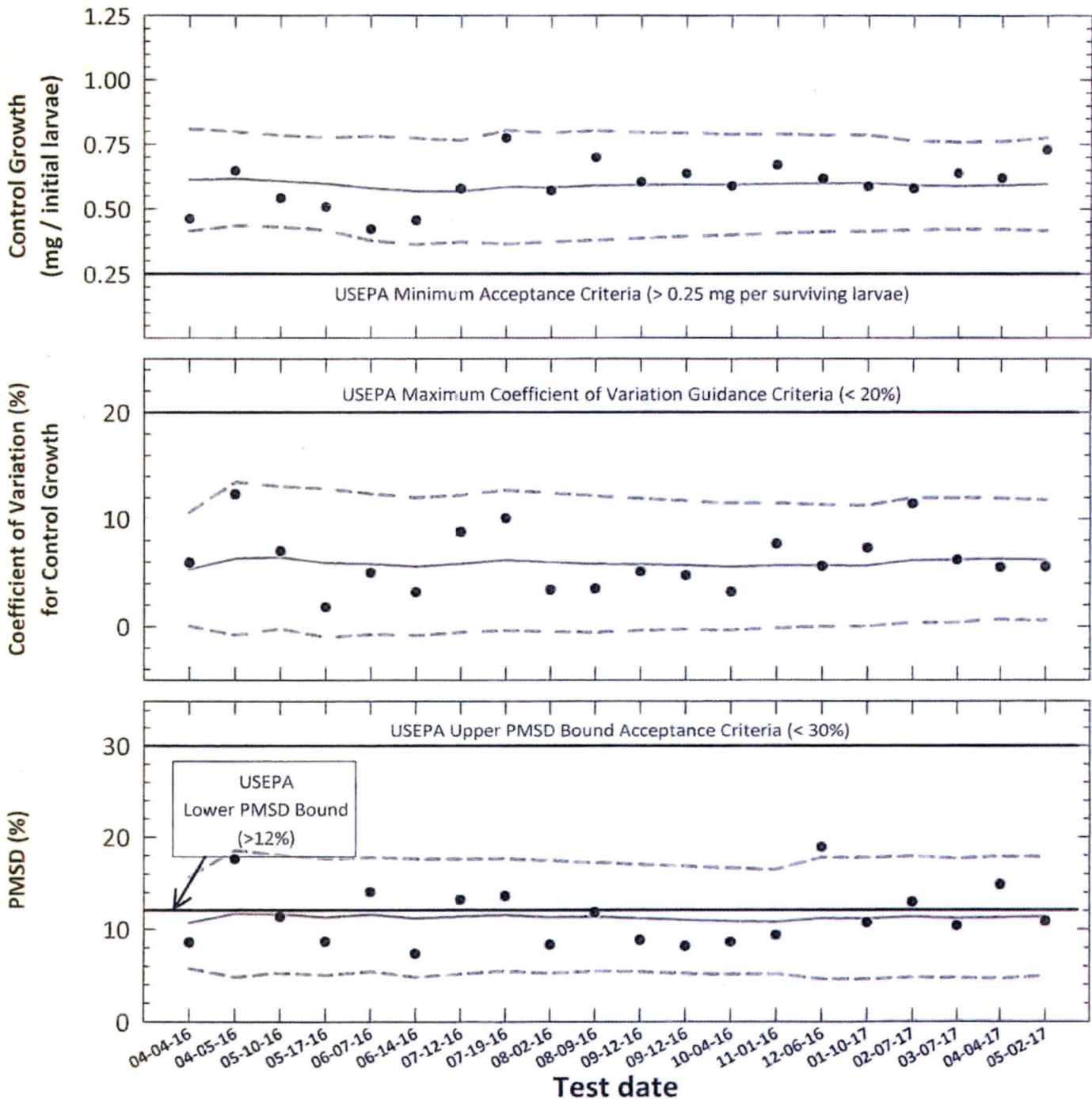
Warning Limits = Mean logarithmic IC₂₅ ± 2CV or S_{A,75} converted to anti-logarithmic values.

S_{A,75} = Standard deviation corresponding to the 75th percentile of CVs reported nationally by USEPA (S_{A,75} = 0.38).

CV = Coefficient of variation.


 Entered and
 Reviewed by
 Jm Sumner

Pimephales promelas
Chronic Reference Toxicant Testing, Test Acceptability Criteria
Organism Source: In-house Culture



- **Control Growth, Coefficient of Variation (CV) or Percent Minimum Significant Difference (PMSD)**
 PMSD is the percent minimum significant difference between the control and treatment that can be declared statistically significant. The lower PMSD bound represents a practical limit to the sensitivity of the test method and is not a minimum acceptance criteria.
- **Central Tendency** (mean Control Growth, CV or PMSD)
- **95% Confidence Interval** (mean Control Growth, CV or PMSD \pm 2 Standard Deviations)





Pimephales promelas
Chronic Reference Toxicant Testing, Test Acceptability Criteria
Source: In-house Culture

Test number	Test date	ToxCal Determination					Control Growth			Control Growth CV			Test PMSD		
		Control Survival (%)	Control Growth		Test		(mg/initial larvae)		(%)		(%)				
			Mean (mg/initial larvae)	CV (%)	MSD	PMSD (%)	CT	95% Confidence Interval CT - 2S	CT + 2S	CT	95% Confidence Interval CT - 2S	CT + 2S	CT	95% Confidence Interval CT - 2S	CT + 2S
1	04-04-16	100	0.461	5.9	0.0395	8.6	0.6125	0.415	0.810	5.3	0.0	10.6	10.7	5.8	15.7
2	04-05-16	100	0.647	12.3	0.1138	17.6	0.617	0.435	0.799	6.3	-0.8	13.5	11.7	4.8	18.6
3	05-10-16	100	0.541	7.0	0.0614	11.3	0.608	0.431	0.785	6.4	-0.2	13.1	11.7	5.3	18.0
4	05-17-16	100	0.507	1.8	0.0438	8.6	0.597	0.418	0.775	5.9	-1.0	12.9	11.3	5.0	17.6
5	06-07-16	100	0.421	5.0	0.0592	14.1	0.579	0.377	0.781	5.8	-0.7	12.4	11.6	5.4	17.8
6	06-14-16	100	0.455	3.2	0.0334	7.3	0.568	0.362	0.773	5.6	-0.8	12.0	11.2	4.8	17.6
7	07-12-16	100	0.578	8.8	0.0763	13.2	0.569	0.373	0.765	5.9	-0.5	12.3	11.4	5.2	17.6
8	07-19-16	100	0.774	10.1	0.1053	13.6	0.584	0.365	0.804	6.2	-0.4	12.7	11.5	5.5	17.6
9	08-02-16	100	0.570	3.4	0.0474	8.3	0.583	0.372	0.794	6.0	-0.5	12.5	11.3	5.2	17.4
10	08-09-16	100	0.699	3.5	0.0827	11.8	0.591	0.379	0.803	5.8	-0.6	12.2	11.4	5.5	17.2
11	09-12-16	100	0.604	5.1	0.0532	8.8	0.592	0.387	0.797	5.8	-0.4	11.9	11.2	5.4	17.0
12	09-12-16	100	0.637	4.8	0.0520	8.2	0.595	0.395	0.794	5.7	-0.3	11.7	11.0	5.2	16.8
13	10-04-16	100	0.588	3.2	0.0506	8.6	0.594	0.401	0.788	5.6	-0.4	11.5	10.9	5.1	16.6
14	11-01-16	100	0.671	7.7	0.0627	9.3	0.598	0.407	0.790	5.7	-0.2	11.5	10.8	5.2	16.4
15	12-06-16	100	0.617	5.6	0.1167	18.9	0.599	0.413	0.786	5.7	0.0	11.4	11.2	4.6	17.8
16	01-10-17	100	0.587	7.3	0.0629	10.7	0.600	0.414	0.786	5.7	0.0	11.3	11.2	4.6	17.7
17	02-07-17	100	0.579	11.5	0.0751	13.0	0.591	0.420	0.763	6.2	0.3	12.0	11.4	4.8	17.9
18	03-07-17	100	0.638	6.2	0.0662	10.4	0.590	0.421	0.759	6.2	0.4	12.0	11.2	4.7	17.7
19	04-04-17	100	0.620	5.5	0.0919	14.8	0.591	0.422	0.761	6.3	0.6	11.9	11.3	4.7	17.9
20	05-02-17	100	0.729	5.6	0.0792	10.9	0.596	0.416	0.776	6.2	0.6	11.8	11.4	5.0	17.8

Note: Control Survival = USEPA minimum test acceptability criteria ≥ 80% survival.

Control Mean Growth = USEPA minimum test acceptability criteria ≥ 0.25 mg/surviving larvae.

CV = Coefficient of variation for control growth.

USEPA maximum CV guidance criteria (90th percentile) < 20%

MSD = Minimum significant difference.

