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

February 09, 2010

State of Tennessee
Department of Environment and Conservation
Division of Water Pollution Control
Enforcement & Compliance Section
6th Floor, L & C Annex
401 Church Street
Nashville, Tennessee 37243-1534

Dear Mr. Patrick Cromer:

SEQUOYAH NUCLEAR PLANT (SQN) - 2009 BIOCIDE/CORROSION TREATMENT PLAN (B/CTP) ANNUAL REPORT – NPDES PERMIT NO. TN0026450

In accordance with Part IV.B. of NPDES Permit No. TN0026450, SQN developed a B/CTP that was approved by the Division of Water Pollution Control on April 27, 2005 for the specific and limited application of oxidizing biocides, non-oxidizing biocides, dispersants, surfactants, corrosion inhibiting chemicals, and detoxification chemicals at SQN. The use of these chemicals is necessary to ensure the safe operation of the facility.

The B/CTP approval requires that "annually, a report shall be submitted to the Division presenting the biomonitoring data for tests conducted during treatments, a summary of all analytical results (daily maximum, daily average, number of samples), the approximate duration in hours of each chemical used, quantity in pounds of each chemical used, and any minor changes that have occurred to the plan. The report shall be submitted to the Enforcement and Compliance Section in Nashville and to the Chattanooga Environmental Field Office by February 15 of the year following the reporting year. Also, in order to compare reliability of the mass balance calculations with the methylene chloride extraction method, SQN shall compare both methods used for analyses of the effluent and report to the Division."

SQN compared the results of both methods (mass balance calculations and the methylene chloride extraction method) used for analyses of the effluent. However, SQN did not detoxify the effluent during any non-oxidizing biocide treatments in 2009. A total of 37 samples from the Diffuser effluent (Outfall 101) have been analyzed by each method, see summary on following page:

IE25
C001
NRR

H-150M/ Spectrus CT1300	Analytical Results Mass Balance Calculations (mg/L)				Analytical Results Methylene Chloride Extraction (mg/L)			
Month	Maximum	Average	Limit	# of Samples	Maximum	Average	Limit	# of Samples
January				0				0
February				0				0
March				0				0
April				0				0
May	0.045	0.041	0.05	12	<0.020	<0.020	0.05	12
June	0.039	0.039	0.05	2	<0.050	<0.050	0.05	2
July	0.040	0.040	0.05	5	<0.050	<0.050	0.05	5
August	0.040	0.040	0.05	1	<0.050	<0.050	0.05	1
September	0.040	0.039	0.05	6	<0.050	<0.050	0.05	5 (1)
October	0.047	0.039	0.05	13	<0.050	<0.044	0.05	12 (2)
November				0				0
December				0				0
Jan-Dec				39				37

(1) No additional sample taken on 9/16/2009. Twenty-four hour composite sample taken on 9/15/2009 to 9/16/2009 covers the period of 0000 - 0640 on 9/16/2009 so that the treatment period was covered by the one sample.

(2) No sample collected on 10/25/2009 from 0800-1800. Reference November 23, 2009 letter from Timothy P. Cleary to Patrick Parker.

TVA SQN requests the removal of the requirement stated in the April 27, 2005 B/CTP approval letter signed by Edward M. Polk, Jr., P.E., "In order to compare reliability of the mass-balance calculations with the methylene chloride extraction method, SQN shall compare both methods used for the analyses of the effluent and report to the Division." SQN has had an outside qualified laboratory analyze 176 samples by the methylene chloride extraction method since May 2005 and all analytical results have been <0.05mg/L. SQN would like to request the discontinuance of the methylene chloride extraction method. See the summary below:

H-150M/ Spectrus CT1300	Analytical Results Mass Balance Calculations (mg/L)			Analytical Results Methylene Chloride Extraction (mg/L)		
Year	Maximum	Limit	# of Samples	Maximum	Limit	# of Samples
2005	0.040	0.05	35	<0.020	0.05	35
2006	0.037	0.05	36	<0.020	0.05	36
2007	0.047	0.05	31	<0.020	0.05	31
2008	0.041	0.05	37	<0.020	0.05	37
2009	0.047	0.05	39	<0.050	0.05	37
2005-2009			178			176

If you have any questions or need additional information, please contact Ann Hurt at (423) 843-6714 or Stephanie Howard at (423) 843-6700 of Sequoyah's Environmental staff.

Sincerely,

Christopher R. Church
Site Vice President
Sequoyah Nuclear Plant

Enclosure
cc (Enclosure):
Mr. Vojin Janjic
State of Tennessee
Dept. of Environment and Conservation
Division of Water Pollution Control
6th Floor, L & C Annex
401 Church Street
Nashville, Tennessee 37243-1534

Chattanooga Environmental Field Office
Division of Water Pollution Control
State Office Building, Suite 550
540 McCallie Avenue
Chattanooga, Tennessee 37402-2013

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

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H 150M

Month	Quantity in Pounds (lbs/day)			Duration in Hours (hrs/day)	Analytical Results mass balance calculations (mg/L)				Analytical Results methylene chloride extraction (mg/L)				Days in Service
	Maximum	Average	Limit	Maximum	Maximum	Average	Limit	# of Samples	Maximum	Average	Limit	# of Samples	
January													0
February													0
March													0
April													0
May	510	381	855	24.00	0.045	0.041	0.05	12	<0.020	<0.020	0.05	12	12
June	314	297	855	14.25	0.039	0.039	0.05	2	<0.050	<0.050	0.05	2	2
July	529	360	855	24.00	0.040	0.040	0.05	5	<0.050	<0.050	0.05	5	5
August	207	207	855	9.40	0.040	0.040	0.05	1	<0.050	<0.050	0.05	1	1
September	529	301	855	24.00	0.040	0.039	0.05	6	<0.050	<0.050	0.05	5[1]	6
October													0
November													0
December													0
Jan. - Dec.								26				20	26

[1]No additional sample taken on 9/16/2009. Twenty-four hour composite sample taken on 9/15/2009 to 9/16/2009 covers the period of 0000 - 0640 on 9/16/2009 so that the treatment period was covered by the one sample.

Per the B/CTP approval: "Whole Effluent toxicity testing (biomonitoring) of Outfall 101 and Outall 110 shall be undertaken once per year when non-oxidizing biocides are being used."

Outfall 101: Toxicity was sampled May 10-15, 2009
Test Results: *Pimephales promelas*: IC25 >100%
Ceriodaphnia dubia: IC25 > 100%

Outfall 110: There has been no discharge from Outfall 110 January - December 2009.

Nothing Injected for January 2009								
Nothing Injected for February 2009								
Nothing Injected for March 2009								
Nothing Injected for April 2009								
H-150M	system	injection start time	injection end time	duration in hours	total quantity	mass balance calc.	methylene chloride extraction	number/type of samples
					855 lbs/day	0.05 mg/L	0.05 mg/L	
05/04/2009	ERCW A	1130	2400	12.50	250.35	0.0401	<0.020	5/4/09 @ 1155 - 5/5/09 @ 1015
05/05/2009	ERCW A	0000	2400	24.00	480.67	0.0402	<0.020	5/5/09 @ 1013 - 5/6/09 @ 0913
05/06/2009	ERCW A	0000	2400	24.00	480.67	0.0399	<0.020	5/6/09 @ 1141 - 5/7/09 @ 1041
05/07/2009	ERCW A	0000	1400	14.00	280.39	0.0403	<0.020	5/7/09 @ 1053 - 5/8/09 @ 0953
05/11/2009	ERCW B	1220	2400	11.67	233.73	0.0446	<0.020	5/11/09 @ 1343 - 5/12/09 @ 1243
05/12/2009	ERCW B	0000	2400	24.00	480.67	0.0396	<0.020	5/12/09 @ 1330 - 5/13/09 @ 1230
05/13/2009	ERCW B	0000	2400	24.00	480.67	0.0396	<0.020	5/13/09 @ 1338 - 5/14/09 @ 1038
05/14/2009	ERCW B	0000	1500	15.00	300.42	0.0397	<0.020	5/14/09 @ 1104 - 5/15/09 @ 1004
05/18/2009	RCW	1015	2400	13.75	291.91	0.0420	<0.020	5/18/09 @ 0950 - 5/19/09 @ 0850
05/19/2009	RCW	0000	2400	24.00	509.51	0.0421	<0.020	5/19/09 @ 0859 - 5/20/09 @ 0759
05/20/2009	RCW	0000	2400	24.00	509.51	0.0420	<0.020	5/20/09 @ 0850 - 5/21/09 @ 0750
05/21/2009	RCW	0000	1300	13.00	275.99	0.0420	<0.020	5/21/09 @ 0841 - 5/22/09 @ 0741

H-150M	system	injection start time	injection end time	duration in hours	total quantity	mass balance calc.	methylene chloride extraction	number/type of samples
					855 lbs/day	0.05 mg/L	0.05 mg/L	
06/29/2009	ERCW A	0945	2400	14.25	313.94	0.039	<0.050	6/29/09 - 6/30/09
06/30/2009	ERCW A	0000	1245	12.75	280.89	0.039	<0.050	6/30/09 - 7/1/09
H-150M	system	injection start time	injection end time	duration in hours	total quantity	mass balance calc.	methylene chloride extraction	number/type of samples
					855 lbs/day	0.05 mg/L	0.05 mg/L	
07/06/2009	ERCW B	1000	2400	14.00	308.43	0.039	<0.050	7/6/09 - 7/7/09
07/07/2009	ERCW B	0000	1400	14.00	308.43	0.039	<0.050	7/7/09 - 7/8/09
07/13/2009	RCW	1130	2400	12.50	275.39	0.040	<0.050	7/13/09 - 7/14/09
07/14/2009	RCW	0000	2400	24.00	528.74	0.040	<0.050	7/14/09 - 7/15/09
07/15/2009	RCW	0000	1715	17.25	380.03	0.040	<0.050	7/15/09 - 7/16/09
H-150M	system	injection start time	injection end time	duration in hours	total quantity	mass balance calc.	methylene chloride extraction	number/type of samples
					855 lbs/day	0.05 mg/L	0.05 mg/L	
08/31/2009	ERCW A	1436	2400	9.40	207.09	0.04	<0.050	8/31/09 - 9/1/09

H-150M	system	injection start time	injection end time	duration in hours	total quantity	mass balance calc.	methylene chloride extraction	number/type of samples
					855 lbs/day	0.05 mg/L	0.05 mg/L	
09/01/2009	ERCW A	0000	1445	14.75	324.95	0.039	<0.050	9/1/09 - 9/2/09
09/08/2009	ERCW B	1230	2400	11.5	253.35	0.038	<0.050	9/8/09 - 9/9/09
09/09/2009	ERCW B	0000	1240	12.67	279.13	0.038	<0.050	9/9/09 - 9/10/09
09/14/2009	RCW	1130	2400	12.5	275.38	0.039	<0.050	9/14/09 - 9/15/09
09/15/2009	RCW	0000	2400	24.00	528.74	0.038	<0.050	9/15/09 - 9/16/09
09/16/2009	RCW	0000	0640	6.67	146.87	0.04	9/15/09 -9/16/09 sample covers this 6 hour	
Nothing Injected for October 2009								
Nothing Injected for November 2009								
Nothing Injected for December 2009								

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Spectrus CT1300

Month	Quantity in Pounds (lbs/day)			Duration in Hours (hrs/day)	Analytical Results mass balance calculations (mg/L)				Analytical Results methylene chloride extraction (mg/L)				Days in Service
	Maximum	Average	Limit	Maximum	Maximum	Average	Limit	# of Samples	Maximum	Average	Limit	# of Samples	
January													0
February													0
March													0
April													0
May													0
June													0
July													0
August													0
September													0
October	652	396	855	24.00	0.047	0.039	0.05	13	<0.05	<0.044	0.05	12[1]	13
November													0
December													0
Jan. - Dec.								13				0	13

[1]No sample collected on 10/25/2009 from 0800-1800. Reference November 23, 2009 letter from Timothy P. Cleary to Patrick Parker.

Per the B/CTP approval: "Whole Effluent toxicity testing (biomonitoring) of Outfall 101 and Outall 110 shall be undertaken once per year when non-oxidizing biocides are being used."

Outfall 101: Toxicity was sampled May 10-15, 2009 during the H-150M treatment.
Test Results: *Pimephales promelas*: IC25 >100%
Ceriodaphnia dubia: IC25 > 100%

Outfall 110: There has been no discharge from Outfall 110 January - December 2009.

Nothing Injected for January 2009								
Nothing Injected for February 2009								
Nothing Injected for March 2009								
Nothing Injected for April 2009								
Nothing Injected for May 2009								
Nothing Injected for June 2009								
Nothing Injected for July 2009								
Nothing Injected for August 2009								
Nothing Injected for September 2009								
Spectrus CT 1300	system	ection start tir	ection end tir	tion in h	total quantity	ss balance cæ	chloride	number/type of samples
					855 lbs/day	0.05 mg/L	0.05 mg/L	
10/05/2009	ERCW B	1610	2400	7.83	167.11	0.037	<0.05	10/5/09 0930 - 10/6/09 0830
10/06/2009	ERCW B	0000	2400	24.00	651.91	0.047	<0.05	10/6/09 0930 - 10/7/09 0830
10/07/2009	ERCW B	0000	2400	24.00	512.21	0.037	<0.05	10/7/09 0930 - 10/8/09 0830
10/08/2009	ERCW B	0000	2400	24.00	512.21	0.037	<0.05	10/8/09 0930 - 10/9/09 0830
10/09/2009	ERCW B	0000	2020	20.33	433.89	0.037	<0.05	10/9/09 0930 - 10/10/09 0830
10/14/2009	RCW	1250	2400	11.17	247.37	0.039	<0.05	10/14/09 1015 - 10/15/09 0915
10/15/2009	RCW	0000	2400	24.00	531.49	0.039	<0.05	10/15/09 0940 - 10/16/09 0840
10/16/2009	RCW	0000	2400	24.00	531.49	0.039	<0.05	10/16/09 0940 - 10/17/09 0840
10/17/2009	RCW	0000	1545	15.75	348.79	0.039	<0.05	10/17/09 1045 - 10/18/09 0945
10/22/2009	ERCW A	1300	2400	11.00	234.77	0.04	< 0.025	10/22/09 0940 - 10/23/09 0840
10/23/2009	ERCW A	0000	2150	21.83	465.9	0.04	< 0.025	10/23/09 0940 - 10/24/09 0840
10/24/2009	ERCW A	1800	2400	6.00	128.05	0.04	< 0.025	10/24/09 0930 - 10/25/09 0830
10/25/2009	ERCW A	0000	1800	18.00	384.16	0.04		no sample from 0830 - 1800
Nothing Injected for November 2009								
Nothing Injected for December 2009								

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Towerbrom 960

Month	Quantity in Pounds (lbs/day)			Duration in Hours (hrs/day)	Analytical Results mass balance calculation (mg/L)				Days in Service
	Maximum	Average (based on days in service)	Limit	Maximum	Maximum	Average	Limit	# of samples	
January	200	100	1425	6.00	0.030	0.014	0.10	12	12
February	180	115	1425	4.67	0.030	0.016	0.10	19	19
March	160	115	1425	4.92	0.036	0.018	0.10	18	18
April	640	388	1425	24.00	0.052	0.025	0.10	35	30
May	600	245	1425	24.00	0.042	<0.018	0.10	27	26
June	450	197	1425	7.42	0.039	0.019	0.10	26	25
July	450	196	1425	18.33	0.031	0.017	0.10	25	23
August	240	195	1425	6.25	0.034	0.021	0.10	22	22
September	460	244	1425	17.42	0.031	0.020	0.10	24	22
October	510	207	1425	24.00	0.037	0.016	0.10	25	24
November	520	254	1425	24.00	0.056	0.024	0.10	41	28
December	180	85	1425	5.00	0.025	0.015	0.10	12	11
Jan. - Dec.								286	260

Per the B/CTP approval: "Whole Effluent toxicity testing (biomonitoring) of Outfall 101 and Outall 110 shall be undertaken once per year when oxidizing biocides are being used."

Outfall 101: Toxicity was sampled November 15-20, 2009
Test Results: *Pimephales promelas*: IC25 >100%
Ceriodaphnia dubia: IC25 > 100%

Outfall 110: There has been no discharge from Outfall 110 January - December 2009.

Towerbrom 960	system	injection			injection			duration in hours	total quantity	mass balance calc.	Additional Results
01/01/2009	n/a		:			:					
01/02/2009	n/a		:			:					
01/03/2009	n/a		:			:					
01/04/2009	n/a		:			:					
01/05/2009	ERCW A & B	10	:	55	15	:	00	4.08	200	0.0189	
01/06/2009	ERCW A & B	11	:	05	15	:	10	4.08	200	0.0300	
01/07/2009	RCW	09	:	15	15	:	15	6.00	50	0.0139	
01/08/2009	RCW	10		15	14	:	10	3.92	50	0.0133	
01/09/2009	n/a		:			:					
01/10/2009	n/a		:			:					
01/11/2009	n/a		:			:					
01/12/2009	RCW	11	:	20	15	:	25	4.08	50	0.0129	
01/13/2009	RCW	10	:	20	14	:	25	4.08	50	0.0078	
01/14/2009	n/a		:			:					
01/15/2009	n/a		:			:					
01/16/2009	n/a		:			:					
01/17/2009	n/a		:			:					
01/18/2009	n/a		:			:					
01/19/2009	RCW	11	:	00	15	:	05	4.08	50	0.0078	
01/20/2009	RCW	11	:	00	15	:	10	4.17	50	0.0092	
01/21/2009	n/a		:			:					
01/22/2009	n/a		:			:					
01/23/2009	n/a		:			:					
01/24/2009	n/a		:			:					
01/25/2009	n/a		:			:					
01/26/2009	RCW	10	:	20	14	:	20	4.00	50	0.0100	
01/27/2009	RCW	10	:	45	15	:	15	4.50	50	0.0122	
01/28/2009	n/a		:			:					
01/29/2009	n/a		:			:					
01/30/2009	ERCW A & B	13	:	10	17	:	10	4.00	200	0.0127	
01/31/2009	ERCW A & B	12	:	05	16	:	05	4.00	200	0.0220	

Towerbrom 960	system	injection start time			injection end			duration in hours	total quantity	mass balance calc.	Additional Results
02/01/2009	ERCW A & B	13	:	05	17	:	05	4.00	180	0.0173	
02/02/2009	ERCW A & B	11	:	55	15	:	55	4.00	180	0.0253	
02/03/2009	RCW	11	:	30	15	:	30	4.00	50	0.0104	
02/04/2009	RCW	11	:	00	15	:	00	4.00	50	0.0115	
02/05/2009	n/a		:			:					
02/06/2009	ERCW A & B	13	:	10	17	:	30	4.33	180	0.0305	
02/07/2009	ERCW A & B	10	:	40	14	:	45	4.08	180	0.0184	
02/08/2009	ERCW A & B	12	:	00	16	:	05	4.08	180	0.0197	
02/09/2009	ERCW A & B	11	:	55	16	:	00	4.08	180	0.0237	
02/10/2009	RCW	11	:	55	15	:	05	3.17	50	0.0104	
02/11/2009	ERCW A & B	11	:	30	15	:	35	4.08	140	0.0155	
02/12/2009	RCW	10	:	30	14	:	30	4.00	50	0.0106	
02/13/2009	n/a		:			:					
02/14/2009	n/a		:			:					
02/15/2009	n/a		:			:					
02/16/2009	RCW	10	:	30	14	:	30	4.00	50	0.0127	
02/17/2009	RCW	10	:	05	14	:	45	4.67	50	0.0102	
02/18/2009	n/a		:			:					
02/19/2009	n/a		:			:					
02/20/2009	ERCW A & B	13	:	15	17	:	15	4.00	140	0.0154	
02/21/2009	ERCW A & B	12	:	45	16	:	45	4.00	140	0.0165	
02/22/2009	n/a		:			:					
02/23/2009	RCW	11	:	10	15	:	50	4.67	50	0.0086	
02/24/2009	RCW	10	:	30	14	:	35	4.08	50	0.0070	
02/25/2009	ERCW A & B	12	:	45	16	:	45	4.00	140	0.0208	
02/26/2009	ERCW A & B	11	:	30	15	:	30	4.00	140	0.0153	
02/27/2009	n/a		:			:					
02/28/2009	n/a		:			:					

Towerbrom 960	system	injection start time			injection end time			duration in hours	total quantity	mass balance calc.	Additional Results
									1,425 lbs/day	0.10 mg/L	0.10 mg/L
			:			:					
03/01/2009	n/a		:			:					
03/02/2009	RCW	11	:	30	15	:	30	4.00	60	0.0161	
03/03/2009	RCW	11	:	00	15	:	00	4.00	60	0.0152	
03/04/2009	n/a		:			:					
03/05/2009	ERCW A & B	15	:	50	19	:	50	4.00	140	0.0166	
03/06/2009	ERCW A & B	11	:	20	15	:	25	4.08	140	0.0176	
03/07/2009	n/a		:			:					
03/08/2009	n/a		:			:					
03/09/2009	n/a		:			:					
03/10/2009	ERCW A & B	11	:	15	15	:	20	4.08	160	0.0155	
03/11/2009	RCW	09	:	30	13	:	35	4.08	60	0.0152	
03/12/2009	ERCW A & B	12	:	40	16	:	45	4.08	160	0.0135	
03/13/2009	RCW	10	:	45	14	:	45	4.00	60	0.0154	
03/14/2009	n/a		:			:					
03/15/2009	n/a		:			:					
03/16/2009	RCW	10	:	45	14	:	55	4.17	60	0.0129	
03/17/2009	RCW	10	:	55	15	:	05	4.17	60	0.0117	
03/18/2009	ERCW A & B	11	:	35	15	:	40	4.08	160	0.0149	
03/19/2009	n/a		:			:					
03/20/2009	n/a		:			:					
03/21/2009	n/a		:			:					
03/22/2009	ERCW A & B	13	:	10	17	:	10	4.00	160	0.0201	
03/23/2009	ERCW A & B	11	:	40	15	:	45	4.08	160	0.0143	
03/24/2009	ERCW A & B	11	:	25	15	:	35	4.17	160	0.0143	
03/25/2009	ERCW A & B	11	:	25	14	:	00	2.58			
	RCW	11		00	15		20	4.33	150	0.0348	
03/26/2009	n/a		:			:					
03/27/2009	RCW	10	:	50	15	:	00	4.17	50	0.0231	
03/28/2009	ERCW A & B	11	:	15	16	:	10	4.92			
	RCW	10	:	45	15	:	00	4.25	110	0.0364	
03/29/2009	ERCW A & B	10	:	30	14	:	30	4.00	160	0.0139	
03/30/2009	n/a		:			:					
03/31/2009	n/a		:			:					
			:			:					
			:			:					

Towerbrom 960	system	injection start time			end time			duration in hours	total quantity	mass balance calc.	Additional Results
									1,425 lbs/day	0.10 mg/L	0.10 mg/L
04/01/2009	RCW	12	:	55	24	:	00	11.08	100	0.0076	
04/02/2009	RCW	00	:	00	24	:	00	24.00	140	0.0092	
04/03/2009	ERCW A & B	11	:	15	16	:	00	4.75			
	RCW	00	:	00	24	:	00	24.00	240	0.0314	
04/04/2009	ERCW A & B	11	:	45	15	:	45	4.00			
	RCW	00	:	00	24	:	00	24.00	270	0.0304	
04/05/2009	ERCW A & B	14	:	00	18	:	00	4.00			
	RCW	00	:	00	24	:	00	24.00	250	0.0339	
04/06/2009	RCW	00	:	00	24	:	00	24.00	140	0.0096	
04/07/2009	RCW	00	:	00	24	:	00	24.00	100	0.0077	
04/08/2009	RCW	00	:	00	24	:	00	24.00	120	0.0245	
04/09/2009	RCW	00	:	00	24	:	00	24.00	140	0.0138	
04/10/2009	RCW	00	:	00	24	:	00	24.00	130	0.0224	
04/11/2009	ERCW A & B	13	:	45	17	:	15	3.50			
	RCW	00	:	00	24	:	00	24.00	380	0.0061	0.0339
04/12/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	350	0.0139	0.004
04/13/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	570	0.0522	0.0307
04/14/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	620	0.0269	
04/15/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	590	0.0262	0.0365
04/16/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	640	0.0387	
04/17/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	640	0.0414	
04/18/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	590	0.0128	0.0417
04/19/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	590	0.0308	
04/20/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	570	0.0362	
04/21/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	470	0.0323	
04/22/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	470	0.0379	
04/23/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	400	0.0210	
04/24/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	470	0.0396	
04/25/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	440	0.0267	
04/26/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	430	0.0216	
04/27/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	450	0.0222	
04/28/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	440	0.0201	
04/29/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	460	0.0205	
04/30/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	430	0.0151	

Towerbrom 960	system	injection start time			injection end time			duration in hours	total quantity	mass balance calc.	Additional Results
									1,425 lbs/day	0.10 mg/L	0.10 mg/L
05/01/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	500	0.0187	
05/02/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	450	0.0287	
05/03/2009	ERCW A & B & RCW	00	:	00	10	:	00	10.00	140	0.0211	
05/04/2009	RCW	00		00	24	:	00	24.00	100	0.0175	
05/05/2009	RCW	00	:	00	24	:	00	24.00	120	0.0174	
05/06/2009	RCW	00	:	00	24	:	00	24.00	100	0.0086	
05/07/2009	ERCW A & B	17	:	55	24	:	00	6.08			
	RCW	00	:	00	24	:	00	24.00	280	0.0159	
05/08/2009	ERCW A & B	00	:	00	18	:	00	18.00			
	RCW	00	:	00	24	:	00	24.00	600	0.0165	
05/09/2009	RCW	00	:	00	24	:	00	24.00	120	0.0075	
05/10/2009	ERCW A & B	07	:	25	11	:	30	4.08			
	RCW	00	:	00	24	:	00	24.00	240	0.0129	
05/11/2009	RCW	00	:	00	24	:	00	24.00	140	0.0415	
05/12/2009	RCW	00	:	00	24	:	00	24.00	80	0.0053	
05/13/2009	RCW	00	:	00	24	:	00	24.00	150	0.0049	
05/14/2009	ERCW A & B	17	:	30	24	:	00	6.50			
	RCW	00	:	00	24	:	00	24.00	340	<0.0141	
05/15/2009	ERCW A & B	00		00	17	:	40	17.67			
	RCW	00	:	00	24	:	00	24.00	240	<0.0160	
05/16/2009	RCW	00	:	00	24	:	00	24.00	140	0.0072	
05/17/2009	RCW	00		00	10	:	00	10.00	80	0.0258	
05/18/2009	n/a		:			:					
05/19/2009	n/a		:			:					
05/20/2009	ERCW A & B	14	:	45	18	:	45	4.00	250	0.0092	
05/21/2009	ERCW A & B	10	:	15	14	:	15	4.00		0.0096	
	RCW	15	:	35	24	:	00	8.42	330	0.0221	
05/22/2009	ERCW A & B	07	:	55	11	:	55	4.00			
	RCW	00	:	00	15	:	35	15.58	390	0.0190	
05/23/2009	n/a		:			:					
05/24/2009	n/a		:			:					
05/25/2009	n/a		:			:					
05/26/2009	ERCW A & B	13	:	15	17	:	20	4.08			
	RCW	10		20	14		20	4.00	300	0.0304	
05/27/2009	ERCW A & B	10	:	35	14	:	35	4.00			
	RCW	12		05	16		05	4.00	350	0.0354	
05/28/2009	ERCW A & B	13	:	30	17	:	30	4.00			
	RCW	11		25	15		35	4.17	300	0.0229	
05/29/2009	ERCW A & B	16	:	00	20	:	00	4.00			
	RCW	14		50	18		55	4.08	240	0.0319	
05/30/2009	ERCW A & B	09	:	45	14	:	45	5.00			
	RCW	11		00	14		55	3.92	240	0.0278	
05/31/2009	ERCW A & B	13	:	00	17	:	00	4.00	150	0.0073	

Towerbrom 960	system	injection	injection	duration in hours	total quantity	mass balance calc.	Additional Results
					1,425 lbs/day	0.10 mg/L	0.10 mg/L
06/01/2009	ERCW A & B	10 : 25	15 : 20	4.92			
	RCW	10 : 50	16 : 00	5.17	250	0.0108	
06/02/2009	ERCW A & B	10 : 10	15 : 05	4.92			
	RCW	11 : 35	15 35	4.00	210	0.0307	
06/03/2009	RCW	11 : 20	15 : 20	4.00	70	0.0124	
06/04/2009	ERCW A & B	10 : 10	16 : 15	6.08			
	RCW	11 : 55	15 : 55	4.00	210	0.0200	
06/05/2009	ERCW A & B	11 : 10	15 : 15	4.08			
	RCW	10 : 20	15 : 50	5.50	250	0.0187	
06/06/2009	ERCW A & B	11 : 10	15 : 10	4.00	170	0.0106	
06/07/2009	n/a	:	:				
06/08/2009	ERCW A & B	09 : 45	14 : 55	5.17			
	RCW	10 : 25	14 : 25	4.00	250	0.0284	
06/09/2009	ERCW A & B	09 : 10	14 : 20	5.17			
	RCW	09 : 30	14 : 00	4.50	260	0.0243	
06/10/2009	RCW	10 : 40	15 : 45	5.08	70	0.0124	
06/11/2009	RCW	10 : 40	14 : 40	4.00	70	0.0165	
06/12/2009	RCW	10 : 40	14 : 40	4.00	70	0.0118	
06/13/2009	n/a	:	:				
06/14/2009	n/a	:	:				
06/15/2009	n/a	:	:				
06/16/2009	RCW	11 : 00	15 : 00	4.00	80	0.0187	
06/17/2009	ERCW A & B	11 : 15	15 : 15	4.00			
	RCW	09 : 45	14 : 05	4.33	260	0.0224	
06/18/2009	ERCW A & B	10 : 00	14 : 05	4.08			
	RCW	11 : 10	16 : 25	5.25	240	0.0388	
06/19/2009	ERCW A & B	09 : 50	14 10	4.33			
	RCW	10 : 45	15 : 15	4.50	240	0.0263	
06/20/2009	ERCW A & B	11 : 00	15 : 00	4.00			
	RCW	11 : 50	15 : 55	4.08	230	0.0189	
06/21/2009	ERCW A & B	11 : 05	15 : 05	4.00	170	0.0126	
06/22/2009	ERCW A & B	09 : 15	13 : 15	4.00			
	RCW	09 : 50	14 : 40	4.83	240	0.0345	
06/23/2009	ERCW A & B	08 : 45	13 : 15	4.50			
	RCW	09 : 10	13 : 45	4.58	210	0.0282	
06/24/2009	ERCW A & B	11 : 05	15 : 30	4.42			
	RCW	12 : 15	16 : 25	4.17	240	0.0271	
06/25/2009	ERCW A & B	11 : 00	15 : 05	4.08			
	RCW	11 : 45	16 : 00	4.25	220	0.0219	
06/26/2009	ERCW A & B	10 : 30	14 : 30	4.00	170	0.0087	
06/27/2009	ERCW A & B	11 : 20	15 : 20	4.00			
	RCW	11 : 45	15 45	4.00	240	0.0220	
06/28/2009	n/a	:	:				
06/29/2009	RCW	06 : 55	11 : 05	4.17	60	0.0075	
06/30/2009	ERCW A & B	16 : 35	24 : 00	7.42		0.0062	
	RCW	09 : 00	13 : 05	4.08	450	0.0097	

Towerbrom 960	system	injection	injection	duration in hours	total quantity	mass balance calc.	Additional Results
					1,425 lbs/day	0.10 mg/L	0.10 mg/L
07/01/2009	ERCW A & B	00 : 00	16 : 40	16.67			
	RCW	10 : 15	14 : 25	4.17	270	0.0209	
07/02/2009	n/a	:	:				
07/03/2009	ERCW A & B	10 : 15	15 : 30	5.25			
	RCW	10 : 15	15 : 40	5.42	230	0.0172	
07/04/2009	ERCW A & B	09 : 45	14 : 00	4.25			
	RCW	10 : 45	15 : 55	5.17	210	0.0199	
07/05/2009	n/a	:	:				
07/06/2009	RCW	07 : 10	12 : 10	5.00	70	0.0065	
07/07/2009	ERCW A & B	18 : 20	24 : 00	5.67		0.0064	
	RCW	08 : 20	12 : 25	4.08	450	0.0126	
07/08/2009	ERCW A & B	00 : 00	18 : 20	18.33			
	RCW	08 : 20	12 : 50	4.50	50	0.0278	
07/09/2009	n/a	:	:				
07/10/2009	ERCW A & B	11 : 05	15 : 45	4.67			
	RCW	09 : 10	13 : 25	4.25	220	0.0254	
07/11/2009	ERCW A & B	09 : 30	13 : 50	4.33			
	RCW	10 : 25	14 : 50	4.42	220	0.0311	
07/12/2009	n/a	:	:				
07/13/2009	ERCW A & B	14 : 00	18 : 00	4.00	160	0.0091	
07/14/2009	ERCW A & B	09 : 30	13 : 30	4.00	150	0.0086	
07/15/2009	ERCW A & B	11 : 00	15 : 05	4.08		0.0087	
	RCW	17 : 40	24 : 00	6.33	230	0.0010	
07/16/2009	ERCW A & B	11 : 50	16 : 00	4.17			
	RCW	00 : 00	17 : 50	17.83	170	0.0162	
07/17/2009	ERCW A & B	12 : 30	16 : 30	4.00			
	RCW	09 : 30	14 : 00	4.50	200	0.0193	
07/18/2009	n/a	:	:				
07/19/2009	n/a	:	:				
07/20/2009	ERCW A & B	11 : 10	15 : 30	4.33			
	RCW	09 : 50	14 : 00	4.17	210	0.0161	
07/21/2009	ERCW A & B	11 : 15	15 : 15	4.00			
	RCW	11 : 50	15 : 55	4.08	210	0.0191	
07/22/2009	ERCW A & B	10 : 25	14 : 25	4.00			
	RCW	11 : 10	15 : 10	4.00	210	0.0191	
07/23/2009	ERCW A & B	09 : 55	13 : 55	4.00			
	RCW	10 : 35	14 : 45	4.17	210	0.0274	
07/24/2009	ERCW A & B	12 : 10	16 : 10	4.00			
	RCW	08 : 45	13 : 00	4.25	220	0.0212	
07/25/2009	n/a	:	:				
07/26/2009	n/a	:	:				
07/27/2009	ERCW A & B	11 : 00	15 : 00	4.00			
	RCW	09 : 30	13 : 30	4.00	220	0.0236	
07/28/2009	ERCW A & B	10 : 40	14 : 40	4.00			
	RCW	11 : 15	15 : 15	4.00	230	0.0213	
07/29/2009	ERCW A & B	09 : 55	13 : 50	3.92			
	RCW	11 : 05	15 : 05	4.00	240	0.0196	
07/30/2009	RCW	09 : 20	13 : 20	4.00	60	0.0137	
07/31/2009	RCW	10 : 20	14 : 50	4.50	60	0.0130	

Towerbrom 960	system	injection			injection			duration in hours	total quantity	mass balance calc.	Additional Results
									1,425 lbs/day	0.10 mg/L	0.10 mg/L
08/01/2009	n/a		:			:					
08/02/2009	n/a		:			:					
08/03/2009	RCW	10	:	05	14	:	25	4.33	60	0.0097	
08/04/2009	ERCW A & B	06	:	35	10	:	35	4.00			
	RCW	07	:	15	11	:	30	4.25	230	0.0203	
08/05/2009	ERCW A & B	06	:	30	10	:	35	4.08			
	RCW	08	:	35	12	:	30	3.92	240	0.0259	
08/06/2009	ERCW A & B	06	:	40	10	:	40	4.00			
	RCW	08	:	15	12	:	35	4.33	230	0.0303	
08/07/2009	n/a		:			:					
08/08/2009	n/a		:			:					
08/09/2009	ERCW A & B	11	:	00	15	:	00	4.00	150	0.0167	
08/10/2009	ERCW A & B	06	:	35	10	:	35	4.00			
	RCW	07	:	30	11	:	30	4.00	220	0.0256	
08/11/2009	ERCW A & B	07	:	45	11	:	45	4.00			
	RCW	08	:	20	12	:	20	4.00	220	0.0234	
08/12/2009	ERCW A & B	07	:	40	12	:	15	4.58			
	RCW	08	:	15	12	:	15	4.00	220	0.0192	
08/13/2009	ERCW A & B	07	:	05	13	:	20	6.25			
	RCW	10	:	40	14	:	40	4.00	170	0.0196	
08/14/2009	ERCW A & B	10	:	15	14	:	15	4.00			
	RCW	11	:	15	15	:	15	4.00	220	0.0192	
08/15/2009	n/a		:			:					
08/16/2009	n/a		:			:					
08/17/2009	ERCW A & B	06	:	30	10	:	45	4.25			
	RCW	08	:	45	12	:	50	4.08	220	0.0221	
08/18/2009	ERCW A & B	07	:	30	11	:	50	4.33			
	RCW	09	:	30	13	:	30	4.00	220	0.0312	
08/19/2009	ERCW A & B	08	:	10	12	:	30	4.33			
	RCW	08	:	45	12	:	50	4.08	220	0.0258	
08/20/2009	ERCW A & B	09	:	25	14	:	20	4.92			
	RCW	07	:	05	12	:	10	5.08	220	0.0247	
08/21/2009	ERCW A & B	10	:	30	14	:	30	4.00			
	RCW	10	:	50	15	:	00	4.17	220	0.0182	
08/22/2009	n/a		:			:					
08/23/2009	n/a		:			:					
08/24/2009	RCW	06	:	00	10	:	45	4.75	60	0.0123	
08/25/2009	ERCW A & B	08	:	30	12	:	30	4.00			
	RCW	09	:	25	13	:	45	4.33	220	0.0262	
08/26/2009	ERCW A & B	08	:	30	12	:	50	4.33			
	RCW	09	:	25	13	:	25	4.00	240	0.0185	
08/27/2009	ERCW A & B	07	:	00	11	:	05	4.08			
	RCW	09	:	15	13	:	50	4.58	240	0.0183	
08/28/2009	ERCW A & B	07	:	40	12	:	05	4.42			
	RCW	08	:	25	12	:	50	4.42	240	0.0345	
08/29/2009	ERCW A & B	12	:	15	16	:	15	4.00	180	0.0091	
08/30/2009	n/a		:			:					
08/31/2009	RCW	07	:	30	11		50	4.33	60	0.0162	

Towerbrom 960	system	injection			injection			duration in hours	total quantity	mass balance calc.	Additional Results
									1,425 lbs/day	0.10 mg/L	0.10 mg/L
			:			:					
09/01/2009	ERCW A & B	17	:	25	24	:	00	6.58		0.0060	
	RCW	10	:	45	15	:	10	4.42	440	0.0133	
09/02/2009	ERCW A & B	00	:	00	17	:	25	17.42			
	RCW	09	:	10	13	:	25	4.25	160	0.0295	
09/03/2009	ERCW A & B	08	:	50	12	:	50	4.00			
	RCW	09	:	50	14	:	05	4.25	230	0.0238	
09/04/2009	n/a		:			:					
09/05/2009	n/a		:			:					
09/06/2009	ERCW A & B	12	:	30	16	:	30	4.00			
	RCW	13	:	20	17	:	20	4.00	240	0.0273	
09/07/2009	n/a		:			:					
09/08/2009	RCW	10	:	10	14	:	45	4.58	60	0.0162	
09/09/2009	ERCW A & B	15	:	45	24	:	00	8.25		0.0062	
	RCW	08	:	40	13	:	00	4.33	460	0.0195	
09/10/2009	ERCW A & B	00	:	00	15	:	50	15.83			
	RCW	09	:	40	14	:	20	4.67	240	0.0186	
09/11/2009	ERCW A & B	09	:	50	13	:	50	4.00			
	RCW	08	:	40	12	:	40	4.00	240	0.0245	
09/12/2009	ERCW A & B	12	:	45	16		25	3.67			
	RCW	13	:	45	17	:	40	3.92	260	0.0190	
09/13/2009	n/a		:			:					
09/14/2009	ERCW A & B	10	:	40	14	:	40	4.00	200	0.0086	
09/15/2009	ERCW A & B	07	:	45	12	:	15	4.50	200	0.0102	
09/16/2009	ERCW A & B	06		15	11	:	15	5.00			
	RCW	07	:	15	24	:	00	16.75	270	0.0163	
09/17/2009	ERCW A & B	08	:	15	12	:	15	4.00			
	RCW	00	:	00	13	:	00	13.00	250	0.0226	
09/18/2009	n/a		:			:					
09/19/2009	n/a		:			:					
09/20/2009	ERCW A & B	11	:	15	15	:	35	4.33			
	RCW	11	:	45	16	:	00	4.25	250	0.0247	
09/21/2009	ERCW A & B	12	:	45	15	:	40	2.92			
	RCW	12	:	00	16	:	00	4.00	240	0.0247	
09/22/2009	ERCW A & B	11	:	30	15	:	30	4.00			
	RCW	12	:	10	16	:	10	4.00	230	0.0290	
09/23/2009	ERCW A & B	11	:	10	15	:	10	4.00			
	RCW	07	:	40	12	:	00	4.33	250	0.0305	
09/24/2009	ERCW A & B	08	:	20	12	:	20	4.00			
	RCW	08	:	50	12	:	00	3.17	240	0.0312	
09/25/2009	ERCW A & B	08	:	15	12	:	15	4.00	180	0.0102	
09/26/2009	n/a		:			:					
09/27/2009	ERCW A & B	08	:	30	12	:	45	4.25			
	RCW	09	:	05	13	:	30	4.42	240	0.0308	
09/28/2009	n/a		:			:					
09/29/2009	ERCW A & B	11	:	45	15	:	50	4.08			
	RCW	11	:	30	15	:	30	4.00	240	0.0172	
09/30/2009	ERCW A & B	08	:	30	12	:	30	4.00			
	RCW	08	:	50	12	:	55	4.08	240	0.0240	

Towerbrom 960	system	injection			injection			duration in hours	total quantity	mass balance calc.	Additional Results
									1,425 lbs/day	0.10 mg/L	0.10 mg/L
			:			:					
10/01/2009	ERCW A & B	11	:	10	15	:	10	4.00	180	0.0118	
10/02/2009	RCW	11	:	10	15	:	10	4.00	60	0.0101	
10/03/2009	ERCW A & B	13	:	45	17	:	45	4.00			
	RCW	14	:	20	18	:	20	4.00	240	0.0349	
10/04/2009	RCW	11	:	20	15	:	20	4.00	60	0.0078	
10/05/2009	RCW	08	:	30	12	:	30	4.00	60	0.0234	
10/06/2009	n/a		:			:					
10/07/2009	n/a		:			:					
10/08/2009	n/a		:			:					
10/09/2009	RCW	10	:	20	14	:	30	4.17	60	0.0263	
10/10/2009	ERCW A & B	10	:	05	24	:	00	13.92	400	0.0091	
10/11/2009	ERCW A & B	00	:	00	13	:	25	13.42			
	RCW	10	:	55	14	:	55	4.00	460	0.0231	
10/12/2009	n/a		:			:					
10/13/2009	n/a		:			:					
10/14/2009	n/a		:			:					
10/15/2009	ERCW A & B	09	:	30	14	:	00	4.50	190	0.0106	
10/16/2009	n/a		:			:					
10/17/2009	ERCW A & B	11	:	15	15	:	15	4.00		0.0099	
	RCW	16	:	30	24	:	00	7.50	280	0.0089	
10/18/2009	RCW	00		00	24	:	00	24.00	110	0.0057	
10/19/2009	RCW	00		00	24	:	00	24.00	110	0.0078	
10/20/2009	RCW	00		00	24	:	00	24.00	110	0.0078	
10/21/2009	RCW	00		00	24	:	00	24.00	110	0.0052	
10/22/2009	RCW	00		00	24	:	00	24.00	110	0.0026	
10/23/2009	RCW	00		00	24	:	00	24.00	100	0.0104	
10/24/2009	RCW	00		00	24	:	00	24.00	60	0.0000	
10/25/2009	RCW	00		00	24	:	00	24.00	100	0.0192	
10/26/2009	RCW	00	:	00	24	:	00	24.00	90	0.0052	
10/27/2009	RCW	00	:	00	24	:	00	24.00	110	0.0152	
10/28/2009	ERCW A & B	14	:	00	24	:	00	10.00			
	RCW	00	:	00	24	:	00	24.00	500	0.0303	
10/29/2009	ERCW A & B	00	:	00	24	:	00	24.00			
	RCW	00	:	00	24	:	00	24.00	460	0.0302	
10/30/2009	ERCW A & B	00	:	00	24	:	00	24.00			
	RCW	00	:	00	24	:	00	24.00	510	0.0353	
10/31/2009	ERCW A & B	00	:	00	24	:	00	24.00			
	RCW	00	:	00	24	:	00	24.00	500	0.0372	

Towerbrom 960	system	injection			injection			duration in hours	total quantity	mass balance calc.	Additional Results
									1,425 lbs/day	0.10 mg/L	0.10 mg/L
11/01/2009	ERCW A & B	00	:	00	14	:	00	14.00			
	RCW	00	:	00	13	:	40	13.67		0.0431	
	ERCW A & B	15	:	50	24	:	00	8.17			
	RCW	16	:	15	24	:	00	7.75	500	0.0188	
11/02/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	390	0.0357	
11/03/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	500	0.0443	
11/04/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	500	0.0459	
11/05/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	520	0.0412	
11/06/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	500	0.0324	
11/07/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	500	0.0559	0.0293
11/08/2009	ERCW A & B & RCW	00	:	00	24	:	00	24.00	490	0.0504	
11/09/2009	ERCW A & B	00	:	00	12		10	12.17			
	RCW	00	:	00	15	:	50	15.83	440	0.0188	
11/10/2009	ERCW A & B	10	:	45	15	:	00	4.25		0.0091	
	RCW	15	:	30	19	:	46	4.27	140	0.0204	
11/11/2009	RCW	10	:	35	14	:	35	4.00	40	0.0357	
11/12/2009	ERCW A & B	09	:	00	13	:	00	4.00		0.0086	
	RCW	13	:	00	17	:	00	4.00	140	0.0562	
11/13/2009	ERCW A & B	08	:	00	12	:	00	4.00		0.0103	
	RCW	12	:	00	16	:	00	4.00	140	0.0255	
11/14/2009	ERCW A & B	10	:	40	14	:	45	4.08		0.0149	
	RCW	15	:	10	19	:	10	4.00	130	0.0500	
11/15/2009	RCW	10	:	35	14	:	40	4.08	20	0.0250	
11/16/2009	ERCW A & B	12	:	15	16	:	15	4.00		0.0133	
	RCW	08	:	15	12	:	15	4.00	120	0.0153	
11/17/2009	ERCW A & B	11	:	45	15	:	45	4.00		0.0129	
	RCW	07	:	45	11		45	4.00	70	0.0255	
11/18/2009	ERCW A & B	10	:	25	14	:	30	4.08		0.0087	
	RCW	15	:	10	19	:	25	4.25	120	0.0306	
11/19/2009	ERCW A & B	08	:	45	13	:	00	4.25		0.0088	
	RCW	13	:	30	17	:	35	4.08	120	0.0204	
11/20/2009	ERCW A & B	09	:	45	15	:	00	5.25		0.0064	
	RCW	15	:	15	19	:	20	4.08	120	0.0093	
11/21/2009	ERCW A & B	10	:	45	14	:	50	4.08			
	RCW	15	:	10	19	:	15	4.08	170	0.0195	
11/22/2009	ERCW A & B	10	:	30	14	:	35	4.08			
	RCW	11	:	35	15	:	35	4.00	170	0.0233	
11/23/2009	ERCW A & B	10	:	35	15	:	10	4.58	180	0.0115	
11/24/2009	ERCW A & B	12	:	15	16	:	15	4.00		0.0109	
	RCW	08	:	15	12	:	30	4.25	220	0.0208	
11/25/2009	ERCW A & B	11	:	30	13	:	30	2.00		0.0132	
	RCW	07	:	30	11	:	30	4.00	220	0.0104	
11/26/2009	n/a		:			:					
11/27/2009	n/a		:			:					
11/28/2009	ERCW A & B	10	:	35	14	:	40	4.08			
	RCW	11	:	15	15	:	30	4.25	220	0.0208	
11/29/2009	ERCW A & B	11	:	35	15	:	40	4.08			
	RCW	12	:	05	16	:	05	4.00	220	0.0232	
11/30/2009	ERCW A & B	09	:	00	14	:	40	5.67			
	RCW	09	:	45	14	:	20	4.58	220	0.0229	

Towerbrom 960	system	injection			injection			duration in hours	total quantity	mass balance calc.	Additional Results
									1,425 lbs/day	0.10 mg/L	0.10 mg/L
12/01/2009	RCW	09	:	00	14	:	00	5.00	40	0.0128	
12/02/2009	*ERCW A & B*	*11*	:	*30*	*15*	:	*30*	*4.00*			
	RCW	08	:	30	13	:	00	4.50	180	0.0250	
12/03/2009	ERCW A & B	12	:	30	16	:	30	4.00		0.0091	
	RCW	08	:	30	12	:	30	4.00	160	0.0182	
12/04/2009	n/a		:			:					
12/05/2009	n/a		:			:					
12/06/2009	n/a		:			:					
12/07/2009	n/a		:			:					
12/08/2009	n/a		:			:					
12/09/2009	n/a		:			:					
12/10/2009	RCW	10	:	00	14	:	00	4.00	40	0.0184	
12/11/2009	RCW	08	:	10	13	:	30	5.33	40	0.0130	
12/12/2009	n/a		:			:					
12/13/2009	n/a		:			:					
12/14/2009	n/a		:			:					
12/15/2009	n/a		:			:					
12/16/2009	n/a		:			:					
12/17/2009	n/a		:			:					
12/18/2009	RCW	08	:	50	13	:	10	4.33	50	0.0149	
12/19/2009	RCW	09	:	55	14	:	00	4.08	50	0.0232	
12/20/2009	n/a		:			:					
12/21/2009	n/a		:			:					
12/22/2009	n/a		:			:					
12/23/2009	n/a		:			:					
12/24/2009	n/a		:			:					
12/25/2009	n/a		:			:					
12/26/2009	RCW	10	:	00	14	:	10	4.17	50	0.0120	
12/27/2009	RCW	09	:	15	13	:	30	4.25	40	0.0110	
12/28/2009	ERCW A & B	12	:	40	16	:	55	4.25	150	0.0150	
12/29/2009	n/a		:			:					
12/30/2009	ERCW A & B	11	:	30	13	:	30	2.00	140	0.0099	
12/31/2009	n/a		:			:					

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	Quantity in Pounds (lbs/day)			Duration in Hours (hrs/day)*		Analytical Results mass balance calculations (mg/L)				
Month	Maximum	Average	Limit	Maximum	Limit	Maximum	Average	Limit	# of samples	Days in Service
January	9	6	50	0.5	0.5	0.025	0.018	2.0	10	10
February	11	8	50	0.5	0.5	0.021	0.018	2.0	17	17
March	11	8	50	0.5	0.5	0.027	0.021	2.0	16	16
April										0
May										0
June	14	9	50	0.5	0.5	0.019	0.019	2.0	9	9
July	9	8	50	0.5	0.5	0.017	0.017	2.0	7	7
August	9	9	50	0.5	0.5	0.017	0.017	2.0	5	5
September										0
October										0
November										0
December										0
Jan. - Dec.									64	64

*Treatment durations shall not exceed 30 minutes at 2-3 times per week into ERCW Train A, ERCW Train B, and RCW systems.