PMSD = Percent minimum significant difference.

PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.

Lower PMSD bound determined by USEPA (10th percentile) > 12%.

The lower PMSD bound represents a practical limit to the sensitivity of the test method and is not a minimum acceptance criteria.

Upper PMSD bound acceptance criteria determined by USEPA (90th percentile) < 30%.

CT = Central tendency of the growth, CV or PMSD values.

S = Standard deviation of the growth, CV or PMSD values.



**Potassium Chloride Chronic Reference Toxicant Test
(EPA-822-R-02-013 Method 1000.0)**

Species: *Pimephales promelas*

PpKCICR Test Number: 25

<i>Dilution preparation information:</i>							<i>Comments:</i>
KCl Stock INSS number:			INSS 1586				
Stock preparation:			50 g KCl/L: Dissolve 50 g KCl in 1-L Milli-Q water.				
Dilution prep (mg/L)	300	450	600	750	900	1050	
Stock volume (mL)	9	13.5	18	22.5	27	31.5	
Diluent volume (mL)	1491	1486.5	1482	1477.5	1473	1468.5	
Total volume (mL)	1500	1500	1500	1500	1500	1500	

<i>Test organism information:</i>		<i>Test information:</i>	
Organism source:	In-house culture	Randomizing template:	Light orange
Age:	< 24-hours old	Incubator number and shelf location:	7B
Spawn date:	04-27-17	Artemia CHM number:	CHM914
Hatch dates and times:	05-01-17 1700 TO 05-02-17 0605	<i>Drying information for weight determination:</i>	
Transfer vessel information:	pH = 7.86 S.U. Temperature = 24.9 °C	Date / Time in oven:	05-09-17 0930
Average transfer volume:	< 0.25 mL	Initial oven temperature:	60°C
		Date / Time out of oven:	05-10-17 0930
		Final oven temperature:	60°C
		Total drying time:	24-Hours

Daily feeding and renewal information:

Day	Date	Morning feeding		Afternoon feeding		Test initiation, renewal, or termination		MHSW batch used
		Time	Analyst	Time	Analyst	Time	Analyst	
0	05-02-17	0610	JL	1230	JL	0820	JL	04-26-17A
1	05-03-17	0600	JL	1200	JL	0834	JL	04-26-17B
2	05-04-17	0605	JL	1205	JL	0839	JL	04-26-17B
3	05-05-17	0610	JL	1210	JL	0840	JL	04-26-17B
4	05-06-17	0715	JL	1315	JL	0915	JL	05-02-17
5	05-07-17	0740	JL	1340	JL	0940	JL	05-02-17
6	05-08-17	0615	JL	1215	JL	0902	JL	05-02-17
7	05-09-17					0840	JL	

<i>Control information:</i>		Acceptance criteria	<i>Summary of test endpoints:</i>	
% Mortality:	07.	≤ 20%	7-day LC ₅₀	865.8
Average weight per initial larvae:	0.729		NOEC	< 300
Average weight per surviving larvae:	0.729	≥ 0.25 mg/larvae	LOEC	300
			ChV	< 300
			IC ₂₅	674.0



Species: *Pimephales promelas*

PpKCICR Test Number: 25

Survival and Growth Data

Day	Control				300 mg KCl/L				450 mg KCl/L			
	A	B	C	D	E	F	G	H	I	J	K	L
0	10	10	10	10	10	10	10	10	10	10	10	10
1	10	10	10	10	10	10	10	10	10	10	10	10
2	10	10	10	10	10	10	10	10	10	10	10	10
3	10	10	10	10	10	10	10	10	10	10	10	10
4	10	10	10	10	10	10	10	10	10	10	10	10
5	10	10	10	10	10	10	10	10	10	10	10	10
6	10	10	10	10	10	10	10	10	10	10	10	10
7	10	10	10	10	10	10	10	10	10	10	10	10
A = Pan weight (mg) Tray color code: <u>light blue</u> Analyst: <u>u</u> Date: <u>04.22.17</u>	15.15	15.35	16.25	15.98	15.40	13.42	15.00	15.89	15.35	16.18	14.72	15.30
B = Pan + Larvae weight (mg) Analyst: <u>u</u> Date: <u>05.11.17</u>	22.70	22.41	23.08	22.81	21.50	19.34	21.08	23.18	21.94	22.04	20.79	20.74
C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>u</u>	7.63	7.06	7.63	6.83	6.10	5.92	6.08	7.29	6.59	5.86	6.07	5.44
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>u</u>	0.763	0.706	0.763	0.683	0.610	0.592	0.608	0.729	0.659	0.586	0.607	0.544
Average weight per initial number of larvae (mg)	0.729				0.635		12.97		0.599		17.87	
Percent reduction from control (%)												

Comment codes: c = clear, d = dead, fg = fungus, k = killed, m = missing, sk = sick, sm = unusually small, lg = unusually large, d&r = decanted and returned, w = wounded.

Comments:



Species: Pimephales promelas

PpKCICR Test Number: 25

Survival and Growth Data

Day	600 mg KCl/L				750 mg KCl/L				900 mg KCl/L						
	M	N	O	P	Q	R	S	T	U	V	W	X			
0	10	10	10	10	10	10	10	10	10	10	10	10			
1	10	10	10	10	10	10	10	10	10	9 ^{id}	10	9 ^{id}			
2	10	10	10	10	10	10	10	10	10	9	9 ^{id}	9			
3	10	10	10	10	10	10	10	10	10	9	9	9			
4	10	10	10	10	10	9 ^{id}	9 ^{id}	8 ^{2d}	8 ^{2d}	9	8 ^{id}	8 ^{id}			
5	8 ^{2d}	10	9 ^{id}	10	7 ^{3d}	8 ^{id}	8 ^{id}	8	7 ^{id}	6 ^{2d}	8	6 ^{2d}			
6	8	10	9	10	7	7 ^{id}	8	8	7	6	6 ^{2d}	6			
7	8	10	9	10	7	7	7 ^{id}	8	7	6	6	6			
A = Pan weight (mg) Tray color code: <u>light blue</u> Analyst: <u>K</u> Date: <u>04.22.17</u>															
B = Pan + Larvae weight (mg) Analyst: <u>K</u> Date: <u>05.11.17</u>															
C = Larvae weight (mg) = B - A															
Hand calculated. Analyst: <u>J</u>															
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>J</u>															
Average weight per initial number of larvae (mg)		Percent reduction from control (%)		0.628		13.87.		0.478		34.47		0.395		45.97.	

Comment codes: c = clear, d = dead, fg = fungus, k = killed, m = missing, sk = sick, sm = unusually small, lg = unusually large, d&r = decanted and returned, w = wounded.

Comments:



Species: Pimephales promelas

PpKCICR Test Number: 25

Survival and Growth Data

Day	1050 mg KCl/L				
	Y	Z	AA	BB	
0	10	10	10	10	
1	7 ^{sk}	7 ^{sk}	6 ^{cd}	6 ^{cd}	
2	6 ^{cd}	6 ^{cd}	6	6	
3	4 ^{sk}	5 ^{cd}	6	6	
4	2 ^{sk}	3 ^{sk}	3 ^{sk}	2 ^{cd}	
5	1 ^{cd}	1 ^{cd}	2 ^{sk}	1 ^{cd}	
6	1	0 ^{cd}	1 ^{cd}	0 ^{cd}	
7	1	0	1	0	
A = Pan weight (mg) Tray color code: <u>Tight Blue</u> Analyst: <u>K</u> Date: <u>04.22.17</u>		16.34	15.67 ^{sk}	16.18	14.63 ^{sk}
B = Pan + Larvae weight (mg) Analyst: <u>K</u> Date: <u>05.11.17</u>		17.07	16.99 ^{sk}	16.99	16.99 ^{sk}
C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>JL</u>		0.730	0.810 ^{sk}	0.810	0.810 ^{sk}
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>JL</u>		0.073	0	0.081	0
Average weight per initial number of larvae (mg)	Percent reduction from control (%)	0.039	94.77.		

Comment codes: c = clear, d = dead, fg = fungus, k = killed, m = missing, sk = sick, sm = unusually small, lg = unusually large, d&r = decanted and returned, w = wounded.