Per the B/CTP approval: "Frequency of use would be appoximately 208 days per year and duration of use would be about 0.5 hours per day with a maximum daily usage of 50 lbs/day for all three-injection points."

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Biodetergent 73551	system	injection start time	injection end time	duration in hours	total quantity	mass balance calc.
					50 lbs/day	2.0 mg/L
01/01/2009	n/a					
01/02/2009	n/a					
01/03/2009	n/a					
01/04/2009	n/a					
01/05/2009	n/a					
01/06/2009	ERCW A	1005	1035	0.50		
	ERCW B	1035	1105	0.50	9.48	0.018
01/07/2009	RCW	825	855	0.50	4.74	0.018
01/08/2009	RCW	935	1005	0.50	4.74	0.017
01/09/2009	n/a					
01/10/2009	n/a					
01/11/2009	n/a					
01/12/2009	RCW	1045	1115	0.50	4.74	0.017
01/13/2009	RCW	945	1015	0.50	4.74	0.017
01/14/2009	n/a					
01/15/2009	n/a					
01/16/2009	n/a					
01/17/2009	n/a					
01/18/2009	n/a					
01/19/2009	RCW	1025	1055	0.50	4.74	0.018
01/20/2009	RCW	1025	1055	0.50	4.74	0.018
01/21/2009	n/a					
01/22/2009	n/a					
01/23/2009	n/a					
01/24/2009	n/a					
01/25/2009	n/a					
01/26/2009	RCW	955	1025	0.50	4.74	0.018
01/27/2009	RCW	1010	1040	0.50	6.67	0.025
01/28/2009	n/a					
01/29/2009	n/a					
01/30/2009	n/a					
01/31/2009	ERCW A	1105	1135	0.50		
	ERCW B	1135	1205	0.50	9.48	0.018

Biodetergent 73551	system	injection start time	injection end time	duration in hours	total quantity	mass balance calc.
					50 lbs/day	2.0 mg/L
02/01/2009	ERCW A	1205	1235	0.50		
	ERCW B	1235	1305	0.50	9.48	0.017
02/02/2009	ERCW A	1055	1125	0.50		
	ERCW B	1125	1155	0.50	9.48	0.018
02/03/2009	RCW	1050	1120	0.50	5.08	0.019
02/04/2009	RCW	1025	1055	0.50	5.08	0.019
02/05/2009	n/a					
02/06/2009	n/a					
02/07/2009	n/a					
02/08/2009	ERCW A	1100	1130	0.50		
	ERCW B	1130	1200	0.50	9.48	0.017
02/09/2009	ERCW A	1055	1125	0.50		
	ERCW B	1125	1155	0.50	9.48	0.017
02/10/2009	RCW	1020	1050	0.50	5.69	0.021
02/11/2009	ERCW A	1030	1100	0.50		
	ERCW B	1100	1130	0.50	9.48	0.017
02/12/2009	RCW	950	1020	0.50	4.74	0.017
02/13/2009	n/a					
02/14/2009	n/a					
02/15/2009	n/a					
02/16/2009	RCW	1000	1030	0.50	4.74	0.017
02/17/2009	RCW	930	1000	0.50	4.74	0.017
02/18/2009	n/a					
02/19/2009	n/a					
02/20/2009	ERCW A	1215	1245	0.50		
	ERCW B	1245	1315	0.50	11.38	0.021
02/21/2009	ERCW A	1145	1215	0.50		
	ERCW B	1215	1245	0.50	11.38	0.02
02/22/2009	n/a					
02/23/2009	RCW	1035	1105	0.50	4.74	0.017
02/24/2009	RCW	1000	1030	0.50	4.74	0.017
02/25/2009	ERCW A	1145	1215	0.50		
	ERCW B	1215	1245	0.50	9.48	0.019
02/26/2009	ERCW A	1030	1100	0.50		
	ERCW B	1100	1130	0.50	9.48	0.019
02/27/2009	n/a					
02/28/2009	n/a					

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Biodetergent 73551	system	injection start time	injection end time	duration in hours	total quantity	mass balance calc.
					50 lbs/day	2.0 mg/L
03/01/2009	n/a					
03/02/2009	RCW	1055	1125	0.50	4.74	0.019
03/03/2009	RCW	1020	1050	0.50	6.64	0.027
03/04/2009	n/a					
03/05/2009	ERCW A	1450	1520	0.50		
	ERCW B	1520	1550	0.50	11.38	0.023
03/06/2009	ERCW A	1020	1050	0.50		
	ERCW B	1050	1120	0.50	11.38	0.023
03/07/2009	n/a					
03/08/2009	n/a					
03/09/2009	n/a					
03/10/2009	ERCW A	1015	1045	0.50		
	ERCW B	1045	1115	0.50	11.38	0.023
03/11/2009	RCW	855	925	0.50	5.69	0.023
03/12/2009	ERCW A	1140	1210	0.50		
	ERCW B	1210	1240	0.50	11.38	0.023
03/13/2009	RCW	1010	1040	0.50	5.69	0.023
03/14/2009	n/a					
03/15/2009	n/a					
03/16/2009	RCW	1010	1040	0.50	4.74	0.019
03/17/2009	RCW	1020	1050	0.50	4.74	0.019
03/18/2009	ERCW A	1035	1105	0.50		
	ERCW B	1105	1135	0.50	11.38	0.023
03/19/2009	n/a					
03/20/2009	n/a					
03/21/2009	n/a					
03/22/2009	ERCW A	1210	1240	0.50		
	ERCW B	1240	1310	0.50	9.48	0.019
03/23/2009	ERCW A	1040	1110	0.50		
	ERCW B	1110	1140	0.50	9.48	0.019
03/24/2009	ERCW A	1025	1055	0.50		
	ERCW B	1055	1125	0.50	9.48	0.019
03/25/2009	RCW	1025	1055	0.50	4.74	0.019
03/26/2009	n/a					
03/27/2009	RCW	1015	1045	0.50	4.74	0.02
03/28/2009	n/a					
03/29/2009	n/a					
03/30/2009	n/a					
03/31/2009	n/a					
Nothing Injected for April 2009						

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Nothing Injected for May 2009						
Biodetergent 73551	system	injection start time	injection end time	duration in hours	total quantity	mass balance calc.
					50 lbs/day	2.0 mg/L
06/01/2009	n/a					
06/02/2009	na					
06/03/2009	n/a					
06/04/2009	ERCW A	910	940	0.50		
	ERCW B	940	1010	0.50		
	RCW	1120	1150	0.50	14.22	0.019
06/05/2009	RCW	945	1015	0.50	4.74	0.019
06/06/2009	ERCW A	1010	1040	0.50		
	ERCW B	1040	1110	0.50	9.48	0.019
06/07/2009	n/a					
06/08/2009	n/a					
06/09/2009	n/a					
06/10/2009	RCW	1005	1035	0.50	4.74	0.019
06/11/2009	n/a					
06/12/2009	RCW	1000	1030	0.50	4.74	0.019
06/13/2009	n/a					
06/14/2009	n/a					
06/15/2009	n/a					
06/16/2009	n/a					
06/17/2009	n/a					
06/18/2009	n/a					
06/19/2009	RCW	1010	1040	0.50	4.74	0.019
06/20/2009	ERCW A	1000	1030	0.50		
	ERCW B	1030	1100	0.50		
	RCW	1120	1150	0.50	14.22	0.019
06/21/2009	n/a					
06/22/2009	n/a					
06/23/2009	n/a					
06/24/2009	ERCW A	1005	1035	0.50		
	ERCW B	1035	1105	0.50		
	RCW	1145	1215	0.50	14.22	0.019
06/25/2009	ERCW A	1000	1030	0.50		
	ERCW B	1030	1100	0.50		
	RCW	1120	1150	0.50	14.22	0.017
06/26/2009	n/a					
06/27/2009	n/a					
06/28/2009	n/a					
06/29/2009	n/a					
06/30/2009	n/a					

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Biodetergent 73551	system	injection start time	injection end time	duration in hours	total quantity	mass balance calc.
					50 lbs/day	2.0 mg/L
07/01/2009	RCW	945	1015	0.50	4.74	0.017
07/02/2009	n/a					
07/03/2009	n/a					
07/04/2009	RCW	1015	1045	0.50	4.74	0.017
07/05/2009	n/a					
07/06/2009	n/a					
07/07/2009	n/a					
07/08/2009	n/a					
07/09/2009	n/a					
07/10/2009	n/a					
07/11/2009	n/a					
07/12/2009	n/a					
07/13/2009	n/a					
07/14/2009	n/a					
07/15/2009	ERCW A	1000	1030	0.50		
	ERCW B	1030	1100	0.50	9.48	0.017
07/16/2009	ERCW A	1050	1120	0.50		
	ERCW B	1120	1150	0.50	9.48	0.017
07/17/2009	n/a					
07/18/2009	n/a					
07/19/2009	n/a					
07/20/2009	n/a					
07/21/2009	ERCW A	1015	1045	0.50		
	ERCW B	1045	1115	0.50	9.48	0.017
07/22/2009	n/a					
07/23/2009	ERCW A	855	925	0.50		
	ERCW B	925	955	0.50	9.48	0.017
07/24/2009	n/a					
07/25/2009	n/a					
07/26/2009	n/a					
07/27/2009	n/a					
07/28/2009	n/a					
07/29/2009	ERCW A	855	925	0.50		
	ERCW B	925	955	0.50	9.48	0.017
07/30/2009	n/a					
07/31/2009	n/a					

Biodetergent 73551	system	injection start time	injection end time	duration in hours	total quantity	mass balance calc.
					50 lbs/day	2.0 mg/L
08/01/2009	n/a					
08/02/2009	n/a					
08/03/2009	n/a					
08/04/2009	n/a					
08/05/2009	n/a					
08/06/2009	n/a					
08/07/2009	n/a					
08/08/2009	n/a					
08/09/2009	n/a					
08/10/2009	n/a					
08/11/2009	ERCW A	645	715	0.50		
	ERCW B	715	745	0.50	9.48	0.017
08/12/2009	n/a					
08/13/2009	n/a					
08/14/2009	ERCW A	915	945	0.50		
	ERCW B	945	1015	0.50	9.48	0.017
08/15/2009	n/a					
08/16/2009	n/a					
08/17/2009	n/a					
08/18/2009	n/a					
08/19/2009	n/a					
08/20/2009	ERCW A	825	855	0.50		
	ERCW B	855	925	0.50	9.48	0.017
08/21/2009	ERCW A	930	1000	0.50		
	ERCW B	1000	1030	0.50	9.48	0.017
08/22/2009	n/a					
08/23/2009	n/a					
08/24/2009	n/a					
08/25/2009	n/a					
08/26/2009	ERCW A	750	820	0.50		
	ERCW B	820	850	0.50	9.48	0.017
08/27/2009	n/a					
08/28/2009	n/a					
08/29/2009	n/a					
08/30/2009	n/a					
08/31/2009	n/a					

Biodetergent 73551

Nothing Injected for September 2009						
Nothing Injected for October 2009						
Nothing Injected for November 2009						
Nothing Injected for December 2009						

2009 Biocide/Corrosion Treatment Plan Annual Report

MSW 101

Month	Quantity in Pounds (lbs/day)			Duration in Hours (hrs/day)	Analytical Results mass balance calculations (mg/L)				Days in Service
	Maximum	Average	Limit	Maximum	Maximum	Average	Limit	# of samples	
January									0
February									0
March									0
April									0
May									0
June	811	665	2280	24.00	0.077	0.062	0.2	29	29
July	811	533	2280	24.00	0.076	0.047	0.2	23	23
August	811	620	2280	24.00	0.061	0.050	0.2	31	31
September	406	331	2280	24.00	0.033	0.030	0.2	22	22
October	406	349	2280	24.00	0.038	0.030	0.2	11	11
November									0
December									0
Jan. - Dec.								116	116

Per the B/CTP approval: "MSW 101 is injected into the ERCW Train A & B system only during warm weather months."

Nothing Injected for January 2009								
Nothing Injected for February 2009								
Nothing Injected for March 2009								
Nothing Injected for April 2009								
Nothing Injected for May 2009								

MSW 101	system	injection		injection		injection		injection		duration in hours	PHOSPHATE	
											total quantity	mass balance calc.
											2,280 lbs/day	0.2 mg/L
06/01/2009	n/a											
06/02/2009	ERCW A & B	11	00	24	00					13.00	219.69	0.034
06/03/2009	ERCW A & B	00	00	16	00	16	00	24	00	24.00		
	RCW	15	30	24	00					8.50	481.62	0.067
06/04/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	11	00	16	00	24	00	19.00	523.87	0.05
06/05/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	09	25	16	00	24	00	17.42	699.96	0.067
06/06/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.066
06/07/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.066
06/08/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	10	10	14	30	24	00	19.67	737.98	0.067
06/09/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	09	30	14	05	24	00	19.42	733.76	0.067
06/10/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	09	50	16	00	24	00	17.83	706.88	0.067
06/11/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	10	20	14	45	24	00	19.58	736.46	0.067
06/12/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	09	40	14	45	24	00	18.92	725.3	0.068
06/13/2009	ERCW A & B	00	00	11	45					11.75		
	RCW	00	00	24	00					24.00	604.14	0.068
06/14/2009	RCW	00	00	24	00					24.00	405.58	0.034
06/15/2009	RCW	00	00	24	00					24.00	405.58	0.034
06/16/2009	ERCW A & B	15	00	24	00					9.00		
	RCW	00	00	10	45	15	05	24	00	19.67	484.5	0.067
06/17/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	09	30	14	10	24	00	19.33	732.23	0.067
06/18/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	11	00	16	30	24	00	18.50	718.21	0.077
06/19/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	10	00	15	20	24	00	18.67	721.08	0.068
06/20/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	11	10	16	00	24	00	19.17	729.53	0.068
06/21/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.067
06/22/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	09	40	14	45	24	00	18.92	725.3	0.067
06/23/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	09	00	13	50	24	00	19.17	729.53	0.067
06/24/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	11	30	16	30	24	00	19.00	726.66	0.067
06/25/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	11	10	16	05	24	00	19.08	728.18	0.06
06/26/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.06
06/27/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	11	30	16	00	24	00	19.50	735.11	0.06
06/28/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.06
06/29/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	06	30	11	10	24	00	19.33	732.23	0.06
06/30/2009	ERCW A & B	00	00	08	30					8.50		
	RCW	00	00	08	45	13	10	24	00	19.58	474.52	0.06

MSW 101	system	injection		injection		injection		injection		duration in hours	PHOSPHATE	
											total quantity	mass balance calc.
											2,280 lbs/day	0.2 mg/L
07/01/2009	RCW	00	00	09	30	14	30	24	00	19.00	321.08	0.031
07/02/2009	RCW	00	00	24	00					24.00	405.58	0.031
07/03/2009	RCW	00	00	10	00	15	45	24	00	18.25	308.41	0.03
07/04/2009	RCW	00	00	10	30	15	00	24	00	19.50	329.53	0.03
07/05/2009	RCW	00	00	24	00					24.00	405.58	0.03
07/06/2009	RCW	00	00	06	50	12	15	24	00	18.58	313.98	0.03
07/07/2009	RCW	00	00	07	40	12	30	24	00	19.17	323.96	0.03
07/08/2009	RCW	00	00	08	15	13	00	24	00	19.25	325.31	0.03
07/09/2009	RCW	00	00	24	00					24.00	405.58	0.03
07/10/2009	RCW	00	00	08	50	13	30	24	00	19.33	326.66	0.03
07/11/2009	RCW	00	00	09	50					9.83	166.12	0.03
07/12/2009	n/a											
07/13/2009	n/a											
07/14/2009	n/a											
07/15/2009	n/a											
07/16/2009	n/a											
07/17/2009	n/a											
07/18/2009	n/a											
07/19/2009	n/a											
07/20/2009	ERCW A & B	15	45	24	00					8.25		
	RCW	14	05	24	00					9.92	376.76	0.076
07/21/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	11	30	16	00	24	00	19.50	735.11	0.061
07/22/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	10	50	15	15	24	00	19.58	736.46	0.06
07/23/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	10	10	14	45	24	00	19.42	733.76	0.061
07/24/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	08	30	13	05	24	00	19.42	733.76	0.061
07/25/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.061
07/26/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.061
07/27/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	09	25	13	35	24	00	19.83	740.85	0.061
07/28/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	10	50	15	20	24	00	19.50	735.11	0.06
07/29/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	10	50	15	10	24	00	19.67	737.81	0.06
07/30/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	10	50	15	10	24	00	19.67	737.81	0.06
07/31/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	10	00	14	30	24	00	19.50	735.11	0.06

MSW 101	system	injection		injection		injection		injection		duration in hours	PHOSPHATE	
											total quantity	*mass balance calc.*
											2,280 lbs/day	0.2 mg/L
08/01/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.06
08/02/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.06
08/03/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	09	45	14	30	24	00	19.25	730.88	0.061
08/04/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	07	00	11	35	24	00	19.42	733.76	0.059
08/05/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	08	10	12	35	24	00	19.58	736.63	0.06
08/06/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	07	50	12	30	24	00	19.33	732.23	0.06
08/07/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.06
08/08/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.06
08/09/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.06
08/10/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	07	10	11	35	24	00	19.58	736.63	0.06
08/11/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	07	55	12	30	24	00	19.42	733.76	0.06
08/12/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	07	50	12	20	24	00	19.50	735.11	0.06
08/13/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	10	10	14	45	24	00	19.42	733.76	0.059
08/14/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	11	00	15	30	24	00	19.50	735.11	0.06
08/15/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.06
08/16/2009	ERCW A & B & RCW	00	00	24	00					24.00	811.15	0.06
08/17/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	08	25	13	00	24	00	19.42	733.76	0.06
08/18/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	09	20	14	00	24	00	19.33	732.23	0.059
08/19/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	08	20	13	00	24	00	19.33	732.23	0.06
08/20/2009	ERCW A & B	00	00	24	00					24.00		
	RCW	00	00	06	40	12	15	24	00	18.42	716.86	0.059
08/21/2009	ERCW A & B	00	00	08	00					8.00		
	RCW	00	00	10	40	15	05	24	00	19.58	466.24	0.06
08/22/2009	RCW	00	00	24	00					24.00	405.58	0.03
08/23/2009	RCW	00	00	24	00					24.00	405.58	0.03
08/24/2009	RCW	00	00	05	49	11	00	24	00	18.82	318.04	0.029
08/25/2009	RCW	00	00	08	50	14	00	24	00	18.83	318.21	0.03
08/26/2009	RCW	00	00	09	00	13	30	24	00	19.50	329.53	0.03
08/27/2009	RCW	00	00	09	00	14	00	24	00	19.00	321.08	0.03
08/28/2009	RCW	00	00	08	10	12	35	24	00	19.58	331.05	0.03
08/29/2009	RCW	00	00	24	00					24.00	405.58	0.03
08/30/2009	RCW	00	00	24	00					24.00	405.58	0.03
08/31/2009	RCW	00	00	07	20	12	00	24	00	19.33	326.65	0.029

MSW 101	system	injection			injection			injection			injection			duration in hours	PHOSPHATE	
															total quantity	mass balance calc.
															2,280 lbs/day	0.2 mg/L
09/01/2009	RCW	00	00	10	30	15	15	24	00					19.25	325.31	0.03
09/02/2009	RCW	00	00	09	00	13	30	24	00					19.50	329.53	0.03
09/03/2009	RCW	00	00	09	30	14	10	24	00					19.33	326.66	0.03
09/04/2009	RCW	00	00	24	00									24.00	405.58	0.03
09/05/2009	RCW	00	00	24	00									24.00	405.58	0.03
09/06/2009	RCW	00	00	13	00	17	30	24	00					19.50	329.53	0.03
09/07/2009	RCW	00	00	24	00									24.00	405.58	0.03
09/08/2009	RCW	00	00	09	30	15	00	24	00					18.50	312.63	0.03
09/09/2009	RCW	00	00	08	20	13	05	24	00					19.25	325.31	0.03
09/10/2009	RCW	00	00	06	00	14	30	24	00					15.50	261.94	0.03
09/11/2009	RCW	00	00	08	20	12	45	24	00					19.58	330.88	0.03
09/12/2009	RCW	00	00	12	50									12.83	216.81	0.03
09/13/2009	n/a															
09/14/2009	n/a															
09/15/2009	n/a															
09/16/2009	n/a															
09/17/2009	n/a															
09/18/2009	n/a															
09/19/2009	n/a															
09/20/2009	n/a															
09/21/2009	RCW	16	05	24	00									7.92	133.84	0.03
09/22/2009	RCW	00	00	11	50	16	15	24	00					19.58	330.88	0.03
09/23/2009	RCW	00	00	07	15	12	05	24	00					19.17	323.95	0.03
09/24/2009	RCW	00	00	08	30	13	00	24	00					19.50	329.53	0.03
09/25/2009	RCW	00	00	24	00									24.00	405.58	0.03
09/26/2009	RCW	00	00	24	00									24.00	405.58	0.03
09/27/2009	RCW	00	00	08	45	13	45	24	00					19.00	321.08	0.03
09/28/2009	RCW	00	00	24	00									24.00	405.58	0.033
09/29/2009	RCW	00	00	11	00	15	55	24	00					19.08	322.43	0.03
09/30/2009	RCW	00	00	08	30	12	55	24	00					19.58	330.89	0.03

MSW 101	system	injection		injection		injection		injection		duration in hours	PHOSPHATE	
											total quantity	mass balance calc.
											2,280 lbs/day	*0.2 mg/L*
10/01/2009	RCW	00	00	24	00					24.00	405.58	0.038
10/02/2009	RCW	00	00	10	30	15	15	24	00	19.25	325.31	0.029
10/03/2009	RCW	00	00	14	00	18	25	24	00	19.58	330.88	0.029
10/04/2009	RCW	00	00	11	00	15	25	24	00	19.58	330.88	0.029
10/05/2009	RCW	00	00	07	45	12	35	24	00	19.17	323.96	0.029
10/06/2009	RCW	00	00	24	00					24.00	405.58	0.03
10/07/2009	RCW	00	00	24	00					24.00	405.58	0.029
10/08/2009	RCW	00	00	24	00					24.00	405.58	0.029
10/09/2009	RCW	00	00	09	50	14	35	24	00	19.25	325.31	0.029
10/10/2009	RCW	00	00	24	00					24.00	405.58	0.029
10/11/2009	RCW	00	00	10	10					10.17	171.86	0.03
10/12/2009	n/a											
10/13/2009	n/a											
10/14/2009	n/a											
10/15/2009	n/a											
10/16/2009	n/a											
10/17/2009	n/a											
10/18/2009	n/a											
10/19/2009	n/a											
10/20/2009	n/a											
10/21/2009	n/a											
10/22/2009	n/a											
10/23/2009	n/a											
10/24/2009	n/a											
10/25/2009	n/a											
10/26/2009	n/a											
10/27/2009	n/a											
10/28/2009	n/a											
10/29/2009	n/a											
10/30/2009	n/a											
10/31/2009	n/a											
Nothing Injected for November 2009												
Nothing Injected for December 2009												

2009 Biocide/Corrosion Treatment Plan Annual Report

Flogard MS6236

Month	Quantity in Pounds (lbs/day)			Duration in Hours (hrs/day)	Analytical Results mass balance calculations (mg/L)				Days in Service
	Maximum	Average	Limit	Maximum	Maximum	Average	Limit	# of samples	
January									0
February									0
March									0
April									0
May									0
June									0
July									0
August	418	405	2275	24.00	0.031	0.031	0.2	11	11
September	418	402	2275	24.00	0.034	0.031	0.2	19	19
October	418	336	2275	24.00	0.038	0.033	0.2	3	3
November									0
December									0
Jan. - Dec.								33	33

Per the B/CTP approval: "Flogard MS6236 is injected into the ERCW Train A & B system only during warm weather months."

Nothing Injected for January 2009																
Nothing Injected for February 2009																
Nothing Injected for March 2009																
Nothing Injected for April 2009																
Nothing Injected for May 2009																
Nothing Injected for June 2009																
Nothing Injected for July 2009																

		injection start time			injection end time			injection start time			injection end time			duration in hours	PHOSPHATE	
Floguard MS6236	system														total quantity	mass balance calc.
															2,275 lbs/day	0.2 mg/L
08/01/2009	n/a															
08/02/2009	n/a															
08/03/2009	n/a															
08/04/2009	n/a															
08/05/2009	n/a															
08/06/2009	n/a															
08/07/2009	n/a															
08/08/2009	n/a															
08/09/2009	n/a															
08/10/2009	n/a															
08/11/2009	n/a															
08/12/2009	n/a															
08/13/2009	n/a															
08/14/2009	n/a															
08/15/2009	n/a															
08/16/2009	n/a															
08/17/2009	n/a															
08/18/2009	n/a															
08/19/2009	n/a															
08/20/2009	n/a															
08/21/2009	ERCW A & B	08		00	24		00							16.00	278.4	0.031
08/22/2009	ERCW A & B	00		00	24		00							24.00	417.6	0.031
08/23/2009	ERCW A & B	00		00	24		00							24.00	417.6	0.031
08/24/2009	ERCW A & B	00		00	24		00							24.00	417.6	0.031
08/25/2009	ERCW A & B	00		00	24		00							24.00	417.6	0.031
08/26/2009	ERCW A & B	00		00	24		00							24.00	417.6	0.031
08/27/2009	ERCW A & B	00		00	24		00							24.00	417.6	0.031
08/28/2009	ERCW A & B	00		00	24		00							24.00	417.6	0.031
08/29/2009	ERCW A & B	00		00	24		00							24.00	417.6	0.031
08/30/2009	ERCW A & B	00		00	24		00							24.00	417.6	0.031
08/31/2009	ERCW A & B	00		00	24		00							24.00	417.6	0.031

		injection start time	injection end time	injection start time	injection end time	duration in hours	PHOSPHATE	
Floguard MS6236	system						total quantity	mass balance calc.
							2,275 lbs/day	0.2 mg/L
09/01/2009	n/a							
09/02/2009	n/a							
09/03/2009	n/a							
09/04/2009	n/a							
09/05/2009	n/a							
09/06/2009	n/a							
09/07/2009	n/a							
09/08/2009	n/a							
09/09/2009	n/a							
09/10/2009	n/a							
09/11/2009	n/a							
09/12/2009	ERCW A & B	17 00	24 00			7.00	121.8	0.031
09/13/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.031
09/14/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.03
09/15/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.03
09/16/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.031
09/17/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.031
09/18/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.031
09/19/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.031
09/20/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.031
09/21/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.031
09/22/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.031
09/23/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.031
09/24/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.031
09/25/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.031
09/26/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.03
09/27/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.03
09/28/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.034
09/29/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.03
09/30/2009	ERCW A & B	00 00	24 00			24.00	417.6	0.03

		injection start time			injection end time			injection start time			injection end time			duration in hours	PHOSPHATE	
Floguard MS6236	system														total quantity	mass balance calc.
															2,275 lbs/day	0.2 mg/L
10/01/2009	ERCW A & B	00		00	24		00							24.00	417.6	0.038
10/02/2009	ERCW A & B	00		00	24		00							24.00	417.6	0.031
10/03/2009	ERCW A & B	00		00	10		00							10.00	174	0.031
10/04/2009	n/a															
10/05/2009	n/a															
10/06/2009	n/a															
10/07/2009	n/a															
10/08/2009	n/a															
10/09/2009	n/a															
10/10/2009	n/a															
10/11/2009	n/a															
10/12/2009	n/a															
10/13/2009	n/a															
10/14/2009	n/a															
10/15/2009	n/a															
10/16/2009	n/a															
10/17/2009	n/a															
10/18/2009	n/a															
10/19/2009	n/a															
10/20/2009	n/a															
10/21/2009	n/a															
10/22/2009	n/a															
10/23/2009	n/a															
10/24/2009	n/a															
10/25/2009	n/a															
10/26/2009	n/a															
10/27/2009	n/a															
10/28/2009	n/a															
10/29/2009	n/a															
10/30/2009	n/a															
10/31/2009	n/a															

Nothing Injected for November 2009															
Nothing Injected for December 2009															

June 9, 2009

Ruth Ann Hurt, SB 2A-SQN

SEQUOYAH NUCLEAR PLANT (SQN) TOXICITY BIOMONITORING, NPDES PERMIT NO. TN0026450, COMPLIANCE TOXICITY TESTS, MAY, 2009

Per your request, I am only submitting an electronic copy of the subject report. The report provides results of compliance testing using fathead minnows and daphnids. Outfall 101, samples collected May 10-15, showed no toxic effects to fathead minnows or daphnids. The resulting IC_{25} values for both species were > 100 percent. Exposure of fathead minnows and daphnids to intake samples resulted in no significant differences from controls during this study period.

Fathead minnows were also exposed to UV treated Outfall 101 and intake samples since fish pathogens present in intake water have been the suspected cause of interference (anomalous dose response and high variability among replicates) in previous toxicity testing at Sequoyah.

Call me at (256) 386-2755 if you have any questions or comments following your review of the report.

Cynthia L. Russell
Biologist
Environmental Engineering Services- West
CEB 3A-M

Attachment
cc (Attachment):
Sherrard, R. M., PSC 1X-C
Files, ER&TA, CEB 1B-M

SQN May 2009m

TENNESSEE VALLEY AUTHORITY
TOXICITY TEST REPORT

INTRODUCTION / EXECUTIVE SUMMARY

Report Date: June 9, 2009

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: May 10-15, 2009
10. Average Flow on Days Sampled (MGD): 1426, 1443, 1448
11. Pertinent Site Conditions: H-150M was injected into the ERCW B train beginning on 5/11/09 @ 1220 through 5/14/09 @ 1500.
12. Test Dates: May 12-19, 2009
13. Test Type: Short-term Chronic Definitive
14. Test Species: Fathead Minnows (*Pimephales promelas*)
    Daphnids (*Ceriodaphnia dubia*)
15. Concentrations Tested (%): Outfall 101: 11.3, 22.6, 45.2, 72.6, 100
    Intake: 100.0

    Pimephales promelas: UV treated Outfall 101: 11.3, 22.6, 45.2, 72.6, 100
    UV treated Intake: 100.0
16. Permit Limit Endpoint (%): Outfall 101: IC_{25} = 45.2%
17. Test Results: Outfall 101: *Pimephales promelas:* IC_{25} > 100%
    Ceriodaphnia dubia: IC_{25} > 100%

    UV treated Outfall 101: *Pimephales promelas:* IC_{25} > 100%

18. Facility Contact: Ann Hurt Phone #: (423) 843-6714

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

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

21. TVA Contact: Cynthia L. Russell Phone #: (256) 386-2755

22. Notes: Outfall 101 samples collected May 10-15, 2009, showed no toxic effects to fathead minnows or daphnids. The resulting IC_{25} values, for both species, were > 100 percent. Exposure of daphnids to intake samples resulted in no significant difference from the control during this study period. Minnow survival was significantly reduced when exposed to intake samples during this study period.

    Fathead minnows were also exposed to UV treated Outfall 101 and intake samples since fish pathogens present in intake water have been the suspected cause of interference (anomalous dose response and high variability among replicates) in previous toxicity testing at Sequoyah.

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) First Used By
101	05-10-09 0859 to 05-11-09 0759	05-11-09 1510	1.8, 1.8†	<0.10	05-12-09 0950 05-13-09 0850
Intake	05-10-09 0933 to 05-11-09 0833	05-11-09 1510	1.3	<0.10	05-12-09 0950 05-13-09 0850
101	05-12-09 0821 to 05-13-09 0721	05-13-09 1433	3.2, 2.0†	<0.10	05-14-09 0900 05-15-09 0853
Intake	05-12-09 0839 to 05-13-09 0739	05-13-09 1433	2.1	<0.10	05-14-09 0900 05-15-09 0853
101	05-14-09 0828 to 05-15-09 0728	05-15-09 1428	2.3, 1.5†	<0.10	05-16-09 0900 05-17-09 0920 05-18-09 0903
Intake	05-14-09 0842 to 05-15-09 0742	05-15-09 1428	1.7	<0.10	05-16-09 0900 05-17-09 0920 05-18-09 0903

*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.

	Pimephales promelas	*Ceriodaphnia dubia*
Test Organisms:		
1. Source:	Aquatox, Inc.	In-house Cultures
2. Age:	20.33 hours old	<24-hours old
Test Method Summary:		
1. Test Conditions:	Static, Renewal	Static, Renewal
2. Test Duration:	7 days	Until at least 60% of control females have 3 broods
3. Control / Dilution Water:	Moderately Hard Synthetic	Moderately Hard Synthetic
4. Number of Replicates:	4	10
5. Organisms per Replicate:	10	1
6. Test Initiation: (Date/Time)		
Outfall 101	05-12-09 1220 ET	05-12-09 0950 ET
UV Treated Outfall 101	05-12-09 1232 ET	
7. Test Termination: (Date/Time)		
Outfall 101	05-19-09 1123 ET	05-19-09 0854 ET
UV Treated Outfall 101	05-19-09 1140 ET	
8. Test Temperature: Outfall 101:	Mean = 24.7°C (24.2 – 25.1°C)	Mean = 24.9°C (24.6 - 25.2°C)

Test Temperature: UV-Treated Outfall 101: Mean = 24.7°C (24.3 - 25.0°C)

9. Physical / Chemical Measurements: 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.

10. Statistics: Statistics were performed according to methods prescribed by EPA using ToxCalc version 5.0 statistical software (Tidepool Scientific Software, McKinneyville, CA).

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 12 – 19, 2009 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
11.3%	100	100	98	98	98	98	98
22.6%	100	100	100	100	100	98	98
45.2%	100	100	100	100	98	98	98
72.6%	100	100	100	100	100	100	100
100.0%	100	100	100	98	98	98	98
Intake	100	100	90	68	60	53	50

Test Solutions (% Effluent)	Mean Dry Weight (mg) (replicate number)				
	1	2	3	4	Mean
Control	0.730	0.684	0.895	0.761	0.768
11.3%	0.753	0.655	0.723	0.717	0.712
22.6%	0.654	0.723	0.673	0.760	0.703
45.2%	0.646	0.684	0.638	0.649	0.654
72.6%	0.665	0.632	0.656	0.603	0.639
100.0%	0.723	0.604	0.700	0.641	0.667
Intake	0.212	0.285	0.496	0.567	0.390

IC_{25} Value: ≥ 100% Permit Limit: 45.2% 95% Confidence Limits: Upper Limit: NA Lower Limit: NA	Calculated TU Estimates: < 1.0 TUc* Permit Limit: 2.2 TUc

*TUa = $100/LC_{50}$: TUc = $100/IC_{25}$

TOXICITY TEST RESULTS (see Appendix C for Bench Sheets)

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

Conducted May 12 – 19, 2009 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
11.3%	100	100	100	100	100	100	100
22.6%	100	100	100	100	100	100	100
45.2%	100	100	100	100	100	100	100
72.6%	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	33	34	33	34	34	32	34	34	31	31	33.0
11.3%	33	36	32	32	36	33	33	34	33	32	33.4
22.6%	35	36	34	36	32	33	35	34	33	33	34.1
45.2%	36	34	31	35	35	33	33	34	33	31	33.5
72.6%	37	37	36	32	35	32	31	34	34	33	34.1
100.0%	39	38	32	36	34	33	34	35	34	31	34.6

IC_{25} Value: > 100% Permit Limit: 45.2% 95% Confidence Limits: Upper Limit: NA Lower Limit: NA	Calculated TU Estimates: < 1.0 TUc* Permit Limit: 2.2 TUc

*TUa = $100/LC_{50}$: TUc = $100/IC_{25}$

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 12 – 19, 2009 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	35	33	35	34	33	31	31	33	33	33.1
Intake	39	35	41	36	35	38	37	36	37	34	36.8

IC_{25} Value: ≥ 100% Permit Limit: N/A 95% Confidence Limits: Upper Limit: NA Lower Limit: NA	Calculated TU Estimates: < 1.0 TUc* Permit Limit: N/A

*TUa = 100/LC_{50}: TUc = 100/ IC_{25}

TOXICITY TEST RESULTS, UV-TREATED (see Appendix C for Bench Sheets)

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

Conducted May 12 – 19, 2009 using effluent from UV Treated 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
11.3%	100	100	100	100	100	100	100
22.6%	100	100	100	100	100	100	98
45.2%	100	100	100	100	100	100	100
72.6%	100	100	100	100	100	100	100
100.0%	100	100	100	100	100	100	100
Intake	100	100	100	100	100	100	100

Test Solutions (% Effluent)	Mean Dry Weight (mg) (replicate number)				
	1	2	3	4	Mean
Control	0.637	0.743	0.695	0.659	0.684
11.3%	0.775	0.852	0.756	0.772	0.789
22.6%	0.737	0.727	0.706	0.653	0.706
45.2%	0.693	0.722	0.683	0.756	0.714
72.6%	0.682	0.668	0.665	0.722	0.684
100.0%	0.631	0.664	0.751	0.745	0.698
Intake	0.695	0.635	0.662	0.642	0.659

IC_{25} Value: > 100% 95% Confidence Limits: Upper Limit: NA Lower Limit: NA	Calculated TU Estimates: < 1.0 TUc*

*TUa = 100/LC_{50}: TUc = 100/ IC_{25}

REFERENCE TOXICANT TEST RESULTS (see Appendix A and D)

Species	Date	Time	Duration	Toxicant	Results (IC_{25})
Pimephales promelas	May 12 – 19, 2009	1208	7-days	KCl	0.75 g/L
Ceriodaphnia dubia	May 05 – 12, 2009	0905	7 days	NaCl	1.07 g/L

PHYSICAL/CHEMICAL SUMMARY

Water Chemistry Mean Values and Ranges for *Pimephales promelas* and *Ceriodaphnia dubia* Tests, Non-treated Sequoyah Nuclear Plant (SQN) Outfall 101 performed May 12-19, 2009.

Test	Sample ID	Temperature (°C)		Dissolved Oxygen (mg/L)		pH (S.U.)		Conductance	Alkalinity	Hardness	Total Residual
		Initial	Final	Initial	Final	Initial	Final	(µmhos/cm)	(mg/L $CaCO_3$)	(mg/L $CaCO_3$)	Chlorine (mg/L)
Pimephales promelas	Control	24.7	24.6	7.6	7.4	7.55	7.25	321	61	89	
		24.7 - 24.8	24.5 - 24.8	7.4 - 7.8	6.9 - 7.5	7.32 - 7.66	7.04 - 7.44	302 - 338	60 - 61	88 - 92	
	11.3%	24.7	24.6	7.7	7.3	7.41	7.22	297			
		24.7 - 24.8	24.2 - 24.9	7.5 - 8.0	6.9 - 7.5	7.26 - 7.50	7.01 - 7.36	284 - 306			
	22.6%	24.8	24.5	7.7	7.2	7.40	7.20	280			
		24.7 - 24.8	24.2 - 25.1	7.5 - 8.1	6.8 - 7.5	7.26 - 7.49	7.03 - 7.34	268 - 287			
	45.2%	24.8	24.6	7.7	7.2	7.37	7.19	243			
		24.7 - 24.9	24.2 - 24.8	7.6 - 8.0	6.8 - 7.4	7.23 - 7.47	6.99 - 7.35	234 - 247			
	72.6%	24.8	24.6	7.8	7.2	7.33	7.17	198			
		24.7 - 24.9	24.4 - 24.8	7.7 - 7.9	6.8 - 7.5	7.18 - 7.46	6.97 - 7.34	189 - 205			
	100.0%	24.8	24.6	7.7	7.2	7.27	7.13	150	57	62	< 0.10
		24.7 - 25.0	24.4 - 24.9	7.7 - 7.8	6.8 - 7.5	7.14 - 7.39	6.95 - 7.24	145 - 156	50 - 65	60 - 64	< 0.10 - < 0.10
	Intake	24.9	24.6	7.8	7.2	7.25	7.13	147	54	63	< 0.10
		24.6 - 25.1	24.4 - 24.7	7.7 - 7.9	6.8 - 7.5	7.11 - 7.39	6.97 - 7.25	143 - 153	52 - 57	60 - 64	< 0.10 - < 0.10
Ceriodaphnia dubia	Control	24.8	25.0	7.6	7.6	7.55	7.39	321	61	89	
		24.7 - 25.0	24.8 - 25.2	7.4 - 7.8	7.5 - 7.8	7.32 - 7.66	7.21 - 7.47	302 - 338	60 - 61	88 - 92	
	11.3%	24.9	25.0	7.7	7.6	7.41	7.40	297			
		24.7 - 25.0	24.8 - 25.2	7.5 - 8.0	7.4 - 7.8	7.26 - 7.50	7.22 - 7.49	284 - 306			
	22.6%	24.9	24.9	7.7	7.6	7.40	7.39	280			
		24.7 - 25.1	24.8 - 25.2	7.5 - 8.1	7.4 - 7.7	7.26 - 7.49	7.22 - 7.48	268 - 287			
	45.2%	24.9	25.0	7.7	7.6	7.37	7.38	243			
		24.8 - 25.1	24.8 - 25.2	7.6 - 8.0	7.4 - 7.7	7.23 - 7.47	7.22 - 7.48	234 - 247			
	72.6%	24.9	24.9	7.8	7.6	7.33	7.35	198			
		24.8 - 25.1	24.7 - 25.2	7.7 - 7.9	7.5 - 7.7	7.18 - 7.46	7.22 - 7.42	189 - 205			
	100.0%	24.9	24.9	7.7	7.6	7.27	7.31	150	57	62	< 0.10
		24.8 - 25.1	24.7 - 25.1	7.7 - 7.8	7.5 - 7.7	7.14 - 7.39	7.20 - 7.38	145 - 156	50 - 65	60 - 64	< 0.10 - < 0.10
	Intake	24.9	24.9	7.8	7.6	7.25	7.28	147	54	63	< 0.10
		24.8 - 25.1	24.6 - 25.1	7.7 - 7.9	7.5 - 7.7	7.11 - 7.39	7.09 - 7.35	143 - 153	52 - 57	60 - 64	< 0.10 - < 0.10

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

PHYSICAL/CHEMICAL SUMMARY

Water Chemistry Mean Values and Ranges for *Pimephales promelas* Tests, UV-treated Sequoyah Nuclear Plant (SQN) Outfall 101 performed May 12-19, 2009.

Test	Sample ID	Temperature (°C)		Dissolved Oxygen (mg/L)		pH (S.U.)		Conductance	Alkalinity	Hardness
		Initial	Final	Initial	Final	Initial	Final	(µmhos/cm)	(mg/L $CaCO_3$)	(mg/L $CaCO_3$)
Pimephales promelas	Control	24.8	24.6	7.7	7.5	7.44	7.27	314	60	91
		24.7 - 24.9	24.4 - 24.9	7.5 - 7.8	7.0 - 7.8	7.28 - 7.53	7.04 - 7.44	296 - 334	59 - 61	88 - 92
	11.3%	24.8	24.6	7.7	7.3	7.45	7.25	302		
		24.7 - 25.0	24.4 - 24.8	7.5 - 7.9	6.8 - 7.5	7.29 - 7.53	7.08 - 7.38	282 - 321		
	22.6%	24.8	24.5	7.7	7.3	7.45	7.23	282		
		24.7 - 24.9	24.4 - 24.7	7.5 - 7.9	6.8 - 7.5	7.29 - 7.54	7.02 - 7.39	264 - 299		
	45.2%	24.8	24.5	7.8	7.2	7.42	7.21	246		
		24.7 - 24.9	24.3 - 24.9	7.6 - 8.0	6.8 - 7.4	7.28 - 7.51	7.03 - 7.38	231 - 258		
	72.6%	24.8	24.6	7.8	7.2	7.38	7.20	200		
		24.7 - 24.9	24.3 - 24.8	7.6 - 8.0	6.8 - 7.5	7.23 - 7.49	7.03 - 7.36	189 - 207		
	100.0%	24.8	24.6	7.8	7.2	7.33	7.18	153	50	62
		24.7 - 25.0	24.3 - 24.8	7.6 - 8.0	6.8 - 7.5	7.19 - 7.43	6.95 - 7.30	147 - 159	44 - 54	60 - 64
	Intake	24.9	24.6	7.8	7.2	7.30	7.14	149	53	62
		24.7 - 25.0	24.4 - 25.0	7.6 - 7.9	6.8 - 7.5	7.15 - 7.43	6.89 - 7.29	141 - 155	50 - 57	58 - 66

Overall temperature (°C)	Average	Minimum	Maximum
Pimephales promelas	24.7	24.3	25.0

SUMMARY / CONCLUSIONS

Outfall 101 samples collected May 10-15, 2009, showed no toxic effects to fathead minnows or daphnids. The resulting IC_{25} values, for both species, were > 100 percent. Exposure of daphnids to intake samples resulted in no significant difference from the control during this study period. Minnow survival was significantly reduced when exposed to intake samples during this study period.

Fathead minnows were also exposed to UV treated Outfall 101 and intake samples since fish pathogens present in intake water have been the suspected cause of interference (anomalous dose response and high variability among replicates) in previous toxicity testing at Sequoyah.

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*

   None

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.

4. Dissolved oxygen was measured by SM 4500 O G.

5. The pH was measured by SM 4500 H+ B.

6. Conductance was measured by SM 2510 B.

7. Alkalinity was measured by SM 2320 B.

8. Total hardness was measured by SM 2340 C.

9. Total residual chlorine was measured by ORION Electrode Method 97-70.

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 IC_{25} 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, 20th Edition, 1998.

4. Quality Assurance Program: Standard Operating Procedures, Environmental Testing Solutions, Inc (most current version).

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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 Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – May 15, 2009

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
03/12/1998	0.016	-	-	-	-	-	-
03/13/1998	0.015	-	-	-	-	-	-
03/14/1998	0.013	-	-	-	-	-	-
03/15/1998	0.030	-	-	-	-	-	-
03/16/1998	0.013	-	-	-	-	-	-
03/17/1998	0.020	-	-	-	-	-	-
03/18/1998	0.018	-	-	-	-	-	-
09/08/1998	0.015	-	0.014	0.005	-	-	0.021
09/09/1998	0.003	-	0.031	0.011	-	-	-
09/10/1998	0.014	-	0.060	0.021	-	-	-
09/11/1998	0.013	-	0.055	0.019	-	-	-
09/12/1998	< 0.001	-	0.044	0.015	-	-	-
09/13/1998	< 0.001	-	0.044	0.015	-	-	-
09/14/1998	0.008	-	0.044	0.015	-	-	-
02/22/1999	< 0.001	-	-	-	-	-	-
02/23/1999	0.005	-	-	-	-	-	-
02/24/1999	0.009	-	-	-	-	-	-
02/25/1999	0.012	-	-	-	-	-	-
02/26/1999	0.008	-	-	-	-	-	-
02/27/1999	< 0.001	-	-	-	-	-	-
02/28/1999	< 0.001	-	-	-	-	-	-
08/18/1999	-	0.015	0.069	0.024	0.006	-	-
08/19/1999	-	0.012	0.068	0.024	-	-	-
08/20/1999	-	0.023	0.070	0.024	-	0.120	-
08/21/1999	-	0.022	0.068	0.024	-	-	-
08/22/1999	-	0.022	0.068	0.024	-	-	-
08/23/1999	-	0.025	0.068	0.024	0.006	-	-
08/24/1999	-	0.016	0.067	0.023	0.020	-	-

Table B-1. Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – May 15, 2009

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
01/31/2000	-	< 0.002	0.026	0.009	-	-	-
02/01/2000	-	0.011	0.026	0.028	-	-	-
02/02/2000	-	0.028	0.026	0.009	0.006	-	-
02/03/2000	-	0.008	0.027	0.009	-	-	-
02/04/2000	-	0.006	0.027	0.009	0.005	0.109	-
02/05/2000	-	< 0.002	0.027	0.009	-	-	-
02/06/2000	-	< 0.002	0.027	0.009	-	-	-
07/26/2000	-	< 0.0057	0.055	0.019	-	-	-
07/27/2000	-	0.019	0.055	0.019	-	-	-
07/28/2000	-	0.0088	0.053	0.018	0.004	0.108	-
07/29/2000	-	< 0.0088	0.055	0.019	-	-	-
07/30/2000	-	< 0.0076	0.055	0.019	-	-	-
07/31/2000	-	< 0.0152	0.055	0.019	0.006	-	-
08/01/2000	-	< 0.0141	0.055	0.019	0.005	-	-
12/11/2000	-	0.0143	0.025	0.020	0.005	-	-
12/12/2000	-	0.0092	0.025	0.020	0.005	-	-
12/13/2000	-	< 0.0120	0.025	0.020	-	-	-
12/14/2000	-	< 0.0087	0.025	0.020	-	-	-
12/15/2000	-	0.0120	0.025	0.020	0.005	-	-
12/16/2000	-	< 0.0036	0.025	0.020	-	-	-
12/17/2000	-	< 0.0036	0.025	0.020	-	-	-
08/26/2001	-	0.017	0.06	0.021	0.006	-	-
08/27/2001	-	<0.0096	0.06	0.021	0.005	-	0.021
08/28/2001	-	<0.0085	0.06	0.021	-	-	-
08/29/2001	-	<0.0094	0.059	0.020	0.005	-	0.021
08/30/2001	-	<0.0123	0.06	0.021	0.005	-	-
08/31/2001	-	<0.005	0.059	0.020	-	-	-
11/25/2001	-	<0.0044	-	-	-	-	-
11/26/2001	-	<0.0119	0.024	0.02	0.005	-	-
11/27/2001	-	0.0137	0.023	0.019	0.007	-	-
11/28/2001	-	<0.0089	0.022	0.019	0.006	-	-
11/29/2001	-	0.0132	0.024	0.02	0.007	-	-
11/30/2001	-	< 0.0043	0.024	0.02	-	-	-
12/09/2001	-	<0.0042	-	-	-	-	-
12/10/2001	-	<0.0042	-	-	-	-	-
12/11/2001	-	<0.0104	-	-	-	-	-
12/12/2001	-	0.0128	0.024	0.02	0.008	-	-
12/13/2001	-	<0.0088	0.024	0.02	-	-	-
12/14/2001	-	0.0134	0.024	0.02	0.007	-	-

Table B-1. Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – May 15, 2009

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
01/02/2002	-	< 0.0079	0.023	0.02	0.006	-	-
01/03/2002	-	< 0.0042	0.023	0.014	-	-	-
01/04/2002	-	0.0124	0.024	0.014	0.009	-	-
01/05/2002	-	< 0.0042	-	-	-	-	-
01/06/2002	-	< 0.0042	-	-	-	-	-
01/07/2002	-	< 0.0089	0.024	0.014	0.006	-	-
02/24/2002	-	< 0.004	-	-	-	-	-
02/25/2002	-	< 0.004	0.023	0.023	-	-	-
02/26/2002	-	0.0143	0.023	0.023	0.007	-	-
02/27/2002	-	< 0.0041	0.023	0.023	-	-	-
02/28/2002	-	< 0.0041	0.024	0.008	-	-	-
03/01/2002	-	< 0.0041	0.024	0.008	-	-	-
05/05/2002	-	-	-	-	-	-	-
05/06/2002	-	-	0.058	0.02	0.014	-	-
05/07/2002	-	-	0.058	0.02	0.015	-	-
05/08/2002	-	-	0.056	0.019	-	-	-
05/09/2002	-	-	0.057	0.02	0.014	-	-
05/10/2002	-	-	0.056	0.019	-	-	-
08/04/2002	-	<0.0058	-	-	-	-	-
08/05/2002	-	<0.0058	0.053	0.018	-	-	0.025
08/06/2002	-	0.0092	0.053	0.018	-	-	-
08/07/2002	-	<0.0107	0.055	0.019	0.007	-	-
08/08/2002	-	<0.0061	0.055	0.019	-	-	-
08/09/2002	-	0.0152	0.054	0.018	0.008	-	-
10/06/2002	-	<0.00497	-	-	-	-	-
10/07/2002	-	0.0153	0.054	0.018	0.009	-	-
10/08/2002	-	<0.0092	0.054	0.018	0.007	-	-
10/09/2002	-	0.0124	0.053	0.018	0.009	-	-
10/10/2002	-	0.0134	0.054	0.018	0.009	-	-
10/11/2002	-	<0.0042	0.054	0.018	-	-	-
01/12/2003	-	<0.0035	-	-	-	-	-
01/13/2003	-	<0.006	0.025	0.019	0.009	-	-
01/14/2003	-	<0.0118	0.026	0.020	-	-	-
01/15/2003	-	<0.0063	0.026	0.020	0.009	-	-
01/16/2003	-	<0.0034	0.026	0.020	-	-	-
01/17/2003	-	<0.0034	0.026	0.009	-	-	-
04/06/2003	-	<0.0073	-	-	-	-	-
04/07/2003	-	<0.0189	-	0.021	-	-	-
04/08/2003	-	<0.0117	-	0.021	-	-	-
04/09/2003	-	<0.0139	-	0.021	0.016	-	-
04/10/2003	-	<0.0113	-	0.021	0.018	-	-
04/11/2003	-	<0.0073	-	0.022	-	-	-

Table B-1 (continued). Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Growth of Microbiologically Induced Bacteria and Mollusks, During Toxicity Test Sampling, March 12, 1998 – May 15, 2009

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
06/15/2003	-	< 0.0045	-	-	-	-	-
06/16/2003	-	< 0.0037	0.057	0.020	-	-	0.022
06/17/2003	-	< 0.0048	0.041	0.014	-	-	0.024
06/18/2003	-	< 0.0048	0.041	0.014	-	-	0.024
06/19/2003	-	< 0.0085	0.058	0.020	-	-	0.025
06/20/2003	-	< 0.0048	0.058	0.020	-	-	0.025
08/03/2003	-	<0.0050	-	-	-	-	-
08/04/2003	-	<0.0050	0.058	0.020	-	-	-
08/05/2003	-	<0.0051	0.057	0.020	-	-	0.025
08/06/2003	-	<0.0084	0.057	0.020	-	-	0.025
08/07/2003	-	0.0129	0.057	0.020	-	-	0.024
08/08/2003	-	0.0153	0.057	0.020	0.009	-	-
10/05/2003	-	<0.0043	0.057	0.020	-	-	-
10/06/2003	-	<0.0043	0.057	0.020	-	-	0.025
10/07/2003	-	<0.0090	0.057	0.020	-	-	0.025
10/08/2003	-	<0.0106	0.057	0.020	-	-	0.025
10/09/2003	-	0.0181	0.026	0.022	-	-	0.025
10/10/2003	-	0.0183	0.026	0.024	0.009	-	-
02/01/2004	-	0.0093	0.027	0.009	-	-	-
02/02/2004	-	<0.0034	0.026	0.009	-	-	-
02/03/2004	-	<0.0034	0.026	0.009	-	-	-
02/04/2004	-	0.0124	0.026	0.009	0.009	-	-
02/05/2004	-	<0.0034	0.026	0.009	-	-	-
02/06/2004	-	0.0105	0.026	0.009	0.010	-	-
05/04/2004	-	<0.0123	0.026	0.019	-	-	0.025
05/05/2004	-	<0.0144	0.026	0.014	0.009	-	0.025
05/06/2004	-	<0.0146	0.037	0.013	-	-	0.025
05/07/2004	-	0.0227	0.058	0.020	0.009	-	0.025
05/08/2004	-	0.016	0.060	0.021	-	-	-
05/09/2004	-	<0.0104	0.058	0.020	-	-	-
07/04/2004	-	0.0217	0.057	0.019	-	-	-
07/05/2004	-	<0.0085	0.057	0.020	0.009	-	-
07/06/2004	-	<0.0077	0.058	0.020	-	-	0.031
07/07/2004	-	0.0252	0.056	0.019	-	-	0.031
07/08/2004	-	0.0223	0.057	0.019	0.009	-	-
07/09/2004	-	0.0182	0.057	0.020	0.009	-	-

Table B-1. Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – May 15, 2009

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
11/07/2004	-	<0.0187	0.000	0.014	-	-	-	-	-
11/08/2004	-	<0.0192	0.047	0.030	-	-	-	-	-
11/09/2004	-	<0.0233	0.048	0.016	-	-	0.041	-	-
11/10/2004	-	<0.0149	0.047	0.016	-	-	0.041	-	-
11/11/2004	-	<0.0149	0.049	0.017	-	-	0.043	-	-
11/12/2004	-	<0.0253	0.048	0.017	-	-	0.042	-	-
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 (continued). Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Growth of Microbiologically Induced Bacteria and Mollusks, During Toxicity Test Sampling, March 12, 1998 – May 15, 2009

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 Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 –May 15, 2009

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
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	-	-	-	-	-	-	-	-

Sequoyah Nuclear Plant Biomonitoring
May 12-19, 2009

Appendix C

Chain of Custody Records and
Toxicity Test Bench Sheets

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: Chevy Williams, Ben Mitchell, Adam Deimling

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:
Chevy Williams:
Ben Mitchell :
Adam Deimling:
Metals Analyzed. Samples remained on ice through out sampling and transport to lab.

Field Identification / Sample Description	Grab/Comp.	Collection Date/Time		Container Number & Volume Collected	Flow MGD	Rain Event? (Mark as Appropriate)				Project #5444 Laboratory Use				
	—	Date	Time (EST)	—	—	Yes	If Yes, Inches	No	Trace	ETS Log Number	Arrival Temp. (°C)	By	Time ET	Appearance
SQN-101-TOX	Comp	05/10/09-05/11/09	0859-0759	2 (2.5gal)	1426	✓	0.01			09051101	1.8/1.8°C	JL	1510	*
SQN-INT-TOX	Comp	05/10/09-05/11/09	0933-0833	1 (2.5 gal)	NA	✓	0.01			09051102	1.3°C	JL	1510	*

Sample Custody – Fill In From Top Down

* Custody seals intact. Samples received in good condition

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
Chevy Williams Chevy Williams	05/11/09 1029 EST	Sonic Delivery BR Skiles	05/11/09 10:29 ET
Sonic Delivery BR Skiles	05/11/09 3:10 PM ET	ETS Jim Jones	05/11/09 1510 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.

BIOMONITORING CHAIN OF CUSTODY RECORD

Client: TVA

Project Name: Sequoyah NP Toxicity

P.O. Number: N/A

Facility Sampled: Sequoyah NP

NPDES Number: TN0026450

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Asheville, NC
28801
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Field Identification / Sample Description	Grab/Comp.	Collection Date/Time		Container Number & Volume Collected	Flow MGD	Rain Event? (Mark as Appropriate)				Project 5444 Laboratory Use				
	—	Date	Time (EST)	—	—	Yes	If Yes, Inches	No	Trace	ETS Log Number	Arrival Temp. (°C)	By	Time ET	Appearance
SQN-101-TOX	Comp	05/12/09-05/13/09	0821 - 0721	2 (2.5gal)	1442.8			✓		090513.08	3.2/2.0°C	JI	1433	*
SQN-INT-TOX	Comp	05/12/09-05/13/09	0839 - 0739	1 (2.5 gal)	NA			✓		090513.09	2.1°C	JI	1433	*

Sample Custody – Fill In From Top Down

* Custody seals intact. Samples received in good condition

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
Chevy Williams	05/13/09 1039 EST	Sonic Delivery BR Skiles	05/13/09 10:33 ET
Sonic Delivery BR Skiles	05/13/09 2:33 PM ET	ETS	05/13/09 1433 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.

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 Chevy Williams, Ben Mitchell, Adam Deimling

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Delivered By (Circle One):

FedEx UPS Bus Client

Other (specify): Sonic Delivery

General Comments:
Chevy Williams:
Ben Mitchell :
Adam Deimling:
Metals samples taken. Samples remained on ice through out sampling and transport to lab.

Field Identification / Sample Description	Grab/Comp.	Collection Date/Time		Container Number & Volume Collected	Flow MGD	Rain Event? (Mark as Appropriate)				5144 PROJECT Laboratory Use				
	—	Date	Time ET	—	—	Yes	If Yes, Inches	No	Trace	ETS Log Number	Arrival Temp. (°C)	By	Time ET	Appearance
SQN-101-TOX	Comp	05/14/09-05/15/09	0828-0728	2 (2.5gal)	1448.3	✓	0.04			090515.02	2.3/1.5°C	[illegible]	1428	*
SQN-INT-TOX	Comp	05/14/09-05/15/09	0842-0742	1 (2.5 gal)	NA	✓	0.04			090515.03	1.7°C	[illegible]	1428	*

Sample Custody – Fill In From Top Down

* Custody seals intact. Samples received in good condition

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
Chevy Williams [signature]	05/15/09 1009ET	Sonic Delivery BR Stiles	05/15/09 10:09 ET
Sonic Delivery BR Stiles	05/15/09 2:28 PM ET	ETS [signature]	05/15/09 1428 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.

ETS Environmental Testing Solutions, Inc.

Chronic Whole Effluent Toxicity Test (EPA-821-R-02-013 Method 1000.0)
Species: *Pimephales promelas*

Client: TVA
Facility: Sequoyah Nuclear Plant
NPDES #: TN 0026450
Project #: 5444

County: Hamilton
Treatment: Non-treated
Outfall: 101

Dilution preparation information:						*Comments:*
Dilution prep (%)	11.3	22.6	45.2	72.6	100	
Effluent volume (mL)	282.5	565	1130	1815	2500	
Diluent volume (mL)	2217.5	1935	1370	685	0	
Total volume (mL)	2500	2500	2500	2500	2500	

Test organism information:		*Test information:*	
Organism age:	20.33 HOURS OLD	Randomizing template:	YELLOW
Date and times organisms were born between:	05-11-09 1600	Incubator number and shelf location:	3C
Organism source:	ATOX BATCH Pp 05-11-09	*Artemia* CHM number:	CHM444
Transfer bowl information:	pH = SU Temperature = °C 7.32 24.6	Date / Time in: 05-19-09	1200
		Date / Time out: 05-20-09	1220
Average transfer volume:	0.2305 ml	Total drying time:	24.25 HOURS
		Initial oven temperature:	60°C
		Final oven temperature:	61°C

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		
0	05-12-09	—	—	1400	JH	1220	JH	090511.01+02	05-09-09A
1	05-13-09	0800	JH	1400	JH	1245	JH	090511.01+02	05-09-09A
2	05-14-09	0800	JH	1400	JH	1120	JH	090513.08+09	05-09-09B
3	05-15-09	0800	JH	1400	JH	1210	JH	090513.08+09	05-09-09B
4	05-16-09	0800	JH	1400	JH	1215	JH	090515.02+03	05-12-09
5	05-17-09	0900	JH	1500	JH	1232	JH	090515.02+03	05-12-09
6	05-18-09	0830	JH	1430	JH	1230	JH	090515.02+03	05-12-09
7	05-19-09					1123		—	—

Control information:		Acceptance criteria	*Summary of test endpoints:*	
% Mortality:	0%	≤ 20%	7-day LC_{50}	>100%
Average weight per initial larvae:	0.768		NOEC	22.6%
Average weight per surviving larvae:	0.768	≥ 0.25 mg/larvae	LOEC	45.2%
			ChV	32.0%
			IC_{25}	>100%

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** **Date:** 05-12-09

Client: TVA / Sequoyah Nuclear Plant - Non-treated

Survival and Growth Data

Day	CONTROL				11.3%				22.6%			
	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	9 1 dff	10	10	10	10	10	10
4	10	10	10	10	10	9	10	10	10	10	10	10
5	10	10	10	10	10	9	10	10	10	10	10	10
6	10	10	10	10	10	9	10	10	10	9 1 dff	10	10
7	10	10	10 lg	10	10	9	10	10	10	9 lg	10	10
A = Pan weight (mg) Tray color code:: ~~blue~~/green (MX) Analyst: MLM Date: 05-12-09	14.87	13.86	15.01	12.40	14.50	13.70	13.68	14.50	13.91	13.27	15.13	13.40
B = Pan + Larvae weight (mg) Analyst: MLM Date: ~~05-1~~ (05-20-09)	22.17	20.70	23.96	20.01	22.03	20.25	20.91	21.67	20.45	20.50	21.86	21.50
C = Larvae weight (mg) = B – A	7.30	6.84	8.95	7.61	7.53	6.55	7.23	7.17	6.54	7.23	6.73	7.60
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.730	0.684	0.895	0.761	0.753	0.655	0.723	0.717	0.654	0.723	0.673	0.760
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.768				0.712		7.2%		0.703		8.5%	

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.

Calculations and data reviewed: JL

Comments:

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** **Date:** 05-12-09
Client: TVA / Sequoyah Nuclear Plant - Non-treated

Survival and Growth Data

Day	45.2%				72.6%				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	9 1dFG	10	10
5	10	10	9 1dFG	10	10	10	10	10	10	9	10	10
6	10	10	9	10	10	10	10	10	10	9	10	10
7	10	10	9	10	10	10	10	10 1SM	10	9	10	10
A = Pan weight (mg) Tray color code:: plum (lime green) Analyst: MLM (mx) Date: 05-12-09	13.89	13.97	13.70	14.08	13.72	15.75	14.24	14.28	14.94	15.87	14.33	13.69
B = Pan + Larvae weight (mg) Analyst: MLM (05-20-09) Date: ~~05-20-09~~	20.35	20.81	20.08	20.57	20.37	22.07	20.80	20.31	22.17	21.91	21.33	20.10
C = Larvae weight (mg) = B – A	6.46	6.84	6.38	6.49	6.65	6.32	6.56	6.03	7.23	6.04	7.00	6.41
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.646	0.684	0.638	0.649	0.665	0.632	0.656	0.603	0.723	0.604	0.700	0.641
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.654		14.8%		0.639		16.7%		0.667		13.1%	

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.

Calculations and data reviewed: [illegible]

Comments:

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** **Date:** 05-12-09
Client: TVA / Sequoyah Nuclear Plant - Non-treated

Survival and Growth Data

Day	100% Intake			
	Y	Z	AA	BB
0	10	10	10	10
1	10	10	10	10
2	10	10	10	10
3	10	~~10~~ 2dFG	~~10~~ 2dFG	10
4	4 1dFG	~~6~~ 2dFG	~~7~~ 2dFG 1dFG	10
5	3 1dFG	4 2dFG	7	10
6	3	4	6 1dFG	8 2dFG
7	3	4	6 1LG	7 1dFG 1LG
A = Pan weight (mg) Tray color code:: plum (lime green) Analyst: MLM (M-Z) Date: 05-12-09	13.79	14.14	14.85	13.49
B = Pan + Larvae weight (mg) Analyst: MLM Date: 05-20-09	15.91	16.99	19.81	19.16
C = Larvae weight (mg) = B – A	2.12	2.85	4.96	5.67
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.212	0.285	0.496	0.567
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.390		49.2%	

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.

Calculations and data reviewed: JL

Comments: * MORTALITY IN THE EFFLUENT + INTAKE DUE TO PATHOGENIC INFECTION
- ~~DEAD~~ FUNGUS PRESENT ON DEAD LARVAE. [illegible]

ETS
Environmental Testing Solutions, Inc.

TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
May 12-19, 2009

***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: 5444
Reveiwed by:

Concentration (%)	Replicate	Initial number of larvae	Final number of larvae	A = Pan weight (mg)	B = Pan + Larvae weight (mg)	Larvae weight (mg) = A - B	Not for Compliance Assessment, Internal Laboratory QC: 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 (Mean weight per initial number of larvae) (%)	Percent reduction from control (%)
Control	A	10	10	14.87	22.17	7.30	0.730	0.768	11.8	0.730	100.0	0.768	11.8	Not applicable
	B	10	10	13.86	20.70	6.84	0.684			0.684				
	C	10	10	15.01	23.96	8.95	0.895			0.895				
	D	10	10	12.40	20.01	7.61	0.761			0.761				
11.3%	E	10	10	14.50	22.03	7.53	0.753	0.730	2.2	0.753	97.5	0.712	5.8	7.2
	F	10	9	13.70	20.25	6.55	0.728			0.655				
	G	10	10	13.68	20.91	7.23	0.723			0.723				
	H	10	10	14.50	21.67	7.17	0.717			0.717				
22.6%	I	10	10	13.91	20.45	6.54	0.654	0.723	9.8	0.654	97.5	0.703	6.9	8.5
	J	10	9	13.27	20.50	7.23	0.803			0.723				
	K	10	10	15.13	21.86	6.73	0.673			0.673				
	L	10	10	13.90	21.50	7.60	0.760			0.760				
45.2%	M	10	10	13.89	20.35	6.46	0.646	0.672	4.5	0.646	97.5	0.654	3.1	14.8
	N	10	10	13.97	20.81	6.84	0.684			0.684				
	O	10	9	13.70	20.08	6.38	0.709			0.638				
	P	10	10	14.08	20.57	6.49	0.649			0.649				
72.6%	Q	10	10	13.72	20.37	6.65	0.665	0.639	4.3	0.665	100.0	0.639	4.3	16.7
	R	10	10	15.75	22.07	6.32	0.632			0.632				
	S	10	10	14.24	20.80	6.56	0.656			0.656				
	T	10	10	14.28	20.31	6.03	0.603			0.603				
100%	U	10	10	14.94	22.17	7.23	0.723	0.684	5.2	0.723	97.5	0.667	8.2	13.1
	V	10	9	15.87	21.91	6.04	0.671			0.604				
	W	10	10	14.33	21.33	7.00	0.700			0.700				
	X	10	10	13.69	20.10	6.41	0.641			0.641				
100% Intake	Y	10	3	13.79	15.91	2.12	0.707	0.764	8.3	0.212	50.0	0.390	43.2	49.2
	Z	10	4	14.14	16.99	2.85	0.712			0.285				
	AA	10	6	14.85	19.81	4.96	0.827			0.496				
	BB	10	7	13.49	19.16	5.67	0.810			0.567				

Outfall 101:
Dunnett's MSD value: 0.0890
PMSD: 11.6

Intake:
Dunnett's MSD value: 0.1860
PMSD: 24.2

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).

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.

TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
May 12-19, 2009
Statistical Analyses

ETS Environmental Testing Solutions, Inc.

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	5/12/2009	Test ID:	PpFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101
End Date:	5/19/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:					

Conc-%	1	2	3	4
D-Control	0.7300	0.6840	0.8950	0.7610
11.3	0.7530	0.6550	0.7230	0.7170
22.6	0.6540	0.7230	0.6730	0.7600
45.2	0.6460	0.6840	0.6380	0.6490
72.6	0.6650	0.6320	0.6560	0.6030
100	0.7230	0.6040	0.7000	0.6410
Intake	0.2120	0.2850	0.4960	0.5670

			Transform: Untransformed						1-Tailed		Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.7675	1.0000	0.7675	0.6840	0.8950	11.817	4				0.7675	1.0000
11.3	0.7120	0.9277	0.7120	0.6550	0.7530	5.777	4	1.502	2.410	0.0890	0.7120	0.9277
22.6	0.7025	0.9153	0.7025	0.6540	0.7600	6.851	4	1.760	2.410	0.0890	0.7025	0.9153
*45.2	0.6543	0.8524	0.6543	0.6380	0.6840	3.113	4	3.066	2.410	0.0890	0.6543	0.8524
*72.6	0.6390	0.8326	0.6390	0.6030	0.6650	4.343	4	3.479	2.410	0.0890	0.6530	0.8508
*100	0.6670	0.8691	0.6670	0.6040	0.7230	8.152	4	2.721	2.410	0.0890	0.6530	0.8508
Intake	0.3900	0.5081	0.3900	0.2120	0.5670	43.230	4					

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97087646	0.884	0.63537989	1.21808683
Bartlett's Test indicates equal variances (p = 0.23)	6.92620468	15.0862722		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	22.6	45.2	31.9612265	4.42477876	0.08902763	0.11599692	0.00884297	0.00272926	0.0292745	5, 18
Treatments vs D-Control										

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)	Skew
IC05*	7.813			
IC10	28.104			
IC15	>100			
IC20	>100			
IC25	>100			
IC40	>100			
IC50	>100			

* indicates IC estimate less than the lowest concentration

sqn101_05-12-09data

TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
Non-treated
May 12-19, 2009

ETS
Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Survival

Start Date:	5/12/2009	Test ID:	PpFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
End Date:	5/19/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:					

Conc-%	1	2	3	4
D-Control	1.0000	1.0000	1.0000	1.0000
11.3	1.0000	0.9000	1.0000	1.0000
22.6	1.0000	0.9000	1.0000	1.0000
45.2	1.0000	1.0000	0.9000	1.0000
72.6	1.0000	1.0000	1.0000	1.0000
100	1.0000	0.9000	1.0000	1.0000
Intake	0.3000	0.4000	0.6000	0.7000

			Transform: Arcsin Square Root						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
D-Control	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4			
11.3	0.9750	0.9750	1.3713	1.2490	1.4120	5.942	4			
22.6	0.9750	0.9750	1.3713	1.2490	1.4120	5.942	4			
45.2	0.9750	0.9750	1.3713	1.2490	1.4120	5.942	4			
72.6	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4			
100	0.9750	0.9750	1.3713	1.2490	1.4120	5.942	4			
*Intake	0.5000	0.5000	0.7854	0.5796	0.9912	23.814	4	6.701	2.353	0.2201

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.93208891	0.749	3.38354E-16	0.88161324
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Heteroscedastic t Test indicates significant differences	0.11179766	0.11466427	0.78530011	0.01749093	5.4E-04	1, 6
Treatments vs D-Control						

TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
Non-treated
May 12-19, 2009

ETS
Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	5/12/2009	Test ID:	PpFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
End Date:	5/19/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:					

Conc-%	1	2	3	4
D-Control	0.7300	0.6840	0.8950	0.7610
11.3	0.7530	0.6550	0.7230	0.7170
22.6	0.6540	0.7230	0.6730	0.7600
45.2	0.6460	0.6840	0.6380	0.6490
72.6	0.6650	0.6320	0.6560	0.6030
100	0.7230	0.6040	0.7000	0.6410
Intake	0.2120	0.2850	0.4960	0.5670

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
D-Control	0.7675	1.0000	0.7675	0.6840	0.8950	11.817	4			
11.3	0.7120	0.9277	0.7120	0.6550	0.7530	5.777	4			
22.6	0.7025	0.9153	0.7025	0.6540	0.7600	6.851	4			
45.2	0.6543	0.8524	0.6543	0.6380	0.6840	3.113	4			
72.6	0.6390	0.8326	0.6390	0.6030	0.6650	4.343	4			
100	0.6670	0.8691	0.6670	0.6040	0.7230	8.152	4			
*Intake	0.3900	0.5081	0.3900	0.2120	0.5670	43.230	4	3.944	1.943	0.1860

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.94991392	0.749	0.13317371	-1.3590747
F-Test indicates equal variances (p = 0.34)	3.45560646	47.4672279		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Homoscedastic t Test indicates significant differences Treatments vs D-Control	0.18600391	0.24235037	0.2850125	0.01832517	0.00759199	1, 6

sqn101_05-12-09data

ETS
Environmental Testing Solutions, Inc.

TVA / Sequoyah Nuclear Plant, Outfall 101 - Non-treated
May 12-19, 2009

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

Daily Chemical Analyses

Project number: 5444
Reviewed by:

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)	7.32	7.28	7.60	7.15	7.65	7.13	7.58	7.30	7.60	7.44	7.43	7.38	7.66	7.04
	DO (mg/L)	7.5	7.4	7.6	7.4	7.4	7.5	7.7	7.5	7.8	7.5	7.6	7.3	7.4	6.9
	Conductivity (µmhos/cm)	317		312		302		326		338		324		328	
	Alkalinity (mg/L $CaCO_3$)	61				61				60					
	Hardness (mg/L $CaCO_3$)	92				88				88					
	Temperature (°C)	24.8	24.8	24.8	24.5	24.7	24.5	24.7	24.5	24.7	24.5	24.7	24.5	24.8	24.6
11.3%	pH (SU)	7.47	7.21	7.40	7.22	7.39	7.12	7.26	7.30	7.41	7.36	7.50	7.33	7.42	7.01
	DO (mg/L)	7.5	7.3	7.6	7.2	7.6	7.3	7.8	7.5	8.0	7.4	7.7	7.4	7.5	6.9
	Conductivity (µmhos/cm)	293		292		284		298		304		300		306	
	Temperature (°C)	24.8	24.9	24.8	24.5	24.7	24.5	24.7	24.7	24.7	24.2	24.7	24.5	24.8	24.6
22.6%	pH (SU)	7.47	7.18	7.41	7.15	7.37	7.09	7.26	7.30	7.40	7.34	7.49	7.33	7.41	7.03
	DO (mg/L)	7.5	7.1	7.7	7.1	7.6	7.3	7.8	7.5	8.1	7.4	7.7	7.4	7.5	6.8
	Conductivity (µmhos/cm)	284		277		268		279		286		280		287	
	Temperature (°C)	24.8	25.1	24.8	24.3	24.7	24.3	24.7	24.7	24.8	24.2	24.8	24.4	24.8	24.5
45.2%	pH (SU)	7.47	7.19	7.41	7.15	7.31	7.09	7.23	7.30	7.36	7.35	7.45	7.28	7.37	6.99
	DO (mg/L)	7.7	7.1	7.7	7.1	7.6	7.2	7.8	7.4	8.0	7.4	7.7	7.4	7.6	6.8
	Conductivity (µmhos/cm)	247		243		234		243		247		243		246	
	Temperature (°C)	24.8	24.8	24.8	24.7	24.7	24.2	24.7	24.8	24.9	24.5	24.8	24.4	24.8	24.5
72.6%	pH (SU)	7.46	7.12	7.35	7.12	7.27	7.09	7.18	7.29	7.30	7.34	7.42	7.23	7.32	6.97
	DO (mg/L)	7.7	7.2	7.7	7.1	7.7	7.3	7.9	7.5	7.8	7.4	7.7	7.4	7.8	6.8
	Conductivity (µmhos/cm)	205		202		189		196		196		196		199	
	Temperature (°C)	24.8	24.8	24.9	24.5	24.7	24.6	24.7	24.6	24.9	24.5	24.8	24.4	24.9	24.6
100%	pH (SU)	7.39	7.13	7.30	7.12	7.19	7.04	7.14	7.23	7.24	7.23	7.36	7.24	7.26	6.95
	DO (mg/L)	7.7	7.1	7.7	7.1	7.7	7.5	7.8	7.4	7.8	7.3	7.7	7.3	7.8	6.8
	Conductivity (µmhos/cm)	156		154		145		152		146		146		149	
	Alkalinity (mg/L $CaCO_3$)	65				57				50					
	Hardness (mg/L $CaCO_3$)	64				62				60					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	24.8	24.9	24.9	24.5	24.7	24.4	24.7	24.6	25.0	24.6	24.9	24.6	24.9	24.6
100% Intake	pH (SU)	7.39	7.15	7.30	7.05	7.17	7.01	7.11	7.24	7.22	7.25	7.34	7.23	7.25	6.97
	DO (mg/L)	7.8	7.2	7.7	7.1	7.8	7.4	7.9	7.5	7.8	7.3	7.7	7.4	7.8	6.8
	Conductivity (µmhos/cm)	153		152		143		148		145		144		147	
	Alkalinity (mg/L $CaCO_3$)	57				54				52					
	Hardness (mg/L $CaCO_3$)	64				64				60					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	24.8	24.7	24.9	24.6	24.9	24.6	24.6	24.7	25.1	24.5	24.8	24.4	24.9	24.5

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** **Date:** 05-12-09

Client: TVA / Sequoyah Nuclear Plant – Non-treated

Daily Chemistry:

		Day					
		0		1		2	
	Analyst	MLM	MLM	MLM	MLM	MLM	KOW
Concentration	Parameter						
CONTROL	pH (S.U.)	7.32	7.28	~~7.60~~ (7.66)	7.15	7.65	7.13
	DO (mg/L)	7.5	7.4	7.6	7.4	7.4	7.5
	Conductivity (µmhos/cm)	317		312		302	
	Alkalinity (mg $CaCO_3$/L)	61				61	
	Hardness (mg $CaCO_3$/L)	92				88	
	Temperature (°C)	24.8	24.8	24.8	24.5	24.7	24.5
11.3%	pH (S.U.)	7.47	7.21	7.40	7.22	7.39	7.12
	DO (mg/L)	7.5	7.3	7.6	7.2	7.6	7.3
	Conductivity (µmhos/cm)	293		292		284	
	Temperature (°C)	24.8	24.9	24.8	24.5	24.7	24.5
22.6%	pH (S.U.)	7.47	7.18	7.41	7.15	7.37	7.09
	DO (mg/L)	7.5	7.1	7.7	7.1	7.6	7.3
	Conductivity (µmhos/cm)	284		277		268	
	Temperature (°C)	24.8	25.1	24.8	24.3	24.7	24.3
45.2%	pH (S.U.)	7.47	7.19	7.41	7.15	7.31	7.09
	DO (mg/L)	7.7	7.1	7.7	7.1	7.6	7.2
	Conductivity (µmhos/cm)	247		243		234	
	Temperature (°C)	24.8	24.8	24.8	24.7	24.7	24.2
72.6%	pH (S.U.)	7.46	7.12	7.35	7.12	7.27	7.09
	DO (mg/L)	7.7	7.2	7.7	7.1	7.7	7.3
	Conductivity (µmhos/cm)	205		202		189	
	Temperature (°C)	24.8	24.8	24.9	24.5	24.7	24.6
100%	pH (S.U.)	7.39	7.13	7.30	7.12	7.19	7.04
	DO (mg/L)	7.7	7.1	7.7	7.1	7.7	7.5
	Conductivity (µmhos/cm)	156		154		145	
	Alkalinity (mg $CaCO_3$/L)	65				57	
	Hardness (mg $CaCO_3$/L)	64				62	
	TR chlorine (mg/L)	<0.10				<0.10	
	Temperature (°C)	24.8	24.9	24.9	24.5	24.7	24.4
100% Intake	pH (S.U.)	7.39	7.15	7.30	7.05	7.17	7.01
	DO (mg/L)	7.8	7.2	7.7	7.1	7.8	7.4
	Conductivity (µmhos/cm)	153		152		143	
	Alkalinity (mg $CaCO_3$/L)	57				54	
	Hardness (mg $CaCO_3$/L)	64				64	
	TR chlorine (mg/L)	<0.10				<0.10	
	Temperature (°C)	24.8	24.7	24.9	24.6	24.9	24.6
		Initial	Final	Initial	Final	Initial	Final

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** **Date:** 05-12-09

Client: TVA / Sequoyah Nuclear Plant – Non-treated

		Day							
		3		4		5		6	
	Analyst	KGL	LAB	LAB	BSC	BSC	MLR	MLR	MLR
Concen-tration	Parameter								
CONTROL	pH (S.U.)	7.50	7.30	7.60	7.44	7.43	7.38	7.66	7.04
	DO (mg/L)	7.7	7.5	7.8	7.5	7.6	7.3	7.4	~~7.8~~ 6.9
	Conductivity (µmhos/cm)	326		338		324		328	
	Alkalinity (mg $CaCO_3$/L)			60					
	Hardness (mg $CaCO_3$/L)			88					
	Temperature (°C)	24.7	24.5	24.7	24.5	24.7	24.5	24.8	24.6
11.3%	pH (S.U.)	7.26	7.30	~~7.56~~ (7.41)	7.36	7.50	7.33	7.42	7.01
	DO (mg/L)	7.8	7.5	8.0	7.4	7.7	7.4	7.5	6.9
	Conductivity (µmhos/cm)	298		304		300		306	
	Temperature (°C)	24.7	24.7	24.7	24.2	24.7	24.5	24.8	24.6
22.6%	pH (S.U.)	7.26	7.30	~~7.48~~ (7.40)	7.34	7.49	7.33	7.41	7.03
	DO (mg/L)	7.8	7.5	8.1	7.4	7.7	7.4	7.5	6.8
	Conductivity (µmhos/cm)	279		286		280		287	
	Temperature (°C)	24.7	24.7	24.8	24.2	24.8	24.4	24.8	24.5
45.2%	pH (S.U.)	7.23	7.30	~~7.47~~ (7.36)	7.35	7.45	7.28	7.37	6.99
	DO (mg/L)	7.8	7.4	8.0	7.4	7.7	7.4	7.6	6.8
	Conductivity (µmhos/cm)	243		247		243		246	
	Temperature (°C)	24.7	24.8	24.9	24.5	24.8	24.4	24.8	24.5
72.6%	pH (S.U.)	7.18	7.29	~~7.45~~ (7.30)	7.34	7.42	7.23	7.32	6.97
	DO (mg/L)	7.9	7.5	7.8	7.4	7.7	7.4	7.8	6.8
	Conductivity (µmhos/cm)	196		196		196		199	
	Temperature (°C)	24.7	24.6	24.9	24.5	24.8	24.4	24.9	24.6
100%	pH (S.U.)	7.14	7.23	~~7.44~~ (7.24)	7.23	7.36	7.24	7.26	6.95
	DO (mg/L)	7.8	7.4	7.8	7.3	7.7	7.3	7.8	6.8
	Conductivity (µmhos/cm)	152		146		146		149	
	Alkalinity (mg $CaCO_3$/L)			50					
	Hardness (mg $CaCO_3$/L)			60					
	TR Chlorine (mg/L)			<0.10					
	Temperature (°C)	24.7	24.6	25.0	24.6	24.9	24.6	24.9	24.6
100% Intake	pH (S.U.)	7.11	7.24	~~7.18~~ (7.22)	7.25	7.37	7.23	7.25	6.97
	DO (mg/L)	7.9	7.5	7.8	7.3	7.7	7.4	7.8	6.8
	Conductivity (µmhos/cm)	148		145		147		147	
	Alkalinity (mg $CaCO_3$/L)			52					
	Hardness (mg $CaCO_3$/L)			60					
	TR chlorine (mg/L)			<0.10					
	Temperature (°C)	24.6	24.7	25.1	24.5	24.8	24.4	24.9	24.5
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

ETS
Environmental Testing Solutions, Inc.