Comments:





Pimephales promelas Chronic Reference Toxicant Test
EPA-821-R-02-013, Method 1000.0

Quality Control
Verification of Data Entry, Calculations, and Statistical Analyses

Test number: _____ 25
Test dates: _____ May 02-09, 2017

Concentration (mg/L KCl)	Replicate	Initial number of larvae	Final number of larvae	A = Pan weight (mg)	B = Pan + larvae weight (mg)	Larvae weight (mg) = B - A	Weight / Surviving number of larvae (mg)	Mean weight / Surviving number of larvae (mg)	Coefficient of variation (Mean weight per surviving number of larvae) (%)	Weight / Initial number of larvae (mg)	Mean survival (%)	Mean weight / Initial number of larvae (mg)	Coefficient of variation (%)	Percent reduction from control (%)
Control	A	10	10	15.15	22.78	7.63	0.763	0.729	5.6	0.763	100.0	0.729	5.6	Not applicable
	B	10	10	15.35	22.41	7.06	0.706			0.706				
	C	10	10	16.25	23.88	7.63	0.763			0.763				
	D	10	10	15.98	22.81	6.83	0.683			0.683				
300	E	10	10	15.40	21.50	6.10	0.610	0.635	10.0	0.610	100.0	0.635	10.0	12.9
	F	10	10	13.42	19.34	5.92	0.592			0.592				
	G	10	10	15.00	21.08	6.08	0.608			0.608				
	H	10	10	15.89	23.18	7.29	0.729			0.729				
450	I	10	10	15.35	21.94	6.59	0.659	0.599	8.0	0.659	100.0	0.599	8.0	17.8
	J	10	10	16.18	22.04	5.86	0.586			0.586				
	K	10	10	14.72	20.79	6.07	0.607			0.607				
	L	10	10	15.30	20.74	5.44	0.544			0.544				
600	M	10	8	14.54	20.41	5.87	0.734	0.681	5.5	0.587	92.5	0.628	6.4	13.8
	N	10	10	15.92	22.37	6.45	0.645			0.645				
	O	10	9	15.84	21.88	6.04	0.671			0.604				
	P	10	10	14.96	21.72	6.76	0.676			0.676				
750	Q	10	7	15.24	20.08	4.84	0.691	0.659	6.1	0.484	72.5	0.478	8.9	34.4
	R	10	7	16.12	20.92	4.80	0.686			0.480				
	S	10	7	14.97	19.19	4.22	0.609			0.422				
	T	10	8	15.03	20.28	5.25	0.656			0.525				
900	U	10	7	15.95	20.65	4.70	0.671	0.630	14.2	0.470	62.5	0.395	18.1	45.9
	V	10	6	15.40	19.75	4.35	0.725			0.435				
	W	10	6	15.78	18.89	3.11	0.518			0.311				
	X	10	6	16.57	20.19	3.62	0.603			0.362				
1050	Y	10	1	16.34	17.07	0.73	0.730	0.770	7.3	0.073	5.0	0.039	115.8	94.7
	Z	10	0	0.00	0.00	0.00	0.000			0.000				
	AA	10	1	16.18	16.99	0.81	0.810			0.081				
	BB	10	0	0.00	0.00	0.00	0.000			0.000				

Junnett's MSD value: 0.0792
MSD: 10.9

MSD = Minimum Significant Difference
PMSD = Percent Minimum Significant Difference

PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.
Lower PMSD bound determined by USEPA (10th percentile) = 12%
Upper PMSD bound determined by USEPA (90th percentile) = 30%.
Lower and upper PMSD bounds were determined from the 10th and 90th percentile, respectively, of PMSD data from EPA's WET Interlaboratory Variability Study (USEPA, 2001a; USEPA, 2001b).
The lower PMSD bound represents a practical limit to the sensitivity of the test method and is not a minimum acceptance criteria.



Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Survival

Start Date: 5/2/2017 Test ID: PpKClCR Sample ID: REF-Ref Toxicant
 End Date: 5/9/2017 Lab ID: ETS-Envir. Testing Sol. Sample Type: KCL-Potassium chloride
 Sample Date: Protocol: FWCHR-EPA-821-R-02-013 Test Species: PP-Pimephales promelas
 Comments:

Conc-mg/L	1	2	3	4
D-Control	1.0000	1.0000	1.0000	1.0000
300	1.0000	1.0000	1.0000	1.0000
450	1.0000	1.0000	1.0000	1.0000
600	0.8000	1.0000	0.9000	1.0000
750	0.7000	0.7000	0.7000	0.8000
900	0.7000	0.6000	0.6000	0.6000
1050	0.1000	0.0000	0.1000	0.0000

Conc-mg/L	Transform: Arcsin Square Root						Rank Sum	1-Tailed Critical	Number Resp	Total Number
	Mean	N-Mean	Mean	Min	Max	CV%				
D-Control	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4		0	40
300	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4	18.00	10.00	40
450	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4	18.00	10.00	40
600	0.9250	0.9250	1.2951	1.1071	1.4120	11.347	4	14.00	10.00	3
*750	0.7250	0.7250	1.0202	0.9912	1.1071	5.685	4	10.00	10.00	11
*900	0.6250	0.6250	0.9123	0.8861	0.9912	5.759	4	10.00	10.00	15
*1050	0.0500	0.0500	0.2403	0.1588	0.3218	39.161	4	10.00	10.00	38

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.87827	0.896	-0.3868	1.96258

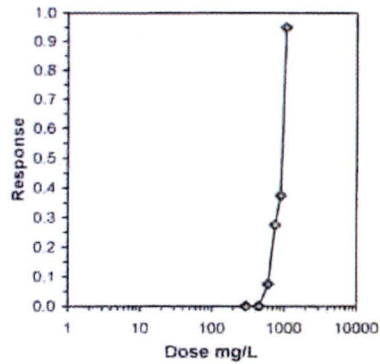
Equality of variance cannot be confirmed

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	600	750	670.82	

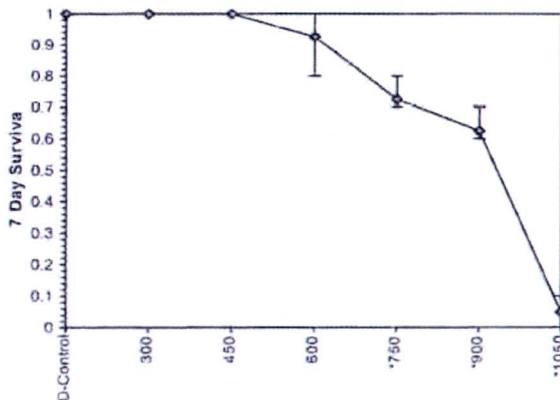
Treatments vs D-Control

Trimmed Spearman-Kärber

Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%	876.51	834.62	920.49
20.0%	897.43	848.37	949.33
Auto-5.0%	865.76	826.27	907.13



Dose-Response Plot



Checked and Reviewed by
JRM/Summer
H

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	5/2/2017	Test ID:	PpKCICR	Sample ID:	RFF-Ref Toxicant
End Date:	5/9/2017	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	KCL-Potassium chloride
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:					

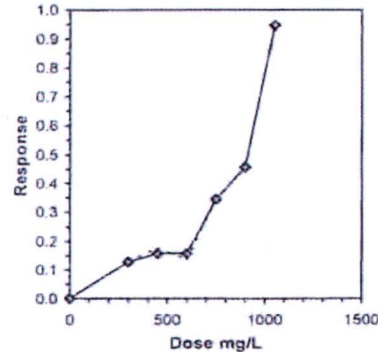
Conc-mg/L	1	2	3	4
D-Control	0.7630	0.7060	0.7630	0.6830
300	0.6100	0.5920	0.6080	0.7290
450	0.6590	0.5860	0.6070	0.5440
600	0.5870	0.6450	0.6040	0.6760
750	0.4840	0.4800	0.4220	0.5250
900	0.4700	0.4350	0.3110	0.3620
1050	0.0730	0.0000	0.0810	0.0000

Conc-mg/L	Transform: Untransformed							1-Tailed			Isotonic	
	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.7288	1.0000	0.7288	0.6830	0.7630	5.578	4				0.7288	1.0000
*300	0.6348	0.8710	0.6348	0.5920	0.7290	9.980	4	2.718	2.290	0.0792	0.6348	0.8710
*450	0.5990	0.8220	0.5990	0.5440	0.6590	7.982	4	3.752	2.290	0.0792	0.6135	0.8419
*600	0.6280	0.8617	0.6280	0.5870	0.6780	6.403	4	2.913	2.290	0.0792	0.6135	0.8419
750	0.4778	0.6556	0.4778	0.4220	0.5250	8.868	4				0.4778	0.6556
900	0.3945	0.5413	0.3945	0.3110	0.4700	18.143	4				0.3945	0.5413
1050	0.0385	0.0528	0.0385	0.0000	0.0810	115.781	4				0.0385	0.0528