Chronic Whole Effluent Toxicity Test (EPA-821-R-02-013 Method 1002.0)
Species: *Ceriodaphnia dubia*

Client: TVA
Facility: Sequoyah Nuclear Plant
NPDES #: TN 0026450
Project #: 5444

County: Hamilton
Treatment: Non-treated
Outfall: 101

Dilution preparation information:						*Comments:*
Dilution prep (%)	11.3	22.6	45.2	72.6	100	
Effluent volume (mL)	282.5	565	1130	1815	2500	
Diluent volume (mL)	2217.5	1935	1370	685	0	
Total volume (mL)	2500	2500	2500	2500	2500	

Test organism source information:											*Test information:*	
Organism age:	< 24-hours old										Randomizing template color:	BLUE
Date and times organisms were born between:	05-12-09 0630 TO 0940										Incubator number and shelf location:	2B1
Culture board:	05-05-09 A											
Replicate number:	1	2	3	4	5	6	7	8	9	10	YWT batch:	04-22-09
Culture board cup number:	3	5	10	15	16	17	19	22	23	25		
Transfer bowl information:	pH = 7.43 SU Temperature = 24.9 °C										*Selenastrum* batch:	05-04-09

Daily renewal information:

Day	Date	Test initiation, renewal, or termination time	MHSW batch used	Sample numbers used	Analyst
0	05-12-09	0950	05-09-09 A	090511.01 + 02	JH
1	05-13-09	0850	05-09-09 A	090511.01 + 02	JH
2	05-14-09	0900	05-09-09 B	090513.08 + 09	JH
3	05-15-09	0853	05-09-09 B	090513.08 + 09	JH
4	05-16-09	0900	05-12-09	090515.02 + 03	JH
5	05-17-09	0920	05-12-09	090515.02 + 03	JH
6	05-18-09	0903	05-12-09	090515.02 + 03	JH
7	05-19-09	0854			JH

Control information:	1	2	Acceptance criteria	*Summary of test endpoints:*	
% of Male Adults:	0%	0%	≤ 20%	7-day LC50	>100%
% Adults having 3rd Broods:	100%	100%	≥ 80%	NOEC	100%
% Mortality:	0%	0%	≤ 20%	LOEC	>100%
Mean Offspring/Female:	33.0	33.1	≥ 15.0 offspring/female	ChV	>100%
% CV:	3.8%	4.1%	< 40.0 %	IC25	>100%

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia***
Client: **Sequoyah Nuclear Plant - Non-treated** **Date:** 05-12-09

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	4	5	4	5	5	5	5	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	13	13	12	13	11	14	12	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	16	17	15	18	16	16	15	17	15	15
Total young produced		33	34	33	34	34	32	34	34	31	31
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3rd Broods		X	X	X	X	X	X	X	X	X	X

Note: Adult mortality (L = live, D = dead)

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	33.0

CONC: **11.3%** ***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	6	4	4	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	14	12	13	13	13	13	14	13	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	17	17	15	14	17	16	16	16	16	15
Total young produced		33	36	32	32	36	33	33	34	33	32
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead)

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	33.4
% Reduction from Control:	-1.2%

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia***
Client: **Sequoyah Nuclear Plant - Non-treated** **Date:** 05-12-09

CONC: **22.6%** ***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	5	4	6	6	4	4	5	4	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	14	13	13	14	11	14	12	13	13	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	16	19	15	16	17	15	18	17	15	15
Total young produced		35	36	34	36	32	33	35	34	33	33
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead)

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	34.1
% Reduction from Control:	-3.3%

CONC: **45.2%** ***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	5	4	5	5	5	5	5	5	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	15	12	12	13	13	12	13	14	14	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	16	18	14	17	17	16	15	15	15	15
Total young produced		36	34	31	35	35	33	33	34	33	31
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead)

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	33.5
% Reduction from Control:	-1.5%

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia***
Client: **Sequoyah Nuclear Plant - Non-treated** **Date:** 05-12-09

CONC: **72.6%** ***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	4	5	5	5	4	4	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	15	15	13	12	13	13	13	14	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	18	18	16	14	18	15	14	17	16	16
Total young produced		37	37	36	32	35	32	31	34	34	33
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead)

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	34.1
% Reduction from Control:	-3.3%

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	5	6	4	5	5	5	4	6	6	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	15	14	12	14	13	14	13	13	13	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	19	18	16	17	16	14	17	16	15	15
Total young produced		39	38	32	36	34	33	34	35	34	31
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead)

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	34.6
% Reduction from Control:	-4.8%

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia***
Client: **Sequoyah Nuclear Plant - Non-treated** **Date:** 05-12-09

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	4	5	4	5	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	14	12	13	13	13	13	12	10	14	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	15	19	16	18	16	16	14	17	15	17
Total young produced		33	35	33	35	34	33	31	31	33	33
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead)

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	33.1

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	5	4	6	4	4	5	5	5	5	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	15	12	14	14	12	13	14	13	13	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	19	21	18	19	20	18	18	19	17
Total young produced		39	35	41	36	35	38	37	36	37	34
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead)

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	36.8
% Reduction from Control:	-11.2%

ETS
Environmental Testing Solutions, Inc.

TVA / Sequoyah Nuclear Plant, Outfall 101 - Non-treated
May 12-19 2009

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
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	5	4	5	5	5	5	4	4	45
5	13	13	13	12	13	11	14	12	12	12	125
6	0	0	0	0	0	0	0	0	0	0	0
7	16	17	15	18	16	16	15	17	15	15	160
Total	**33**	**34**	**33**	**34**	**34**	**32**	**34**	**34**	**31**	**31**	**330**

11.3%

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	6	4	4	4	4	4	45
5	12	14	12	13	13	13	13	14	13	13	130
6	0	0	0	0	0	0	0	0	0	0	0
7	17	17	15	14	17	16	16	16	16	15	159
Total	**33**	**36**	**32**	**32**	**36**	**33**	**33**	**34**	**33**	**32**	**334**

22.6%

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	5	4	6	6	4	4	5	4	5	5	48
5	14	13	13	14	11	14	12	13	13	13	130
6	0	0	0	0	0	0	0	0	0	0	0
7	16	19	15	16	17	15	18	17	15	15	163
Total	**35**	**36**	**34**	**36**	**32**	**33**	**35**	**34**	**33**	**33**	**341**

45.2%

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	5	4	5	5	5	5	5	5	4	4	47
5	15	12	12	13	13	12	13	14	14	12	130
6	0	0	0	0	0	0	0	0	0	0	0
7	16	18	14	17	17	16	15	15	15	15	158
Total	**36**	**34**	**31**	**35**	**35**	**33**	**33**	**34**	**33**	**31**	**335**

72.6%

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	4	5	5	5	4	4	4	4	4	45
5	13	15	15	13	12	13	13	13	14	13	134
6	0	0	0	0	0	0	0	0	0	0	0
7	18	18	16	14	18	15	14	17	16	16	162
Total	**37**	**37**	**36**	**32**	**35**	**32**	**31**	**34**	**34**	**33**	**341**

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	5	6	4	5	5	5	4	6	6	4	50
5	15	14	12	14	13	14	13	13	13	12	133
6	0	0	0	0	0	0	0	0	0	0	0
7	19	18	16	17	16	14	17	16	15	15	163
Total	**39**	**38**	**32**	**36**	**34**	**33**	**34**	**35**	**34**	**31**	**346**

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	5	4	5	4	4	4	42
5	14	12	13	13	13	13	12	10	14	12	126
6	0	0	0	0	0	0	0	0	0	0	0
7	15	19	16	18	16	16	14	17	15	17	163
Total	**33**	**35**	**33**	**35**	**34**	**33**	**31**	**31**	**33**	**33**	**331**

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	5	4	6	4	4	5	5	5	5	4	47
5	15	12	14	14	12	13	14	13	13	13	133
6	0	0	0	0	0	0	0	0	0	0	0
7	19	19	21	18	19	20	18	18	19	17	188
Total	**39**	**35**	**41**	**36**	**35**	**38**	**37**	**36**	**37**	**34**	**368**

ETS
Environmental Testing Solutions, Inc.

TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
May 12-19, 2009

***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: 5444
Reveiwed by:

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	33	34	33	34	34	32	34	34	31	31	100	33.0	3.8	Not applicable
11.3%	33	36	32	32	36	33	33	34	33	32	100	33.4	4.5	-1.2
22.6%	35	36	34	36	32	33	35	34	33	33	100	34.1	4.0	-3.3
45.2%	36	34	31	35	35	33	33	34	33	31	100	33.5	4.9	-1.5
72.6%	37	37	36	32	35	32	31	34	34	33	100	34.1	6.3	-3.3
100%	39	38	32	36	34	33	34	35	34	31	100	34.6	7.2	-4.8
Control - 2	33	35	33	35	34	33	31	31	33	33	100	33.1	4.1	Not applicable
100% Intake	39	35	41	36	35	38	37	36	37	34	100	36.8	5.7	-11.2

Outfall 101:
Dunnett's MSD value: 1.831
PMSD: 5.5

Intake:
Dunnett's MSD value: 1.374
PMSD: 4.2

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).

USEPA. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination Program. EPA-833-R-00-003. US Environmental Protection Agency, Cincinnati, OH.

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.

TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
May 12-19, 2009
Statistical Analyses

ETS Environmental Testing Solutions, Inc.

Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date:	5/12/2009	Test ID:	CdFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101
End Date:	5/19/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	CD-Ceriodaphnia dubia
Comments:					

Conc-%	1	2	3	4	5	6	7	8	9	10
Control-1	33.000	34.000	33.000	34.000	34.000	32.000	34.000	34.000	31.000	31.000
Control-2	33.000	35.000	33.000	35.000	34.000	33.000	31.000	31.000	33.000	33.000
11.3	33.000	36.000	32.000	32.000	36.000	33.000	33.000	34.000	33.000	32.000
22.6	35.000	36.000	34.000	36.000	32.000	33.000	35.000	34.000	33.000	33.000
45.2	36.000	34.000	31.000	35.000	35.000	33.000	33.000	34.000	33.000	31.000
72.6	37.000	37.000	36.000	32.000	35.000	32.000	31.000	34.000	34.000	33.000
100	39.000	38.000	32.000	36.000	34.000	33.000	34.000	35.000	34.000	31.000
Intake	39.000	35.000	41.000	36.000	35.000	38.000	37.000	36.000	37.000	34.000

			Transform: Untransformed						1-Tailed		Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
Control-1	33.000	0.9970	33.000	31.000	34.000	3.779	10				33.783	1.0000
Control-2	33.100	1.0000	33.100	31.000	35.000	4.140	10					
11.3	33.400	1.0091	33.400	32.000	36.000	4.508	10	-0.500	2.287	1.831	33.783	1.0000
22.6	34.100	1.0302	34.100	32.000	36.000	4.019	10	-1.374	2.287	1.831	33.783	1.0000
45.2	33.500	1.0121	33.500	31.000	36.000	4.925	10	-0.624	2.287	1.831	33.783	1.0000
72.6	34.100	1.0302	34.100	31.000	37.000	6.252	10	-1.374	2.287	1.831	33.783	1.0000
100	34.600	1.0453	34.600	31.000	39.000	7.235	10	-1.998	2.287	1.831	33.783	1.0000
Intake	36.800	1.1118	36.800	34.000	41.000	5.700	10					

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.653808415	1.035	0.254140335	-0.23607601
Bartlett's Test indicates equal variances (p = 0.26)	6.457315922	15.08627224		
The control means are not significantly different (p = 0.87)	0.170664037	2.100922029		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	100	>100		1	1.83092058	0.055482442	3.416666667	3.205555556	0.389506936	5, 54
Treatments vs Control-1										

Linear Interpolation (200 Resamples)

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

TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
Non-treated
May 12-19, 2009

ETS
Environmental Testing Solutions, Inc.

Statistical Analyses

Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date:	5/12/2009	Test ID:	CdFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
End Date:	5/19/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	CD-Ceriodaphnia dubia
Comments:					

Conc-%	1	2	3	4	5	6	7	8	9	10
Control-1	33.000	34.000	33.000	34.000	34.000	32.000	34.000	34.000	31.000	31.000
Control-2	33.000	35.000	33.000	35.000	34.000	33.000	31.000	31.000	33.000	33.000
11.3	33.000	36.000	32.000	32.000	36.000	33.000	33.000	34.000	33.000	32.000
22.6	35.000	36.000	34.000	36.000	32.000	33.000	35.000	34.000	33.000	33.000
45.2	36.000	34.000	31.000	35.000	35.000	33.000	33.000	34.000	33.000	31.000
72.6	37.000	37.000	36.000	32.000	35.000	32.000	31.000	34.000	34.000	33.000
100	39.000	38.000	32.000	36.000	34.000	33.000	34.000	35.000	34.000	31.000
Intake	39.000	35.000	41.000	36.000	35.000	38.000	37.000	36.000	37.000	34.000

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control-1	33.000	0.9970	33.000	31.000	34.000	3.779	10			
Control-2	33.100	1.0000	33.100	31.000	35.000	4.140	10			
11.3	33.400	1.0091	33.400	32.000	36.000	4.508	10			
22.6	34.100	1.0302	34.100	32.000	36.000	4.019	10			
45.2	33.500	1.0121	33.500	31.000	36.000	4.925	10			
72.6	34.100	1.0302	34.100	31.000	37.000	6.252	10			
100	34.600	1.0453	34.600	31.000	39.000	7.235	10			
Intake	36.800	1.1118	36.800	34.000	41.000	5.700	10	-4.670	1.734	1.374

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.955419481	0.868	0.544660572	0.427540628
F-Test indicates equal variances (p = 0.22)	2.3431952	6.541089535		
The control means are not significantly different (p = 0.87)	0.170664037	2.100922029		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences Treatments vs Control-2	1.373940728	0.041508783	68.45	3.138888889	1.9E-04	1, 18

TVA / Sequoyah Nuclear Plant, Outfall 101 - Non-treated
May 12-19, 2009

ETS
Environmental Testing Solutions, Inc.

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

Daily Chemical Analyses

Project number: 5444
Reviewed by: [signature]

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)	7.32	7.41	7.60	7.43	7.65	7.21	7.58	7.41	7.60	7.47	7.43	7.40	7.66	7.39
	DO (mg/L)	7.5	7.6	7.6	7.8	7.4	7.8	7.7	7.7	7.8	7.5	7.6	7.6	7.4	7.5
	Conductivity (µmhos/cm)	317		312		302		326		338		324		328	
	Alkalinity (mg/L $CaCO_3$)	61				61				60					
	Hardness (mg/L $CaCO_3$)	92				88				88					
	Temperature (°C)	25.0	25.2	25.0	24.8	24.7	25.0	24.8	25.1	24.7	24.8	24.7	25.0	24.8	24.8
11.3%	pH (SU)	7.47	7.41	7.40	7.43	7.39	7.22	7.26	7.44	7.41	7.49	7.50	7.40	7.42	7.40
	DO (mg/L)	7.5	7.5	7.6	7.7	7.6	7.6	7.8	7.8	8.0	7.5	7.7	7.6	7.5	7.4
	Conductivity (µmhos/cm)	293		292		284		298		304		300		306	
	Temperature (°C)	25.0	25.2	25.0	24.9	24.7	24.8	25.0	24.9	24.8	25.0	24.7	25.0	24.8	25.0
22.6%	pH (SU)	7.47	7.40	7.41	7.42	7.37	7.22	7.26	7.43	7.40	7.48	7.49	7.40	7.41	7.39
	DO (mg/L)	7.5	7.6	7.7	7.7	7.6	7.6	7.8	7.7	8.1	7.6	7.7	7.6	7.5	7.4
	Conductivity (µmhos/cm)	284		277		268		279		286		280		287	
	Temperature (°C)	25.0	25.0	25.1	24.9	24.7	24.8	25.0	25.2	24.8	24.8	24.7	24.8	24.8	25.0
45.2%	pH (SU)	7.47	7.39	7.41	7.42	7.31	7.22	7.23	7.42	7.36	7.48	7.45	7.38	7.37	7.35
	DO (mg/L)	7.7	7.6	7.7	7.6	7.6	7.6	7.8	7.7	8.0	7.6	7.7	7.6	7.6	7.4
	Conductivity (µmhos/cm)	247		243		234		243		247		243		246	
	Temperature (°C)	24.9	25.2	25.1	24.9	24.8	24.9	25.0	25.2	24.9	24.8	24.8	24.9	24.9	24.8
72.6%	pH (SU)	7.46	7.38	7.35	7.37	7.27	7.22	7.18	7.38	7.30	7.42	7.42	7.35	7.32	7.32
	DO (mg/L)	7.7	7.6	7.7	7.7	7.7	7.7	7.9	7.6	7.8	7.6	7.7	7.6	7.8	7.5
	Conductivity (µmhos/cm)	205		202		189		196		196		196		199	
	Temperature (°C)	24.9	25.1	25.1	24.9	24.8	24.7	25.0	25.2	24.9	24.9	24.8	24.9	24.9	24.9
100%	pH (SU)	7.39	7.34	7.30	7.33	7.19	7.20	7.14	7.36	7.24	7.38	7.36	7.30	7.26	7.28
	DO (mg/L)	7.7	7.6	7.7	7.7	7.7	7.7	7.8	7.6	7.8	7.6	7.7	7.6	7.8	7.5
	Conductivity (µmhos/cm)	156		154		145		152		146		146		149	
	Alkalinity (mg/L $CaCO_3$)	65				57				50					
	Hardness (mg/L $CaCO_3$)	64				62				60					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	24.9	25.1	25.1	24.8	24.8	24.7	25.0	25.0	25.0	24.8	24.8	24.9	24.9	24.9
100% Intake	pH (SU)	7.39	7.32	7.30	7.30	7.17	7.09	7.11	7.33	7.22	7.35	7.34	7.30	7.25	7.26
	DO (mg/L)	7.8	7.6	7.7	7.6	7.8	7.7	7.9	7.6	7.8	7.5	7.7	7.5	7.8	7.5
	Conductivity (µmhos/cm)	153		152		143		148		145		144		147	
	Alkalinity (mg/L $CaCO_3$)	57				54				52					
	Hardness (mg/L $CaCO_3$)	64				64				60					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	24.9	25.1	25.1	24.8	24.8	24.6	24.9	25.0	24.8	24.9	24.8	24.9	24.9	24.9

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia*** **Date:** 05-12-09

Client: **Sequoyah Nuclear Plant - Non-treated**

Daily Chemistry:

		Day					
		0		1		2	
	Analyst	MLR	MLR	MLR	MLR	MLR	KLZ
Concentration	Parameter						
CONTROL	pH (S.U.)	7.32	7.41	7.60	7.43	7.65	7.21
	DO (mg/L)	7.5	7.6	7.6	7.8	7.4	7.8
	Conductivity (µmhos/cm)	317		312		302	
	Alkalinity (mg $CaCO_3$/L)	61				61	
	Hardness (mg $CaCO_3$/L)	92				88	
	Temperature (°C)	25.0	25.2	25.0	24.8	24.7	25.0
11.3%	pH (S.U.)	7.47	7.41	7.40	7.43	7.39	7.22
	DO (mg/L)	7.5	7.5	7.6	7.7	7.6	7.6
	Conductivity (µmhos/cm)	293		292		284	
	Temperature (°C)	25.0	25.2	25.0	24.9	24.7	24.8
22.6%	pH (S.U.)	7.47	7.40	7.41	7.42	7.37	7.22
	DO (mg/L)	7.5	7.6	7.7	7.7	7.6	7.6
	Conductivity (µmhos/cm)	284		277		268	
	Temperature (°C)	25.0	25.0	25.1	24.9	24.7	24.8
45.2%	pH (S.U.)	7.47	7.39	7.41	7.42	7.31	7.22
	DO (mg/L)	7.7	7.6	7.7	7.6	7.6	7.6
	Conductivity (µmhos/cm)	247		243		234	
	Temperature (°C)	24.9	25.2	25.1	24.9	24.8	24.9
72.6%	pH (S.U.)	7.46	7.38	7.35	7.37	7.27	7.22
	DO (mg/L)	7.7	7.6	7.7	7.7	7.7	7.7
	Conductivity (µmhos/cm)	205		202		189	
	Temperature (°C)	24.9	25.1	25.1	24.9	24.8	24.7
100%	pH (S.U.)	7.39	7.34	7.30	7.33	7.19	7.20
	DO (mg/L)	7.7	7.6	7.7	7.7	7.7	7.7
	Conductivity (µmhos/cm)	156		154		145	
	Alkalinity (mg $CaCO_3$/L)	65				57	
	Hardness (mg $CaCO_3$/L)	64				62	
	TR chlorine (mg/L)	<0.10				<0.10	
	Temperature (°C)	24.9	25.1	25.1	24.8	24.8	24.7
100% Intake	pH (S.U.)	7.34	7.32	7.30	7.30	7.17	7.09
	DO (mg/L)	7.8	7.6	7.7	7.6	7.8	7.7
	Conductivity (µmhos/cm)	153		152		143	
	Alkalinity (mg $CaCO_3$/L)	57				54	
	Hardness (mg $CaCO_3$/L)	64				64	
	TR chlorine (mg/L)	<0.10				<0.10	
	Temperature (°C)	24.9	25.1	25.1	24.8	24.8	24.6
		Initial	Final	Initial	Final	Initial	Final

ETS Environmental Testing Solutions, Inc.

Species: *Ceriodaphnia dubia*
Client: Sequoyah Nuclear Plant - Non-treated **Date:** 05-12-09

		Day							
		3		4		5		6	
	Analyst	MLR	LAB	LAB	BSL	BSL	MLR	MLR	MLR
Concen-tration	Parameter								
CONTROL	pH (S.U.)	7.58	7.41	7.60	7.47	7.43	7.40	7.66	7.39
	DO (mg/L)	7.7	7.7	7.8	7.5	7.6	7.6	7.4	7.5
	Conductivity (µmhos/cm)	326		338		324		328	
	Alkalinity (mg $CaCO_3$/L)			60					
	Hardness (mg $CaCO_3$/L)			88					
	Temperature (°C)	24.8	25.1	24.7	24.8	24.7	25.0	24.8	24.8
11.3%	pH (S.U.)	7.26	7.44	~~7.51~~ 7.41	7.49	7.50	7.40	7.42	7.40
	DO (mg/L)	7.8	7.8	8.0	7.5	7.7	7.6	7.5	7.4
	Conductivity (µmhos/cm)	298		304		300		306	
	Temperature (°C)	25.0	24.9	24.8	25.0	24.7	25.0	24.8	25.0
22.6%	pH (S.U.)	7.26	7.43	~~7.48~~ 7.40	7.48	7.49	7.40	7.41	7.39
	DO (mg/L)	7.8	7.7	8.1	7.6	7.7	7.6	7.5	7.4
	Conductivity (µmhos/cm)	279		286		~~317~~ 280		287	
	Temperature (°C)	25.0	25.2	24.8	24.8	24.7	24.8	24.8	25.0
45.2%	pH (S.U.)	7.23	7.42	~~7.47~~ 7.36	7.48	7.45	7.38	7.37	7.35
	DO (mg/L)	7.8	7.7	8.0	7.6	7.7	7.6	7.6	7.4
	Conductivity (µmhos/cm)	243		247		~~317~~ 243 BSL		246	
	Temperature (°C)	25.0	25.2	24.9	24.8	24.8	24.9	24.9	24.8
72.6%	pH (S.U.)	7.18	7.38	~~7.45~~ 7.30	7.42	7.42	7.35	7.32	7.32
	DO (mg/L)	7.9	7.6	7.8	7.6	7.7	7.6	7.8	7.5
	Conductivity (µmhos/cm)	196		196		~~317~~ 196 BSL		199	
	Temperature (°C)	25.0	25.2	24.9	24.9	24.8	24.9	24.9	24.9
100%	pH (S.U.)	7.14	7.36	~~7.44~~ 7.24	7.38	7.36	7.30	7.26	7.28
	DO (mg/L)	7.8	7.6	7.8	7.6	7.7	7.6	7.8	7.5
	Conductivity (µmhos/cm)	152		146		~~317~~ 146 BSL		149	
	Alkalinity (mg $CaCO_3$/L)			50					
	Hardness (mg $CaCO_3$/L)			60					
	TR Chlorine (mg/L)			<0.10					
	Temperature (°C)	25.0	25.0	25.0	24.8	24.8	24.9	24.9	24.9
100% Intake	pH (S.U.)	7.11	7.33	~~7.48~~ 7.23	7.35	7.34	7.30	7.25	7.26
	DO (mg/L)	7.9	7.6	7.8	7.5	7.7	7.5	7.8	7.5
	Conductivity (µmhos/cm)	148		145		144		147	
	Alkalinity (mg $CaCO_3$/L)			52					
	Hardness (mg $CaCO_3$/L)			60					
	TR chlorine (mg/L)			<0.10					
	Temperature (°C)	24.9	25.0	24.8	24.9	24.8	24.9	24.9	24.9
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

ETS Environmental Testing Solutions, Inc.

Chronic Whole Effluent Toxicity Test (EPA-821-R-02-013 Method 1000.0)
Species: *Pimephales promelas*

Client: TVA
Facility: Sequoyah Nuclear Plant
NPDES #: TN 0026450
Project #: 5444

County: Hamilton
Treatment: UV-treated
Outfall: 101

Dilution preparation information:						*Comments:*
Dilution prep (%)	11.3	22.6	45.2	72.6	100	Each concentration was treated
Effluent volume (mL)	282.5	565	1130	1815	2500	for 2 minutes with a UV sterilizer
Diluent volume (mL)	2217.5	1935	1370	685	0	to remove pathogenic
Total volume (mL)	2500	2500	2500	2500	2500	interferences.

Test organism information:		*Test information:*	
Organism age:	70.53 HOURS OLD	Randomizing template:	BLUE
Date and times organisms were born between:	05-11-09 1600	Incubator number and shelf location:	3B
Organism source:	ATOX BATCH Pp 05-11-09	*Artemia* CHM number:	CHM444
Transfer bowl information:	pH = 7.32 SU Temperature = 24.6 °C	Date / Time in: 05-19-09	1200
		Date / Time out: 05-20-09	1220
Average transfer volume:	0.2305 ml	Total drying time:	24.25 HOURS
		Initial oven temperature:	60°C
		Final oven temperature:	61°C

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		
0	05-12-09	—	JH	1400	JH	1232	JH	090511.01+02	05-09-09A
1	05-13-09	0800	JH	1400	JH	1255	JH	090511.01+02	05-09-09A
2	05-14-09	0800	JH	1400	JH	1230	JH	090513.08+09	05-09-09B
3	05-15-09	0800	JH	1400	JH	1223	JH	090513.08+09	05-09-09B
4	05-16-09	0800	JH	1400	JH	1227	JH	090515.02+03	05-12-09
5	05-17-09	0900	JH	1500	JH	1245	JH	090515.02+03	05-12-09
6	05-18-09	0830	JH	1430	JH	1243	JH	090515.02+03	05-12-09
7	05-19-09					1140		—	JH

Control information:		Acceptance criteria	*Summary of test endpoints:*	
% Mortality:	0%	≤ 20%	7-day LC_{50}	>100%
Average weight per initial larvae:	0.684		NOEC	100%
Average weight per surviving larvae:	0.684	≥ 0.25 mg/larvae	LOEC	>100%
			ChV	>100%
			IC_{25}	>100%

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** **Date:** 05-12-09

Client: TVA / Sequoyah Nuclear Plant - UV-treated

Survival and Growth Data

Day	CONTROL				11.3%				22.6%			
	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 16	10	10	10	10	10	9 1d
A = Pan weight (mg) Tray color code:: l. blue beaker Analyst: MLM Date: 05-12-09	13.85	13.62	13.80	14.45	14.60	13.77	12.60	14.14	13.86	14.15	14.14	14.31
B = Pan + Larvae weight (mg) Analyst: MLM Date: 05-20-09	20.22	21.05	20.75	21.04	22.35	22.29	20.16	21.86	21.23	21.42	21.20	20.84
C = Larvae weight (mg) = B – A	6.37	7.43	6.95	6.59	7.75	8.52	7.56	7.72	7.37	7.27	7.06	6.53
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.637	0.743	0.695	0.659	0.775	0.852	0.756	0.772	0.737	0.727	0.706	0.653
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.684				0.789		-15.4%		0.706		-3.3%	

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.

Calculations and data reviewed: [illegible]

Comments:

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** **Date:** 05-12-09
Client: TVA / Sequoyah Nuclear Plant - UV-treated

Survival and Growth Data

Day	45.2%				72.6%				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:: 1-blue beaker Analyst: MLR Date: 05-12-09	15.59	13.95	13.09	13.45	13.68	14.35	14.41	13.34	13.60	14.40	14.19	13.44
B = Pan + Larvae weight (mg) Analyst: MLR Date: 05-20-09	22.52	21.17	19.92	21.01	20.50	21.03	21.06	20.56	19.91	21.04	21.70	20.89
C = Larvae weight (mg) = B – A	6.93	7.22	6.83	7.56	6.82	6.68	6.65	7.22	6.31	6.64	7.51	7.45
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.693	0.722	0.683	0.756	0.682	0.668	0.665	0.722 ~~0.7220~~	0.631	0.664	0.751	0.745
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.714		-4.4%		0.684		-0.1%		0.698		-2.1%	

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.

Calculations and data reviewed: [illegible]

Comments:

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** **Date:** 05-12-09
Client: TVA / Sequoyah Nuclear Plant - UV-treated

Survival and Growth Data

Day	100% Intake			
	Y	Z	AA	BB
0	10	10	10	10
1	10	10	10	10
2	10	10	10	10
3	10	10 ~~10~~	10 ~~10~~	10
4	10	10	10	10
5	10	10	10	10
6	10	10	10	10
7	10	10	10	10
A = Pan weight (mg) Tray color code:: 1. blue beaker Analyst: MLM Date: 05-12-09	14.20	14.82	14.20	12.96
B = Pan + Larvae weight (mg) Analyst: MLM Date: 05-20-09	21.15	21.17	20.82	19.38
C = Larvae weight (mg) = B – A	6.95	6.35	6.62	6.42
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.695	0.635	0.662	0.642
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.659		3.7%	

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.

Calculations and data reviewed: JK

Comments:

ETS
Environmental Testing Solutions, Inc.

TVA / Sequoyah Nuclear Plant, Outfall 101
UV-treated
May 12-19, 2009

***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: 5444
Reveiwed by:

Concentration (%)	Replicate	Initial number of larvae	Final number of larvae	A = Pan weight (mg)	B = Pan + Larvae weight (mg)	Larvae weight (mg) = A - B	Not for Compliance Assessment, Internal Laboratory QC: 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 (Mean weight per initial number of larvae) (%)	Percent reduction from control (%)
Control	A	10	10	13.85	20.22	6.37	0.637	0.684	6.8	0.637	100.0	0.684	6.8	Not applicable
	B	10	10	13.62	21.05	7.43	0.743			0.743				
	C	10	10	13.80	20.75	6.95	0.695			0.695				
	D	10	10	14.45	21.04	6.59	0.659			0.659				
11.3%	E	10	10	14.60	22.35	7.75	0.775	0.789	5.4	0.775	100.0	0.789	5.4	-15.4
	F	10	10	13.77	22.29	8.52	0.852			0.852				
	G	10	10	12.60	20.16	7.56	0.756			0.756				
	H	10	10	14.14	21.86	7.72	0.772			0.772				
22.6%	I	10	10	13.86	21.23	7.37	0.737	0.724	1.8	0.737	97.5	0.706	5.3	-3.3
	J	10	10	14.15	21.42	7.27	0.727			0.727				
	K	10	10	14.14	21.20	7.06	0.706			0.706				
	L	10	9	14.31	20.84	6.53	0.726			0.653				
45.2%	M	10	10	15.59	22.52	6.93	0.693	0.714	4.6	0.693	100.0	0.714	4.6	-4.4
	N	10	10	13.95	21.17	7.22	0.722			0.722				
	O	10	10	13.09	19.92	6.83	0.683			0.683				
	P	10	10	13.45	21.01	7.56	0.756			0.756				
72.6%	Q	10	10	13.68	20.50	6.82	0.682	0.684	3.8	0.682	100.0	0.684	3.8	-0.1
	R	10	10	14.35	21.03	6.68	0.668			0.668				
	S	10	10	14.41	21.06	6.65	0.665			0.665				
	T	10	10	13.34	20.56	7.22	0.722			0.722				
100%	U	10	10	13.60	19.91	6.31	0.631	0.698	8.5	0.631	100.0	0.698	8.5	-2.1
	V	10	10	14.40	21.04	6.64	0.664			0.664				
	W	10	10	14.19	21.70	7.51	0.751			0.751				
	X	10	10	13.44	20.89	7.45	0.745			0.745				
100% Intake	Y	10	10	14.20	21.15	6.95	0.695	0.659	4.1	0.695	100.0	0.659	4.1	3.7
	Z	10	10	14.82	21.17	6.35	0.635			0.635				
	AA	10	10	14.20	20.82	6.62	0.662			0.662				
	BB	10	10	12.96	19.38	6.42	0.642			0.642				

Outfall 101:
Dunnett's MSD value: 0.0720
PMSD: 10.5

Intake:
Dunnett's MSD value: 0.0520
PMSD: 7.6

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).

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.

TVA / Sequoyah Nuclear Plant, Outfall 101
UV-treated
May 12-19, 2009
Statistical Analyses

ETS Environmental Testing Solutions, Inc.

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	5/12/2009	Test ID:	PpFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101
End Date:	5/19/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:					

Conc-%	1	2	3	4
D-Control	0.6370	0.7430	0.6950	0.6590
11.3	0.7750	0.8520	0.7560	0.7720
22.6	0.7370	0.7270	0.7060	0.6530
45.2	0.6930	0.7220	0.6830	0.7560
72.6	0.6820	0.6680	0.6650	0.7220
100	0.6310	0.6640	0.7510	0.7450
Intake	0.6950	0.6350	0.6620	0.6420

			Transform: Untransformed						1-Tailed		Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.6835	1.0000	0.6835	0.6370	0.7430	6.776	4				0.7361	1.0000
11.3	0.7888	1.1540	0.7888	0.7560	0.8520	5.450	4	-3.522	2.410	0.0720	0.7361	1.0000
22.6	0.7058	1.0326	0.7058	0.6530	0.7370	5.308	4	-0.745	2.410	0.0720	0.7096	0.9640
45.2	0.7135	1.0439	0.7135	0.6830	0.7560	4.598	4	-1.004	2.410	0.0720	0.7096	0.9640
72.6	0.6843	1.0011	0.6843	0.6650	0.7220	3.834	4	-0.025	2.410	0.0720	0.6910	0.9387
100	0.6978	1.0208	0.6978	0.6310	0.7510	8.544	4	-0.477	2.410	0.0720	0.6910	0.9387
Intake	0.6585	0.9634	0.6585	0.6350	0.6950	4.083	4					

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.957272053	0.884	0.185406404	-0.99302071
Bartlett's Test indicates equal variances (p = 0.83)	2.111745119	15.08627224		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	100	>100		1	0.072014927	0.105361999	0.0061735	0.001785833	0.023020582	5, 18
Treatments vs D-Control										

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)	Skew
IC05	60.362			
IC10	>100			
IC15	>100			
IC20	>100			
IC25	>100			
IC40	>100			
IC50	>100			

TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
UV-treated
May 12-19, 2009

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	5/12/2009	Test ID:	PpFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
End Date:	5/19/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:					

Conc-%	1	2	3	4
D-Control	0.6370	0.7430	0.6950	0.6590
11.3	0.7750	0.8520	0.7560	0.7720
22.6	0.7370	0.7270	0.7060	0.6530
45.2	0.6930	0.7220	0.6830	0.7560
72.6	0.6820	0.6680	0.6650	0.7220
100	0.6310	0.6640	0.7510	0.7450
Intake	0.6950	0.6350	0.6620	0.6420

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
D-Control	0.6835	1.0000	0.6835	0.6370	0.7430	6.776	4			
11.3	0.7888	1.1540	0.7888	0.7560	0.8520	5.450	4			
22.6	0.7058	1.0326	0.7058	0.6530	0.7370	5.308	4			
45.2	0.7135	1.0439	0.7135	0.6830	0.7560	4.598	4			
72.6	0.6843	1.0011	0.6843	0.6650	0.7220	3.834	4			
100	0.6978	1.0208	0.6978	0.6310	0.7510	8.544	4			
Intake	0.6585	0.9634	0.6585	0.6350	0.6950	4.083	4	0.934	1.943	0.0520

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.95557791		0.749		0.566287708	-0.42008898
F-Test indicates equal variances (p = 0.40)	2.96680498		47.46722794			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences Treatments vs D-Control	0.05203226	0.0761262	0.00125	0.001434	0.386520296	1, 6

TVA / Sequoyah Nuclear Plant, Outfall 101 - UV-treated
May 12-19, 2009

ETS
Environmental Testing Solutions, Inc.

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

Daily Chemical Analyses

Project number: 5444
Reviewed by:

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)	7.51	7.26	7.42	7.23	7.38	7.15	7.28	7.38	7.49	7.44	7.53	7.42	7.50	7.04
	DO (mg/L)	7.8	7.7	7.6	7.3	7.5	7.5	7.8	7.6	7.8	7.6	7.7	7.8	7.7	7.0
	Conductivity (µmhos/cm)	313		308		296		317		318		315		334	
	Alkalinity (mg/L $CaCO_3$)	61				59				60					
	Hardness (mg/L $CaCO_3$)	88				92				92					
	Temperature (°C)	24.8	24.8	24.8	24.9	24.8	24.6	24.8	24.6	24.8	24.6	24.7	24.5	24.9	24.4
11.3%	pH (SU)	7.52	7.20	7.43	7.24	7.40	7.15	7.29	7.34	7.49	7.38	7.53	7.38	7.52	7.08
	DO (mg/L)	7.9	7.2	7.7	7.3	7.5	7.5	7.8	7.3	7.7	7.3	7.7	7.5	7.7	6.8
	Conductivity (µmhos/cm)	301		299		282		302		303		304		321	
	Temperature (°C)	24.8	24.7	25.0	24.8	24.7	24.4	24.8	24.6	24.8	24.6	24.7	24.5	24.9	24.4
22.6%	pH (SU)	7.52	7.19	7.43	7.24	7.39	7.11	7.29	7.28	7.48	7.39	7.54	7.37	7.50	7.02
	DO (mg/L)	7.9	7.3	7.8	7.2	7.5	7.5	7.9	7.2	7.7	7.4	7.7	7.4	7.7	6.8
	Conductivity (µmhos/cm)	284		280		264		281		284		283		299	
	Temperature (°C)	24.8	24.7	24.9	24.5	24.7	24.4	24.7	24.5	24.8	24.4	24.7	24.6	24.9	24.4
45.2%	pH (SU)	7.51	7.15	7.42	7.18	7.34	7.11	7.28	7.30	7.44	7.38	7.50	7.32	7.48	7.03
	DO (mg/L)	7.9	7.2	7.8	7.1	7.6	7.4	8.0	7.4	7.7	7.4	7.8	7.4	7.7	6.8
	Conductivity (µmhos/cm)	247		244		231		245		246		248		258	
	Temperature (°C)	24.8	24.9	24.9	24.4	24.7	24.3	24.7	24.5	24.9	24.3	24.8	24.6	24.9	24.5
72.6%	pH (SU)	7.47	7.19	7.38	7.13	7.29	7.12	7.23	7.27	7.39	7.30	7.49	7.36	7.43	7.03
	DO (mg/L)	8.0	7.1	7.8	7.1	7.6	7.4	8.0	7.3	7.7	7.4	7.8	7.5	7.6	6.8
	Conductivity (µmhos/cm)	204		200		189		206		198		197		207	
	Temperature (°C)	24.8	24.8	24.9	24.6	24.7	24.5	24.7	24.3	24.9	24.7	24.9	24.6	24.8	24.5
100%	pH (SU)	7.43	7.19	7.34	7.14	7.25	7.11	7.19	7.30	7.34	7.29	7.41	7.28	7.38	6.95
	DO (mg/L)	7.9	7.1	7.8	7.1	7.8	7.4	8.0	7.4	7.7	7.3	7.8	7.5	7.6	6.8
	Conductivity (µmhos/cm)	159		156		148		156		147		148		157	
	Alkalinity (mg/L $CaCO_3$)	52				44				54					
	Hardness (mg/L $CaCO_3$)	62				64				60					
	Temperature (°C)	24.8	24.8	24.9	24.6	24.8	24.5	24.7	24.7	25.0	24.3	24.9	24.4	24.8	24.6
100% Intake	pH (SU)	7.43	7.11	7.31	7.13	7.19	7.01	7.15	7.29	7.31	7.29	7.38	7.24	7.36	6.89
	DO (mg/L)	7.9	7.2	7.8	7.1	7.8	7.4	7.9	7.4	7.8	7.3	7.7	7.5	7.6	6.8
	Conductivity (µmhos/cm)	154		153		141		150		146		147		155	
	Alkalinity (mg/L $CaCO_3$)	57				52				50					
	Hardness (mg/L $CaCO_3$)	66				62				58					
	Temperature (°C)	24.8	25.0	24.8	24.7	25.0	24.6	24.7	24.4	25.0	24.5	24.9	24.4	24.9	24.4

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** **Date:** 05-12-09

Client: TVA / Sequoyah Nuclear Plant – UV-treated

Daily Chemistry:

		Day					
		0		1		2	
	Analyst	MLR	MLR	MLR	MLR	MLR	MLR
Concentration	Parameter						
CONTROL	pH (S.U.)	7.51	7.26	7.42	7.23	7.38	7.15
	DO (mg/L)	7.8	7.7	7.6	~~7.9~~ 7.3	7.5	7.5
	Conductivity (µmhos/cm)	313		308		296	
	Alkalinity (mg $CaCO_3$/L)	61				59	
	Hardness (mg $CaCO_3$/L)	88				92	
	Temperature (°C)	24.8	24.8	24.8	24.9	24.8	24.6
11.3%	pH (S.U.)	7.52	7.20	7.43	7.24	7.40	7.15
	DO (mg/L)	7.9	7.2	7.7	7.3	7.5	7.5
	Conductivity (µmhos/cm)	301		299		282	
	Temperature (°C)	24.8	24.7	25.0	24.8	24.7	24.4
22.6%	pH (S.U.)	7.52	7.19	7.43	7.24	7.39	7.11
	DO (mg/L)	7.9	7.3	7.8	7.2	7.5	7.5
	Conductivity (µmhos/cm)	284		280		264	
	Temperature (°C)	24.8	24.7	24.9	24.5	24.7	24.4
45.2%	pH (S.U.)	7.51	7.15	7.42	7.18	7.34	7.11
	DO (mg/L)	7.9	7.2	7.8	7.1	7.6	7.4
	Conductivity (µmhos/cm)	247		244		231	
	Temperature (°C)	24.8	24.9	24.9	24.4	24.7	24.3
72.6%	pH (S.U.)	7.47	7.19	7.38	7.13	7.29	7.12
	DO (mg/L)	8.0	7.1	7.8	7.1	7.6	7.4
	Conductivity (µmhos/cm)	204		200		189	
	Temperature (°C)	24.8	24.8	24.9	24.6	24.7	24.5
100%	pH (S.U.)	7.43	7.19	7.34	7.14	7.25	7.11
	DO (mg/L)	7.9	7.1	7.8	7.1	7.8	7.4
	Conductivity (µmhos/cm)	159		156		148	
	Alkalinity (mg $CaCO_3$/L)	52				44	
	Hardness (mg $CaCO_3$/L)	62				64	
	TR chlorine (mg/L)	<0.10				<0.10	
	Temperature (°C)	24.8	24.8	24.9	24.6	24.8	24.5
100% Intake	pH (S.U.)	7.43	7.11	7.31	7.13	7.19	7.01
	DO (mg/L)	7.9	7.2	7.8	7.1	7.8	7.4
	Conductivity (µmhos/cm)	154		153		141	
	Alkalinity (mg $CaCO_3$/L)	51				52	
	Hardness (mg $CaCO_3$/L)	66				62	
	TR chlorine (mg/L)	<0.10				<0.10	
	Temperature (°C)	24.8	25.0	24.8	24.7	25.0	24.6
		Initial	Final	Initial	Final	Initial	Final

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas***
Client: TVA / Sequoyah Nuclear Plant – UV-treated

Date: 05-12-09

7.53 dilution

		Day							
		3		4		5		6	
	Analyst	KLL	LAB	LAB	BSC	BSC	MLM	MLM	MLM
Concentration	Parameter								
CONTROL	pH (S.U.)	7.28	7.38	7.49	7.44	~~7.43~~ 7.53	7.42	7.50	7.04
	DO (mg/L)	7.8	7.6	7.8	7.6	7.7	7.8	7.7	7.0
	Conductivity (µmhos/cm)	317		318		315		334	
	Alkalinity (mg $CaCO_3$/L)			60					
	Hardness (mg $CaCO_3$/L)			92					
	Temperature (°C)	24.8	24.6	24.8	24.6	24.7	24.5	24.9	24.4
11.3%	pH (S.U.)	7.29	7.34	7.49	7.38	7.53	7.38	7.52	7.08
	DO (mg/L)	7.8	7.3	7.7	7.3	7.7	7.5	7.7	6.8
	Conductivity (µmhos/cm)	302		303		304		321	
	Temperature (°C)	24.8	24.6	24.8	24.6	24.7	24.5	24.9	24.4
22.6%	pH (S.U.)	7.29	7.28	7.48	7.39	7.54	7.37	7.50	7.02
	DO (mg/L)	7.9	7.2	7.7	7.4	7.7	7.4	7.7	6.8
	Conductivity (µmhos/cm)	281		284		283		299	
	Temperature (°C)	24.7	24.5	24.8	24.4	24.7	24.6	24.9	24.4
45.2%	pH (S.U.)	7.28	7.30	7.44	7.38	7.50	7.32	7.48	7.03
	DO (mg/L)	8.0	7.4	7.7	7.4	7.8	7.4	7.7	6.8
	Conductivity (µmhos/cm)	245		246		248		258	
	Temperature (°C)	24.7	24.5	24.9	24.3	24.8	24.6	24.9	24.5
72.6%	pH (S.U.)	7.23	7.27	7.39	7.30	7.49	7.36	7.43	7.03
	DO (mg/L)	8.0	7.3	7.7	7.4	7.8	7.5	7.6	6.8
	Conductivity (µmhos/cm)	206		198		~~206~~ 197		207	
	Temperature (°C)	24.7	24.3	24.9	24.7	24.9	24.6	24.8	24.5
100%	pH (S.U.)	7.19	7.30	7.34	7.29	7.41	7.28	7.38	6.95
	DO (mg/L)	8.0	7.4	7.7	7.3	7.8	7.5	7.6	6.8
	Conductivity (µmhos/cm)	156		147		148		157	
	Alkalinity (mg $CaCO_3$/L)			54					
	Hardness (mg $CaCO_3$/L)			60					
	TR Chlorine (mg/L)			<0.10					
	Temperature (°C)	24.7	24.7	25.0	24.3	24.9	24.4	24.8	24.6
100% Intake	pH (S.U.)	7.15	7.29	7.31	7.29	7.38	7.24	7.36	6.89
	DO (mg/L)	7.9	7.4	7.8	7.3	7.7	7.5	7.6	6.8
	Conductivity (µmhos/cm)	150		146		147		155	
	Alkalinity (mg $CaCO_3$/L)			50					
	Hardness (mg $CaCO_3$/L)			58					
	TR chlorine (mg/L)			<0.10					
	Temperature (°C)	24.7	24.4	25.0	24.5	24.9	24.4	24.9	24.4
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

ETS
Environmental Testing Solutions, Inc.

-50.5%

Total Residual Chlorine
(Orion Electrode Method, Orion 97-70)

Matrix: Water, RL = 0.10 mg/L
Meter: Accumet Model AR25 pH/Ion Meter

Analyst	MLM	Iodide reagent:	INR 337
Date analyzed	05-12-09	Acid reagent:	INR 330

Calibration:

	0.10 mg/L	1.00 mg/L
Reference standard number	INSS 673	INSS 673

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

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%)
INSS 673	0.50	0.506	~~1.012~~ 101.2%

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
090512.01	Foxwood Hills	no color, clear, no particles	S <0.000425	
↓	Duplicate		D <0.0000712	MLM

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	Blank (should be = < 0.10 mg/L)		<0.0213
090512.02	Hercules	no color, cloudy, no particles	0.000607
090511.02	~~Sequoia~~ (SQN - intake)	no color, cloudy, particles	0.00290
090511.01	~~Sequ~~ SQN -101	no color, cloudy, no particles	<0.00197
			MLM

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%)
INSS 673	0.50	0.491	98.2%

Reviewed by	[illegible]
Date reviewed	05-12-09

-49.0%

ETS
Environmental Testing Solutions, Inc.

Total Residual Chlorine
(Orion Electrode Method, Orion 97-70)

Matrix: Water, RL = 0.10 mg/L
Meter: Accumet Model AR25 pH/Ion Meter

Analyst	MLr	Iodide reagent:	InR 337
Date analyzed	05-14-09	Acid reagent:	InR 330

Calibration:

	0.10 mg/L	1.00 mg/L
Reference standard number	Inss 673	Inss 673

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

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%)
Inss 673	0.50	0.464	92.8%

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
090514.02	Foxwood Hills (#2)	no color, clear, particles	S <0.00151	
↓	Duplicate		D <0.000290	MLr

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	Blank (should be = < 0.10 mg/L)		<0.0277
090514.04	Harris E & E	no color, cloudy, particles	0.0000939
090514.01	Hercules (Sample 3)	no color, cloudy, particles	<0.000263
090513.10	Marshall WWTP	no color, clear, particles	0.00331
090514.03	McQuire 001	no color, clear, particles	<0.00726
090513.08	SQN - 101	no color, cloudy, particles	<0.00328
090513.09	SQN - Intake	no color, cloudy, particles	<0.00443
			MLr

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%)
Inss 673	0.50	0.469	93.8%

Reviewed by [illegible]
Date reviewed 05-15-09

-49.0%

ETS
Environmental Testing Solutions, Inc.

Total Residual Chlorine
(Orion Electrode Method, Orion 97-70)

Matrix: Water, RL = 0.10 mg/L
Meter: Accumet Model AR25 pH/Ion Meter

Analyst	UAB
Date analyzed	05-16-09

Iodide reagent:	INR337
Acid reagent:	INR330

Calibration:

	0.10 mg/L	1.00 mg/L
Reference standard number	INSS1673	INSS1673

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

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%)
INSS1673	0.50	0.507	101.4%

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
090515.01	B.R Parkway	clear, pale tan	S <0.000229	
↓	Duplicate		D <0.000113	UB

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	Blank (should be = < 0.10 mg/L)		<0.0129
090516.04	Raleigh CC	clear, no color	0.00344
090516.01	Scarlette Acres	slightly cloudy w/part, grey	<0.00156
090516.05	Scotland Neck	slightly cloudy, pale tan	<0.000168
090516.02	~~Dallate~~ Dallas WWTP	clear w/particles, pale tan	<0.0000164
090516.03	Enfield WWTP	cloudy, pale tan	<0.000167
090516.06	Foxwood Hills	clear, no color	<0.00000384
090515.03	SQN-intake-TOX	clear w/particles, pale tan	<0.0149
090515.02 DUP	SQN-101-~~TOX #1~~ CONTAINER #1	clear, pale tan	<0.00571
090515.02	SQN-101-~~TOX #2~~ INTAKE CONTAINER #2	clear, pale tan	<0.00261

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%)
~~INSS5~~ INSS1673	0.50	0.460	92.0%

Reviewed by	KGL
Date reviewed	05-17-09

ETS Environmental Testing Solutions, Inc.

Alkalinity
(SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	BSC	Time initiated	1154
Date analyzed	05-10-09	Time completed	1445

Titrate samples to pH = 4.50 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_2SO_4 = (5 ml Na_2CO_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
4.5	INR329	INSS653	0.0	11.7	11.7	0.0214	10.7

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%)
INSS 654	100	100	11.7	20.6	8.9	10.7	95	95%

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%)
05-07-09B	MHS H_2O	100	20.6	26.3	5.7	10.7	S 61	
↓	Duplicate (B)	↓	26.3	32.2	5.9	↓	D 63	3.2%

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)
INSS654	50	100	26.3	37.0	10.7	10.7	110

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%)
63	47	94%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
05-09-09A	MHS H_2O	100	37.0	42.7	5.7	10.7	61
05-09-09B	↓	↓	42.7	48.4	5.7	↓	61
05-08-09	SSW	↓	0.0	2.9	2.9	↓	~~3.1~~ 31
05-04-09	↓	↓	2.9	6.0	3.1	↓	33
05-05-09A	MHS H_2O	↓	6.0	12.0	6.0	↓	64
05-05-09B	↓	↓	12.0	17.7	5.7	↓	61
05-07-09A	↓	↓	17.7	23.5	5.8	↓	62
04-28-09	↓	↓	23.5	29.5	6.0	↓	64
090507.04	Washington	25	29.5	34.0	4.5 (4)	↓	190

Reviewed by: [illegible] Date reviewed: 05-10-09

ETS Environmental Testing Solutions, Inc.

Alkalinity
(SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	BSC
Date analyzed	~~05-09 BSC~~ BSC 05-10-09

Titrate samples to pH = 4.50 S.U.

Time initiated	
Time completed	

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_2SO_4 = (5 ml Na_2CO_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

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%)
INSS654	100	100	34.0	43.4	9.4	10.7	~~100~~ BSC 101	~~100%~~ BSC 101%

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%)
05.05.09A	SALT SW	100	~~43.4~~ 0.0 BSC	10.7	10.7	10.7	S 114 = 110	
↓	Duplicate (B)	↓	10.7	21.3	10.6	↓	D 113 = 110	~~0.9%~~ 0%

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)
INSS654	50	100	10.7	26.0	15.3	10.7	160

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%)
~~110~~ BSC 110	50	100%

Sample measurements:

Sample number	Sample ID		Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
05.09.09	SALTSW		100	26.0	35.5	9.5	10.7	100
05.05.09A	↓			35.5	45.9	10.4		110
090505.06	Apex	1		0.0	7.6	7.6		81
090507.09	↓	2		7.6	14.7	7.1		76
090509.02	↓	3		14.7	21.1	6.4		68
090505.07	South Cary	1		21.1	28.0	6.9		74
090507.10	↓	2		28.0	33.6	5.6		60
090509.04	↓	3	↓	33.6	38.8	5.2	↓	56
090505.02	CORR-A1	1	25	38.8	42.6	3.8 (4)		~~44~~ BSC 160

Reviewed by: KDR

Date reviewed: 05.10.09

ETS Environmental Testing Solutions, Inc.

Alkalinity
(SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst: BSL
Date analyzed: 05-10-09

Titrate samples to pH = 4.50 S.U.

Time initiated:
Time completed:

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_2SO_4 = (5 ml Na_2CO_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

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%)
INSS1654	100	100	0.0	9.4	9.4	10.7	101	101%

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%)
090507.02	CURR-A1 2	25	~~9.4~~	~~11.2~~	~~1.8 (4)~~	~~10.7~~	S ~~77~~	~~[illegible]~~ good!
↓	Duplicate (B)	25	11.2	~~13.7~~ 13.7	~~2.5 (4)~~ 2.5 (4) BSL	↓	D ~~110~~ BSL 107	110 0%

13.7 16.2 2.5 (4) 107 = 110

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)
INSS1654	~~50~~ 25 BSL	200	~~10.2~~ BSL (13.1)	20.9	~~4.7 (4)~~ BSL (4)	10.7	~~201~~ BSL 310

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%)
110	200	100%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
090509.06	CURR-A1 3	25	20.9	24.9	4.0 (4)	10.7	170
090505.01	Chattanooga 1	25	24.9	27.3	2.4 (4)	↓	100
090507.01	↓ 2	↓	27.3	30.5	3.2 (4)	↓	140
090509.05	↓ 3	↓	30.5	33.6	3.1 (4)	↓	130
04-27-09	MHS-W 1	100	33.6	39.5	5.9	↓	63
04-28-09	2	↓	39.5	~~45.0~~	5.5	↓	59
05-05-09A	↓ 3	↓	(0.7) ~~45.0~~	~~[illegible]~~ (6.3) ~~[illegible]~~	(5.6) ~~5.7~~ BSL	↓	~~60~~ BSL (60)
05-07-09A	↓ 4	↓	6.3	12.0	5.7	↓	~~60~~ BSL (61)
090504.01	TA BRF 1	25	12.0	14.2	2.2 (4)	↓	94

Reviewed by: KOL

Date reviewed: 05-10-09

ETS Environmental Testing Solutions, Inc.

Alkalinity
(SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst: BSL
Date analyzed: 05-10-09

Titrate samples to pH = 4.50 S.U.

Time initiated:
Time completed:

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_2SO_4 = (5 ml Na_2CO_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

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%)
INSS 654	100	100	14.2	23.5	9.3	10.7	100	100%

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%)
090506.24	TVA BLF 2	25	23.5	25.8	2.3 (4)	10.7	S 98	
↓	Duplicate (B)	25	25.8	28.2	2.4 (4)	↓	D 103	5.0%

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)
INSS 654	200	25	25.8	32.8	7.0 (4)	10.7	300

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%)
~~103~~ BSL 100	200	100%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
090508.08	TVA BLF 3	25	32.8	35.3	2.5 (4)	10.7	110 = 107
090504.02	TVA BFR INT 1	↓	35.3	37.9	2.6 (4)	↓	110 = 111
090506.25	↓ 2	↓	37.9	40.5	2.6 (4)	↓	110 = 111
090508.09	↓ 3	↓	40.5	43.1	2.6 (4)	↓	110 = 111
090504.03	TVA-WBN 101 1	50	43.1	46.0	2.9 (2)	↓	62
090506.26	↓ 2	↓	46.0	49.1	3.1 (2)	↓	66
090508.10	↓ 3	↓	0.0	3.0	3.0 (2)	↓	64
090504.04	TVA WBN 101 INT 1	↓	3.0	5.7	2.7 (2)	↓	58
090506.27	↓ 2	↓	5.7	8.4	2.7 (2)	—	58

Reviewed by: KCN

Date reviewed: 05-10-09

ETS Environmental Testing Solutions, Inc.

Alkalinity
(SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst: BSC

Date analyzed: 05-10-09

Time initiated:

Time completed:

Titrate samples to pH = 4.50 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_2SO_4 = (5 ml Na_2CO_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

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%)
INSS1654	100	100	8.4	17.6	9.2	10.7	98	98%

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%)
090508.11	TVA WBN 1U1NT3	~~50~~	~~17.6~~	~~20.6~~	~~3.0 (2)~~	~~10.7~~	S ~~64~~	~~out of range~~
↓	Duplicate (B)	50	20.6	23.2	2.6 (2)	↓	D 56	3.5%
			23.2	25.9	2.7 (2)		58	

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)
INSS1654	100	50	~~20.6~~ 25.9	30.5	4.6 (2)	10.7	98

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%)
58	40	100%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
090504.05	TVA-WBN 112 1	50	30.5	35.1	4.6 (2)	10.7	98
090506.28	↓ 2		35.1	39.5	4.4 (2)		94
090508.12	↓ 3		39.5	43.3	3.8 (2)		81
090504.06	TVA WBN 112NT 1		43.3	44.3	1.0 (2)		21
090506.29	↓ 2		44.3	45.3	1.0 (2)		21
090508.13	↓ 3		45.3	46.2	0.9 (2)		19
090504.05	TVA WBN UU 1	112	46.2	00-70.9	4.7 (2)		101 = 100
090506.28	↓ 2		0.9	5.3	4.4 (2)		94
090508.12	↓ 3		5.3	9.1	3.8 (2)	—	81

Reviewed by: KDr

Date reviewed: 05-10-09

ETS Environmental Testing Solutions, Inc.

Alkalinity
(SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst: BSC

Date analyzed: ~~10~~ BSC 05-10-09

Titrate samples to pH = 4.50 S.U.

Time initiated:

Time completed:

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_2SO_4 = (5 ml Na_2CO_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

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%)
INS5654	100	100	9.1	18.4	9.3	10.7	100	100%

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%)
090504.06	TVA WBN 112 INT 1	50	18.4	20.0	1.6 (2)	10.7	S 34	
↓	Duplicate (B)	50	20.0	21.6	1.6 (2)	↓	D 34	0%

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)
INS5654	100	50	20.0	26.0	6.0 (2)	10.7	130

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%)
34	96	96%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
090506.29	TVA WBN 112 INTW 2	50	26.0	27.0	1.0 (2)	10.7	21
090508.13	↓ 3	50	27.0	28.2	1.2 (2)		26
090507.05	ERM - 001	50	28.2	30.7	2.5 (2)		54
090507.06	ERM up 001	~~50~~ 100	30.7	38.4	7.7		82
090507.07	ERM 002	25	38.4	43.5	5.1 (4)		220
090507.08	ERM up 002	100	43.5	19.2	10.6		110
05-07-09B	MHS WV5	100	23.3	28.8	5.5		59

Reviewed by: Kbn

Date reviewed: 05-10-09

ETS Environmental Testing Solutions, Inc.

Alkalinity
(SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst: BSL
Date analyzed: 05-17-09

Titrate samples to pH = 4.50 S.U.

Time initiated: 1225
Time completed: 1351

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_2SO_4 = (5 ml Na_2CO_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
5.0	INR329	INSS653	0.1	11.6	11.5	0.0217	10.9

Blk Correction: 0.0 → 0.1

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%)
INSS654	100	100	11.6	20.3	8.7	10.9	95	95%

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%)
05-12-09	MHS H_2O	100	20.3	25.8	5.5	10.9	S 60	
↓	Duplicate (B)	↓	25.8	31.3	5.5	↓	D 60	0%

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)
INSS654	50	100	25.8	36.0	10.2	10.9	110

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%)
60	~~60~~ 50	100%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
05-13-09	MHS H_2O	100	36.0	41.5	5.5	10.9	60
05-16-09	↓		41.5	47.1	5.6		61
05-09-09 A	MHS UV 1		~~47.1~~ 0.0	5.6	5.6		61
05-09-09 B	↓ 2		5.6	11.0	5.4		59
05-12-09	↓ 3		11.0	16.5	5.5		60
05-12-09	SaltSW		16.5	26.1	9.6		100
~~05-13-09~~	~~↓~~		~~26.1~~	~~35.9~~	~~9.8~~		~~110~~
~~09D513.10~~	~~MARSHCELL WWTP~~		~~35.9~~	~~38.1~~	~~2.2~~		~~24~~
09D512.01	RAYWOOD 1	—	38.1	41.6	3.5	—	38

Reviewed by: [illegible]

Date reviewed: 05-17-09

ETS Environmental Testing Solutions, Inc.

Alkalinity
(SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	BSC
Date analyzed	05-17-09

Titrate samples to pH = 4.50 S.U.

Time initiated	
Time completed	BSC

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_2SO_4 = (5 ml Na_2CO_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
							BSC

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%)
INS5654	100	100	0.0	9.4	9.4	10.9	102	102%

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%)
090514.02	Foxwood 2	100	9.4	14.2	4.8	10.9	S 52	
↓	Duplicate (B)	↓	14.2	19.0	4.8	↓	D 52	0%

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)
INS5654	50	100	14.2	23.1	8.9	10.9	~~100~~ 97

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%)
52	~~48~~ 45	~~96%~~ 90%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
090516.06	Foxwood 3	100	23.1	27.1	4.0	10.9	44
090511.01	TVASGN 101 1	50	27.1	30.1	3.0 (2)	↓	65
090513.08	↓ 2	↓	30.1	32.7	2.6 (2)	↓	57
090515.02	↓ 3	↓	32.7	35.0	2.3 (2)	↓	50
090511.02	TVASGN INT 1	↓	35.0	37.6	2.6 (2)	↓	57
090513.09	↓ 2	↓	37.6	40.1	2.5 (2)	↓	54
090515.03	↓ 3	↓	40.1	42.5	2.4 (2)	↓	52
090511.01	TVASGN UV 1	↓	42.5	44.9	2.4 (2)	↓	52
090513.08	↓ 2	↓	44.9	46.9	2.0 (2)	↓	44

Reviewed by: BSC

Date reviewed: 05-17-09

ETS Environmental Testing Solutions, Inc.

Alkalinity
(SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	BSL
Date analyzed	05-17-09

Titrate samples to pH = 4.50 S.U.

Time initiated	
Time completed	BSL

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_2SO_4 = (5 ml Na_2CO_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
							BSL

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%)
INSS1654	100	100	0.0	9.2	9.2	10.9	100	100%

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%)
090515.02	TVA SQn UV 3	50	9.2	11.7	2.5 (2)	10.9	S 54	
↓	Duplicate (B)	↓	11.7	14.3	2.6 (2)	↓	D 57	5.4%

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)
INSS1654	100	50	11.7	18.7	7.0 (2)	10.9	150

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%)
57	93	93%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
090511.02	TVA SQnINTUV 1	50	18.7	21.3	2.6 (2)	10.9	57
090513.09	↓ 2	↓	21.3	23.7	2.4 (2)	↓	52
090515.03	↓ 3	↓	23.7	26.0	2.3 (2)	↓	50
090506.20	TVA WCF 001	↓	26.0	28.6	2.6 (2)	↓	57
090506.21	↓ up	↓	28.6	32.0	3.4 (2)	↓	74
090509.16	Hercules 1	25	32.0	35.2	3.2 (4)	↓	140
090512.02	↓ 2	↓	35.2	38.7	3.5 (4)	↓	150
090514.01	↓ 3	↓	38.7	42.0	3.3 (4)	↓	140
							BSL

Reviewed by: KGL

Date reviewed: 05-17-09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst	ASL	Time initiated	0904
Date analyzed	05-10-09	Time completed	1132

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
INR332	INS5571	0.0	10.0	10.0	0.020	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%)
INS5656	40	50	10.0	12.0	2.0	20.0	40.0	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
05-09-09B	MHS H2O	50	12.0	16.6	4.6	20.0	S 92	
↓	Duplicate (B)	↓	16.6	21.3	4.7	↓	D 94	2.2%

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)
INS5656	40	50	16.6	23.5	6.9	20.0	140

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%)
94	46	115%

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)	100	23.5	23.5	0.0	20.0	ND
05-09-09A	MHS H2O	↓	23.5	28.1	4.6	↓	92
05-09-09B	↓	↓	28.1	32.5	4.4	↓	88
05/08-09	SSW	↓	32.5	34.7	2.2	↓	44
~~05-04-09~~ *	↓	↓	34.7	39.2	4.5	↓	90
05-05-09A	MHS H2O	↓	39.2	43.9	4.7	↓	94
05-05-09B	↓	↓	43.9	48.4	4.5	↓	90
05-07-09A	↓	↓	0.0	4.7	4.7	↓	94
~~05-07-09B~~ 04-29-09	↓	↓	~~4.7~~ 10.6	~~10.6~~ 15.2	4.6	↓	92
090507.04	Washington	↓	~~15.2~~ 11.2	23.0	5.8	↓	120
04-04-09 + SSW		50	0.0	2.1	2.1		(42)

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: KGW Date reviewed 05-10-09

re-Checked. used MHS-05-05-09A for initial result.

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst	BSC	Time initiated	
Date analyzed	05-10-09	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

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%)
INS5656	40	50	23.0	25.1	2.1	20.0	42	105%

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
090505.06	Apex 1	50	25.1	28.4	3.3	20.0	S 66	
↓	Duplicate (B)	↓	28.4	31.7	3.3	↓	D 66	~~10~~ 0%

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)
INS5656	210	50	28.4	33.7	5.3	20.0	110

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%)
66	44	110%

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)						
090507.09	Apex 2	~~29~~ BSC 50	33.7	36.8	3.1	20.0	62
090509.02	↓ 3		36.8	39.7	2.9		58
090507.07	South Cary 1		39.7	42.4	2.7		54
090507.10	2		42.4	44.9	2.5		50
090509.04	↓ 3		44.9	47.4	2.5		50
04-27-09	MHS VV 1		0.0	4.5	4.5		90
04-28-09	2		4.5	9.2	4.7		94
05-05-09A	3		9.2	13.7	4.5		90
05-07-09 A	↓ 4	—	13.7	18.2	4.5	—	90

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: KG Date reviewed 05-10-09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst	RSC	Time initiated	
Date analyzed	05-10-09	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

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%)
INS5656	40	50	18.2	20.2	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
090505.02	CURR AL 1	25	~~20.2~~	~~21.9~~	~~1.7~~	~~20.0 (2)~~	S ~~94~~ 190	
↓	Duplicate (B)	↓	24.9	29.2	4.3 (2)	↓	D 170	0%
			29.2	33.5	4.3 (2)		170	

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)
INS5656	80 ~~80.0~~	25	~~24.9~~ 29.2	35.4	6.2 (2)	20.0	250

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%)
170	80	100%

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)						
090507.02	CURR AL 2	25	35.4	38.2	2.8 (2)	20.0	110
090509.06	1 3	25	38.2	42.6	4.4 (2)		180
090505.01	Chattanooga 1	25	42.6	45.9	3.3 (2)		130
090507.01	2	25	45.9	49.8	3.9 (2)		160
090509.05	3	25	0.0	3.7	3.7 (2)		150
090504.01	T/A BRF 1	25	3.7	8.5	4.8 (2)		190 = 192
090506.24	2		8.5	13.4	4.9 (2)		200 = 196
090508.08	3		13.4	18.1	4.7 (2)		190 = 188
090504.02	T/A BRF lot 1	↓	18.1	21.8	3.7 (2)	↓	150 = 148

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: KRL Date reviewed 05.10.09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst: BSL

Date analyzed: 05-10-09

Time initiated:

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

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%)
INS51056	40	50	21.8	23.8	2.0	20.0	40.0	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
090506.25	T/A BRF Int 2	25	23.8	27.3	3.5 (2)	20.0	S ~~7~~ BSL 140	
↓	Duplicate (B)	25	27.3	30.7	3.4 (2)	↓	(140) = 136 ~~140~~ BSL	~~2.9%~~ ~~0.7%~~ BSL 0.1.

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)
INS51056	80	25	27.3	32.7	5.4 (2)	20.0	220

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%)
140	80	100%

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)						
090508.09	T/A BRF Int 3	25	32.7	36.2	3.5 (2)	20.0	140
090504.03	T/A WBN 101 1	50	36.2	39.9	3.7 ~~(2)~~ BSL		74
090506.26	↓ 2	↓	39.9	43.6	3.7 ~~(2)~~ BSL		74
090508.10	↓ 3		43.6	47.5	3.9 ~~(2)~~ BSL		78
090504.04	T/A WBN101 Int 1		~~47.5~~ = 50.0	0.0 = 1.1	3.6		72
090506.27	↓ 2		1.1	4.5	3.4		68
090508.11	↓ 3	↓	4.5	8.1	3.6		72
090504.05	T/A WBN112 VV 1	25	8.1	10.9	2.8 (2)		110 = 112
090506.28	↓ 2	↓	10.9	13.5	2.6 (2)	↓	100 = 104

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: [illegible] Date reviewed: 05.10.09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst	BSC	Time initiated	
Date analyzed	05-10-09	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

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%)
INS6656	40	50	13.5	15.5	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
090508.12	T/A WBN112NV3	25	15.5	17.7	2.2(2)	20.0	S 88	
↓	Duplicate (B)	25	17.7	20.0	2.3(2)	↓	D 92	4.4%

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)
INS6656	80	25	~~20.0~~ 17.7	21.9	4.2(2)	20.0	170

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%)
92	78	98%

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)						
090504.06	T/A WBN112INT 1	25	21.9	22.8	0.9(2)	~~2.0~~ 20.0	36
090506.29	↓ 2	↓	22.8	23.6	0.8 (2)	↓	32
090508.13	↓ 3	↓	23.6	24.2	0.6 (2)	↓	24
090504.05	T/A WBN112~~UUBX~~ 1	↓	24.2	27.0	2.8 (2)	↓	110 = 112
090506.28	↓ 2	↓	27.0	29.6	2.6 (2)	↓	100 = 104
090508.12	↓ 3	↓	29.6	31.9	2.3 (2)	↓	92
090504.06	T/A WBN112INTUV 1	↓	31.9	32.8	0.9 (2)	↓	36
090506.29	↓ 2	↓	32.8	33.5	0.7 (2)	↓	28
090508.13	↓ 3	↓	33.5	34.2	0.7 (2)	↓	28

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: KEL Date reviewed 05-10-09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst	BSC	Time initiated	
Date analyzed	05-10-09	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

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%)
INSS6654	40	50	34.2	36.2	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
090507.05	ERM 001	25	36.2	39.9	3.7 (L)	20.0	S 150 → 148	
↓	Duplicate (B)	25	39.9	43.6	3.7 (L)	↓	D 150 → 148	0%

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)
INSS6656	80	25	39.9	45.4	5.5 (L)	20.0	220

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%)
150	70	88%

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)						
090507.06	ERM up 001	50	41.4	50.0	4.6	20.0	92
090507.07	ERM 002	10	18.1	28.0	9.9 (S)	↓	990
090507.08	ERM up002	50	28.0	33.8	5.8	↓	120
05-07-09B	MHS VVS	↓	33.8	38.2	4.4	↓	88

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: KGL Date reviewed 05-10-09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst	BSL	Time initiated	0959
Date analyzed	05-17-09	Time completed	1103

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
INR332	INSS 571	0.0	10.0	10.0	0.020	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%)
INSS 656	40	50	10.0	12.0	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
05-12-09	MHS H2O	50	~~12.0~~ 17.1 BSL	~~17.1~~ 21.5 BSL	~~5.1~~ 4.4 BSL	20.0	S 88	[illegible]
↓	Duplicate (B)	↓	21.5	26.1	4.6	↓	D 92	4.4%

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)
INSS 656	~~50~~ BSL 40	50	21.5	28.1	6.6	20.0	130

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%)
92	38	95%

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	28.1	28.1	0.0	20.0	ND
05.13.09	MHS H2O		28.1	32.9	4.8		96
05.16.09	↓		32.9	37.4	4.5		90
05-09-09A	MHS UV 1		37.4	~~41.8~~ 41.8 BSL	4.4		88
05-09-09B	↓ 2		41.8	46.4	4.6		92
05.12-09	↓ 3		0.0	4.6	4.6		~~96~~ 92
09 05 12.01	Foxwood 1		4.6	6.0	1.4		28
09 05 14.02	↓ 2		6.0	8.0	2.0		40
09 05 16.06	↓ 3		8.0	10.1	2.1		42
09 05 3.10	Marshall WWTP	↓	10.1	12.8	2.7	↓	54

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: TGL Date reviewed 051709

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst	BSC
Date analyzed	05-17-09

Time initiated	
Time completed	BSC

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
						BSC

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%)
INSS 6516	40	50	12.8	14.8	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
090511.01	TVA SQN 101 1	50	14.8	18.0	3.2	20.0	S 64	
↓	Duplicate (B)	↓	18.0	21.2	3.2	↓	D 64	0%

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)
INSS 6516	40	50	18.0	23.2	5.2	20.0	100

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%)
64	36	90%

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)						↓
090513.08	TVA SQN 101 2	50	23.2	26.3	3.1	20.0	62
090515.02	1 3		26.3	29.3	3.0		60
090511.02	TVA SQN INT 1		29.3	32.5	3.2		64
090513.09	2		32.5	35.7	3.2		64
090515.03	↓ 3		35.7	38.7	3.0		60
090511.01	TVA SQN 101 UV 1		38.7	41.8	3.1		62
~~090513.08~~	2		~~41.8~~	~~45.0~~	~~3.2~~		~~64~~
~~090515.02~~	↓ 3		~~45.0~~	~~48.0~~	~~3.0~~		~~60~~
090511.02	TVA SQN UV INT 1	↓	0.0	3.3	3.3	↓	66

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: KOL Date reviewed 05-17-09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst	BSL	Time initiated	
Date analyzed	05-17-09	Time completed	BSL

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
						BSL

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%)
INSS656	40	50	3.3	5.4	2.1	20.0	42	105%

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
090513.09	TVA SGW INFLUV 2	50	5.4	8.5	3.1	20.0	S 62	
↓	Duplicate (B)	↓	8.5	11.7	3.2	↓	D 64	3.2%

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)
INSS656	40	50	8.5	13.7	5.2	20.0	100

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%)
64	36	90%

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)						
090515.03	TVA SGW INFLUV 3	50	13.7	16.6	2.9	20.0	58
~~050~~ 090506.20	TVA WCF001	25	16.6	21.9	5.3 (2)	↓	210 = 212
090506.21	↓ up	↓	21.9	23.7	1.8 (2)	↓	72
							BSL

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: KDL Date reviewed 05-17-09

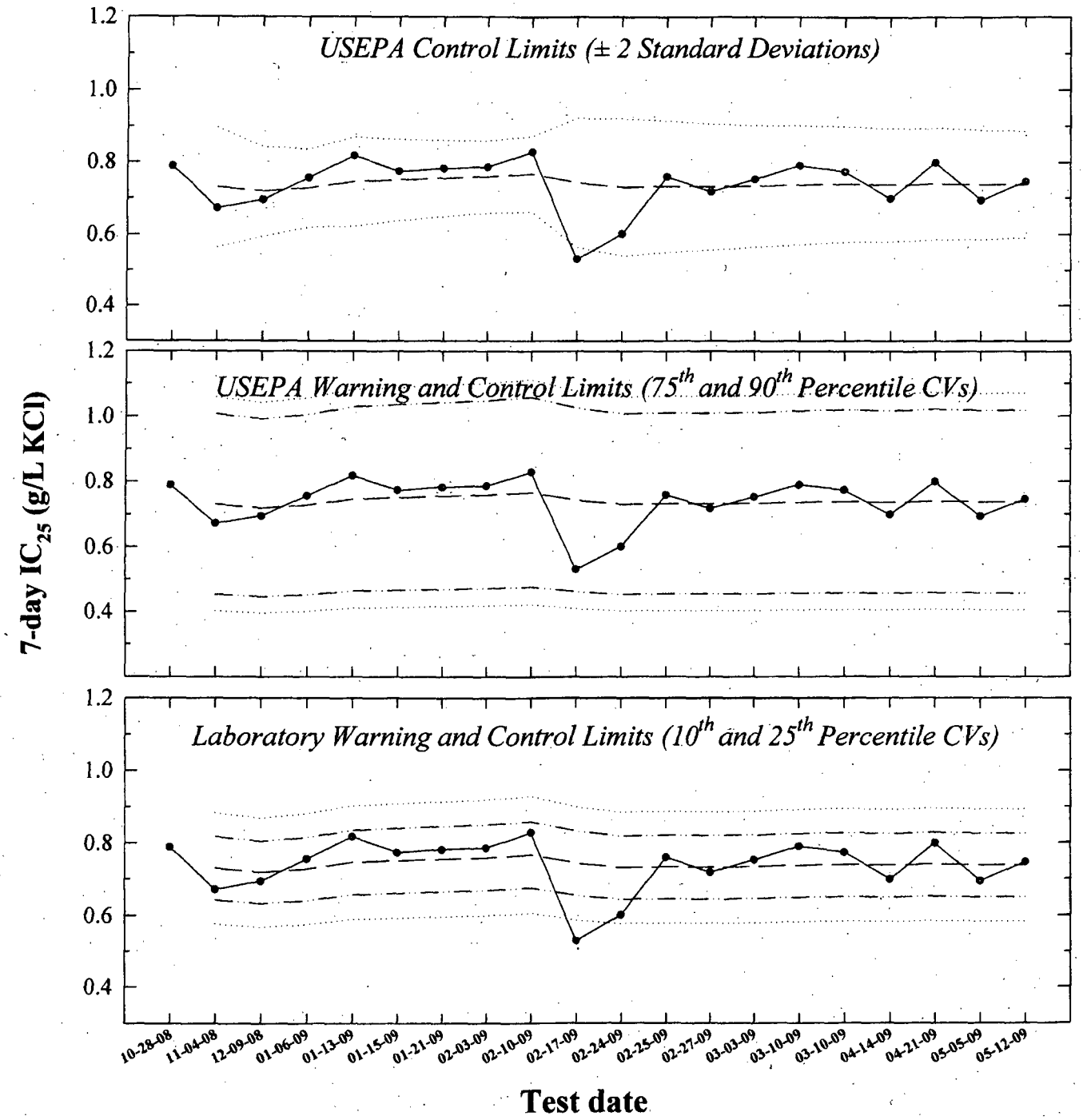
Sequoyah Nuclear Plant Biomonitoring
May 12-19, 2009

Appendix D

Reference Toxicant Test and
Control Chart

Environmental Testing Solutions, Inc.

Pimephales promelas
Chronic Reference Toxicant Control Chart
Organism Source: Aquatox, Inc.



—•— **7-day IC_{25}** = 25% inhibition concentration. An estimation of the concentration of potassium chloride that would cause a 25% reduction in *Pimephales* growth for the test population.

— — **Central Tendency** (mean IC_{25})

— · — **Warning Limits** (mean $IC_{25} \pm S_{A.10}$ or $S_{A.75}$)

..... **Control Limits** (mean $IC_{25} \pm S_{A.25}$, $S_{A.90}$, or 2 Standard Deviations)

ETS
Environmental Testing Solutions, Inc.

Pimephales promelas
Chronic Reference Toxicant Control Chart

Test number	Test date	7-day IC_{25} (g/L KCl)	CT (g/L KCl)	S	State and USEPA Control Limits CT - 2S	CT + 2S	$S_{A.10}$	Laboratory Warning Limits CT - $S_{A.10}$	CT + $S_{A.10}$	$S_{A.25}$	Laboratory Control Limits CT - $S_{A.25}$	CT + $S_{A.25}$	$S_{A.75}$	USEPA Warning Limits CT - $S_{A.75}$	CT + $S_{A.75}$	$S_{A.90}$	USEPA Control Limits CT - $S_{A.90}$	CT + $S_{A.90}$	CV
1	10-28-08	0.79																	
2	11-04-08	0.67	0.73	0.08	0.56	0.90	0.09	0.64	0.82	0.15	0.58	0.88	0.28	0.45	1.01	0.33	0.40	1.06	0.11
3	12-09-08	0.69	0.72	0.06	0.59	0.84	0.09	0.63	0.80	0.15	0.57	0.87	0.27	0.45	0.99	0.32	0.39	1.04	0.09
4	01-06-09	0.76	0.73	0.05	0.62	0.84	0.09	0.64	0.81	0.15	0.57	0.88	0.28	0.45	1.00	0.33	0.40	1.05	0.07
5	01-13-09	0.82	0.75	0.06	0.62	0.87	0.09	0.66	0.83	0.16	0.59	0.90	0.28	0.46	1.03	0.34	0.41	1.08	0.08
6	01-15-09	0.77	0.75	0.06	0.64	0.86	0.09	0.66	0.84	0.16	0.59	0.91	0.29	0.47	1.04	0.34	0.41	1.09	0.08
7	01-21-09	0.78	0.75	0.05	0.65	0.86	0.09	0.66	0.85	0.16	0.60	0.91	0.29	0.47	1.04	0.34	0.42	1.09	0.07
8	02-03-09	0.79	0.76	0.05	0.66	0.86	0.09	0.67	0.85	0.16	0.60	0.92	0.29	0.47	1.05	0.34	0.42	1.10	0.07
9	02-10-09	0.83	0.77	0.05	0.66	0.87	0.09	0.67	0.86	0.16	0.61	0.93	0.29	0.48	1.06	0.34	0.42	1.11	0.07
10	02-17-09	0.53	0.74	0.09	0.56	0.92	0.09	0.65	0.83	0.16	0.59	0.90	0.28	0.46	1.02	0.33	0.41	1.08	0.12
11	02-24-09	0.60	0.73	0.10	0.54	0.92	0.09	0.64	0.82	0.15	0.58	0.88	0.28	0.45	1.01	0.33	0.40	1.06	0.13
12	02-25-09	0.76	0.73	0.09	0.55	0.91	0.09	0.64	0.82	0.15	0.58	0.89	0.28	0.45	1.01	0.33	0.40	1.06	0.12
13	02-27-09	0.72	0.73	0.09	0.56	0.91	0.09	0.64	0.82	0.15	0.58	0.88	0.28	0.45	1.01	0.33	0.40	1.06	0.12
14	03-03-09	0.75	0.73	0.08	0.56	0.90	0.09	0.64	0.82	0.15	0.58	0.89	0.28	0.45	1.01	0.33	0.40	1.06	0.11
15	03-10-09	0.79	0.74	0.08	0.57	0.90	0.09	0.65	0.82	0.15	0.58	0.89	0.28	0.46	1.02	0.33	0.41	1.07	0.11
16	03-10-09	0.77	0.74	0.08	0.58	0.90	0.09	0.65	0.83	0.16	0.58	0.89	0.28	0.46	1.02	0.33	0.41	1.07	0.11
17	04-14-09	0.70	0.74	0.08	0.58	0.89	0.09	0.65	0.82	0.15	0.58	0.89	0.28	0.46	1.02	0.33	0.40	1.07	0.11
18	04-21-09	0.80	0.74	0.08	0.59	0.89	0.09	0.65	0.83	0.16	0.58	0.90	0.28	0.46	1.02	0.33	0.41	1.07	0.10
19	05-05-09	0.69	0.74	0.08	0.59	0.89	0.09	0.65	0.83	0.15	0.58	0.89	0.28	0.46	1.02	0.33	0.41	1.07	0.10
20	05-12-09	0.75	0.74	0.07	0.59	0.89	0.09	0.65	0.83	0.15	0.58	0.89	0.28	0.46	1.02	0.33	0.41	1.07	0.10

Note: **7-d IC_{25}** = 7-day 25% inhibition concentration. An estimation of the concentration of potassium chloride that would cause a 25% reduction in Pimephales growth for the test population.

CT = Central tendency (mean IC_{25}).

S = Standard deviation of the IC_{25} values.

Laboratory Control and Warning Limits

Laboratory control and warning limits were established using the standard deviation of the IC_{25} values corresponding to the 10th and 25th percentile CVs. These ranges are more stringent than the control and warning limits recommended by USEPA for the test method and endpoint.

$S_{A.10}$ = Standard deviation corresponding to the 10th percentile CV. ($S_{A.10} = 0.12$)

$S_{A.25}$ = Standard deviation corresponding to the 25th percentile CV. ($S_{A.25} = 0.21$)

USEPA Control and Warning Limits

$S_{A.75}$ = Standard deviation corresponding to the 75th percentile CV. ($S_{A.75} = 0.38$)

$S_{A.90}$ = Standard deviation corresponding to the 90th percentile CV. ($S_{A.90} = 0.45$)

CV = Coefficient of variation of the IC_{25} values.

USEPA. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination Program. EPA-833-R-00-003. US Environmental Protection Agency, Cincinnati, OH.

Organisms obtained from Aquatox, Inc.

ETS Environmental Testing Solutions, Inc.

Precision of Endpoint Measurements

Pimephales promelas
Chronic Reference Toxicant Data

Test number	Test date	Control Survival (%)	Control Mean Growth (mg/larvae)	CT for Control Growth (mg/larvae)	CV (%)	CT for Control Growth CV (%)	MSD	PMSD (%)	CT for PMSD (%)
1	10-28-08	100	0.586		6.5		0.10	17.8	
2	11-04-08	97.5	0.643	0.614	2.5	4.5	0.12	18.7	18.2
3	12-09-08	100	0.522	0.583	2.4	3.8	0.05	10.0	15.5
4	01-06-09	100	0.644	0.599	3.2	3.6	0.09	13.3	14.9
5	01-13-09	97.5	0.556	0.590	9.7	4.9	0.06	11.2	14.2
6	01-15-09	100	0.707	0.610	6.5	5.1	0.09	13.3	14.1
7	01-21-09	97.5	0.594	0.607	4.9	5.1	0.07	11.5	13.7
8	02-03-09	100	0.671	0.615	8.4	5.5	0.06	9.6	13.2
9	02-10-09	100	0.591	0.613	5.1	5.5	0.09	15.7	13.5
10	02-17-09	100	0.804	0.632	3.3	5.2	0.06	6.8	12.8
11	02-24-09	100	0.744	0.642	2.5	5.0	0.10	13.0	12.8
12	02-25-09	100	0.659	0.643	8.2	5.3	0.07	11.1	12.7
13	02-27-09	100	0.578	0.638	6.8	5.4	0.08	13.1	12.7
14	03-03-09	100	0.664	0.640	8.1	5.6	0.08	12.3	12.7
15	03-10-09	100	0.661	0.642	6.8	5.7	0.09	12.9	12.7
16	03-10-09	100	0.696	0.645	8.8	5.9	0.09	12.6	12.7
17	04-14-09	100	0.671	0.646	10.3	6.1	0.08	11.4	12.6
18	04-21-09	100	0.642	0.646	8.3	6.2	0.07	11.2	12.5
19	05-05-09	100	0.805	0.655	7.9	6.3	0.07	8.4	12.3
20	05-12-09	100	0.717	0.658	7.0	6.4	0.06	8.9	12.1

Note:

CV = Coefficient of variation for control growth.
Lower CV bound determined by USEPA (10th percentile) = 3.5%.
Upper CV bound determined by USEPA (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%.
Upper PMSD bound determined by USEPA (90th percentile) = 30%.