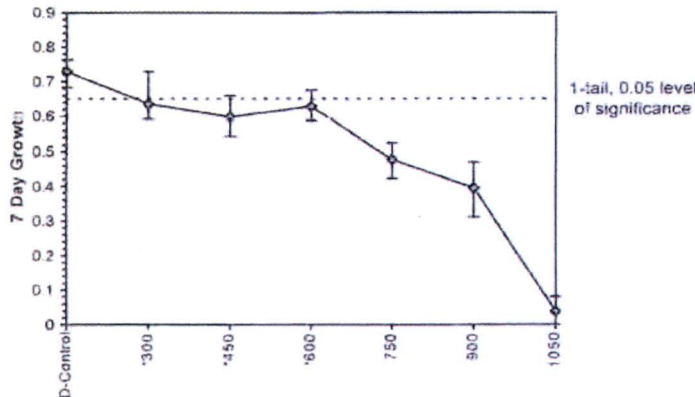
Auxiliary Tests	Statistic	Critical	Skew	Kurt						
Shapiro-Wilk's Test indicates normal distribution ($p > 0.01$)	0.92374	0.844	0.70843	-0.4102						
Bartlett's Test indicates equal variances ($p = 0.86$)	0.76291	11.3449								
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnnett's Test	<300	300			0.07919	0.10867	0.01266	0.00239	0.0148	3 12
Treatments vs D-Control										

Point	Linear Interpolation (200 Resamples)				
	mg/L	SD	95% CL(Exp)	Skew	
IC05*	116.29	61.66	54.14	438.34	1.8870
IC10*	232.58	85.50	108.28	602.01	1.6404
IC15	408.09	138.74	128.89	754.60	0.3100
IC20	633.70	58.72	316.33	696.56	-3.8530
IC25	673.96	19.94	613.55	747.38	0.2701
IC40	822.97	41.45	715.37	958.28	0.3965
IC50	912.69	18.66	829.43	945.96	-1.0893

* indicates IC estimate less than the lowest concentration



Dose-Response Plot



Reviewed and
Endorsed by
John Summers
JS



Species: Pimephales promelas

PpKCICR Test Number: 25

Daily Chemistry:

Concentration		Analyst		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
				0		1		2	
				u	v	u	u	u	u
Parameter									
CONTROL	pH (S.U.)	8.21	7.93	8.10	7.72	8.08	7.73		
	DO (mg/L)	7.9	7.6	7.7	7.4	7.7	7.2		
	Conductivity (µmhos/cm)	321		328		319			
	*Alkalinity (mg CaCO ₃ /L)	61		62		61			
	*Hardness (mg CaCO ₃ /L)	88		82					
	*Temperature (°C)	24.7	25.2	24.7	24.7	24.6	24.4		
300 mg KCl/L	pH (S.U.)	8.17	7.83	8.07	7.60	8.00	7.59		
	DO (mg/L)	7.9	7.6	7.9	7.4	7.8	7.4		
	Conductivity (µmhos/cm)	862		848		841			
	*Temperature (°C)	24.6	25.4	24.7	24.5	24.6	24.4		
450 mg KCl/L	pH (S.U.)	8.15	7.85	8.06	7.62	8.05	7.61		
	DO (mg/L)	7.9	7.6	7.9	7.3	7.8	7.3		
	Conductivity (µmhos/cm)	1090		1070		1060			
	*Temperature (°C)	24.6	25.0	24.8	24.5	24.6	24.2		
600 mg KCl/L	pH (S.U.)	8.15	7.85	8.05	7.61	8.04	7.61		
	DO (mg/L)	8.0	7.6	7.9	7.3	7.9	7.5		
	Conductivity (µmhos/cm)	1340		1320		1320			
	*Temperature (°C)	24.6	24.8	24.8	24.5	24.7	24.2		
750 mg KCl/L	pH (S.U.)	8.14	7.84	8.05	7.60	8.02	7.60		
	DO (mg/L)	8.0	7.7	8.0	7.3	8.0	7.3		
	Conductivity (µmhos/cm)	1570		1540		1530			
	*Temperature (°C)	24.6	25.0	24.8	24.6	24.7	24.5		
900 mg KCl/L	pH (S.U.)	8.13	7.82	8.04	7.63	8.03	7.59		
	DO (mg/L)	8.0	7.7	8.0	7.3	8.0	7.3		
	Conductivity (µmhos/cm)	1830		1820		1810			
	*Temperature (°C)	24.6	25.0	24.8	24.4	24.8	24.5		
1050 mg KCl/L	pH (S.U.)	8.13	7.80	8.04	7.64	8.04	7.57		
	DO (mg/L)	8.1	7.6	8.0	7.2	8.0	7.3		
	Conductivity (µmhos/cm)	2150		2100		2120			
	*Temperature (°C)	24.7	24.9	24.9	24.7	24.8	24.6		
		Initial	Final	Initial	Final	Initial	Final		

*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1. Alkalinity and hardness performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: J

Independent Review by
Kaitly E. Keenan

Species: Pimephales promelas

PpKCICR Test Number: 25

Analyst		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)							
		3		4		5		6	
		u	BSC	K/ase	u	u	u	u	u
Concentration	Parameter								
CONTROL	pH (S.U.)	8.13	7.83	8.08	7.67	8.15	7.02	8.19	7.49
	DO (mg/L)	7.7	7.7	7.8	6.9	7.7	7.0	7.0	6.0
	Conductivity (µmhos/cm)	326		317		324		320	
	*Alkalinity (mg CaCO ₃ /L)	8.1		63		8.1		8.1	
	*Hardness (mg CaCO ₃ /L)	8.1		86		8.1		8.1	
	*Temperature (°C)	24.6	24.4	24.6	24.6	24.8	24.4	24.8	24.3
300 mg KCl/L	pH (S.U.)	8.07	7.75	8.11	7.53	8.10	7.76	8.15	7.43
	DO (mg/L)	7.9	7.7	7.8	7.0	7.7	7.6	7.9	6.1
	Conductivity (µmhos/cm)	841		894		809		805	
	*Temperature (°C)	24.8	24.6	24.7	24.3	24.7	24.6	24.9	24.2
450 mg KCl/L	pH (S.U.)	8.06	7.76	8.12	7.50	8.09	7.69	8.14	7.52
	DO (mg/L)	7.9	7.7	7.9	7.0	7.7	7.0	7.9	6.3
	Conductivity (µmhos/cm)	1070		1150		1140		1110	
	*Temperature (°C)	24.6	24.7	24.7	24.7	24.7	24.2	24.9	24.2
600 mg KCl/L	pH (S.U.)	8.05	7.79	8.12	7.54	8.09	7.66	8.13	7.51
	DO (mg/L)	8.0	7.9	8.0	6.9	7.7	7.6	7.9	6.3
	Conductivity (µmhos/cm)	1320		1430		1420		1370	
	*Temperature (°C)	24.6	24.3	24.7	24.6	24.7	24.2	24.9	24.5
750 mg KCl/L	pH (S.U.)	8.05	7.72	8.11	7.50	8.08	7.45	8.13	7.49
	DO (mg/L)	8.0	7.6	8.0	7.0	7.8	7.5	8.0	6.3
	Conductivity (µmhos/cm)	1550		1680		1070		1620	
	*Temperature (°C)	24.7	24.4	24.7	24.4	24.7	24.5	24.9	24.4
900 mg KCl/L	pH (S.U.)	8.04	7.71	8.11	7.53	8.08	7.69	8.12	7.48
	DO (mg/L)	8.1	7.7	8.0	6.8	7.8	7.5	8.0	6.3
	Conductivity (µmhos/cm)	1830		2010		1970		1860	
	*Temperature (°C)	24.7	24.4	24.8	24.4	24.7	24.2	24.9	24.4
1050 mg KCl/L	pH (S.U.)	8.03	7.75	8.09	7.60	8.07	7.79	8.12	7.40
	DO (mg/L)	8.1	7.7	8.2	7.5	7.8	7.6	8.1	6.2
	Conductivity (µmhos/cm)	2160		2190		2140		2140	
	*Temperature (°C)	24.6	24.4	24.8	24.3	24.7	24.4	25.0	24.4
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