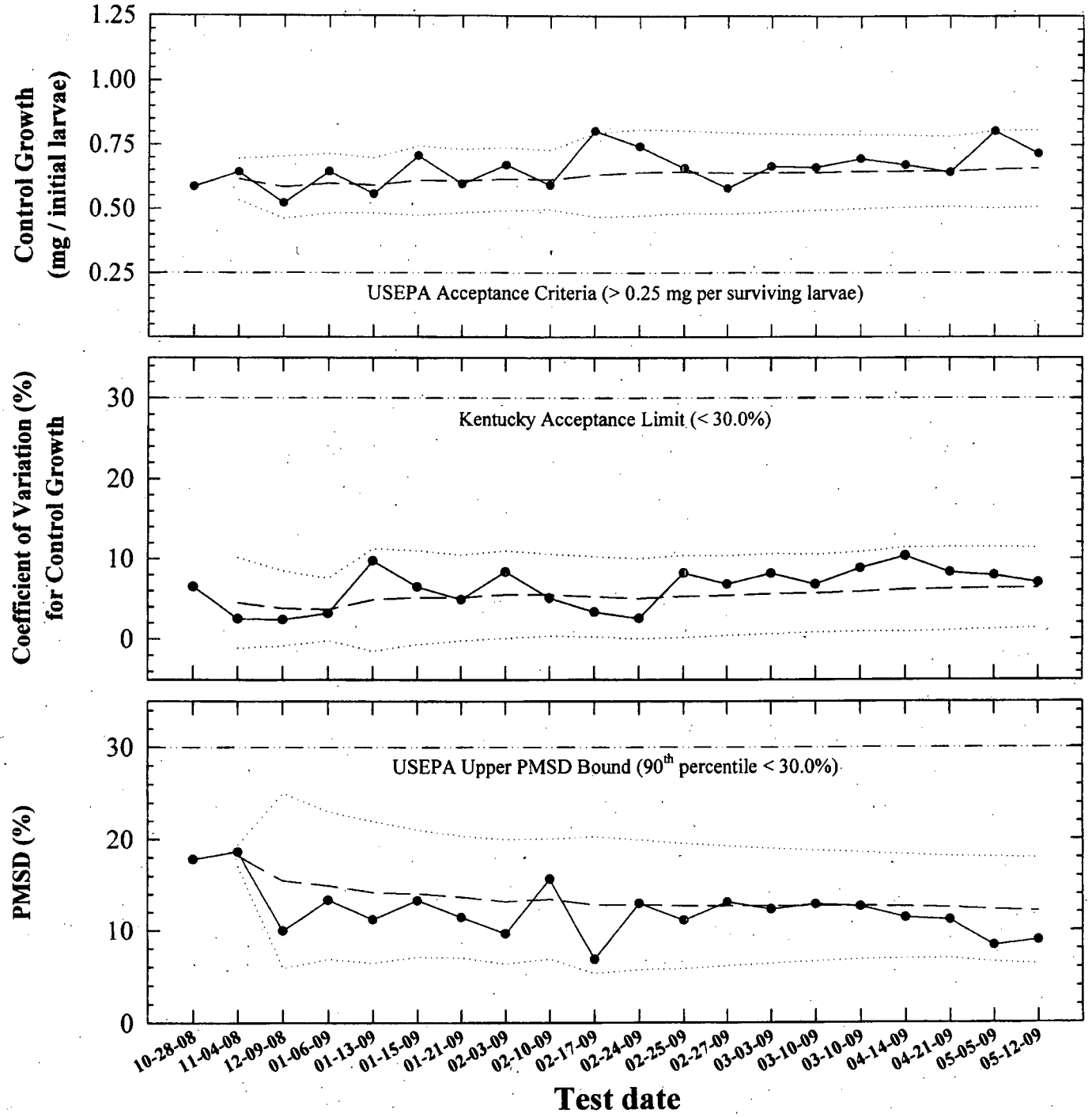
CT = Central Tendancy (mean Control Growth, CV, or PMSD)

USEPA. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination Program. EPA-833-R-00-003. US Environmental Protection Agency, Cincinnati, OH.
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.

Organisms obtained from Aquatox, Inc.

Environmental Testing Solutions, Inc.

Pimephales promelas
Chronic Reference Toxicant Control Chart
Precision of Endpoint Measurements
Organism Source: Aquatox, Inc.



—•— **Control Reproduction, Coefficient of Variation (CV), or Percent Minimum Significant Difference (PMSD)** PMSD is the minimum significant difference between the control and treatment that can be declared statistically significant.

— — **Central Tendency** (mean Control Growth, CV, or PMSD)

Control Limits (mean Control Growth, CV, or PMSD ± 2 Standard Deviations)

ETS
Environmental Testing Solutions, Inc.

Potassium Chloride Chronic Reference Toxicant Test
(EPA-821-R-02-013 Method 1000.0)
Species: *Pimephales promelas*

PpKClCR Test Number: 182

Dilution preparation information:						***Comments:***
KCl Stock INSS number:	INSS 641					
Stock preparation:	50 g KCl/L: Dissolve 50 g KCl in 1-L Deionized water					
Dilution prep (mg/L)	450	600	750	900	1050	
Stock volume (mL)	9	12	15	18	21	
Diluent volume (mL)	991	988	985	982	979	
Total volume (mL)	1000	1000	1000	1000	1000	

Test organism information:		***Test information:***	
Organism age:	20.13 HOURS OLD	Randomizing template:	GREEN
Date and times organisms were born between:	05-11-09 1600	Incubator number and shelf location:	3D
Organism source:	ATOX BATCH Pp 05-11-09	*Artemia* CHM number:	CHM 444
Transfer bowl information:	pH = 7.32 SU Temperature = 24.6 °C	Date / Time in: 05-19-09	1200
		Date / Time out: 05-20-09	1220
Average transfer volume:	0.2305 ml	Total drying time:	24.25 HOURS
		Initial oven temperature:	60°C
		Final oven temperature:	61°C

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	05-12-09	—	—	1400	JH	1208	JH	JH 05-09-09 A
1	05-13-09	0800	JH	1400	JH	1238	JH	05-09-09 A
2	05-14-09	0800	JH	1400	JH	1242	JH	05-09-09 B
3	05-15-09	0800	JH	1400	JH	1233	JH	05-09-09 B
4	05-16-09	0800	JH	1400	JH	1237	JH	05-12-09
5	05-17-09	0900	JH	1500	JH	1222	JH	05-12-09
6	05-18-09	0830	JH	1430	JH	1220	JH	05-12-09
7	05-19-09					1156		—

Control information:		Acceptance criteria	***Summary of test endpoints:***	
% Mortality:	0%	≤ 20%	7-day LC_{50}	949.0
Average weight per initial larvae:	0.717		NOEC	600
Average weight per surviving larvae:	0.717	≥ 0.25 mg/larvae	LOEC	750
			ChV	670.8
			IC_{25}	745.9

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** PpKClCR Test Number: 182

Survival and Growth Data

Day	Control				450 mg KCl/L				600 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	9 d	10	10	10	10
A = Pan weight (mg) Tray color code:: Orange Analyst: MLM Date: ~~05-20~~ 05-12-09	14.77	13.67	14.33	13.05	14.49	14.27	13.31	14.89	13.41	12.75	15.43	12.93
B = Pan + Larvae weight (mg) Analyst: MLM Date: 05-20-09	21.46	20.88	22.18	19.97	21.61	20.79	20.29	21.03	20.82	19.93	22.26	19.90
C = Larvae weight (mg) = B – A	6.69	7.21	7.85	6.92	7.12	6.52	6.98	6.14	7.41	7.18	6.83	6.97
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.669	0.721	0.785	0.692	0.712	0.652	0.698	0.614	0.741	0.718	0.683	0.697
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.717				0.669		6.7%		0.710		1.0%	

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.

Calculations and data reviewed: JL

Comments:

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** PpKClCR Test Number: 182

Survival and Growth Data

Day	750 mg KCl/L				900 mg KCl/L				1050 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	8 2d	10	10	7 3d	6 4d	7 3d	6 4d	5 5d	5 5d	5 5d	6 4d
2	10	8	10	10	7	6	6 1d	6	5	5	4 1d	6
3	10	8	9 1d	10	7	6	5 1d	6	5	5	4	6
4	10	8	8 1d	10	6 1d	5 1d	5	6	3 2d	4 1d	4	6
5	10	8	8	10	6	5	5	6	3	4	4	6
6	8 2d	8	8	9 1d	6	5	5	6	3	4	4	5 1d
7	8	8	8	8 1d	6	5	4 1d	6	3	4 1lg	4	4 1d
A = Pan weight (mg) Tray color code:: Orange Analyst: MLR Date: 05-12-09	14.44	14.92	14.85	14.01	13.62	13.11	14.76	12.64	14.23	14.11	13.81	15.13
B = Pan + Larvae weight (mg) Analyst: MLR Date: 05-20-09	19.90	19.87	20.20	19.58	17.95	16.11	17.32	16.56	16.47	17.39	16.77	17.63
C = Larvae weight (mg) = B – A	5.46	4.95	5.35	5.57	4.33	3.00	2.56	3.92	2.24	3.28	2.96	2.50
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.546	0.495	0.535	0.557	0.433	0.300	0.256	0.392	0.224	0.328	0.296	0.250
Average weight per initial number of larvae (mg)	0.533				0.345				0.275			
Percent reduction from control (%)			25.6%				51.8%				61.7%	

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.

Calculations and data reviewed: [illegible]

Comments:

ETS
Environmental Testing Solutions, Inc.

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: PpKCICR #182
Test dates: May 12-19, 2009
Reveiwed by:

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) = A - B	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	14.77	21.46	6.69	0.669	0.717	7.0	0.669	100.0	0.717	7.0	Not applicable
	B	10	10	13.07	20.28	7.21	0.721			0.721				
	C	10	10	14.33	22.18	7.85	0.785			0.785				
	D	10	10	13.05	19.97	6.92	0.692			0.692				
450	E	10	10	14.49	21.61	7.12	0.712	0.686	3.8	0.712	97.5	0.669	6.7	6.7
	F	10	10	14.27	20.79	6.52	0.652			0.652				
	G	10	10	13.31	20.29	6.98	0.698			0.698				
	H	10	9	14.89	21.03	6.14	0.682			0.614				
600	I	10	10	13.41	20.82	7.41	0.741	0.710	3.6	0.741	100.0	0.710	3.6	1.0
	J	10	10	12.75	19.93	7.18	0.718			0.718				
	K	10	10	15.43	22.26	6.83	0.683			0.683				
	L	10	10	12.93	19.90	6.97	0.697			0.697				
750	M	10	8	14.44	19.90	5.46	0.683	0.667	5.1	0.546	80.0	0.533	5.1	25.6
	N	10	8	14.92	19.87	4.95	0.619			0.495				
	O	10	8	14.85	20.20	5.35	0.669			0.535				
	P	10	8	14.01	19.58	5.57	0.696			0.557				
900	Q	10	6	13.62	17.95	4.33	0.722	0.654	7.7	0.433	52.5	0.345	23.6	51.8
	R	10	5	13.11	16.11	3.00	0.600			0.300				
	S	10	4	14.76	17.32	2.56	0.640			0.256				
	T	10	6	12.64	16.56	3.92	0.653			0.392				
1050	U	10	3	14.23	16.47	2.24	0.747	0.733	11.0	0.224	37.5	0.275	16.9	61.7
	V	10	4	14.11	17.39	3.28	0.820			0.328				
	W	10	4	13.81	16.77	2.96	0.740			0.296				
	X	10	4	15.13	17.63	2.50	0.625			0.250				

Dunnett's MSD value: 0.0640 MSD = Minimum Significant Difference
PMSD: 8.9 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).

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.

Organisms obtained from Aquatox, Inc.

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Survival

Start Date:	5/12/2009	Test ID:	PpKClCR	Sample ID:	REF-Ref Toxicant
End Date:	5/19/2009	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
450	1.0000	1.0000	1.0000	0.9000
600	1.0000	1.0000	1.0000	1.0000
750	0.8000	0.8000	0.8000	0.8000
900	0.6000	0.5000	0.4000	0.6000
1050	0.3000	0.4000	0.4000	0.4000

			Transform: Arcsin Square Root					Rank	1-Tailed	Number	Total
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Resp	Number
D-Control	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4			0	40
450	0.9750	0.9750	1.3713	1.2490	1.4120	5.942	4	16.00	10.00	1	40
600	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4	18.00	10.00	0	40
*750	0.8000	0.8000	1.1071	1.1071	1.1071	0.000	4	10.00	10.00	8	40
*900	0.5250	0.5250	0.8106	0.6847	0.8861	11.892	4	10.00	10.00	19	40
*1050	0.3750	0.3750	0.6584	0.5796	0.6847	7.979	4	10.00	10.00	25	40

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.81382352	0.884	-1.2632773	2.14787125
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	600	750	670.820393	
Treatments vs D-Control				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	8.14828973	1.29114829	5.61763904	10.6789404	0	6.87582293	7.81472778	0.08	2.97727854	0.12272514	4
Intercept	-19.259728	3.78378062	-26.675938	-11.843518							

TSCR

Point	Probits	mg/L	95% Fiducial Limits	
EC01	2.674	491.787145	380.202898	566.020355
EC05	3.355	596.229761	500.029379	659.146411
EC10	3.718	660.693371	577.154041	716.766606
EC15	3.964	708.079653	634.372816	760.17228
EC20	4.158	748.153069	682.308654	798.356768
EC25	4.326	784.335178	724.514185	834.704503
EC40	4.747	883.459176	829.997827	948.216155
EC50	5.000	949.026949	890.476916	1035.58115
EC60	5.253	1019.46098	949.626271	1137.82792
EC75	5.674	1148.30007	1049.26122	1340.14047
EC80	5.842	1203.83407	1090.1848	1431.97553
EC85	6.036	1271.96449	1139.27255	1547.85189
EC90	6.282	1363.19229	1203.47434	1708.07612
EC95	6.645	1510.57893	1304.3074	1978.13621
EC99	7.326	1831.38628	1514.60449	2608.95733

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	5/12/2009	Test ID:	PpKClCR	Sample ID:	REF-Ref Toxicant
End Date:	5/19/2009	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	0.6690	0.7210	0.7850	0.6920
450	0.7120	0.6520	0.6980	0.6140
600	0.7410	0.7180	0.6830	0.6970
750	0.5460	0.4950	0.5350	0.5570
900	0.4330	0.3000	0.2560	0.3920
1050	0.2240	0.3280	0.2960	0.2500

			Transform: Untransformed					1-Tailed			Isotonic	
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.7168	1.0000	0.7168	0.6690	0.7850	7.008	4				0.7168	1.0000
450	0.6690	0.9334	0.6690	0.6140	0.7120	6.687	4	1.627	2.180	0.0640	0.6894	0.9618
600	0.7098	0.9902	0.7098	0.6830	0.7410	3.567	4	0.239	2.180	0.0640	0.6894	0.9618
750	0.5333	0.7440	0.5333	0.4950	0.5570	5.070	4				0.5333	0.7440
900	0.3453	0.4817	0.3453	0.2560	0.4330	23.589	4				0.3453	0.4817
1050	0.2745	0.3830	0.2745	0.2240	0.3280	16.925	4				0.2745	0.3830

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97055012	0.805	0.28149786	-0.6879762
Bartlett's Test indicates equal variances (p = 0.55)	1.1904434	9.2103405		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	600	>600			0.06396215	0.08923913	0.00265975	0.00172172	0.2649911	2, 9
Treatments vs D-Control										

Linear Interpolation (200 Resamples)

Point	mg/L	SD	95% CL(Exp)		Skew
IC05	608.13	149.72	0.00	651.16	-0.8286
IC10	642.56	54.75	277.41	687.07	-3.5954
IC15	676.99	19.21	608.59	724.00	-0.4242
IC20	711.43	18.63	652.82	760.37	-0.2084
IC25	745.86	17.03	695.14	791.43	-0.2232
IC40	832.34	23.14	784.14	931.75	0.9228
IC50	889.53	36.16	825.86	1033.39	0.8216

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** PpKClCR Test Number: 182

Daily Chemistry:

		Day					
		0		1		2	
	Analyst	MLr	MLr	MLr	MLr	MLr	MLr
Concentration	Parameter						
CONTROL	pH (S.U.)	7.28 7.5	7.32	7.60	7.22	7.65	7.30
	DO (mg/L)	7.5	7.3	7.6	7.5	7.4	7.4
	Conductivity (µmhos/cm)	317		312		303	
	Alkalinity (mg $CaCO_3$/L)	61				61	
	Hardness (mg $CaCO_3$/L)	92				88	
	Temperature (°C)	24.6	24.8	24.8	24.5	24.8	24.3
450 mg KCl/L	pH (S.U.)	7.37	7.35	7.51	7.28	7.57	7.32
	DO (mg/L)	7.6	7.3	7.6	7.3	7.3	7.6
	Conductivity (µmhos/cm)	1070		1100		1080	
	Temperature (°C)	24.6	25.0	24.7	24.6	24.7	24.6
600 mg KCl/L	pH (S.U.)	7.41	7.42	7.51	7.27	7.57	7.30
	DO (mg/L)	7.6	7.3	7.7	7.1	7.3	7.3
	Conductivity (µmhos/cm)	1330		1350		1290	
	Temperature (°C)	24.6	24.7	24.7	24.6	24.7	24.6
750 mg KCl/L	pH (S.U.)	7.46	7.40	7.56	7.33	7.58	7.29
	DO (mg/L)	7.6	7.3	7.6	7.3	7.4	7.2
	Conductivity (µmhos/cm)	1590		1610		1530	
	Temperature (°C)	24.6	24.9	24.8	24.6	24.7	24.5
900 mg KCl/L	pH (S.U.)	7.48	7.38	7.57	7.32	7.61	7.30
	DO (mg/L)	7.7	7.3	7.6	7.3	7.5	7.3
	Conductivity (µmhos/cm)	1870		1890		1820	
	Temperature (°C)	24.6	24.9	24.8	24.7	24.9	24.4
1050 mg KCl/L	pH (S.U.)	7.48	7.42	7.57	7.32	7.61	7.36
	DO (mg/L)	7.7	7.3	7.6	7.3	7.6	7.2
	Conductivity (µmhos/cm)	2090		2130		2050	
	Temperature (°C)	24.6	24.9	24.8	24.5	24.7	24.6
STOCK	Conductivity (µmhos/cm)	68100		—		—	
		Initial	Final	Initial	Final	Initial	Final

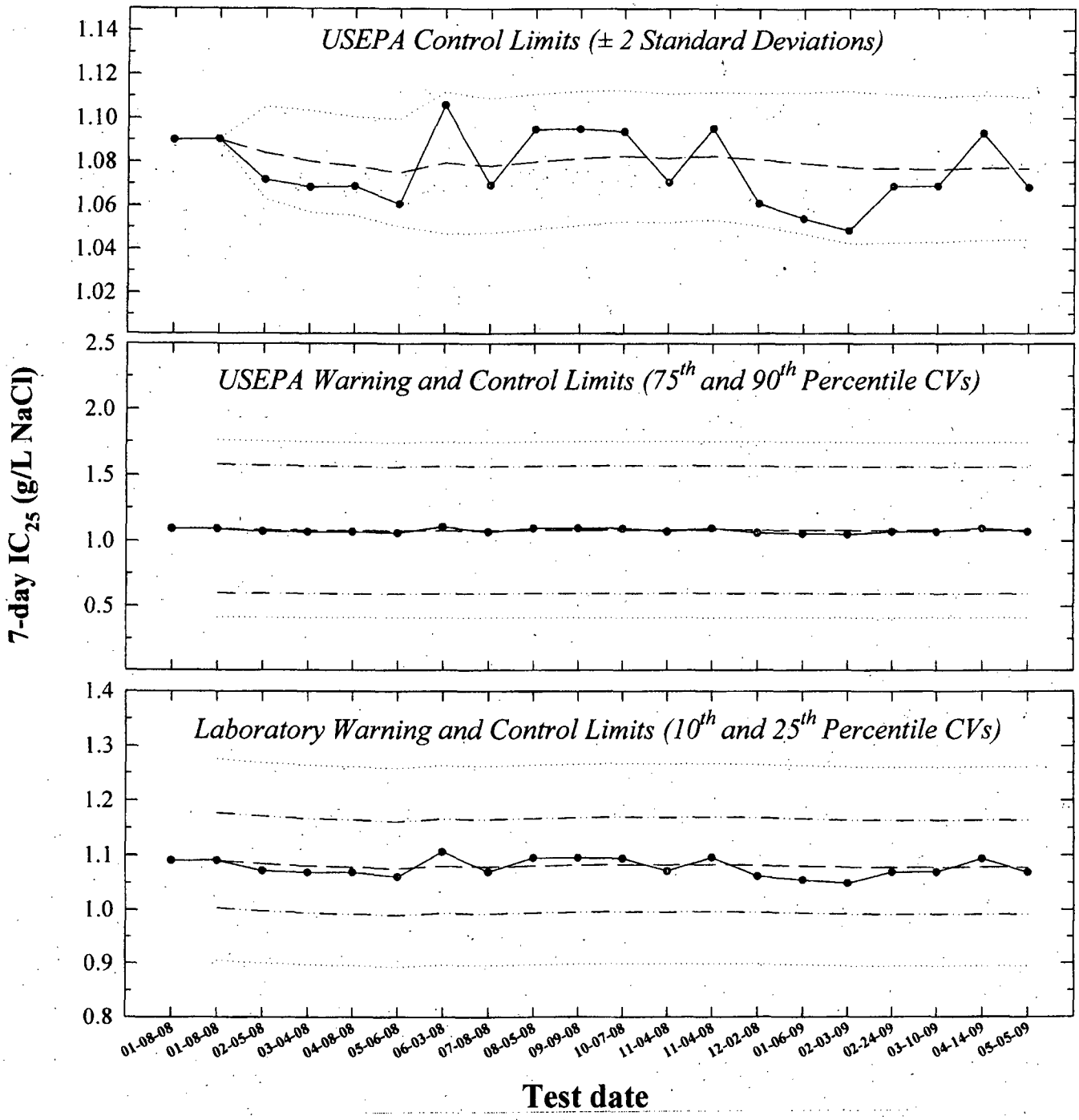
ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** PpKClCR Test Number: 182

		Day							
		3		4		5		6	
	Analyst	KBL	LAB	LAB	BSC	BSC	MLR	MLR	MLR
Concentration	Parameter								
CONTROL	pH (S.U.)	7.58	7.31	7.60	7.40	7.43	7.40	7.66	7.12
	DO (mg/L)	7.7	7.3	7.8	7.4	~~8.4~~ 7.6	7.4	7.4	~~7.8~~ 7.0
	Conductivity (µmhos/cm)	324		338		324		328	
	Alkalinity (mg $CaCO_3$/L)			60					
	Hardness (mg $CaCO_3$/L)			88					
	Temperature (°C)	24.8	24.9	24.8	24.6	24.7	24.5	24.7	24.4
450 mg KCl/L	pH (S.U.)	7.61	7.38	7.64	7.44	7.57	7.47	7.65	7.12
	DO (mg/L)	7.7	7.4	7.7	7.3	7.6	7.3	7.4	7.0
	Conductivity (µmhos/cm)	1110		1150		1110		1160	
	Temperature (°C)	24.8	24.6	24.9	24.4	24.7	24.5	24.7	24.4
600 mg KCl/L	pH (S.U.)	7.61	7.41	7.65	7.42	7.58	7.44	7.65	7.16
	DO (mg/L)	7.7	7.5	7.8	7.3	7.7	7.3	7.4	6.9
	Conductivity (µmhos/cm)	1320		1430		1370		1420	
	Temperature (°C)	24.8	24.6	24.9	24.3	24.7	24.5	24.7	24.4
750 mg KCl/L	pH (S.U.)	7.60	7.39	7.65	7.44	7.61	7.45	7.67	7.19
	DO (mg/L)	7.7	7.3	7.8	7.3	7.6	7.3	7.5	6.9
	Conductivity (µmhos/cm)	1620		1680		1570		1700	
	Temperature (°C)	24.8	24.7	24.8	24.5	24.7	24.5	24.7	24.3
900 mg KCl/L	pH (S.U.)	7.60	7.40	7.65	7.41	7.61	7.44	7.67	7.09
	DO (mg/L)	7.7	7.3	7.8	7.3	7.7	7.2	7.4	6.9
	Conductivity (µmhos/cm)	1880		1960		1800		1960	
	Temperature (°C)	24.8	24.6	24.8	24.5	24.7	24.5	24.7	24.6
1050 mg KCl/L	pH (S.U.)	7.59	7.45	7.66	7.49	7.61	7.44	7.67	7.09
	DO (mg/L)	7.8	7.5	7.8	7.3	7.7	7.2	7.4	6.9
	Conductivity (µmhos/cm)	2120		2200		2010		2190	
	Temperature (°C)	24.7	24.6	24.9	24.5	24.7	24.5	24.7	24.4
STOCK	Conductivity (µmhos/cm)	—		—		—		—	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

Environmental Testing Solutions, Inc.

Ceriodaphnia dubia
Chronic Reference Toxicant Control Chart



—•— **7-day IC_{25}** = 25% inhibition concentration. An estimation of the concentration of sodium chloride that would cause a 25% reduction in *Ceriodaphnia* reproduction for the test population.

— — **Central Tendency** (mean IC_{25})

— · — **Warning Limits** (mean $IC_{25} \pm S_{A.10}$ or $S_{A.75}$)

..... **Control Limits** (mean $IC_{25} \pm S_{A.25}$, $S_{A.90}$, or 2 Standard Deviations)

ETS
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Ceriodaphnia dubia
Chronic Reference Toxicant Control Chart

Test number	Test date	7-day IC_{25} (g/L NaCl)	CT (g/L NaCl)	S	State and USEPA Control Limits CT - 2S	CT + 2S	$S_{A.10}$	Laboratory Warning Limits CT - $S_{A.10}$	CT + $S_{A.10}$	$S_{A.25}$	Laboratory Control Limits CT - $S_{A.25}$	CT + $S_{A.25}$	$S_{A.75}$	USEPA Warning Limits CT - $S_{A.75}$	CT + $S_{A.75}$	$S_{A.90}$	USEPA Control Limits CT - $S_{A.90}$	CT + $S_{A.90}$	CV
1	01-08-08	1.09																	
2	01-08-08	1.09	1.09	0.00	1.09	1.09	0.09	1.00	1.18	0.19	0.90	1.28	0.49	0.60	1.58	0.68	0.41	1.77	0.00
3	02-05-08	1.07	1.08	0.01	1.06	1.11	0.09	1.00	1.17	0.18	0.90	1.27	0.49	0.60	1.57	0.67	0.41	1.76	0.01
4	03-04-08	1.07	1.08	0.01	1.06	1.10	0.09	0.99	1.17	0.18	0.90	1.26	0.49	0.59	1.57	0.67	0.41	1.75	0.01
5	04-08-08	1.07	1.08	0.01	1.06	1.10	0.09	0.99	1.16	0.18	0.89	1.26	0.49	0.59	1.56	0.67	0.41	1.75	0.01
6	05-06-08	1.06	1.08	0.01	1.05	1.10	0.09	0.99	1.16	0.18	0.89	1.26	0.48	0.59	1.56	0.67	0.41	1.74	0.01
7	06-03-08	1.11	1.08	0.02	1.05	1.11	0.09	0.99	1.17	0.18	0.90	1.26	0.49	0.59	1.57	0.67	0.41	1.75	0.02
8	07-08-08	1.07	1.08	0.02	1.05	1.11	0.09	0.99	1.16	0.18	0.89	1.26	0.49	0.59	1.56	0.67	0.41	1.75	0.01
9	08-05-08	1.09	1.08	0.02	1.05	1.11	0.09	0.99	1.17	0.18	0.90	1.26	0.49	0.59	1.57	0.67	0.41	1.75	0.01
10	09-09-08	1.10	1.08	0.02	1.05	1.11	0.09	1.00	1.17	0.18	0.90	1.27	0.49	0.59	1.57	0.67	0.41	1.75	0.01
11	10-07-08	1.09	1.08	0.02	1.05	1.11	0.09	1.00	1.17	0.18	0.90	1.27	0.49	0.60	1.57	0.67	0.41	1.75	0.01
12	11-04-08	1.07	1.08	0.01	1.05	1.11	0.09	1.00	1.17	0.18	0.90	1.27	0.49	0.59	1.57	0.67	0.41	1.75	0.01
13	11-04-08	1.10	1.08	0.01	1.05	1.11	0.09	1.00	1.17	0.18	0.90	1.27	0.49	0.60	1.57	0.67	0.41	1.75	0.01
14	12-02-08	1.06	1.08	0.02	1.05	1.11	0.09	0.99	1.17	0.18	0.90	1.26	0.49	0.59	1.57	0.67	0.41	1.75	0.01
15	01-06-09	1.05	1.08	0.02	1.05	1.11	0.09	0.99	1.17	0.18	0.90	1.26	0.49	0.59	1.57	0.67	0.41	1.75	0.02
16	02-03-09	1.05	1.08	0.02	1.04	1.11	0.09	0.99	1.16	0.18	0.89	1.26	0.48	0.59	1.56	0.67	0.41	1.75	0.02
17	02-24-09	1.07	1.08	0.02	1.04	1.11	0.09	0.99	1.16	0.18	0.89	1.26	0.48	0.59	1.56	0.67	0.41	1.74	0.02
18	03-10-09	1.07	1.08	0.02	1.04	1.11	0.09	0.99	1.16	0.18	0.89	1.26	0.48	0.59	1.56	0.67	0.41	1.74	0.02
19	04-14-09	1.09	1.08	0.02	1.04	1.11	0.09	0.99	1.16	0.18	0.89	1.26	0.48	0.59	1.56	0.67	0.41	1.75	0.02
20	05-05-09	1.07	1.08	0.02	1.04	1.11	0.09	0.99	1.16	0.18	0.89	1.26	0.48	0.59	1.56	0.67	0.41	1.74	0.02

Note: **7-d IC_{25}** = 7-day 25% inhibition concentration. An estimation of the concentration of sodium chloride that would cause a 25% reduction in *Ceriodaphnia* reproduction for the test population.

CT = Central tendency (mean IC_{25}).

S = Standard deviation of the IC_{25} values.

Laboratory Control and Warning Limits

Laboratory control and warning limits were established using the standard deviation of the IC_{25} values corresponding to the 10th and 25th percentile CVs. These ranges are more stringent than the control and warning limits recommended by USEPA for the test method and endpoint.

$S_{A.10}$ = Standard deviation corresponding to the 10th percentile CV. ($S_{A.10} = 0.08$)

$S_{A.25}$ = Standard deviation corresponding to the 25th percentile CV. ($S_{A.25} = 0.17$)

USEPA Control and Warning Limits

$S_{A.75}$ = Standard deviation corresponding to the 75th percentile CV. ($S_{A.75} = 0.45$)

$S_{A.90}$ = Standard deviation corresponding to the 90th percentile CV. ($S_{A.90} = 0.62$)

CV = Coefficient of variation of the IC_{25} values.

USEPA. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination Program. EPA-833-R-00-003. US Environmental Protection Agency, Cincinnati, OH.

Environmental Testing Solutions, Inc.

Precision of Endpoint Measurements

Ceriodaphnia dubia
Chronic Reference Toxicant Data

Test number	Test date	Control Survival (%)	Control Mean Reproduction (offspring/female)	CT for Control Mean Reproduction (offspring/female)	CV (%)	CT for Control Reproduction CV (%)	MSD	PMSD (%)	CT for PMSD (%)
1	01-08-08	100	30.3		6.6		2.2	7.3	
2	01-08-08	100	31.8	31.1	4.9	5.7	2.4	7.7	7.5
3	02-05-08	100	31.3	31.1	6.4	6.0	2.8	9.1	8.0
4	03-04-08	100	31.5	31.2	8.0	6.5	2.7	8.5	8.1
5	04-08-08	100	29.6	30.9	7.7	6.7	2.6	8.8	8.3
6	05-06-08	100	32.1	31.1	6.3	6.6	2.5	7.9	8.2
7	06-03-08	100	30.5	31.0	7.9	6.8	3.0	9.9	8.4
8	07-08-08	100	30.9	31.0	6.7	6.8	2.4	7.7	8.4
9	08-05-08	100	29.4	30.8	7.9	6.9	2.2	7.6	8.3
10	09-09-08	100	28.3	30.6	8.5	7.1	3.0	10.5	8.5
11	10-07-08	100	32.4	30.7	7.2	7.1	2.7	8.4	8.5
12	11-04-08	100	32.3	30.9	5.1	6.9	2.2	6.8	8.3
13	11-04-08	100	31.5	30.9	6.2	6.9	2.4	7.7	8.3
14	12-02-08	100	31.5	31.0	4.6	6.7	2.5	8.0	8.3
15	01-06-09	100	33.2	31.1	4.0	6.5	2.0	6.1	8.1
16	02-03-09	100	31.4	31.1	6.6	6.5	1.9	6.0	8.0
17	02-24-09	100	32.2	31.2	6.0	6.5	1.8	5.7	7.9
18	03-10-09	100	31.9	31.2	5.8	6.5	2.6	8.2	7.9
19	04-14-09	100	33.9	31.4	6.7	6.5	2.0	5.8	7.8
20	05-05-09	100	33.6	31.5	4.3	6.4	2.3	6.8	7.7

Note:

CV = Coefficient of variation for control reproduction.
Lower CV bound determined by USEPA (10th percentile) = 8.9%.
Upper CV bound determined by USEPA (90th percentile) = 42%

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%.

CT = Central Tendancy (Mean Control Reproduction, CV, or PMSD)

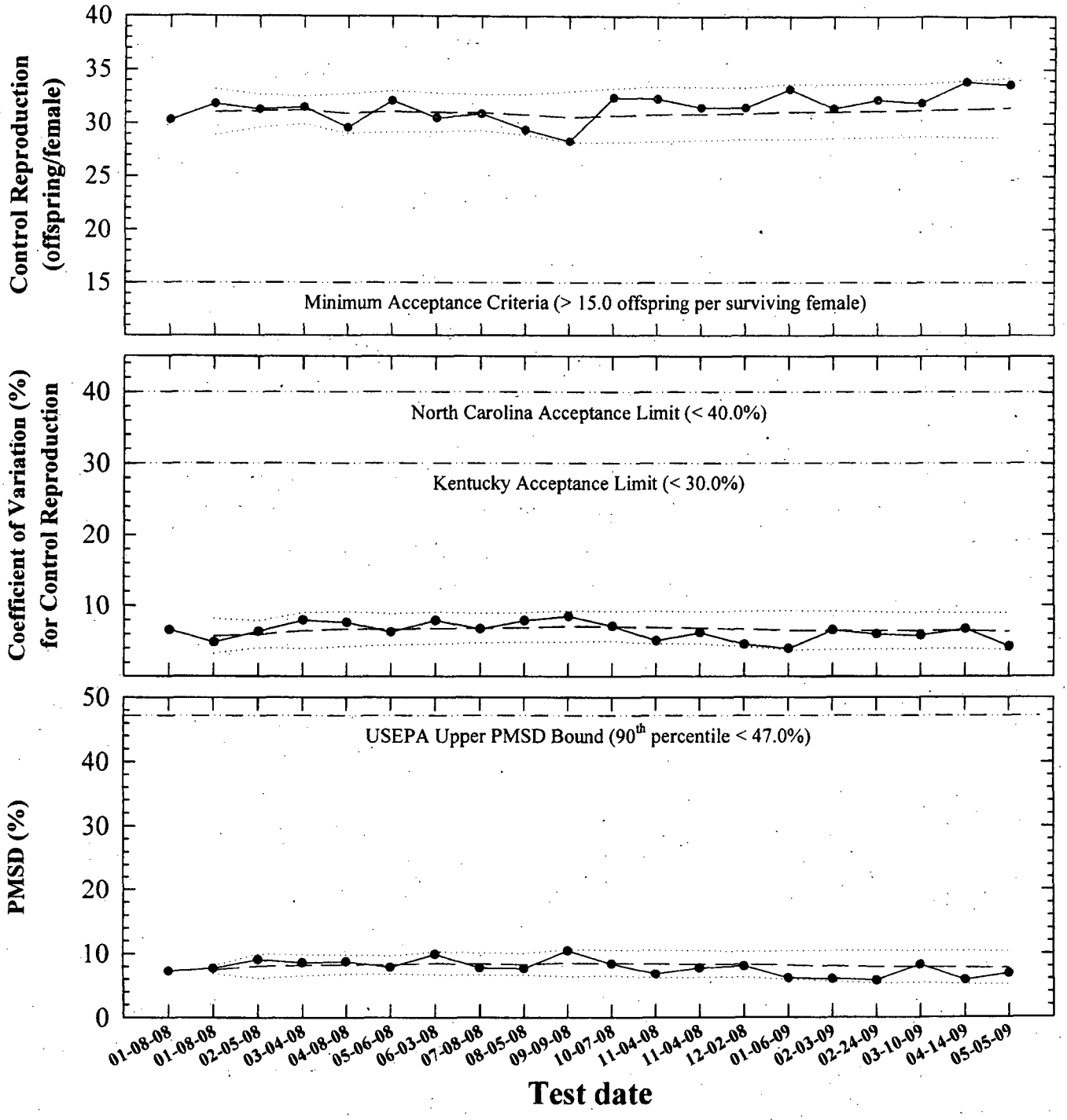
USEPA. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination Program. EPA-833-R-00-003. US Environmental Protection Agency, Cincinnati, OH.

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.

05-05-09

Environmental Testing Solutions, Inc.

Ceriodaphnia dubia
Chronic Reference Toxicant Control Chart
Precision of Endpoint Measurements



—•— **Control Reproduction, Coefficient of Variation (CV), or Percent Minimum Significant Difference (PMSD)** PMSD is the minimum significant difference between the control and treatment that can be declared statistically significant.

— — **Central Tendency** (mean Control Reproduction, CV, or PMSD)

Control Limits (mean Control Reproduction, CV, or PMSD ± 2 Standard Deviations)

ETS Environmental Testing Solutions, Inc.

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

CdNaCLCR #: 89

Dilution preparation information:						***Comments:***
NaCl Stock INSS number:		INSS640				
Stock preparation:		100 g NaCl/l (dissolve 50 g NaCl in 500 ml deionized 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	

Test organism source information:											***Test information:***	
Organism age:				< 24-hours old							Randomizing template color:	ORANGE
Date and times organisms were born between:				05-05-09 0645 TO 0855							Incubator number and shelf location:	281
Culture board:	04-28-09 A											
Replicate number:	1	2	3	4	5	6	7	8	9	10	YWT batch:	04-07-09
Culture board cup number:	2	8	9	10	12	16	17	21	22	24		
Transfer bowl information:	pH = 7.49 SU Temperature = 25.2 °C										*Selenastrum* batch:	~~04-02-09~~ 05-04-09

Daily renewal information:

Day	Date	Test initiation and feeding, renewal and feeding, or termination time	MHSW batch used	Analyst
0	05-05-09	0905	04-27-09	dl
1	05-06-09	0806	04-28-09	dl
2	05-07-09	0805	05-05-09 A	dl
3	05-08-09	0805	05-05-09 A	dl
4	05-09-09	0905	05-07-09 A	dl
5	05-10-09	0845	05-07-09 B	dl
6	05-11-09	0807	05-07-09 B	dl
7	05-12-09	0805		dl

Control information:		Acceptance criteria	***Summary of test endpoints:***	
% of Male Adults:	0%	≤ 20%	7-day LC_{50}	>1400
% Adults having 3rd Broods:	~~33.6~~ 100%	≥ 80%	NOEC	800
% Mortality:	0%	≤ 20%	LOEC	1000
Mean Offspring/Female:	33.6	≥ 15.0 offspring/female	ChV	894.4
% CV:	4.3%	< 40.0 %	IC_{25}	1068.2

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia*** **CdNaCLCR #:** 89

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	6	4	5	5	6	5	5	6	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	13	12	12	12	14	12	12	13	13
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	17	0	0	0	0	16	0	17	15
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	17	0	17	14	16	16	0	15	0	0
Total young produced		36	~~33~~ 34	34	31	34	35	33	33	34	32
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3rd 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:	33.6

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	6	4	5	5	5	6	5	6	6	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	13	14	14	14	13	13	11	13	13
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	18	0	16	0	0	18	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	17	0	15	0	18	15	0	16	16	16
Total young produced		35	35	34	35	37	34	36	33	35	34
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:	0%
Mean Offspring/Female:	34.8
% Reduction from Control:	~~0~~ -3.6%

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia*** **CdNaCLCR #:** 89

800 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	5	4	4	5	5	5	6	5	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	13	11	13	11	12	13	12	12	12
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	17	0	16	16
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	16	16	15	15	17	18	0	15	0	0
Total young produced		34	33	30	33	33	35	36	32	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:	0%
Mean Offspring/Female:	33.2
% Reduction from Control:	1.2%

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	6	4	6	5	4	5	5	5	4	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	11	12	10	10	13	11	11	12	12
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	17	0	0	0	15
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	13	14	12	15	13	0	14	14	16	0
Total young produced		32	29	30	30	27	35	30	30	32	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:	0%
Mean Offspring/Female:	30.7
% Reduction from Control:	8.6%

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia*** **CdNaCLCR #:** 89

1200 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	5	5	5	4	4	5	4	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	5	5	7	3	7	5	5	6	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	+1	0	6
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	5	9	6	5	8	6	4	7	5	0
Total young produced		15	19	18	12	19	16	13	18	14	15
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

* DEAD NEONATES OBSERVED.

+ CARRY OVER

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:	15.9
% Reduction from Control:	52.7%

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	5	3	4	2	5	4	3	3	3	2
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	4	0	3	3	5	5	6	0	0	4
	Adult mortality	L	L	L	L	L	L	L	L	D	L
6	Young produced	0	4	0	0	0	0	0	2	↓	0
	Adult mortality	L	L	L	L	L	L	L	L		L
7	Young produced	3	1	0	0	5	2	0	0		3
Total young produced		12	8	7	5	15	11	9	5	3	9
Final Adult Mortality		L	L	L	L	L	L	L	L	D	L

* DEAD NEONATES OBSERVED

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:	10%
Mean Offspring/Female:	8.4
% Reduction from Control:	75.0%

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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	6	4	5	5	6	5	5	6	4	4	50
5	13	13	12	12	12	14	12	12	13	13	126
6	0	17	0	0	0	0	16	0	17	15	65
7	17	0	17	14	16	16	0	15	0	0	95
Total	**36**	**34**	**34**	**31**	**34**	**35**	**33**	**33**	**34**	**32**	**336**

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	6	4	6	5	4	5	5	5	4	5	49
5	13	11	12	10	10	13	11	11	12	12	115
6	0	0	0	0	0	17	0	0	0	15	32
7	13	14	12	15	13	0	14	14	16	0	111
Total	**32**	**29**	**30**	**30**	**27**	**35**	**30**	**30**	**32**	**32**	**307**

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	6	4	5	5	5	6	5	6	6	5	53
5	12	13	14	14	14	13	13	11	13	13	130
6	0	18	0	16	0	0	18	0	0	0	52
7	17	0	15	0	18	15	0	16	16	16	113
Total	**35**	**35**	**34**	**35**	**37**	**34**	**36**	**33**	**35**	**34**	**348**

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	5	5	5	4	4	5	4	4	4	4	44
5	5	5	7	3	7	5	5	6	5	5	53
6	0	0	0	0	0	0	0	1	0	6	7
7	5	9	6	5	8	6	4	7	5	0	55
Total	**15**	**19**	**18**	**12**	**19**	**16**	**13**	**18**	**14**	**15**	**159**

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	5	4	4	5	5	5	6	5	5	5	49
5	13	13	11	13	11	12	13	12	12	12	122
6	0	0	0	0	0	0	17	0	16	16	49
7	16	16	15	15	17	18	0	15	0	0	112
Total	**34**	**33**	**30**	**33**	**33**	**35**	**36**	**32**	**33**	**33**	**332**

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	5	3	4	2	5	4	3	3	3	2	34
5	4	0	3	3	5	5	6	0	0	4	30
6	0	4	0	0	0	0	0	2	0	0	6
7	3	1	0	0	5	2	0	0	0	3	14
Total	**12**	**8**	**7**	**5**	**15**	**11**	**9**	**5**	**3**	**9**	**84**

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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: CdNaClCR #89
Test dates: May 05-12, 2009
Reveiwed by:

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	36	34	34	31	34	35	33	33	34	32	100	33.6	4.3	Not applicable
600	35	35	34	35	37	34	36	33	35	34	100	34.8	3.3	-3.6
800	34	33	30	33	33	35	36	32	33	33	100	33.2	4.9	1.2
1000	32	29	30	30	27	35	30	30	32	32	100	30.7	7.0	8.6
1200	15	19	18	12	19	16	13	18	14	15	100	15.9	15.8	52.7
1400	12	8	7	5	15	11	9	5	3	9	90	8.4	43.2	75.0

Dunnett's MSD value: 2.291
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.