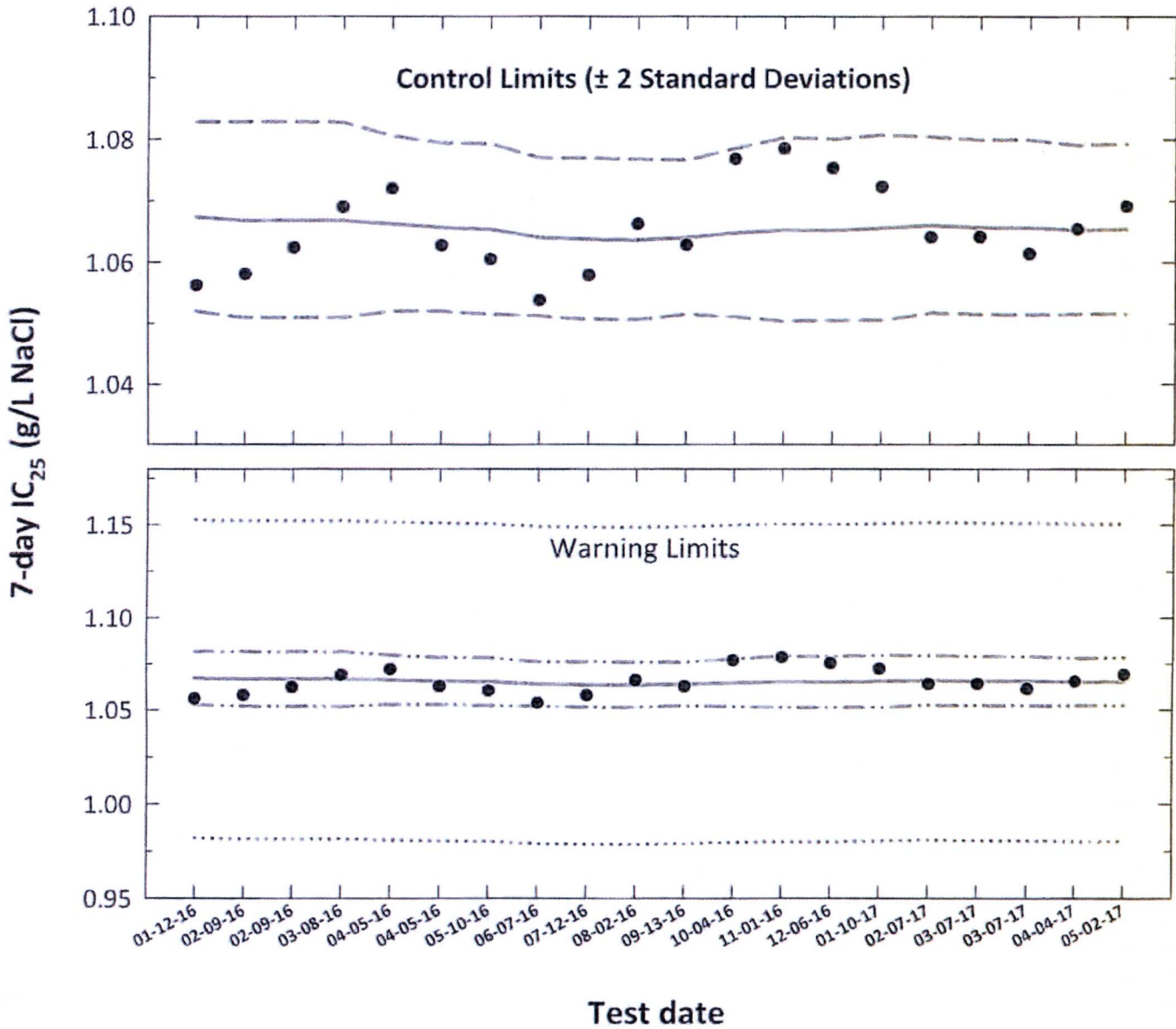


Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1. Alkalinity and hardness performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: u

Ceriodaphnia dubia

Chronic Reference Toxicant Control Chart

Source: In-house Culture



- 7-day IC_{25} = 25% inhibition concentration. An estimation of the sodium chloride concentration which would cause a 25% reduction in *Ceriodaphnia* reproduction (calculated using ToxCalc).
- Central Tendency (mean logarithmic IC_{25} converted to anti-logarithmic values)
- - - Control Limits (mean logarithmic $IC_{25} \pm 2$ standard deviations converted to anti-logarithmic values)
- · - · - Laboratory Warning Limits (mean logarithmic $IC_{25} \pm 2$ coefficient of variations converted to anti-logarithmic values)
- · · · · USEPA Warning Limits (mean logarithmic $IC_{25} \pm S_{A,10}$ converted to anti-logarithmic values, $S_{A,10} = 10^{\text{th}}$ percentile of CVs reported nationally by USEPA)



Ceriodaphnia dubia
Chronic Reference Toxicant Control Chart
Source: In-house Culture

Test number	Test date	7-day IC ₂₅ ToxCal Determination (g/L NaCl)	Log ₁₀ Conversion			Anti-logarithmic Values (g/L NaCl)						
			7-day IC ₂₅	CT	S	CT	Control Limits		Laboratory Calculated CV Warning Limits		10th Percentile CV Warning Limits	
							CT - 2S	CT + 2S	CT - 2CV	CT + 2CV	CT - S _{A,10}	CT + S _{A,10}
1	01-12-16	1.0562	0.0238	0.0283	0.0031	1.0673	1.0520	1.0828	1.0530	1.0816	0.9819	1.1527
2	02-09-16	1.0581	0.0245	0.0281	0.0032	1.0668	1.0510	1.0829	1.0520	1.0816	0.9815	1.1521
3	02-09-16	1.0624	0.0263	0.0281	0.0032	1.0668	1.0510	1.0829	1.0520	1.0816	0.9815	1.1522
4	03-08-16	1.0690	0.0290	0.0281	0.0032	1.0668	1.0510	1.0828	1.0520	1.0815	0.9814	1.1521
5	04-05-16	1.0720	0.0302	0.0279	0.0029	1.0662	1.0521	1.0806	1.0529	1.0795	0.9809	1.1515
6	04-05-16	1.0627	0.0264	0.0276	0.0028	1.0656	1.0520	1.0794	1.0528	1.0784	0.9804	1.1509
7	05-10-16	1.0605	0.0255	0.0275	0.0028	1.0654	1.0516	1.0793	1.0524	1.0783	0.9801	1.1506
8	06-07-16	1.0538	0.0228	0.0270	0.0026	1.0640	1.0512	1.0770	1.0520	1.0760	0.9789	1.1491
9	07-12-16	1.0579	0.0244	0.0268	0.0027	1.0637	1.0507	1.0770	1.0515	1.0760	0.9786	1.1488
10	08-02-16	1.0662	0.0278	0.0268	0.0027	1.0637	1.0507	1.0768	1.0515	1.0759	0.9786	1.1487
11	09-13-16	1.0628	0.0265	0.0269	0.0026	1.0640	1.0515	1.0766	1.0523	1.0757	0.9789	1.1491
12	10-04-16	1.0768	0.0321	0.0273	0.0028	1.0648	1.0511	1.0786	1.0519	1.0776	0.9796	1.1499
13	11-01-16	1.0785	0.0328	0.0274	0.0030	1.0652	1.0504	1.0803	1.0513	1.0792	0.9800	1.1505
14	12-06-16	1.0753	0.0315	0.0274	0.0030	1.0652	1.0505	1.0800	1.0514	1.0789	0.9800	1.1504
15	01-10-17	1.0723	0.0303	0.0276	0.0031	1.0656	1.0506	1.0808	1.0515	1.0796	0.9803	1.1508
16	02-07-17	1.0641	0.0270	0.0278	0.0029	1.0660	1.0517	1.0804	1.0526	1.0794	0.9807	1.1513
17	03-07-17	1.0641	0.0270	0.0276	0.0029	1.0657	1.0516	1.0800	1.0524	1.0789	0.9804	1.1509
18	03-07-17	1.0614	0.0259	0.0276	0.0029	1.0656	1.0515	1.0800	1.0524	1.0789	0.9804	1.1509
19	04-04-17	1.0654	0.0275	0.0274	0.0028	1.0652	1.0516	1.0791	1.0524	1.0781	0.9800	1.1505
20	05-02-17	1.0691	0.0290	0.0275	0.0028	1.0654	1.0516	1.0794	1.0525	1.0783	0.9802	1.1506

Note: 7-day IC₂₅ = 25% inhibition concentration. An estimation of the sodium chloride concentration that would cause a 25% reduction in *Ceriodaphnia* reproduction (calculated using ToxCalc).

CT = Central tendency of the IC₂₅ values.

S = Standard deviation of the IC₂₅ values.

Control Limits = Mean logarithmic IC₂₅ ± 2 standard deviations converted to anti-logarithmic values.

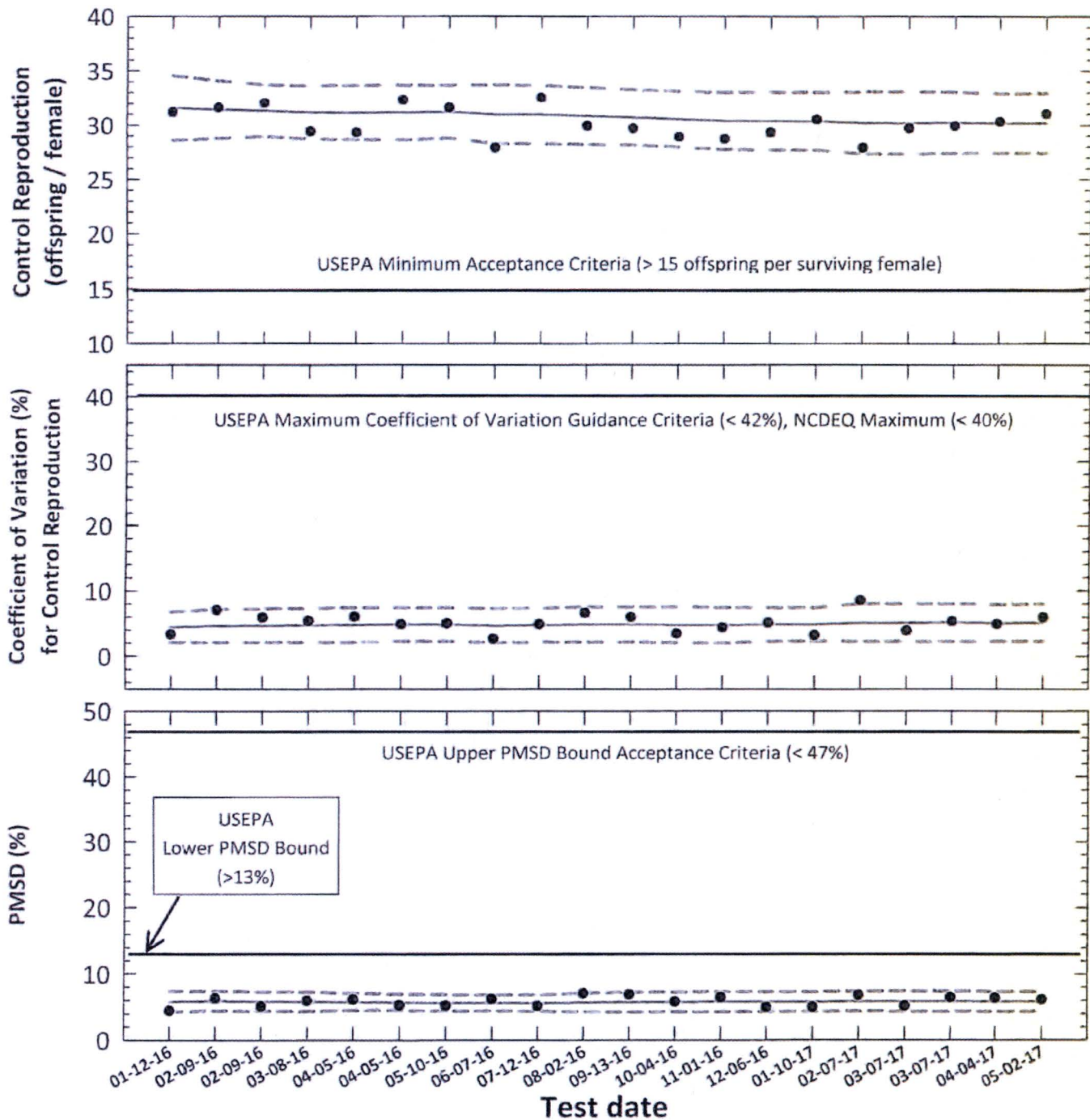
Warning Limits = Mean logarithmic IC₂₅ ± 2CV or S_{A,10} converted to anti-logarithmic values.

S_{A,10} = Standard deviation corresponding to the 10th percentile of CVs reported nationally by USEPA (S_{A,10} = 0.08).

CV = Coefficient of variation.



Ceriodaphnia dubia
Chronic Reference Toxicant Testing, Test Acceptability Criteria
Organism Source: In-house Culture



- Control Reproduction, Coefficient of Variation (CV) or Percent Minimum Significant Difference (PMSD)
PMSD is the percent minimum significant difference between the control and treatment that can be declared statistically significant. The lower PMSD bound represents a practical limit to the sensitivity of the test method and is not a minimum acceptance criteria.
- Central Tendency (mean Control Reproduction, CV or PMSD)
- 95% Confidence Interval (mean Control Reproduction, CV or PMSD \pm 2 Standard Deviations)





Ceriodaphnia dubia
Chronic Reference Toxicant Testing, Test Acceptability Criteria
Source: In-house Culture

Test number	Test date	ToxCal Determination					Control Reproduction			Control Reproduction CV			Test PMSD		
		Control Survival (%)	Control Reproduction		Test		(offspring/female)			(%)			(%)		
			Mean (offspring/female)	CV (%)	MSD	PMSD (%)	CT	95% Confidence Interval		CT	95% Confidence Interval		CT	95% Confidence Interval	
							CT - 2S	CT + 2S		CT - 2S	CT + 2S		CT - 2S	CT + 2S	
1	01-12-16	100	31.2	3.3	1.3860	4.4	31.6	28.6	34.6	4.4	2.1	6.8	5.8	4.3	7.4
2	02-09-16	100	31.6	7.0	1.9910	6.3	31.4	28.8	34.1	4.6	2.1	7.1	5.9	4.4	7.4
3	02-09-16	100	32.0	5.9	1.6300	5.1	31.3	29.0	33.7	4.7	2.1	7.2	5.8	4.3	7.3
4	03-08-16	100	29.4	5.4	1.7490	5.9	31.2	28.7	33.6	4.7	2.1	7.3	5.8	4.3	7.3
5	04-05-16	100	29.3	6.0	1.7920	6.1	31.1	28.6	33.6	4.8	2.1	7.4	5.7	4.5	7.0
6	04-05-16	100	32.3	4.9	1.6950	5.2	31.2	28.6	33.7	4.8	2.3	7.4	5.7	4.4	6.9
7	05-10-16	100	31.6	5.0	1.6360	5.2	31.2	28.8	33.7	4.8	2.3	7.4	5.6	4.4	6.9
8	06-07-16	100	27.9	2.6	1.7310	6.2	31.0	28.3	33.7	4.7	2.0	7.3	5.6	4.4	6.9
9	07-12-16	100	32.5	4.9	1.6710	5.1	31.0	28.3	33.7	4.7	2.1	7.3	5.6	4.4	6.9
10	08-02-16	100	29.9	6.6	2.1010	7.0	30.8	28.2	33.5	4.8	2.2	7.5	5.7	4.3	7.1
11	09-13-16	100	29.7	5.9	2.0410	6.9	30.7	28.2	33.3	4.8	2.2	7.5	5.7	4.2	7.2
12	10-04-16	100	28.9	3.4	1.6720	5.8	30.5	28.0	33.1	4.8	2.0	7.5	5.8	4.3	7.2
13	11-01-16	100	28.7	4.4	1.8440	6.4	30.4	27.8	33.0	4.7	2.0	7.5	5.8	4.3	7.3
14	12-06-16	100	29.3	5.1	1.4550	5.0	30.4	27.7	33.0	4.8	2.3	7.4	5.8	4.3	7.3
15	01-10-17	100	30.5	3.2	1.5240	5.0	30.4	27.7	33.0	4.8	2.3	7.4	5.8	4.3	7.3
16	02-07-17	100	27.9	8.5	1.8950	6.8	30.2	27.4	33.0	5.1	2.2	8.0	5.9	4.4	7.4
17	03-07-17	100	29.7	3.9	1.5300	5.2	30.2	27.4	33.0	5.1	2.2	8.0	5.8	4.3	7.4
18	03-07-17	100	29.9	5.3	1.9180	6.4	30.2	27.4	33.1	5.1	2.2	8.0	5.9	4.3	7.4
19	04-04-17	100	30.3	4.9	1.9240	6.3	30.2	27.4	32.9	5.1	2.2	7.9	5.8	4.3	7.3
20	05-02-17	100	31.0	5.9	1.8940	6.1	30.2	27.4	32.9	5.1	2.3	8.0	5.8	4.3	7.3

Note: Control Survival = USEPA minimum test acceptability criteria ≥ 80% survival.

Control Mean Reproduction = USEPA minimum test acceptability criteria ≥ 15 offspring/surviving female.

CV = Coefficient of variation for control reproduction.

USEPA maximum CV guidance criteria (90th percentile) < 42%, NCDEQ maximum CV acceptance criteria < 40%.

MSD = Minimum significant difference.

PMSD = Percent minimum significant difference.

PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.

Lower PMSD bound determined by USEPA (10th percentile) > 13%.

The lower PMSD bound represents a practical limit to the sensitivity of the test method and is not a minimum acceptance criteria.

Upper PMSD bound acceptance criteria determined by USEPA (90th percentile) < 47%.

CT = Central tendency of the reproduction, CV or PMSD values.

S = Standard deviation of the reproduction, CV or PMSD values.