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.

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date:	5/5/2009	Test ID:	CdNaClCR	Sample ID:	REF-Ref Toxicant
End Date:	5/12/2009	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
Comments:					

Conc-mg/L	1	2	3	4	5	6	7	8	9	10
D-Control	36.000	34.000	34.000	31.000	34.000	35.000	33.000	33.000	34.000	32.000
600	35.000	35.000	34.000	35.000	37.000	34.000	36.000	33.000	35.000	34.000
800	34.000	33.000	30.000	33.000	33.000	35.000	36.000	32.000	33.000	33.000
1000	32.000	29.000	30.000	30.000	27.000	35.000	30.000	30.000	32.000	32.000
1200	15.000	19.000	18.000	12.000	19.000	16.000	13.000	18.000	14.000	15.000
1400	12.000	8.000	7.000	5.000	15.000	11.000	9.000	5.000	3.000	9.000

			Transform: Untransformed					Rank	1-Tailed	Isotonic	
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
D-Control	33.600	1.0000	33.600	31.000	36.000	4.255	10			34.200	1.0000
600	34.800	1.0357	34.800	33.000	37.000	3.262	10	129.50	75.00	34.200	1.0000
800	33.200	0.9881	33.200	30.000	36.000	4.877	10	95.50	75.00	33.200	0.9708
*1000	30.700	0.9137	30.700	27.000	35.000	7.045	10	68.00	75.00	30.700	0.8977
*1200	15.900	0.4732	15.900	12.000	19.000	15.814	10	55.00	75.00	15.900	0.4649
*1400	8.400	0.2500	8.400	3.000	15.000	43.179	10	55.00	75.00	8.400	0.2456

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.81542361	1.035	0.21736896	0.95569016
Bartlett's Test indicates unequal variances (p = 8.87E-03)	15.3749275	15.0862722		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	800	1000	894.427191	
Treatments vs D-Control				

Linear Interpolation (200 Resamples)

Point	mg/L	SD	95% CL		Skew
IC05	856.8	42.6664107	764.087662	941.198214	0.0444
IC10	993.6	29.0004806	921.551731	1015.99639	-0.8830
IC15	1022.02703	8.689644	1004.45361	1037.76034	-0.3344
IC20	1045.13514	7.64509171	1029.66986	1060.12003	-0.0590
IC25	1068.24324	7.05805813	1055.32988	1081.38741	0.0234
IC40	1137.56757	7.32664661	1123.52221	1151.44087	0.2385
IC50	1183.78378	9.03530003	1167.78076	1201.21731	0.2331

ETS
Environmental Testing Solutions, Inc.

Statistical Analyses

Used for PMSD calculation only. Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date:	5/5/2009	Test ID:	CdNaClCR	Sample ID:	REF-Ref Toxicant
End Date:	5/12/2009	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
Comments:					

Conc-mg/L	1	2	3	4	5	6	7	8	9	10
D-Control	36.000	34.000	34.000	31.000	34.000	35.000	33.000	33.000	34.000	32.000
600	35.000	35.000	34.000	35.000	37.000	34.000	36.000	33.000	35.000	34.000
800	34.000	33.000	30.000	33.000	33.000	35.000	36.000	32.000	33.000	33.000
1000	32.000	29.000	30.000	30.000	27.000	35.000	30.000	30.000	32.000	32.000
1200	15.000	19.000	18.000	12.000	19.000	16.000	13.000	18.000	14.000	15.000
1400	12.000	8.000	7.000	5.000	15.000	11.000	9.000	5.000	3.000	9.000

			Transform: Untransformed						1-Tailed	
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
D-Control	33.600	1.0000	33.600	31.000	36.000	4.255	10			
600	34.800	1.0357	34.800	33.000	37.000	3.262	10	-1.198	2.287	2.291
800	33.200	0.9881	33.200	30.000	36.000	4.877	10	0.399	2.287	2.291
*1000	30.700	0.9137	30.700	27.000	35.000	7.045	10	2.895	2.287	2.291
*1200	15.900	0.4732	15.900	12.000	19.000	15.814	10	17.667	2.287	2.291
*1400	8.400	0.2500	8.400	3.000	15.000	43.179	10	25.153	2.287	2.291

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.81542361	1.035	0.21736896	0.95569016
Bartlett's Test indicates unequal variances (p = 8.87E-03)	15.3749275	15.0862722		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	800	1000	894.427191		2.29089729	0.06818147	1241.68	5.01851852	6.4E-36	5, 54
Treatments vs D-Control										

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia*** **CdNaCLCR #:** 89

Daily Chemistry:

		Day					
		0		1		2	
	Analyst	MLM	MLM	MLM	MLM	MLM	MLM
Concentration	Parameter						
CONTROL	pH (S.U.)	7.47	7.46	7.35	7.57	7.25	7.51
	DO (mg/L)	7.7	7.9	7.8	7.9	7.9	7.7
	Conductivity (µmhos/cm)	326		330		309	
	Alkalinity (mg $CaCO_3$/L)	62		64		64	
	Hardness (mg $CaCO_3$/L)	85		92		94	
	Temperature (°C)	24.8	24.9	24.7	25.1	24.8	24.8
600 mg NaCl/L	pH (S.U.)	7.63	7.50	7.54	7.47	7.51	7.55
	DO (mg/L)	7.8	7.9	7.7	7.9	7.7	7.8
	Conductivity (µmhos/cm)	1450		1460		1410	
	Temperature (°C)	25.0	24.9	24.9	25.1	24.8	24.9
800 mg NaCl/L	pH (S.U.)	7.62	7.52	7.55	7.50	7.51	7.54
	DO (mg/L)	7.9	7.9	7.7	7.8	7.8	7.9
	Conductivity (µmhos/cm)	1800		1840		1780	
	Temperature (°C)	25.0	24.7	24.9	25.2	24.8	24.9
1000 mg NaCl/L	pH (S.U.)	7.64	7.53	7.57	7.52	7.54	7.61
	DO (mg/L)	7.9	7.8	7.7	7.9	7.9	7.9
	Conductivity (µmhos/cm)	2180		2120		2110	
	Temperature (°C)	24.9	24.9	24.9	25.0	24.9	24.9
1200 mg NaCl/L	pH (S.U.)	7.66	7.56	7.57	7.55	7.53	7.62
	DO (mg/L)	7.9	7.8	7.8	7.9	7.9	8.0
	Conductivity (µmhos/cm)	2530		2550		2450	
	Temperature (°C)	24.9	24.8	24.8	24.9	24.9	24.9
1400 mg NaCl/L	pH (S.U.)	7.66	7.56	7.59	7.57	7.58	7.65
	DO (mg/L)	7.9	7.8	7.9	7.9	7.9	8.0
	Conductivity (µmhos/cm)	2860		2920		2730	
	Temperature (°C)	25.0	24.9	24.8	24.9	24.9	24.9
STOCK	Conductivity (µmhos/cm)	116000		—		—	
		Initial	Final	Initial	Final	Initial	Final

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia*** **CdNaCLCR #:** 89

		Day							
		3		4		5		6	
	Analyst	MLM	LAB	LAB	MLM	MLM	MLM	MLM	MLM
Concentration	Parameter								
CONTROL	pH (S.U.)	7.38	7.36	7.20	7.69	7.53	7.80	~~7.41~~	7.33
	DO (mg/L)	8.0	7.9	7.6	7.6	7.6	7.9	7.4	7.5
	Conductivity (µmhos/cm)	314		322		323		319	
	Alkalinity (mg $CaCO_3$/L)			62		61			
	Hardness (mg $CaCO_3$/L)			94		92			
	Temperature (°C)	24.7	24.8	24.8	24.5	24.8	24.7	24.8	25.2
600 mg NaCl/L	pH (S.U.)	7.60	7.43	7.45	7.63	7.71	7.84	7.86	~~7.38~~
	DO (mg/L)	~~8.2~~ 7.7	7.9	8.0	7.5	7.5	7.8	8.0	7.4
	Conductivity (µmhos/cm)	1360		1430		1450		1370	
	Temperature (°C)	24.8	25.1	24.9	24.7	24.9	24.6	24.8	24.8
800 mg NaCl/L	pH (S.U.)	7.59	7.47	7.44	7.66	7.70	7.84	7.89	7.43
	DO (mg/L)	~~8.3~~ 7.7	7.9	8.0	7.5	7.5	7.8	7.7	7.5
	Conductivity (µmhos/cm)	1760		1810		1850		1870	
	Temperature (°C)	24.8	25.0	25.0	24.7	25.1	24.8	24.8	24.9
1000 mg NaCl/L	pH (S.U.)	7.60	7.50	7.47	7.67	7.70	7.85	7.88	7.48
	DO (mg/L)	7.8	7.9	7.9	7.5	7.5	7.8	7.8	7.5
	Conductivity (µmhos/cm)	2080		2190		2230		2140	
	Temperature (°C)	25.0	25.0	25.0	24.8	24.8	24.8	24.8	24.9
1200 mg NaCl/L	pH (S.U.)	7.62	7.51	7.48	7.69	7.71	7.84	7.88	7.47
	DO (mg/L)	7.8	7.9	7.9	7.6	7.5	7.8	7.8	7.6
	Conductivity (µmhos/cm)	2580		2550		2570		~~2370~~ 2550	
	Temperature (°C)	24.9	25.1	25.0	24.8	24.9	24.9	24.8	25.0
1400 mg NaCl/L	pH (S.U.)	7.63	7.53	7.51	7.69	7.71	7.84	7.88	7.48
	DO (mg/L)	7.8	7.9	7.8	7.6	7.5	7.7	7.8	7.5
	Conductivity (µmhos/cm)	2740		2830		2860		~~2500~~ 2830	
	Temperature (°C)	24.9	24.8	24.9	24.7	24.8	24.7	24.8	25.0
STOCK	Conductivity (µmhos/cm)	—		—		—		—	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

December 10, 2009

Ruth Ann Hurt, SB 2A-SQN

SEQUOYAH NUCLEAR PLANT (SQN) TOXICITY BIOMONITORING, NPDES PERMIT NO. TN0026450, COMPLIANCE TOXICITY TESTS, NOVEMBER, 2009

Per your request, I am only submitting an electronic copy of the subject report. The report provides results of compliance testing using fathead minnows and daphnids. Outfall 101, samples collected November 15-20, showed no toxic effects to fathead minnows or daphnids. The resulting IC_{25} values for both species were > 100 percent. Exposure of fathead minnows and daphnids to intake samples resulted in no significant differences from controls during this study period.

Fathead minnows were also exposed to UV treated Outfall 101 and intake samples since fish pathogens present in intake water have been the suspected cause of interference (anomalous dose response and high variability among replicates) in previous toxicity testing at Sequoyah.

Call me at (256) 386-2755 if you have any questions or comments following your review of the report.

Cynthia L. Russell
Biologist
Environmental Engineering Services- West
CEB 3A-M

Attachment
cc (Attachment):
Sherrard, R. M., PSC 1X-C
Files, OE&R, CEB 1B-M

SQN November 2009M

TENNESSEE VALLEY AUTHORITY
TOXICITY TEST REPORT

INTRODUCTION / EXECUTIVE SUMMARY

Report Date: December 10, 2009

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: November 15-20, 2009
10. Average Flow on Days Sampled (MGD): 870, 873, 1761
11. Pertinent Site Conditions: Production / operation data will be provided upon request.
12. Test Dates: November 17-24, 2009
13. Test Type: Short-term Chronic Definitive
14. Test Species: Fathead Minnows (*Pimephales promelas*)
    Daphnids (*Ceriodaphnia dubia*)
15. Concentrations Tested (%): Outfall 101: 11.3, 22.6, 45.2, 72.6, 100
    Intake: 100.0
    Pimephales promelas: UV treated Outfall 101: 11.3, 22.6, 45.2, 72.6, 100
    UV treated Intake: 100.0
16. Permit Limit Endpoint (%): Outfall 101: IC_{25} = 45.2%
17. Test Results: Outfall 101: *Pimephales promelas:* IC_{25} > 100%
    Ceriodaphnia dubia: IC_{25} > 100%
    UV treated Outfall 101: *Pimephales promelas:* IC_{25} > 100%

18. Facility Contact: Ann Hurt Phone #: (423) 843-6714

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

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

21. TVA Contact: Cynthia L. Russell Phone #: (256) 386-2755

22. Notes: Outfall 101 samples collected November 15 – 20, 2009, showed no toxic effects to fathead minnows or daphnids. The resulting IC_{25} 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.

    Fathead minnows were also exposed to UV treated Outfall 101 and intake samples since fish pathogens present in intake water have been the suspected cause of interference (anomalous dose response and high variability among replicates) in previous toxicity testing at Sequoyah.

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	11-15-09 0944 to 11-16-09 0844	11-17-09 1315	0.6, 0.7	<0.10	11-17-09 1500 11-18-09 1413
Intake	11-15-09 1014 to 11-16-09 0914	11-17-09 1315	1.1	<0.10	11-17-09 1500 11-18-09 1413
101	11-17-09 0745 to 11-18-09 0645	11-18-09 1505	1.3, 1.4	<0.10	11-19-09 1400 11-20-09 1411
Intake	11-17-09 0805 to 11-18-09 0705	11-18-09 1505	0.7	<0.10	11-19-09 1400 11-20-09 1411
101	11-19-09 0735 to 11-20-09 0635	11-20-09 1440	0.8, 0.9	<0.10	11-20-09 1405 11-21-09 1418 11-22-09 1410
Intake	11-19-09 0756 to 11-20-09 0656	11-20-09 1440	1.0	<0.10	11-20-09 1405 11-21-09 1418 11-22-09 1410

*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.

	Pimephales promelas	*Ceriodaphnia dubia*
Test Organisms:		
1. Source:	Aquatox, Inc.	In-house Cultures
2. Age:	22.50-22.73 hours old	<24-hours old
Test Method Summary:		
1. Test Conditions:	Static, Renewal	Static, Renewal
2. Test Duration:	7 days	Until at least 60% of control females have 3 broods
3. Control / Dilution Water:	Moderately Hard Synthetic	Moderately Hard Synthetic
4. Number of Replicates:	4	10
5. Organisms per Replicate:	10	1
6. Test Initiation: (Date/Time)		
Outfall 101	11-17-09 1444 ET	11-17-09 1500 ET
UV Treated Outfall 101	11-17-09 1430 ET	
7. Test Termination: (Date/Time)		
Outfall 101	11-24-09 1346 ET	11-24-09 1402 ET
UV Treated Outfall 101	11-24-09 1331 ET	
8. Test Temperature: Outfall 101:	Mean = 24.8°C (24.5 – 25.3°C)	Mean = 24.9°C (24.6 - 25.3°C)

Test Temperature: UV-Treated Outfall 101: Mean = 24.9°C (24.5 - 25.3°C)

9. Physical / Chemical Measurements: 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.

10. Statistics: Statistics were performed according to methods prescribed by EPA using ToxCalc version 5.0 statistical software (Tidepool Scientific Software, McKinneyville, CA).

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 November 17 – 24, 2009 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
11.3%	100	100	100	100	100	100	100
22.6%	100	100	100	100	100	100	100
45.2%	100	100	100	98	98	98	98
72.6%	100	100	100	100	100	100	100
100.0%	100	100	100	100	100	100	100
Intake	100	100	100	98	90	88	88

Test Solutions (% Effluent)	Mean Dry Weight (mg) (replicate number)				
	1	2	3	4	Mean
Control	0.830	0.817	0.842	0.797	0.822
11.3%	0.857	0.820	0.819	0.839	0.834
22.6%	0.849	0.792	0.794	0.884	0.830
45.2%	0.782	0.832	0.849	0.772	0.809
72.6%	0.806	0.758	0.770	0.781	0.779
100.0%	0.852	0.792	0.697	0.716	0.764
Intake	0.397	0.778	0.801	0.889	0.716

IC_{25} Value: > 100% Permit Limit: 45.2% 95% Confidence Limits: Upper Limit: NA Lower Limit: NA	Calculated TU Estimates: < 1.0 TUc* Permit Limit: 2.2 TUc

*TUa = $100/LC_{50}$: TUc = $100/IC_{25}$

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 November 17 – 24, 2009 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
11.3%	100	100	100	100	100	100	100
22.6%	100	100	100	100	100	100	100
45.2%	100	100	100	100	100	100	100
72.6%	100	100	100	100	100	100	100
100.0%	100	100	100	100	100	100	100

Test Solutions (% Effluent)	Reproduction (#young/female/6 days) Data (replicate number)										
	1	2	3	4	5	6	7	8	9	10	Mean
Control	32	29	26	30	27	30	28	29	31	33	29.5
11.3%	32	31	28	31	30	30	30	28	29	33	30.2
22.6%	32	32	29	32	32	32	32	32	32	34	31.9
45.2%	33	34	33	31	32	36	30	34	33	32	32.8
72.6%	33	34	34	32	37	33	38	34	30	32	33.7
100.0%	35	36	32	36	34	36	38	36	38	38	35.9

IC_{25} Value: > 100% Permit Limit: 45.2% 95% Confidence Limits: Upper Limit: NA Lower Limit: NA	Calculated TU Estimates: < 1.0 TUc* Permit Limit: 2.2 TUc

*TUa = 100/LC_{50}: TUc = 100/ IC_{25}

TOXICITY TEST RESULTS (see Appendix C for Bench Sheets)

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

Conducted November 17 – 24, 2009 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/6 days) Data (replicate number)										
	1	2	3	4	5	6	7	8	9	10	Mean
Control	31	27	30	32	28	30	31	30	31	28	29.8
Intake	38	35	33	30	29	33	32	31	31	33	32.5

IC_{25} Value: > 100% Permit Limit: N/A 95% Confidence Limits: Upper Limit: NA Lower Limit: NA	Calculated TU Estimates: < 1.0 TUc* Permit Limit: N/A

*TUa = 100/LC_{50}: TUc = 100/ IC_{25}

TOXICITY TEST RESULTS, UV-TREATED (see Appendix C for Bench Sheets)

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

Conducted November 17 – 24, 2009 using effluent from UV Treated 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
11.3%	100	100	100	100	100	98	98
22.6%	100	100	100	100	100	100	100
45.2%	100	100	100	100	100	100	100
72.6%	100	100	100	100	100	100	100
100.0%	100	100	100	100	100	100	100
Intake	100	100	100	100	100	100	100

Test Solutions (% Effluent)	Mean Dry Weight (mg) (replicate number)				
	1	2	3	4	Mean
Control	0.848	0.718	0.772	0.870	0.802
11.3%	0.876	0.857	0.764	0.755	0.813
22.6%	0.749	0.796	0.854	0.806	0.801
45.2%	0.724	0.816	0.825	0.865	0.808
72.6%	0.890	0.775	0.856	0.814	0.834
100.0%	0.775	0.757	0.939	0.867	0.835
Intake	0.813	0.726	0.780	0.770	0.772

IC_{25} Value: > 100% 95% Confidence Limits: Upper Limit: NA Lower Limit: NA	Calculated TU Estimates: < 1.0 TUc*

*TUa = 100/LC_{50}: TUc = 100/ IC_{25}

REFERENCE TOXICANT TEST RESULTS (see Appendix A and D)

Species	Date	Time	Duration	Toxicant	Results (IC_{25})
Pimephales promelas	November 17-24, 2009	1220	7-days	KCl	0.79 g/L
Ceriodaphnia dubia	November 10-17, 2009	1115	6-days	NaCl	1.07 g/L

PHYSICAL/CHEMICAL SUMMARY

Water Chemistry Mean Values and Ranges for *Pimephales promelas* and *Ceriodaphnia dubia* Tests, Non-treated Sequoyah Nuclear Plant (SQN) Outfall 101 performed November 17-24, 2009.

Test	Sample ID	Temperature (°C)		Dissolved Oxygen (mg/L)		pH (S.U.)		Conductance	Alkalinity	Hardness	Total Residual
		Initial	Final	Initial	Final	Initial	Final	(µmhos/cm)	(mg/L $CaCO_3$)	(mg/L $CaCO_3$)	Chlorine (mg/L)
Pimephales promelas	Control	24.8	24.7	7.8	7.4	7.58	7.37	332	62	90	-
		24.7 - 24.8	24.6 - 24.8	7.6 - 8.0	6.9 - 7.7	7.42 - 7.79	7.20 - 7.56	325 - 336	61 - 62	88 - 90	- -
	11.3%	24.8	24.7	7.9	7.3	7.66	7.32	308	-	-	-
		24.7 - 25.0	24.5 - 24.9	7.7 - 8.2	6.9 - 7.6	7.57 - 7.79	7.15 - 7.50	297 - 317	- -	- -	- -
	22.6%	24.9	24.8	8.0	7.1	7.63	7.29	291	-	-	-
		24.7 - 25.0	24.6 - 25.0	7.8 - 8.2	6.3 - 7.6	7.53 - 7.74	7.11 - 7.50	280 - 299	- -	- -	- -
	45.2%	24.9	24.8	8.0	7.1	7.61	7.29	256	-	-	-
		24.7 - 25.1	24.6 - 25.0	7.7 - 8.2	6.4 - 7.7	7.47 - 7.73	7.14 - 7.51	249 - 266	- -	- -	- -
	72.6%	24.9	24.7	8.1	7.2	7.57	7.28	218	-	-	-
		24.7 - 25.1	24.5 - 24.9	7.7 - 8.3	6.6 - 7.8	7.41 - 7.70	7.04 - 7.51	211 - 225	- -	- -	- -
	100.0%	25.0	24.7	8.1	7.2	7.52	7.25	172	75	87	< 0.10
		24.7 - 25.3	24.5 - 25.1	7.7 - 8.3	6.5 - 7.7	7.32 - 7.67	7.01 - 7.46	166 - 181	62 - 96	69 - 110	< 0.10 - < 0.10
	Intake	24.9	24.7	8.2	7.2	7.49	7.24	170	63	75	< 0.10
		24.8 - 25.0	24.6 - 25.1	7.8 - 8.4	6.5 - 7.9	7.26 - 7.64	7.01 - 7.49	163 - 179	58 - 66	69 - 82	< 0.10 - < 0.10
Ceriodaphnia dubia	Control	24.8	25.0	7.8	7.9	7.58	7.59	332	62	90	-
		24.6 - 24.9	24.9 - 25.3	7.6 - 8.0	7.7 - 8.1	7.42 - 7.79	7.51 - 7.71	325 - 336	61 - 62	88 - 90	- -
	11.3%	24.8	25.0	7.9	7.9	7.66	7.59	309	-	-	-
		24.7 - 24.9	24.9 - 25.2	7.7 - 8.2	7.6 - 8.1	7.57 - 7.79	7.52 - 7.71	297 - 317	- -	- -	- -
	22.6%	24.9	25.0	8.0	7.9	7.63	7.59	291	-	-	-
		24.7 - 25.0	25.0 - 25.1	7.8 - 8.2	7.5 - 8.1	7.53 - 7.74	7.52 - 7.71	280 - 299	- -	- -	- -
	45.2%	24.9	25.0	8.0	7.9	7.61	7.58	256	-	-	-
		24.7 - 25.0	24.9 - 25.2	7.7 - 8.2	7.6 - 8.2	7.47 - 7.73	7.51 - 7.71	249 - 266	- -	- -	- -
	72.6%	24.9	24.9	8.1	7.9	7.57	7.57	218	-	-	-
		24.8 - 25.0	24.8 - 25.1	7.7 - 8.3	7.6 - 8.2	7.41 - 7.70	7.48 - 7.69	211 - 225	- -	- -	- -
	100.0%	25.0	25.0	8.1	7.9	7.52	7.55	172	75	87	< 0.10
		24.8 - 25.2	24.8 - 25.2	7.7 - 8.3	7.6 - 8.2	7.32 - 7.67	7.46 - 7.66	166 - 181	62 - 96	69 - 110	< 0.10 - < 0.10
	Intake	25.0	25.0	8.2	7.9	7.49	7.56	170	63	75	< 0.10
		24.9 - 25.0	24.8 - 25.2	7.8 - 8.4	7.6 - 8.1	7.26 - 7.64	7.46 - 7.66	163 - 179	58 - 66	69 - 82	< 0.10 - < 0.10

Overall temperature (°C)	Average	Minimum	Maximum
Pimephales promelas	24.8	24.5	25.3
Ceriodaphnia dubia	24.9	24.6	25.3

PHYSICAL/CHEMICAL SUMMARY

Water Chemistry Mean Values and Ranges for *Pimephales promelas* Tests, UV-treated Sequoyah Nuclear Plant (SQN) Outfall 101 performed November 17-24, 2009.

Test	Sample ID	Temperature (°C)		Dissolved Oxygen (mg/L)		pH (S.U.)		Conductance	Alkalinity	Hardness
		Initial	Final	Initial	Final	Initial	Final	(µmhos/cm)	(mg/L $CaCO_3$)	(mg/L $CaCO_3$)
Pimephales promelas	Control	24.8	24.8	8.0	7.3	7.61	7.35	321	61	89
		24.7 - 25.0	24.7 - 24.9	7.9 - 8.2	6.4 - 8.1	7.53 - 7.68	7.19 - 7.53	312 - 332	61 - 62	86 - 90
	11.3%	24.9	24.8	7.9	7.3	7.62	7.33	308		
		24.8 - 25.1	24.6 - 25.0	7.7 - 8.0	6.9 - 7.6	7.54 - 7.68	7.16 - 7.51	301 - 312		
	22.6%	24.9	24.7	7.9	7.3	7.61	7.33	293		
		24.8 - 25.1	24.6 - 24.9	7.8 - 8.1	7.1 - 7.7	7.53 - 7.69	7.16 - 7.52	290 - 299		
	45.2%	25.0	24.8	8.0	7.3	7.59	7.31	265		
		24.8 - 25.2	24.7 - 24.8	7.9 - 8.1	7.0 - 7.7	7.49 - 7.68	7.15 - 7.49	259 - 273		
	72.6%	25.0	24.8	8.0	7.2	7.55	7.30	218		
		24.8 - 25.2	24.6 - 25.0	7.8 - 8.1	6.8 - 7.7	7.43 - 7.65	7.11 - 7.48	214 - 223		
	100.0%	25.1	24.8	8.0	7.3	7.51	7.28	173	63	74
		24.9 - 25.3	24.7 - 24.9	8.0 - 8.2	6.9 - 7.8	7.37 - 7.62	7.09 - 7.47	169 - 181	58 - 68	65 - 78
	Intake	25.0	24.7	8.1	7.3	7.51	7.26	171	63	72
		24.9 - 25.2	24.5 - 24.8	8.0 - 8.3	6.9 - 7.8	7.37 - 7.61	7.07 - 7.47	160 - 189	60 - 66	69 - 78

Overall temperature (°C)	Average	Minimum	Maximum
Pimephales promelas	24.9	24.5	25.3

SUMMARY / CONCLUSIONS

Outfall 101 samples collected November 15-20, 2009, showed no toxic effects to fathead minnows or daphnids. The resulting IC_{25} 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.

Fathead minnows were also exposed to UV treated Outfall 101 and intake samples since fish pathogens present in intake water have been the suspected cause of interference (anomalous dose response and high variability among replicates) in previous toxicity testing at Sequoyah. At the time this study was conducted, insignificant mortality occurred in minnows exposed to non-treated and UV treated samples.

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*

   None

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.

4. Dissolved oxygen was measured by SM 4500 O G.

5. The pH was measured by SM 4500 H+ B.

6. Conductance was measured by SM 2510 B.

7. Alkalinity was measured by SM 2320 B.

8. Total hardness was measured by SM 2340 C.

9. Total residual chlorine was measured by ORION Electrode Method 97-70.

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 IC_{25} 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, 21st Edition, 2005.

4. Quality Assurance Program: Standard Operating Procedures, Environmental Testing Solutions, Inc (most current version).

Sequoyah Nuclear Plant Biomonitoring
November 17 – 24, 2009

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 Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – November 20, 2009

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
03/12/1998	0.016	-	-	-	-	-	-
03/13/1998	0.015	-	-	-	-	-	-
03/14/1998	0.013	-	-	-	-	-	-
03/15/1998	0.030	-	-	-	-	-	-
03/16/1998	0.013	-	-	-	-	-	-
03/17/1998	0.020	-	-	-	-	-	-
03/18/1998	0.018	-	-	-	-	-	-
09/08/1998	0.015	-	0.014	0.005	-	-	0.021
09/09/1998	0.003	-	0.031	0.011	-	-	-
09/10/1998	0.014	-	0.060	0.021	-	-	-
09/11/1998	0.013	-	0.055	0.019	-	-	-
09/12/1998	< 0.001	-	0.044	0.015	-	-	-
09/13/1998	< 0.001	-	0.044	0.015	-	-	-
09/14/1998	0.008	-	0.044	0.015	-	-	-
02/22/1999	< 0.001	-	-	-	-	-	-
02/23/1999	0.005	-	-	-	-	-	-
02/24/1999	0.009	-	-	-	-	-	-
02/25/1999	0.012	-	-	-	-	-	-
02/26/1999	0.008	-	-	-	-	-	-
02/27/1999	< 0.001	-	-	-	-	-	-
02/28/1999	< 0.001	-	-	-	-	-	-
08/18/1999	-	0.015	0.069	0.024	0.006	-	-
08/19/1999	-	0.012	0.068	0.024	-	-	-
08/20/1999	-	0.023	0.070	0.024	-	0.120	-
08/21/1999	-	0.022	0.068	0.024	-	-	-
08/22/1999	-	0.022	0.068	0.024	-	-	-
08/23/1999	-	0.025	0.068	0.024	0.006	-	-
08/24/1999	-	0.016	0.067	0.023	0.020	-	-

Table B-1. Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – November 20, 2009

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
01/31/2000	-	< 0.002	0.026	0.009	-	-	-
02/01/2000	-	0.011	0.026	0.028	-	-	-
02/02/2000	-	0.028	0.026	0.009	0.006	-	-
02/03/2000	-	0.008	0.027	0.009	-	-	-
02/04/2000	-	0.006	0.027	0.009	0.005	0.109	-
02/05/2000	-	< 0.002	0.027	0.009	-	-	-
02/06/2000	-	< 0.002	0.027	0.009	-	-	-
07/26/2000	-	< 0.0057	0.055	0.019	-	-	-
07/27/2000	-	0.019	0.055	0.019	-	-	-
07/28/2000	-	0.0088	0.053	0.018	0.004	0.108	-
07/29/2000	-	< 0.0088	0.055	0.019	-	-	-
07/30/2000	-	< 0.0076	0.055	0.019	-	-	-
07/31/2000	-	< 0.0152	0.055	0.019	0.006	-	-
08/01/2000	-	< 0.0141	0.055	0.019	0.005	-	-
12/11/2000	-	0.0143	0.025	0.020	0.005	-	-
12/12/2000	-	0.0092	0.025	0.020	0.005	-	-
12/13/2000	-	< 0.0120	0.025	0.020	-	-	-
12/14/2000	-	< 0.0087	0.025	0.020	-	-	-
12/15/2000	-	0.0120	0.025	0.020	0.005	-	-
12/16/2000	-	< 0.0036	0.025	0.020	-	-	-
12/17/2000	-	< 0.0036	0.025	0.020	-	-	-
08/26/2001	-	0.017	0.06	0.021	0.006	-	-
08/27/2001	-	<0.0096	0.06	0.021	0.005	-	0.021
08/28/2001	-	<0.0085	0.06	0.021	-	-	-
08/29/2001	-	<0.0094	0.059	0.020	0.005	-	0.021
08/30/2001	-	<0.0123	0.06	0.021	0.005	-	-
08/31/2001	-	<0.005	0.059	0.020	-	-	-
11/25/2001	-	<0.0044	-	-	-	-	-
11/26/2001	-	<0.0119	0.024	0.02	0.005	-	-
11/27/2001	-	0.0137	0.023	0.019	0.007	-	-
11/28/2001	-	<0.0089	0.022	0.019	0.006	-	-
11/29/2001	-	0.0132	0.024	0.02	0.007	-	-
11/30/2001	-	< 0.0043	0.024	0.02	-	-	-
12/09/2001	-	<0.0042	-	-	-	-	-
12/10/2001	-	<0.0042	-	-	-	-	-
12/11/2001	-	<0.0104	-	-	-	-	-
12/12/2001	-	0.0128	0.024	0.02	0.008	-	-
12/13/2001	-	<0.0088	0.024	0.02	-	-	-
12/14/2001	-	0.0134	0.024	0.02	0.007	-	-

Table B-1. Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – November 20, 2009

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
01/02/2002	-	< 0.0079	0.023	0.02	0.006	-	-
01/03/2002	-	< 0.0042	0.023	0.014	-	-	-
01/04/2002	-	0.0124	0.024	0.014	0.009	-	-
01/05/2002	-	< 0.0042	-	-	-	-	-
01/06/2002	-	< 0.0042	-	-	-	-	-
01/07/2002	-	< 0.0089	0.024	0.014	0.006	-	-
02/24/2002	-	< 0.004	-	-	-	-	-
02/25/2002	-	< 0.004	0.023	0.023	-	-	-
02/26/2002	-	0.0143	0.023	0.023	0.007	-	-
02/27/2002	-	< 0.0041	0.023	0.023	-	-	-
02/28/2002	-	< 0.0041	0.024	0.008	-	-	-
03/01/2002	-	< 0.0041	0.024	0.008	-	-	-
05/05/2002	-	-	-	-	-	-	-
05/06/2002	-	-	0.058	0.02	0.014	-	-
05/07/2002	-	-	0.058	0.02	0.015	-	-
05/08/2002	-	-	0.056	0.019	-	-	-
05/09/2002	-	-	0.057	0.02	0.014	-	-
05/10/2002	-	-	0.056	0.019	-	-	-
08/04/2002	-	<0.0058	-	-	-	-	-
08/05/2002	-	<0.0058	0.053	0.018	-	-	0.025
08/06/2002	-	0.0092	0.053	0.018	-	-	-
08/07/2002	-	<0.0107	0.055	0.019	0.007	-	-
08/08/2002	-	<0.0061	0.055	0.019	-	-	-
08/09/2002	-	0.0152	0.054	0.018	0.008	-	-
10/06/2002	-	<0.00497	-	-	-	-	-
10/07/2002	-	0.0153	0.054	0.018	0.009	-	-
10/08/2002	-	<0.0092	0.054	0.018	0.007	-	-
10/09/2002	-	0.0124	0.053	0.018	0.009	-	-
10/10/2002	-	0.0134	0.054	0.018	0.009	-	-
10/11/2002	-	<0.0042	0.054	0.018	-	-	-
01/12/2003	-	<0.0035	-	-	-	-	-
01/13/2003	-	<0.006	0.025	0.019	0.009	-	-
01/14/2003	-	<0.0118	0.026	0.020	-	-	-
01/15/2003	-	<0.0063	0.026	0.020	0.009	-	-
01/16/2003	-	<0.0034	0.026	0.020	-	-	-
01/17/2003	-	<0.0034	0.026	0.009	-	-	-
04/06/2003	-	<0.0073	-	-	-	-	-
04/07/2003	-	<0.0189	-	0.021	-	-	-
04/08/2003	-	<0.0117	-	0.021	-	-	-
04/09/2003	-	<0.0139	-	0.021	0.016	-	-
04/10/2003	-	<0.0113	-	0.021	0.018	-	-
04/11/2003	-	<0.0073	-	0.022	-	-	-

Table B-1 (continued). Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Growth of Microbiologically Induced Bacteria and Mollusks, During Toxicity Test Sampling, March 12, 1998 – November 20, 2009

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
06/15/2003	-	< 0.0045	-	-	-	-	-
06/16/2003	-	< 0.0037	0.057	0.020	-	-	0.022
06/17/2003	-	< 0.0048	0.041	0.014	-	-	0.024
06/18/2003	-	< 0.0048	0.041	0.014	-	-	0.024
06/19/2003	-	< 0.0085	0.058	0.020	-	-	0.025
06/20/2003	-	< 0.0048	0.058	0.020	-	-	0.025
08/03/2003	-	<0.0050	-	-	-	-	-
08/04/2003	-	<0.0050	0.058	0.020	-	-	-
08/05/2003	-	<0.0051	0.057	0.020	-	-	0.025
08/06/2003	-	<0.0084	0.057	0.020	-	-	0.025
08/07/2003	-	0.0129	0.057	0.020	-	-	0.024
08/08/2003	-	0.0153	0.057	0.020	0.009	-	-
10/05/2003	-	<0.0043	0.057	0.020	-	-	-
10/06/2003	-	<0.0043	0.057	0.020	-	-	0.025
10/07/2003	-	<0.0090	0.057	0.020	-	-	0.025
10/08/2003	-	<0.0106	0.057	0.020	-	-	0.025
10/09/2003	-	0.0181	0.026	0.022	-	-	0.025
10/10/2003	-	0.0183	0.026	0.024	0.009	-	-
02/01/2004	-	0.0093	0.027	0.009	-	-	-
02/02/2004	-	<0.0034	0.026	0.009	-	-	-
02/03/2004	-	<0.0034	0.026	0.009	-	-	-
02/04/2004	-	0.0124	0.026	0.009	0.009	-	-
02/05/2004	-	<0.0034	0.026	0.009	-	-	-
02/06/2004	-	0.0105	0.026	0.009	0.010	-	-
05/04/2004	-	<0.0123	0.026	0.019	-	-	0.025
05/05/2004	-	<0.0144	0.026	0.014	0.009	-	0.025
05/06/2004	-	<0.0146	0.037	0.013	-	-	0.025
05/07/2004	-	0.0227	0.058	0.020	0.009	-	0.025
05/08/2004	-	0.016	0.060	0.021	-	-	-
05/09/2004	-	<0.0104	0.058	0.020	-	-	-
07/04/2004	-	0.0217	0.057	0.019	-	-	-
07/05/2004	-	<0.0085	0.057	0.020	0.009	-	-
07/06/2004	-	<0.0077	0.058	0.020	-	-	0.031
07/07/2004	-	0.0252	0.056	0.019	-	-	0.031
07/08/2004	-	0.0223	0.057	0.019	0.009	-	-
07/09/2004	-	0.0182	0.057	0.020	0.009	-	-

Table B-1. Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – November 20, 2009

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
11/07/2004	-	<0.0187	0.000	0.014	-	-	-	-	-
11/08/2004	-	<0.0192	0.047	0.030	-	-	-	-	-
11/09/2004	-	<0.0233	0.048	0.016	-	-	0.041	-	-
11/10/2004	-	<0.0149	0.047	0.016	-	-	0.041	-	-
11/11/2004	-	<0.0149	0.049	0.017	-	-	0.043	-	-
11/12/2004	-	<0.0253	0.048	0.017	-	-	0.042	-	-
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 (continued). Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Growth of Microbiologically Induced Bacteria and Mollusks, During Toxicity Test Sampling, March 12, 1998 – November 20, 2009

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 Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 –November 20, 2009

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
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	-	-	-	-	-	-	-	-

Sequoyah Nuclear Plant Biomonitoring
November 17 – 24, 2009

Appendix C

Chain of Custody Records and
Toxicity Test Bench Sheets

BIOMONITORING CHAIN OF CUSTODY RECORD

Page 2 of 102

Client: TVA

Project Name: Sequoyah NP Toxicity

P.O. Number: N/A

Facility Sampled: Sequoyah NP

NPDES Number: TN0026450

Collected By: Adam Deimling & Stephen Williams

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): Express Courier

General Comments:
Adam Deimling :
Stephen Williams :
Samples remained on ice throughout sampling and transport to lab. Dissolved Metals sample filtered and place on ice.

Field Identification / Sample Description	Grab/Comp	Collection Date/Time		Container Number & Volume Collected	Flow (MGD)	Rain Event? (Mark as Appropriate)				Laboratory Use: proj# 5012 SQN INT 091117.06	1.1°C	JL	1315	*
		Date (mm/dd/yy)	Time (EST)			Yes	If Yes, Inches	No	Trace	ETS Log Number	Arrival Temp (°C)	By	Time ET	Appearance
SQN-101-TOX A	Comp	11/15/09 – 11/16/09	0944 - 0844	1 (2.5gal)	870.34					091117.05	0.6°C	JL	1315	*
SQN-101-TOX B	Comp	11/15/09 – 11/16/09	0944 - 0844	1 (2.5gal)	870.34					↓	0.7°C	JL	1315	*
SQN-INT-TOX	Comp	11/15/09 – 11/16/09	1014 - 0914	1 (2.5 gal)	NA					* custody seals intact. Samples received in good condition. JL				

Sample Custody – Fill In From Top Down

* TRC ABSENT IN ALL SAMPLES

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
Adam Deimling TVA	12:30 ET 11/16/09	Express Courier BR Shiles	12:30 ET 11-16-09
Express Courier BR Shiles	11-17-09 1315 ET	ETS Jm/um	11-17-09 1315 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.

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: Adam Deimling & Stephen Williams

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): Express Courier

General Comments:
Adam Deimling : [signature]
Jonathan Walker : [signature]
Samples remained on ice throughout sampling and transport to lab. Dissolved Metals sample filtered and place on ice.

Field Identification / Sample Description	Grab/Comp	Collection Date/Time		Container Number & Volume Collected	Flow (MGD)	Rain Event? (Mark as Appropriate)				Laboratory Use				
		Date (mm/dd/yy)	Time (EST)			Yes	If Yes, Inches	No	Trace	ETS Log Number	Arrival Temp (°C)	By	Time ET	Appearance
SQN-101-TOX A	Comp	11/17/09 – 11/18/09	0745 - 0645	1 (2.5gal)	872.78		0.18			091118 03	1.3 °C	[illegible]	1505	*
SQN-101-TOX B	Comp	11/17/09 – 11/18/09	0745 - 0645	1 (2.5gal)	872.78		0.18			091118-03	1.4 °C	[illegible]	1505	*
SQN-INT-TOX	Comp	11/17/09 – 11/18/09	0805 - 0705	1 (2.5 gal)	NA		0.18			091118 04	0.7 °C	[illegible]	1505	*

project # 5812

Sample Custody – Fill In From Top Down

* Custody seals intact. Samples received in good condition. [signature]
* TRC ABSENT IN ALL SAMPLES

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
Adam Deimling [signature] TVA	1005 ET 11-18-09	Express Courier BR Shiles	10:05 ET 11-18-09
Express Courier BR Shiles	11-18-09 1505 ET	ETS [signature]	11-18-09 1505 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.

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: Adam Deimling & Stephen Williams

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): Express Courier

General Comments:
Adam Deimling :
Stephen Williams :
Samples remained on ice throughout sampling and transport to lab. Dissolved Metals sample filtered and place on ice.

Field Identification / Sample Description	Grab/Comp	Collection Date/Time		Container Number & Volume Collected	Flow (MGD)	Rain Event? (Mark as Appropriate)				Project # 5812 Laboratory Use				
		Date (mm/dd/yy)	Time (EST)			Yes	If Yes, Inches	No	Trace	ETS Log Number	Arrival Temp. (°C)	By	Time ET	Appearance
SQN-101-TOX A	Comp	11/19/09 – 11/20/09	0735 - 0635	1 (2.5gal)	1760.46					091120.04	0.8°C		1440	*
SQN-101-TOX B	Comp	11/19/09 – 11/20/09	0735 - 0635	1 (2.5gal)	1760.46					091120.04	0.9°C		1440	*
SQN-INT-TOX	Comp	11/19/09 – 11/20/09	0756 - 0656	1 (2.5 gal)	NA					091120.05	1.0°C		1440	*

Sample Custody – Fill In From Top Down

* Custody seals intact. Sample received in good condition. TRC ABSENT IN ALL SAMPLES.

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
Adam Deimling	11-20-09 0950 ET	Express Courier BR Skiles	11-20-09 - 09:50 ET
Express Courier BR Skiles	11-20-09 ~~0950~~ 1440 ET	ETS	11-20-09 1440 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.

ETS
Environmental Testing Solutions, Inc.