Reviewed and
Reviewed by
the Sumner
JS

Sodium Chloride Chronic Reference Toxicant Test
(EPA-821-R-02-013 Method 1002.0)
Species: *Ceriodaphnia dubia*

CdNaCICR #: 201

<i>Dilution preparation information:</i>						<i>Comments:</i>
NaCl Stock INSS number:		INSS 1585				
Stock preparation:		100 g NaCl/L: Dissolve 50 g NaCl in 500 mL Milli-Q water.				
Dilution prep (mg/L)	600	800	1000	1200	1400	
Stock volume (mL)	9	12	15	18	21	
Diluent volume (mL)	1491	1488	1485	1482	1479	
Total volume (mL)	1500	1500	1500	1500	1500	

<i>Test organism source information:</i>										<i>Test information:</i>				
Organism age:		< 24-hours old								Randomizing template color:		RED		
Date and times organisms were born between:		05-02-17 0625 TO 0900								Incubator number and shelf location:		2B1		
Culture board:		04-25-17 A								YWT batch:		04-21-17		
Replicate number:		1	2	3	4	5	6	7	8	9	10	Selenastrum batch:		05-01-17
Culture board cup number:		3	4	7	10	13	16	19	22	24	28			
Transfer vessel information:		pH = 7.85 S.U. Temperature = 25.1 °C												
Average transfer volume (mL):		< 0.25 mL												

Daily renewal information:

Day	Date	Test initiation and feeding, renewal and feeding, or termination time	MHSW batch used	Analyst
0	05-02-17	0911	04-26-17A	JH
1	05-03-17	0812	04-26-17 B	JH
2	05-04-17	0819	04-26-17 B	JH
3	05-05-17	0820	04-26-17 B	JH
4	05-06-17	0825	05-02-17	JH
5	05-07-17	0820	05-02-17	JH
6	05-08-17	0811	05-02-17	JH
7	05-09-17	0812		JH

<i>Control information:</i>		Acceptance criteria	<i>Summary of test endpoints:</i>	
% of Male Adults:	07.	≤ 20%	7-day LC ₅₀	71400
% Adults having 3 rd Broods:	1007.	≥ 80%	NOEC	1000
% Mortality:	07.	≤ 20%	LOEC	1200
Mean Offspring/Female:	31.0	≥ 15.0 offspring/female	ChV	1095.5
% CV:	5.97.	< 40.0 %	IC ₂₅	1069.1



Species: Ceriodaphnia dubia

CdNaCICR #: 201

CONTROL

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	4	5	4	5	4	4	4	4	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	13	12	11	12	12	12	11	11	10
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	16	15	18	15	14	16	13	13	16	16
Total young produced		30	33	34	31	30	32	29	28	32	31
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3 rd Broods		X	X	X	X	X	X	X	X	X	X

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	31.0

600 mg NaCl/L

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	4	5	5	5	4	5	4	5	5	6
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	13	10	12	12	10	12	13	11	11
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	15	15	17	13	14	16	15	16	13	16
Total young produced		29	33	32	30	30	31	31	34	29	33
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	31.2
% Reduction from Control:	-0.67.



Species: Ceriodaphnia dubia
800 mg NaCl/L

CdNaCICR #: 201

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	4	3	5	5	4	5	4	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	11	12	11	10	10	13	12	12	12	13
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	15	14	14	18	14	15	13	15	17	16
Total young produced		30	29	30	33	28	33	29	31	33	33
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:	
% Mortality:	02
Mean Offspring/Female:	30.9
% Reduction from Control:	0.37.

1000 mg NaCl/L

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	4	5	4	3	3	4	4	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	11	11	10	12	10	11	12	12	11	12
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	13	12	15	15	15	16	13	14	13	15
Total young produced		28	28	29	30	28	31	29	30	28	31
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	29.2
% Reduction from Control:	5.87.



Species: Ceriodaphnia dubia
 1200 mg NaCl/L

CdNaCICR #: 201

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	3	2	2	4	2	4	4	3	3	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	4	6	5	5	3	8	5	6	3	7
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	5	1	6	5	2	4	3	3	6	4
Total young produced		12	9	13	14	7	16	12	12	12	15
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	12.2
% Reduction from Control:	60.67.

1400 mg NaCl/L

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	1	2	2	1	3	1	2	3	3	3
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	0	0	0	2	0	1	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	3	0	0	2	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	2	0	0	0	0	0	1	0	0	0
Total young produced		3	2	2	3	6	2	3	5	3	3
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	3.2
% Reduction from Control:	89.77.



ETS

Environmental Testing Solutions, Inc.

Verification of *Ceriodaphnia* Reproduction Totals

Control

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	4	5	4	5	4	4	4	4	5	5	44
5	10	13	12	11	12	12	12	11	11	10	114
6	0	0	0	0	0	0	0	0	0	0	0
7	16	15	18	15	14	16	13	13	16	16	152
Total	30	33	34	31	30	32	29	28	32	31	310

1000 mg NaCl/L

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	4	5	4	3	3	4	4	4	4	4	39
5	11	11	10	12	10	11	12	12	11	12	112
6	0	0	0	0	0	0	0	0	0	0	0
7	13	12	15	15	15	16	13	14	13	15	141
Total	28	28	29	30	28	31	29	30	28	31	292

600 mg NaCl/L

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	4	5	5	5	4	5	4	5	5	6	48
5	10	13	10	12	12	10	12	13	11	11	114
6	0	0	0	0	0	0	0	0	0	0	0
7	15	15	17	13	14	16	15	16	13	16	150
Total	29	33	32	30	30	31	31	34	29	33	312

1200 mg NaCl/L

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	3	2	2	4	2	4	4	3	3	4	31
5	4	6	5	5	3	8	5	6	3	7	52
6	0	0	0	0	0	0	0	0	0	0	0
7	5	1	6	5	2	4	3	3	6	4	39
Total	12	9	13	14	7	16	12	12	12	15	122

800 mg NaCl/L

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	4	3	5	5	4	5	4	4	4	4	42
5	11	12	11	10	10	13	12	12	12	13	116
6	0	0	0	0	0	0	0	0	0	0	0
7	15	14	14	18	14	15	13	15	17	16	151
Total	30	29	30	33	28	33	29	31	33	33	309

1400 mg NaCl/L

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	1	2	2	1	3	1	2	3	3	3	21
5	0	0	0	2	0	1	0	0	0	0	3
6	0	0	0	0	3	0	0	2	0	0	5
7	2	0	0	0	0	0	1	0	0	0	3
Total	3	2	2	3	6	2	3	5	3	3	32

Entered and
 Reviewed by




Environmental Testing Solutions, Inc.

Ceriodaphnia dubia Chronic Reference Toxicant Test
EPA-821-R-02-013, Method 1002.0

Quality Control
Verification of Data Entry, Calculations, and Statistical Analyses

Test number: CdNaCICR #201Test dates: May 02-09, 2017

Concentration (mg/L NaCl)	Replicate number										Survival (%)	Average reproduction (offspring/female)	Coefficient of variation (%)	Percent reduction from control (%)
	1	2	3	4	5	6	7	8	9	10				
Control	30	33	34	31	30	32	29	28	32	31	100	31.0	5.9	Not applicable
500	29	33	32	30	30	31	31	34	29	33	100	31.2	5.6	-0.6
800	30	29	30	33	28	33	29	31	33	33	100	30.9	6.4	0.3
1000	28	28	29	30	28	31	29	30	28	31	100	29.2	4.2	5.8
1200	12	9	13	14	7	16	12	12	12	15	100	12.2	21.8	60.6
1400	3	2	2	3	6	2	3	5	3	3	100	3.2	41.1	89.7

Dunnett's MSD value: 1.894
PMSD: 6.1

MSD = Minimum Significant Difference

PMSD = Percent Minimum Significant Difference

PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.

Lower PMSD bound determined by USEPA (10th percentile) = 13%.

Upper PMSD bound determined by USEPA (90th percentile) = 47%.

Lower and upper PMSD bounds were determined from the 10th and 90th percentile, respectively, of PMSD data from EPA's WET Interlaboratory Variability Study (USEPA, 2001a; USEPA, 2001b). The lower PMSD bound represents a practical limit to the sensitivity of the test method and is not a minimum acceptance criteria.

USEPA. 2001a, 2001b. Final Report: Interlaboratory Variability Study of EPA Short-term Chronic and Acute Whole Effluent Toxicity Test Methods, Volumes 1 and 2-Appendix. EPA-821-B-01-004 and EPA-821-B-01-005. US Environmental Protection Agency, Cincinnati, OH.

Entered and
Reviewed by
JMS
JMS

Statistical Analyses

Ceriodaphnia Survival and Reproduction Test-Reproduction

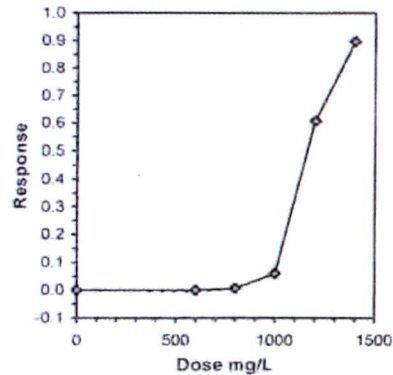
Start Date: 5/2/2017 Test ID: CdNaClCR Sample ID: REF-Ref Toxicant
 End Date: 5/9/2017 Lab ID: ETS-Envir. Testing Sol. Sample Type: NACL-Sodium chloride
 Sample Date: Protocol: FWCHR-EPA-821-R-02-013 Test Species: CD-Ceriodaphnia dubia

Conc-mg/L	1	2	3	4	5	6	7	8	9	10
D-Control	30.000	33.000	34.000	31.000	30.000	32.000	29.000	28.000	32.000	31.000
600	29.000	33.000	32.000	30.000	30.000	31.000	31.000	34.000	29.000	33.000
800	30.000	29.000	30.000	33.000	28.000	33.000	29.000	31.000	33.000	33.000
1000	28.000	28.000	29.000	30.000	28.000	31.000	29.000	30.000	28.000	31.000
1200	12.000	9.000	13.000	14.000	7.000	16.000	12.000	12.000	12.000	15.000
1400	3.000	2.000	2.000	3.000	6.000	2.000	3.000	5.000	3.000	3.000

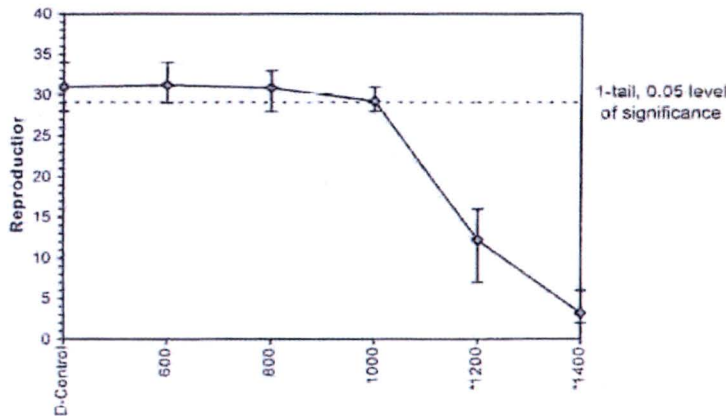
Conc-mg/L	Transform: Untransformed							1-Tailed		isotonic		
	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	31.000	1.0000	31.000	28.000	34.000	5.889	10				31.100	1.0000
600	31.200	1.0065	31.200	29.000	34.000	5.613	10	-0.241	2.287	1.894	31.100	1.0000
800	30.900	0.9968	30.900	28.000	33.000	6.373	10	0.121	2.287	1.894	30.900	0.9936
1000	29.200	0.9419	29.200	28.000	31.000	4.210	10	2.173	2.287	1.894	29.200	0.9389
*1200	12.200	0.3935	12.200	7.000	16.000	21.790	10	22.694	2.287	1.894	12.200	0.3923
*1400	3.200	0.1032	3.200	2.000	6.000	41.143	10	33.557	2.287	1.894	3.200	0.1029

Auxiliary Tests	Statistic	Critical	Skew	Kurt						
Kolmogorov D Test indicates normal distribution ($p > 0.01$)	1.00629	1.035	-0.1735	0.13786						
Bartlett's Test indicates equal variances ($p = 0.23$)	6.90044	15.0863								
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	1000	1200	1095.45		1.89434	0.06111	1481.51	3.43148	3.2E-42	5, 54
Treatments vs D-Control										

Point	Linear Interpolation (200 Resamples)				
	mg/L	SD	95% CL	Skew	
IC05	959.412	63.1306	779.218	1005.53	-1.2229
IC10	1014.24	8.41223	999.237	1023.54	-3.6237
IC15	1032.53	5.71313	1018.89	1041.09	-0.0750
IC20	1050.82	5.39734	1038.27	1058.92	-0.0191
IC25	1069.12	5.25268	1057.36	1077.82	0.0038
IC40	1124	5.8972	1110.95	1135.01	-0.0715
IC50	1160.59	7.02907	1145.4	1173.15	-0.0800



Dose-Response Plot



Entered and Reviewed by

Species: Ceriodaphnia dubia

CdNaClCR #: 201

Daily Chemistry:

Concentration		Day						
		(Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)						
		0		1		2		
Parameter	Analyst	u	u	u	u	u	u	
CONTROL	pH (S.U.)		8.21	8.03	8.10	8.02	8.08	7.94
	DO (mg/L)		7.9	7.8	7.7	7.9	7.7	7.8
	Conductivity (µmhos/cm)		321		328		319	
	*Alkalinity (mg CaCO ₃ /L)		61		62		65	
	*Hardness (mg CaCO ₃ /L)		88		82			
	*Temperature (°C)		24.6	25.1	24.7	24.8	24.8	24.9
600 mg NaCl/L	pH (S.U.)		8.15	7.96	8.04	7.95	8.03	7.94
	DO (mg/L)		7.8	7.8	7.7	7.9	7.7	7.8
	Conductivity (µmhos/cm)		1440		1390		1360	
	*Temperature (°C)		24.7	24.8	24.7	24.8	24.7	24.9
800 mg NaCl/L	pH (S.U.)		8.13	7.93	8.02	7.95	8.02	7.91
	DO (mg/L)		7.8	7.8	7.7	7.9	7.7	7.9
	Conductivity (µmhos/cm)		1770		1740		1760	
	*Temperature (°C)		24.7	25.0	24.8	24.9	24.7	24.8
1000 mg NaCl/L	pH (S.U.)		8.13	7.91	8.02	7.96	8.02	7.88
	DO (mg/L)		7.8	7.8	7.8	7.9	7.8	7.9
	Conductivity (µmhos/cm)		2130		2080		2050	
	*Temperature (°C)		24.7	24.8	24.8	24.9	24.7	24.8
1200 mg NaCl/L	pH (S.U.)		8.12	7.91	8.01	7.94	8.02	7.86
	DO (mg/L)		7.8	7.8	7.9	7.9	7.8	7.9
	Conductivity (µmhos/cm)		2450		2410		2430	
	*Temperature (°C)		24.7	24.8	24.8	25.0	24.9	24.8
1400 mg NaCl/L	pH (S.U.)		8.12	7.91	8.01	7.94	8.01	7.85
	DO (mg/L)		8.0	7.9	8.0	8.0	7.9	7.9
	Conductivity (µmhos/cm)		2790		2740		2710	
	*Temperature (°C)		24.7	24.8	24.8	24.9	24.9	24.8
			Initial	Final	Initial	Final	Initial	Final

*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1. Alkalinity and hardness performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: K



Species: Ceriodaphnia dubia

CdNaCICR #: 201

Analyst		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)							
		3		4		5		6	
		W	BSU ^W	BSU ^W	W	W	W	W	W
Concentration	Parameter								
CONTROL	pH (S.U.)	0.13	8.03	8.08	7.99	8.15	8.09	8.19	8.13
	DO (mg/L)	7.7	7.9	7.8	7.8	7.7	7.9	7.8	7.8
	Conductivity (µmhos/cm)	320		317		324		320	
	*Alkalinity (mg CaCO ₃ /L)	8.4		63		8.4		8.4	
	*Hardness (mg CaCO ₃ /L)	8.4		86		8.4		8.4	
	*Temperature (°C)	24.7	25.2	24.9	24.9	24.7	25.1	24.8	25.0
600 mg NaCl/L	pH (S.U.)	8.05	7.97	8.08	7.91	8.05	8.01	8.14	8.03
	DO (mg/L)	7.7	7.9	7.9	7.8	7.8	7.9	7.8	7.9
	Conductivity (µmhos/cm)	1350		1410		1400		1420	
	*Temperature (°C)	24.9	25.2	24.9	25.0	24.7	24.8	24.9	25.0
800 mg NaCl/L	pH (S.U.)	8.03	7.96	8.07	7.94	8.06	8.02	8.13	8.02
	DO (mg/L)	7.9	8.0	8.0	7.9	7.8	7.9	7.8	7.9
	Conductivity (µmhos/cm)	1740		1730		1720		1750	
	*Temperature (°C)	24.8	25.0	25.0	25.0	24.7	24.8	24.8	24.8
1000 mg NaCl/L	pH (S.U.)	8.03	7.95	8.06	7.91	8.06	8.01	8.13	8.00
	DO (mg/L)	7.9	8.1	8.0	7.9	7.8	7.9	7.8	8.0
	Conductivity (µmhos/cm)	2070		2110		2100		2130	
	*Temperature (°C)	24.8	24.9	25.0	25.0	24.8	24.9	24.8	24.8
1200 mg NaCl/L	pH (S.U.)	8.02	7.94	8.06	7.90	8.06	7.99	8.13	7.99
	DO (mg/L)	8.0	8.2	8.0	8.0	7.9	8.0	7.9	8.0
	Conductivity (µmhos/cm)	2430		2460		2450		2460	
	*Temperature (°C)	24.8	25.1	25.0	25.1	24.8	25.2	24.9	24.9
1400 mg NaCl/L	pH (S.U.)	8.02	7.93	8.05	7.90	8.05	8.00	8.13	7.98
	DO (mg/L)	8.0	8.2	7.9	8.0	8.0	8.0	8.0	8.0
	Conductivity (µmhos/cm)	2770		2800		2790		2810	
	*Temperature (°C)	24.9	24.8	25.0	24.8	24.9	24.9	24.9	25.0
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1. Alkalinity and hardness performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: J