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 #: ~~TN0020168~~ TN0026450
Project #: 5812

County: ~~Rhea~~ HAMILTON
Outfall: 101

Dilution preparation information:						*Comments:*
Dilution prep (%)	11.3	22.6	45.2	72.6	100	
Effluent volume (mL)	282.5	565	1130	1815	2500	
Diluent volume (mL)	2217.5	1935	1370	685	0	
Total volume (mL)	2500	2500	2500	2500	2500	

Test organism information:		*Test information:*	
Organism age:	22.73 HOURS OLD	Randomizing template:	Yellow
Date and times organisms were born between:	11-16-09 1600	Incubator number and shelf location:	3C
Organism source:	ATOX BATCH 11-16-09	*Artemia* CHM number:	CHM444
		Drying information for weight determination:	
Transfer bowl information:	pH = 7.50 S.U. Temperature = 24.7°C	Date / Time in oven:	11-24-09 1350
		Initial oven temperature:	60°C
Average transfer volume:	0.2305 ml	Date / Time out of oven:	11-25-09 1350
		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	11-17-09	—	—	1600	JH	1444	JH	091117.05	091117.06	11-12-09 A
1	11-18-09	0800	JH	1400	JH	1348	JH	091117.05	091117.06	11-12-09 A
2	11-19-09	0800	JH	1400	JH	1345	JH	091118.03	091118.04	11-12-09 B
3	11-20-09	0800	JH	1400	JH	1349	JH	091118.03	091118.04	11-12-09 B
4	11-21-09	0800	JH	1400	JH	1345	JH	091120.04	091120.05	11-17-09
5	11-22-09	0800	JH	1400	JH	1350	JH	091120.04	091120.05	11-19-09
6	11-23-09	0800	JH	1400	JH	1347	JH	091120.04	091120.05	11-19-09
7	11-24-09					1346	JH			

Control information:		Acceptance criteria	*Summary of test endpoints:*	
% Mortality:	0%	≤20%	7-day LC_{50}	>100%
Average weight per initial larvae:	0.822		NOEC	100%
Average weight per surviving larvae:	0.822	≥ 0.25mg/larvae	LOEC	>100%
			ChV	>100%
			IC_{25}	>100%

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas***
Client: **TVA / Sequoyah Nuclear Plant, Outfall 101, Non-treated** **Date:** 11-17-09

Survival and Growth Data

Day	CONTROL Non-treated				11.3%				22.6%			
	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:: Purple Analyst: KS Date: 10-29-09	13.60	14.25	13.11	15.55	13.18	14.47	14.12	13.60	13.09	14.93	14.42	14.65
B = Pan + Larvae weight (mg) Analyst: MS Date: 12-01-09	21.90	22.42	21.53	23.52	21.75	22.67	22.31	21.99	21.58	22.85	22.36	23.49
C = Larvae weight (mg) = B – A	8.30	8.17	8.42	7.97	8.57	8.20	8.19	8.39	8.49	7.92	7.94	8.84
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.830	0.817	0.842	0.797	0.857	0.820	0.819	0.839	0.849	0.792	0.794	0.884
Average weight per initial number of larvae (mg)	0.822				0.834				0.830			
Percent reduction from control (%)					-1.5%				-1.0%			

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.

Calculations and data reviewed: [illegible]

Comments:

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas***
Client: **TVA / Sequoyah Nuclear Plant, Outfall 101, Non-treated** **Date:** 11-17-09

Survival and Growth Data

Day	45.2%				72.6%				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	9 d	10	10	10	10	10	10	10	10	10	10
5	10	9	10	10	10	10	10	10	10	10	10	10
6	10	9	10	10	10	10	10	10	10	10	10	10
7	10	9 lg	10	10	10	10	10	10	10	10	10 ISM	10 ISM
A = Pan weight (mg) Tray color code:: Purple Analyst: KIS Date: 10-29-09	13.13	14.12	13.99	11.91	14.05	14.01	15.77	14.91	13.61	14.38	13.83	15.26
B = Pan + Larvae weight (mg) Analyst: MJ Date: 12-01-09	20.95	22.44	22.48	19.63	22.11	21.59	23.47	22.72	22.13	22.30	20.80	22.42
C = Larvae weight (mg) = B – A	7.82	8.32	8.49	7.72	8.06	7.58	7.70	7.81	8.52	7.92	6.97	7.16
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.782	0.832	0.849	0.772	0.806	0.758	0.770	0.781	0.852	0.792	0.697	0.716
Average weight per initial number of larvae (mg)	0.809				0.779				0.764			
Percent reduction from control (%)			1.6%				5.2%				7.0%	

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.

Calculations and data reviewed: [illegible]

Comments:

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas***
Client: **TVA / Sequoyah Nuclear Plant, Outfall 101, Non-treated** **Date:** 11-17-09

Survival and Growth Data

Day	100% Intake			
	Y	Z	AA	BB
0	10	10	10	10
1	10	10	10	10
2	10	10	10	10
3	10	10	10	10
4	9 1dFG	10	10	10
5	6 3dFG	10	10	10
6	5 1dFG	10	10	10
7	5	10	10	10
A = Pan weight (mg) Tray color code:: Purple Analyst: KLS Date: 10-29-09	14.87	13.41	14.49	14.40
B = Pan + Larvae weight (mg) Analyst: BW Date: 12.01.09	18.84	21.19	22.50	23.29
C = Larvae weight (mg) = B – A	3.97	7.78	8.01	8.89
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.397	0.778	0.801	0.889
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.716		12.87%	

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.

Calculations and data reviewed: JH

Comments:

TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
November 17-24, 2009

ETS
Environmental Testing Solutions, Inc.

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: 5812
Reveiwed by:

Concentration (%)	Replicate	Initial number of larvae	Final number of larvae	A = Pan weight (mg)	B = Pan + Larvae weight (mg)	Larvae weight (mg) = A - B	Not for Compliance Assessment, Internal Laboratory QC: 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 (Mean weight per initial number of larvae) (%)	Percent reduction from control (%)
Control	A	10	10	13.60	21.90	8.30	0.830	0.822	2.3	0.830	100.0	0.822	2.3	Not applicable
	B	10	10	14.25	22.42	8.17	0.817			0.817				
	C	10	10	13.11	21.53	8.42	0.842			0.842				
	D	10	10	15.55	23.52	7.97	0.797			0.797				
11.3%	E	10	10	13.18	21.75	8.57	0.857	0.834	2.2	0.857	100.0	0.834	2.2	-1.5
	F	10	10	14.47	22.67	8.20	0.820			0.820				
	G	10	10	14.12	22.31	8.19	0.819			0.819				
	H	10	10	13.60	21.99	8.39	0.839			0.839				
22.6%	I	10	10	13.09	21.58	8.49	0.849	0.830	5.4	0.849	100.0	0.830	5.4	-1.0
	J	10	10	14.93	22.85	7.92	0.792			0.792				
	K	10	10	14.42	22.36	7.94	0.794			0.794				
	L	10	10	14.65	23.49	8.84	0.884			0.884				
45.2%	M	10	10	13.13	20.95	7.82	0.782	0.832	8.5	0.782	97.5	0.809	4.6	1.6
	N	10	9	14.12	22.44	8.32	0.924			0.832				
	O	10	10	13.99	22.48	8.49	0.849			0.849				
	P	10	10	11.91	19.63	7.72	0.772			0.772				
72.6%	Q	10	10	14.05	22.11	8.06	0.806	0.779	2.6	0.806	100.0	0.779	2.6	5.2
	R	10	10	14.01	21.59	7.58	0.758			0.758				
	S	10	10	15.77	23.47	7.70	0.770			0.770				
	T	10	10	14.91	22.72	7.81	0.781			0.781				
100%	U	10	10	13.61	22.13	8.52	0.852	0.764	9.4	0.852	100.0	0.764	9.4	7.0
	V	10	10	14.38	22.30	7.92	0.792			0.792				
	W	10	10	13.83	20.80	6.97	0.697			0.697				
	X	10	10	15.26	22.42	7.16	0.716			0.716				
100% Intake	Y	10	5	14.87	18.84	3.97	0.794	0.816	6.1	0.397	87.5	0.716	30.5	12.8
	Z	10	10	13.41	21.19	7.78	0.778			0.778				
	AA	10	10	14.49	22.50	8.01	0.801			0.801				
	BB	10	10	14.40	23.29	8.89	0.889			0.889				

Outfall 101:
Dunnett's MSD value: 0.0683
PMSD: 8.3

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: 0.2577
PMSD: 31.4

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).

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.

TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
November 17-24, 2009
Statistical Analyses

ETS Environmental Testing Solutions, Inc.

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	11/17/2009	Test ID:	PpFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101
End Date:	11/24/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	Non-treated				

Conc-%	1	2	3	4
D-Control	0.8300	0.8170	0.8420	0.7970
11.3	0.8570	0.8200	0.8190	0.8390
22.6	0.8490	0.7920	0.7940	0.8840
45.2	0.7820	0.8320	0.8490	0.7720
72.6	0.8060	0.7580	0.7700	0.7810
100	0.8520	0.7920	0.6970	0.7160
Intake	0.3970	0.7780	0.8010	0.8890

			Transform: Untransformed						1-Tailed		Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.8215	1.0000	0.8215	0.7970	0.8420	2.345	4				0.8283	1.0000
11.3	0.8338	1.0149	0.8338	0.8190	0.8570	2.162	4	-0.432	2.410	0.0683	0.8283	1.0000
22.6	0.8298	1.0100	0.8298	0.7920	0.8840	5.397	4	-0.291	2.410	0.0683	0.8283	1.0000
45.2	0.8088	0.9845	0.8088	0.7720	0.8490	4.641	4	0.450	2.410	0.0683	0.8088	0.9764
72.6	0.7788	0.9480	0.7788	0.7580	0.8060	2.626	4	1.509	2.410	0.0683	0.7788	0.9401
100	0.7643	0.9303	0.7643	0.6970	0.8520	9.351	4	2.020	2.410	0.0683	0.7643	0.9226
Intake	0.7163	0.8719	0.7163	0.3970	0.8890	30.456	4					

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.98188138	0.884	0.392664346	0.32317638
Bartlett's Test indicates equal variances (p = 0.14)	8.39288521	15.0862722		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	100	>100		1	0.06829131	0.08313002	0.00325397	0.00160593	0.123331696	5, 18
Treatments vs D-Control										

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)	Skew
IC05	65.141			
IC10	>100			
IC15	>100			
IC20	>100			
IC25	>100			
IC40	>100			
IC50	>100			

TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
Non-treated
November 17-24, 2009

ETS
Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	11/17/2009	Test ID:	PpFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
End Date:	11/24/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	Non-treated				

Conc-%	1	2	3	4
D-Control	0.8300	0.8170	0.8420	0.7970
11.3	0.8570	0.8200	0.8190	0.8390
22.6	0.8490	0.7920	0.7940	0.8840
45.2	0.7820	0.8320	0.8490	0.7720
72.6	0.8060	0.7580	0.7700	0.7810
100	0.8520	0.7920	0.6970	0.7160
Intake	0.3970	0.7780	0.8010	0.8890

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
D-Control	0.8215	1.0000	0.8215	0.7970	0.8420	2.345	4			
11.3	0.8338	1.0149	0.8338	0.8190	0.8570	2.162	4			
22.6	0.8298	1.0100	0.8298	0.7920	0.8840	5.397	4			
45.2	0.8088	0.9845	0.8088	0.7720	0.8490	4.641	4			
72.6	0.7788	0.9480	0.7788	0.7580	0.8060	2.626	4			
100	0.7643	0.9303	0.7643	0.6970	0.8520	9.351	4			
Intake	0.7163	0.8719	0.7163	0.3970	0.8890	30.456	4	0.961	2.353	0.2577

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.82512182	0.749	-1.7159101	4.30798649
F-Test indicates unequal variances (p = 2.30E-03)	128.264832	47.4672279		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Heteroscedastic t Test indicates no significant differences	0.25768323	0.31367405	0.02215513	0.02397863	0.37355912	1, 6
Treatments vs D-Control						

TVA / Sequoyah Nuclear Plant, Outfall 101 - Non-treated
November 17-24, 2009

ETS
Environmental Testing Solutions, Inc.

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

Daily Chemical Analyses

Project number: 5812
Reviewed by:

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)	7.48	7.50	7.63	7.41	7.50	7.44	7.71	7.56	7.55	7.20	7.42	7.23	7.79	7.24
	DO (mg/L)	7.8	7.5	7.6	7.3	7.7	7.5	7.8	7.7	7.9	7.5	7.8	6.9	8.0	7.1
	Conductivity (µmhos/cm)	325		332		328		332		336		334		334	
	Alkalinity (mg/L $CaCO_3$)	61				62				62		62			
	Hardness (mg/L $CaCO_3$)	90				90				90		88			
	Temperature (°C)	24.8	24.6	24.8	24.8	24.8	24.6	24.7	24.8	24.7	24.6	24.7	24.6	24.8	24.8
11.3%	pH (SU)	7.79	7.46	7.66	7.37	7.57	7.37	7.73	7.50	7.68	7.18	7.57	7.20	7.62	7.15
	DO (mg/L)	8.0	7.3	7.7	7.3	7.7	7.3	8.2	7.6	8.1	7.4	7.8	6.9	8.0	7.1
	Conductivity (µmhos/cm)	317		312		313		308		307		303		297	
	Temperature (°C)	25.0	24.6	24.9	24.9	24.9	24.8	24.7	24.5	24.8	24.8	24.7	24.8	24.8	24.8
22.6%	pH (SU)	7.74	7.44	7.62	7.35	7.56	7.33	7.72	7.50	7.65	7.17	7.53	7.11	7.61	7.14
	DO (mg/L)	8.0	7.4	7.8	7.1	7.9	7.2	8.2	7.6	8.0	7.3	7.9	6.3	8.1	6.8
	Conductivity (µmhos/cm)	299		293		296		288		296		286		280	
	Temperature (°C)	25.0	24.8	24.9	25.0	24.9	24.8	24.8	24.9	24.8	24.8	24.7	24.6	24.9	24.8
45.2%	pH (SU)	7.73	7.44	7.61	7.32	7.51	7.33	7.71	7.51	7.62	7.16	7.47	7.15	7.59	7.14
	DO (mg/L)	8.1	7.4	7.7	7.1	7.9	7.1	8.2	7.7	8.1	7.3	8.0	6.4	8.1	6.8
	Conductivity (µmhos/cm)	266		259		258		254		255		254		249	
	Temperature (°C)	25.1	24.9	24.9	25.0	24.9	24.9	25.0	24.9	24.8	24.7	24.7	24.6	24.9	24.7
72.6%	pH (SU)	7.70	7.43	7.59	7.29	7.48	7.33	7.67	7.51	7.60	7.23	7.41	7.15	7.56	7.04
	DO (mg/L)	8.1	7.3	7.7	7.0	7.9	7.1	8.2	7.8	8.3	7.4	8.2	6.6	8.2	6.9
	Conductivity (µmhos/cm)	225		221		222		217		213		217		211	
	Temperature (°C)	25.1	24.8	24.9	24.9	24.9	24.5	25.0	24.8	24.8	24.7	24.7	24.6	24.9	24.5
100%	pH (SU)	7.67	7.42	7.57	7.34	7.44	7.33	7.63	7.46	7.55	7.09	7.32	7.13	7.48	7.01
	DO (mg/L)	8.1	7.3	7.7	7.2	8.0	7.3	8.0	7.7	8.1	7.5	8.3	6.8	8.2	6.5
	Conductivity (µmhos/cm)	181		180		174		166		167		168		166	
	Alkalinity (mg/L $CaCO_3$)	96				66				62					
	Hardness (mg/L $CaCO_3$)	82				110				69					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	25.3	24.5	25.0	25.1	25.0	24.7	25.1	24.6	25.0	24.7	24.7	24.5	24.9	24.7
100% Intake	pH (SU)	7.57	7.43	7.57	7.34	7.42	7.33	7.64	7.49	7.52	7.07	7.26	7.04	7.47	7.01
	DO (mg/L)	8.3	7.6	7.8	7.2	8.1	7.4	8.2	7.9	8.1	7.5	8.4	6.5	8.2	6.5
	Conductivity (µmhos/cm)	178		179		172		164		167		167		163	
	Alkalinity (mg/L $CaCO_3$)	66				64				58					
	Hardness (mg/L $CaCO_3$)	82				69				73					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	25.0	24.7	25.0	25.1	24.8	24.7	25.0	24.6	25.0	24.6	24.9	24.6	24.9	24.7

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** **Date:** 11-17-09
Client: **TVA / Sequoyah Nuclear Plant, Outfall 101, Non-treated**
Daily Chemistry:

		Day					
		0		1		2	
	Analyst	KLK	KLK	KLK	LAB	LAB	KLK
Concentration	Parameter						
CONTROL Non-treated	pH (S.U.)	7.48	7.50	7.63	7.41	7.50	7.44
	DO (mg/L)	7.8	7.5	7.6	7.3	7.7	7.5
	Conductivity (µmhos/cm)	325		332		328	
	Alkalinity (mg $CaCO_3$/L)	61				62	
	Hardness (mg $CaCO_3$/L)	90				90	
	Temperature (°C)	24.8	24.6	24.8	24.8	24.8	24.6
11.3%	pH (S.U.)	7.79	7.46	7.66	7.37	7.57	7.37
	DO (mg/L)	8.0	7.3	7.7	7.3	7.7	7.3
	Conductivity (µmhos/cm)	317		312		313	
	Temperature (°C)	25.0	24.6	24.9	24.9	24.9	24.8
22.6%	pH (S.U.)	7.74	7.44	7.62	7.35	7.56	7.33
	DO (mg/L)	8.0	7.4	7.8	7.1	7.9	7.2
	Conductivity (µmhos/cm)	299		293		296	
	Temperature (°C)	25.0	24.8	24.9	25.0	24.9	24.8
45.2%	pH (S.U.)	7.73	7.44	7.61	7.32	7.51	7.33
	DO (mg/L)	8.1	7.4	7.7	7.1	7.9	7.1
	Conductivity (µmhos/cm)	266		259		258	
	Temperature (°C)	25.1	24.9	24.9	25.0	24.9	24.9
72.6%	pH (S.U.)	7.70	7.43	7.59	7.29	7.48	7.33
	DO (mg/L)	8.1	7.3	7.7	7.0	7.9	7.1
	Conductivity (µmhos/cm)	225		221		222	
	Temperature (°C)	25.1	24.8	24.9	24.9	24.9	24.5
100%	pH (S.U.)	7.67	7.42	7.57	7.34	7.44	7.33
	DO (mg/L)	8.1	7.3	7.7	7.2	8.0	7.3
	Conductivity (µmhos/cm)	181		180		174	
	Alkalinity (mg $CaCO_3$/L)	96				66	
	Hardness (mg $CaCO_3$/L)	82				110	
	TR chlorine (mg/L)	<0.10				<0.10	
	Temperature (°C)	25.3	24.5	25.0	25.1	25.0	24.7
100% Intake	pH (S.U.)	7.57	7.43	7.57	7.34	7.42	7.33
	DO (mg/L)	8.3	7.6	7.8	7.2	8.1	7.4
	Conductivity (µmhos/cm)	170		179		172	
	Alkalinity (mg $CaCO_3$/L)	66				64	
	Hardness (mg $CaCO_3$/L)	82				69	
	TR chlorine (mg/L)	<0.10				<0.10	
	Temperature (°C)	25.0	24.7	25.0	25.1	24.8	24.7
		Initial	Final	Initial	Final	Initial	Final

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas***
Client: **TVA / Sequoyah Nuclear Plant, Outfall 101, Non-treated** **Date:** 11-17-09

		Day							
		3		4 KEK		KEK 5		6	
	Analyst	KEK	LAB	LAB	BSC	BSC	KEK	KEK	KEK
Concen-tration	Parameter								
CONTROL Non-treated	pH (S.U.)	7.71	7.56	7.55	7.20	7.42	7.23	7.79	7.24
	DO (mg/L)	7.8	7.7	7.9	7.5	7.8	6.9 ~~8.0~~	8.0	7.1
	Conductivity (µmhos/cm)	332		336		334		334	
	Alkalinity (mg $CaCO_3$/L)			62		62			
	Hardness (mg $CaCO_3$/L)			90		88			
	Temperature (°C)	24.7	24.8	24.7	24.6	24.7	24.6	24.8	24.8
11.3%	pH (S.U.)	7.73	7.50	7.68	7.18	7.57	7.20	7.62	7.15
	DO (mg/L)	8.2	7.6	8.1	7.4	7.8	~~8.~~ 6.9	8.0	7.1
	Conductivity (µmhos/cm)	308		307		303		297	
	Temperature (°C)	24.7	24.5	24.8	24.8	24.7	24.8	24.8	24.8
22.6%	pH (S.U.)	7.72	7.50	7.65	7.17	7.53	7.11	7.61	7.14
	DO (mg/L)	8.2	7.6	8.0	7.3	7.9	6.3	8.1	6.8
	Conductivity (µmhos/cm)	288		296		286		280	
	Temperature (°C)	24.8	24.9	24.8	24.8	24.7	24.6	24.9	24.8
45.2%	pH (S.U.)	7.71	7.51	7.62	7.16	7.47	7.15	7.59	7.14
	DO (mg/L)	8.2	7.7	8.1	7.3	8.0	6.4	8.1	6.8
	Conductivity (µmhos/cm)	254		255		254		249	
	Temperature (°C)	25.0	24.9	24.8	24.7	24.7	24.6	24.9	24.7
72.6%	pH (S.U.)	7.67	7.51	7.60	7.23	7.41	7.15	7.56	7.04
	DO (mg/L)	8.2	7.8	8.3	7.4	8.2	6.6	8.2	6.9
	Conductivity (µmhos/cm)	217		213		217		211	
	Temperature (°C)	25.0	24.8	24.8	24.7	24.7	24.6	24.9	24.5
100%	pH (S.U.)	7.63	7.46	7.55	7.09	7.32	7.13	7.48	7.01
	DO (mg/L)	8.0	7.7	8.1	7.5	8.3	6.8	8.2	6.5
	Conductivity (µmhos/cm)	166		167		168		166	
	Alkalinity (mg $CaCO_3$/L)			62					
	Hardness (mg $CaCO_3$/L)			69					
	TR Chlorine (mg/L)			<0.10					
	Temperature (°C)	25.1	24.6	25.0	24.7	24.7	24.5	24.9	24.7
100% Intake	pH (S.U.)	7.64	7.49	7.52	7.07	7.26	7.04	7.47	7.01
	DO (mg/L)	8.2	7.9	8.1	7.5	8.4	6.5	8.2	6.5
	Conductivity (µmhos/cm)	164		167		167		163	
	Alkalinity (mg $CaCO_3$/L)			58					
	Hardness (mg $CaCO_3$/L)			73					
	TR chlorine (mg/L)			<0.10					
	Temperature (°C)	25.0	24.6	25.0	24.6	24.9	24.6	24.9	24.7
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

ETS Environmental Testing Solutions, Inc.

Chronic Whole Effluent Toxicity Test (EPA-821-R-02-013 Method 1002.0)
Species: *Ceriodaphnia dubia*

Client: Tennessee Valley Authority
Facility: Sequoyah Nuclear Plant
NPDES #: TN0026450
Project #: 5812

County: Hamilton
Outfall: 101

Dilution preparation information:						*Comments:*
Dilution prep (%)	11.3	22.6	45.2	72.6	100	
Effluent volume (mL)	282.5	565	1130	1815	2500	
Diluent volume (mL)	2217.5	1935	1370	685	0	
Total volume (mL)	2500	2500	2500	2500	2500	

Test organism source information:											*Test information:*	
Organism age:	< 24-hours old										Randomizing template color:	ORANGE
Date and times organisms were born between:	11-17-09 0700 TO 1200										Incubator number and shelf location:	2B
Culture board:	11-10-09 A											
Replicate number:	1	2	3	4	5	6	7	8	9	10	YWT batch:	11-05-09
Culture board cup number:	6	7	8	9	10	11	22	23	26	27		
Transfer vessel information:	pH = 7.59 S.U. Temperature = 25.0 °C										*Selenastrum* batch:	11-01-09
Average transfer volume (mL):	0.0375 mL											

Daily renewal information:

Day	Date	Test initiation and feeding, renewal and feeding, or termination time	MHSW batch used	Sample numbers used Outfall 101	Sample numbers used Intake	Analyst
0	11-17-09	1500	11-12-09A	091117.05	091117.06	JL
1	11-18-09	1413	11-12-09A	091117.05	091117.06	JL
2	11-19-09	1400	11-12-09B	091118.03	091118.04	JL
3	11-20-09	1411	11-12-09B	091118.03	091118.04	JL
4	11-21-09	1405	11-17-09	091120.04	091120.05	JL
5	11-22-09	1418	11-19-09	091120.04	091120.05	JL
6	11-23-09	1410	11-19-09	091120.04	091120.05	JL
7	11-24-09	1402				JL

Control information:	Control-1	Control-2	Acceptance criteria	*Summary of test endpoints:*	
% of Male Adults:	0%	0%	≤ 20%	7-day LC_{50}	>100%
% Adults having 3rd Broods:	100%	100%	≥ 80%	NOEC	100%
% Mortality:	0%	0%	≤ 20%	LOEC	>100%
Mean Offspring/Female:	29.5	29.8	≥ 15.0 offspring/female	ChV	>100%
% CV:	7.4%	5.4%	< 40.0 %	IC_{25}	>100%

ETS Environmental Testing Solutions, Inc.

Species: *Ceriodaphnia dubia*
Client: TVA / Sequoyah Nuclear Plant, Outfall 101 **Date:** 11-17-09

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	4	4	4	5	5	4	4	6	6
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	10	10	12	10	12	12	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	15	15	12	14	12	13	12	13	12	16
Total young produced		32	29	26	30	27	30	28	29	31	33
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3rd 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:	29.5

CONC: 11.3% ***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	4	4	4	5	5	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	11	13	12	13	13	12	12	10	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	16	14	12	14	13	13	13	14	13	17
Total young produced		32	31	28	31	30	30	30	28	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:	0%
Mean Offspring/Female:	30.2
% Reduction from Control-1:	-2.4%

ETS Environmental Testing Solutions, Inc.

Species: *Ceriodaphnia dubia*
Client: TVA / Sequoyah Nuclear Plant, Outfall 101 **Date:** 11-17-09

CONC: **22.6%** ***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	4	5	4	4	6	4	4	4	6	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	14	11	12	12	12	12	11	13	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	14	16	13	16	14	16	17	15	13	18
Total young produced		32	32	29	32	32	32	32	32	32	34
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:	0%
Mean Offspring/Female:	31.9
% Reduction from Control-1:	-8.1%

CONC: **45.2%** ***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	5	5	6	4	5	6	5	5	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	14	12	10	12	12	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	15	15	17	15	18	13	17	17	15
Total young produced		33	34	33	31	32	36	30	34	33	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:	0%
Mean Offspring/Female:	32.8
% Reduction from Control-1:	-11.2%

ETS Environmental Testing Solutions, Inc.

Species: *Ceriodaphnia dubia*
Client: TVA / Sequoyah Nuclear Plant, Outfall 101 **Date:** 11-17-09

CONC: **72.6%** ***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	5	5	4	6	6	4	6	5	5	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	12	14	12	13	13	13	14	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	16	17	16	14	18	16	19	15	14	17
Total young produced		33	34	34	32	37	33	38	34	30	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:	0%
Mean Offspring/Female:	33.7
% Reduction from Control-1:	-14.2%

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	5	6	5	6	5	5	7	5	6	6
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	14	12	10	13	13	12	15	11	14	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	16	18	17	17	16	19	16	20	18	18
Total young produced		35	36	32	36	34	36	38	36	38	38
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:	0%
Mean Offspring/Female:	35.9
% Reduction from Control-1:	-21.7%

ETS Environmental Testing Solutions, Inc.

Species: *Ceriodaphnia dubia*
Client: TVA / Sequoyah Nuclear Plant, Outfall 101 **Date:** 11-17-09

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	6	4	4	5	4	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	9	12	12	11	13	12	13	12	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	14	14	12	16	13	12	15	13	15	14
Total young produced		31	27	30	32	28	30	31	30	31	28
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3rd 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:	29.8

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	5	6	5	4	4	4	5	4	4	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	14	12	11	12	12	13	12	12	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	19	17	17	14	13	16	15	15	15	16
Total young produced		38	35	33	30	29	33	32	31	31	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:	0%
Mean Offspring/Female:	32.5
% Reduction from Control-2:	-9.1%

ETS
Environmental Testing Solutions, Inc.

TVA / Sequoyah Nuclear Plant, Outfall 101 - Non-treated
November 17-24, 2009

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
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	5	5	4	4	6	6	46
5	13	10	10	12	10	12	12	12	13	11	115
6	0	0	0	0	0	0	0	0	0	0	0
7	15	15	12	14	12	13	12	13	12	16	134
Total	32	29	26	30	27	30	28	29	31	33	295

72.6%

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	5	5	4	6	6	4	6	5	5	4	50
5	12	12	14	12	13	13	13	14	11	11	125
6	0	0	0	0	0	0	0	0	0	0	0
7	16	17	16	14	18	16	19	15	14	17	162
Total	33	34	34	32	37	33	38	34	30	32	337

11.3%

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	4	4	4	5	5	4	4	4	43
5	11	13	12	13	13	12	12	10	12	12	120
6	0	0	0	0	0	0	0	0	0	0	0
7	16	14	12	14	13	13	13	14	13	17	139
Total	32	31	28	31	30	30	30	28	29	33	302

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	5	6	5	6	5	5	7	5	6	6	56
5	14	12	10	13	13	12	15	11	14	14	128
6	0	0	0	0	0	0	0	0	0	0	0
7	16	18	17	17	16	19	16	20	18	18	175
Total	35	36	32	36	34	36	38	36	38	38	359

22.6%

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	4	5	4	4	6	4	4	4	6	5	46
5	14	11	12	12	12	12	11	13	13	11	121
6	0	0	0	0	0	0	0	0	0	0	0
7	14	16	13	16	14	16	17	15	13	18	152
Total	32	32	29	32	32	32	32	32	32	34	319

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	6	4	4	5	4	4	4	4	43
5	13	9	12	12	11	13	12	13	12	10	117
6	0	0	0	0	0	0	0	0	0	0	0
7	14	14	12	16	13	12	15	13	15	14	138
Total	31	27	30	32	28	30	31	30	31	28	298

45.2%

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	5	5	6	4	5	6	5	5	4	4	49
5	13	14	12	10	12	12	12	12	12	13	122
6	0	0	0	0	0	0	0	0	0	0	0
7	15	15	15	17	15	18	13	17	17	15	157
Total	33	34	33	31	32	36	30	34	33	32	328

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	5	6	5	4	4	4	5	4	4	5	46
5	14	12	11	12	12	13	12	12	12	12	122
6	0	0	0	0	0	0	0	0	0	0	0
7	19	17	17	14	13	16	15	15	15	16	157
Total	38	35	33	30	29	33	32	31	31	33	325

TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
November 17-24, 2009

ETS
Environmental Testing Solutions, Inc.

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: 5812
Reveiwed by:

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	32	29	26	30	27	30	28	29	31	33	100	29.5	7.4	Not applicable
11.3%	32	31	28	31	30	30	30	28	29	33	100	30.2	5.4	-2.4
22.6%	32	32	29	32	32	32	32	32	32	34	100	31.9	3.8	-8.1
45.2%	33	34	33	31	32	36	30	34	33	32	100	32.8	5.1	-11.2
72.6%	33	34	34	32	37	33	38	34	30	32	100	33.7	7.0	-14.2
100%	35	36	32	36	34	36	38	36	38	38	100	35.9	5.3	-21.7
Control - 2	31	27	30	32	28	30	31	30	31	28	100	29.8	5.4	Not applicable
100% Intake	38	35	33	30	29	33	32	31	31	33	100	32.5	8.0	-9.1

Outfall 101:
Dunnett's MSD value: 1.906
PMSD: 6.5

Intake:
Dunnett's MSD value: 1.676
PMSD: 5.6

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).

USEPA. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination Program. EPA-833-R-00-003. US Environmental Protection Agency, Cincinnati, OH.

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.

TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
November 17-24, 2009
Statistical Analyses

ETS Environmental Testing Solutions, Inc.

Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date:	11/17/2009	Test ID:	CdFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101
End Date:	11/24/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		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	32.000	29.000	26.000	30.000	27.000	30.000	28.000	29.000	31.000	33.000
Control-2	31.000	27.000	30.000	32.000	28.000	30.000	31.000	30.000	31.000	28.000
11.3	32.000	31.000	28.000	31.000	30.000	30.000	30.000	28.000	29.000	33.000
22.6	32.000	32.000	29.000	32.000	32.000	32.000	32.000	32.000	32.000	34.000
45.2	33.000	34.000	33.000	31.000	32.000	36.000	30.000	34.000	33.000	32.000
72.6	33.000	34.000	34.000	32.000	37.000	33.000	38.000	34.000	30.000	32.000
100	35.000	36.000	32.000	36.000	34.000	36.000	38.000	36.000	38.000	38.000
Intake	38.000	35.000	33.000	30.000	29.000	33.000	32.000	31.000	31.000	33.000

			Transform: Untransformed					Rank	1-Tailed	Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
Control-1	29.500	0.9899	29.500	26.000	33.000	7.366	10			32.333	1.0000
Control-2	29.800	1.0000	29.800	27.000	32.000	5.434	10				
11.3	30.200	1.0134	30.200	28.000	33.000	5.362	10	115.00	75.00	32.333	1.0000
22.6	31.900	1.0705	31.900	29.000	34.000	3.753	10	137.00	75.00	32.333	1.0000
45.2	32.800	1.1007	32.800	30.000	36.000	5.142	10	144.00	75.00	32.333	1.0000
72.6	33.700	1.1309	33.700	30.000	38.000	7.001	10	147.00	75.00	32.333	1.0000
100	35.900	1.2047	35.900	32.000	38.000	5.326	10	153.50	75.00	32.333	1.0000
Intake	32.500	1.0906	32.500	29.000	38.000	7.978	10				

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates non-normal distribution (p <= 0.01)	1.045023799	1.035	0.04119118	0.090545302
Bartlett's Test indicates equal variances (p = 0.46)	4.634984493	15.08627224		
The control means are not significantly different (p = 0.73)	0.350059429	2.100922029		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	100	>100		1
Treatments vs Control-1				

Linear Interpolation (200 Resamples)

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

TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
November 17-24, 2009

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Used for PMSD calculation only. Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date:	11/17/2009	Test ID:	CdFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101
End Date:	11/24/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		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	32.000	29.000	26.000	30.000	27.000	30.000	28.000	29.000	31.000	33.000
Control-2	31.000	27.000	30.000	32.000	28.000	30.000	31.000	30.000	31.000	28.000
11.3	32.000	31.000	28.000	31.000	30.000	30.000	30.000	28.000	29.000	33.000
22.6	32.000	32.000	29.000	32.000	32.000	32.000	32.000	32.000	32.000	34.000
45.2	33.000	34.000	33.000	31.000	32.000	36.000	30.000	34.000	33.000	32.000
72.6	33.000	34.000	34.000	32.000	37.000	33.000	38.000	34.000	30.000	32.000
100	35.000	36.000	32.000	36.000	34.000	36.000	38.000	36.000	38.000	38.000
Intake	38.000	35.000	33.000	30.000	29.000	33.000	32.000	31.000	31.000	33.000

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control-1	29.500	0.9899	29.500	26.000	33.000	7.366	10			
Control-2	29.800	1.0000	29.800	27.000	32.000	5.434	10			
11.3	30.200	1.0134	30.200	28.000	33.000	5.362	10	-0.840	2.287	1.906
22.6	31.900	1.0705	31.900	29.000	34.000	3.753	10	-2.879	2.287	1.906
45.2	32.800	1.1007	32.800	30.000	36.000	5.142	10	-3.959	2.287	1.906
72.6	33.700	1.1309	33.700	30.000	38.000	7.001	10	-5.039	2.287	1.906
100	35.900	1.2047	35.900	32.000	38.000	5.326	10	-7.678	2.287	1.906
Intake	32.500	1.0906	32.500	29.000	38.000	7.978	10			

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates non-normal distribution (p <= 0.01)	1.045023799	1.035	0.04119118	0.090545302
Bartlett's Test indicates equal variances (p = 0.46)	4.634984493	15.08627224		
The control means are not significantly different (p = 0.73)	0.350059429	2.100922029		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	100	>100		1	1.906063607	0.064612326	55.14666667	3.474074074	1.3E-09	5, 54
Treatments vs Control-1										

TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
Non-treated
November 17-24, 2009

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date:	11/17/2009	Test ID:	CdFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
End Date:	11/24/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		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	32.000	29.000	26.000	30.000	27.000	30.000	28.000	29.000	31.000	33.000
Control-2	31.000	27.000	30.000	32.000	28.000	30.000	31.000	30.000	31.000	28.000
11.3	32.000	31.000	28.000	31.000	30.000	30.000	30.000	28.000	29.000	33.000
22.6	32.000	32.000	29.000	32.000	32.000	32.000	32.000	32.000	32.000	34.000
45.2	33.000	34.000	33.000	31.000	32.000	36.000	30.000	34.000	33.000	32.000
72.6	33.000	34.000	34.000	32.000	37.000	33.000	38.000	34.000	30.000	32.000
100	35.000	36.000	32.000	36.000	34.000	36.000	38.000	36.000	38.000	38.000
Intake	38.000	35.000	33.000	30.000	29.000	33.000	32.000	31.000	31.000	33.000

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control-1	29.500	0.9899	29.500	26.000	33.000	7.366	10			
Control-2	29.800	1.0000	29.800	27.000	32.000	5.434	10			
11.3	30.200	1.0134	30.200	28.000	33.000	5.362	10			
22.6	31.900	1.0705	31.900	29.000	34.000	3.753	10			
45.2	32.800	1.1007	32.800	30.000	36.000	5.142	10			
72.6	33.700	1.1309	33.700	30.000	38.000	7.001	10			
100	35.900	1.2047	35.900	32.000	38.000	5.326	10			
Intake	32.500	1.0906	32.500	29.000	38.000	7.978	10	-2.793	1.734	1.676

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.951577842	0.868	0.62319944	1.12773217
F-Test indicates equal variances (p = 0.18)	2.563559294	6.541089535		
The control means are not significantly different (p = 0.73)	0.350059429	2.100922029		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences Treatments vs Control-2	1.676261504	0.056250386	36.45	4.672222222	0.0120129	1, 18

TVA / Sequoyah Nuclear Plant, Outfall 101 - Non-treated
November 17-27, 2009

ETS
Environmental Testing Solutions, Inc.

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

Daily Chemical Analyses

Project number: 5812

Reviewed by: [signature]

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)	7.48	7.58	7.63	7.54	7.50	7.71	7.71	7.68	7.55	7.54	7.42	7.57	7.79	7.51
	DO (mg/L)	7.8	7.8	7.6	7.7	7.7	8.0	7.8	8.1	7.9	8.1	7.8	8.0	8.0	7.8
	Conductivity (µmhos/cm)	325		332		328		332		336		334		334	
	Alkalinity (mg/L $CaCO_3$)	61				62				62		62			
	Hardness (mg/L $CaCO_3$)	90				90				90		88			
	Temperature (°C)	24.9	24.9	24.9	24.9	24.8	25.1	24.6	24.9	24.7	25.0	24.7	24.9	24.8	25.3
11.3%	pH (SU)	7.79	7.57	7.66	7.56	7.57	7.71	7.73	7.68	7.68	7.54	7.57	7.58	7.62	7.52
	DO (mg/L)	8.0	7.7	7.7	7.6	7.7	8.1	8.2	8.1	8.1	8.0	7.8	8.1	8.0	7.8
	Conductivity (µmhos/cm)	317		317		313		308		307		303		297	
	Temperature (°C)	24.9	24.9	24.9	25.0	24.9	25.1	24.9	24.9	24.7	25.0	24.7	25.2	24.9	25.1
22.6%	pH (SU)	7.74	7.57	7.62	7.55	7.56	7.71	7.72	7.68	7.65	7.54	7.53	7.59	7.61	7.52
	DO (mg/L)	8.0	7.7	7.8	7.5	7.9	8.1	8.2	8.1	8.0	8.0	7.9	8.1	8.1	7.8
	Conductivity (µmhos/cm)	299		293		296		288		296		286		280	
	Temperature (°C)	25.0	25.0	24.9	25.0	24.9	25.1	24.9	25.0	24.7	25.0	24.7	25.0	24.9	25.0
45.2%	pH (SU)	7.73	7.56	7.61	7.54	7.51	7.71	7.71	7.66	7.62	7.53	7.47	7.58	7.59	7.51
	DO (mg/L)	8.1	7.8	7.7	7.6	7.9	8.1	8.2	8.2	8.1	7.9	8.0	8.0	8.1	7.8
	Conductivity (µmhos/cm)	266		259		258		254		255		254		249	
	Temperature (°C)	25.0	25.0	24.9	25.1	24.9	25.0	25.0	24.9	24.7	24.9	24.7	25.0	24.9	25.2
72.6%	pH (SU)	7.70	7.56	7.59	7.54	7.48	7.69	7.67	7.65	7.60	7.52	7.41	7.56	7.56	7.48
	DO (mg/L)	8.1	7.8	7.7	7.6	7.9	8.0	8.2	8.2	8.3	7.9	8.2	8.0	8.2	7.8
	Conductivity (µmhos/cm)	225		221		222		217		213		217		211	
	Temperature (°C)	25.0	24.8	24.9	24.9	25.0	24.8	25.0	25.1	24.8	24.9	24.8	25.1	24.9	24.9
100%	pH (SU)	7.67	7.56	7.57	7.54	7.44	7.66	7.63	7.62	7.55	7.48	7.32	7.54	7.48	7.46
	DO (mg/L)	8.1	7.8	7.7	7.6	8.0	8.0	8.0	8.2	8.1	7.9	8.3	8.1	8.2	7.9
	Conductivity (µmhos/cm)	181		180		174		166		167		168		166	
	Alkalinity (mg/L $CaCO_3$)	96				66				62					
	Hardness (mg/L $CaCO_3$)	82				110				69					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	25.0	24.8	24.9	25.1	25.0	25.2	25.2	24.8	24.9	24.8	24.8	25.1	24.9	25.2
100% Intake	pH (SU)	7.57	7.55	7.57	7.54	7.42	7.66	7.64	7.63	7.52	7.49	7.26	7.56	7.47	7.46
	DO (mg/L)	8.3	7.9	7.8	7.6	8.1	8.0	8.2	8.0	8.1	8.0	8.4	8.1	8.2	8.0
	Conductivity (µmhos/cm)	178		179		172		164		167		167		163	
	Alkalinity (mg/L $CaCO_3$)	66				64				58					
	Hardness (mg/L $CaCO_3$)	82				69				73					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	24.9	24.8	24.9	25.0	25.0	25.0	25.0	24.8	24.9	25.0	25.0	24.9	25.0	25.2

ETS Environmental Testing Solutions, Inc.

Species: *Ceriodaphnia dubia* **Date:** 11-17-09

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Daily Chemistry:

		Day					
		0		1		2	
	Analyst	KW	KW	KW	UAB	UAB	KW
Concentration	Parameter						
CONTROL	pH (S.U.)	7.48	7.58	7.63	7.54	7.50	7.71
	DO (mg/L)	7.8	7.8	7.6	7.7	7.7	8.0
	Conductivity (µmhos/cm)	325		332		328	
	Alkalinity (mg $CaCO_3$/L)	61				62	
	Hardness (mg $CaCO_3$/L)	90				90	
	Temperature (°C)	24.9	24.9	24.9	24.9	24.8	25.1
11.3%	pH (S.U.)	7.79	7.57	7.66	7.56	7.57	7.71
	DO (mg/L)	8.0	7.7	7.7	7.6	7.7	8.1
	Conductivity (µmhos/cm)	317		~~330~~ 317		313	
	Temperature (°C)	24.9	24.9	24.9	25.0	24.9	25.1
22.6%	pH (S.U.)	7.74	7.57	7.62	7.55	7.56	7.71
	DO (mg/L)	8.0	7.7	7.8	7.5	7.9	8.1
	Conductivity (µmhos/cm)	299		~~[illegible]~~ 293		296	
	Temperature (°C)	25.0	25.0	24.9	25.0	24.9	25.1
45.2%	pH (S.U.)	7.73	7.56	7.61	7.54	7.51	7.71
	DO (mg/L)	8.1	7.8	7.7	7.6	7.9	8.1
	Conductivity (µmhos/cm)	266		~~[illegible]~~ 257		258	
	Temperature (°C)	25.0	25.0	24.9	25.1	24.9	25.0
72.6%	pH (S.U.)	7.70	7.56	7.59	7.54	7.48	7.69
	DO (mg/L)	8.1	7.8	7.7	7.6	7.9	8.0
	Conductivity (µmhos/cm)	225		~~[illegible]~~ 221		222	
	Temperature (°C)	25.0	24.8	24.9	24.9	25.0	24.8
100%	pH (S.U.)	7.67	7.56	7.57	7.54	7.44	7.66
	DO (mg/L)	8.1	7.8	7.7	7.6	8.0	8.0
	Conductivity (µmhos/cm)	181		180		~~[illegible]~~ 174	
	Alkalinity (mg $CaCO_3$/L)	96				66	
	Hardness (mg $CaCO_3$/L)	82				110	
	TR chlorine (mg/L)	<0.10				<0.10	
	Temperature (°C)	25.0	24.8	24.9	25.1	25.0	25.2
100% Intake	pH (S.U.)	7.57	7.55	7.57	7.54	7.42	7.66
	DO (mg/L)	8.3	7.9	7.8	7.6	8.1	8.0
	Conductivity (µmhos/cm)	170		179		172	
	Alkalinity (mg $CaCO_3$/L)	66				64	
	Hardness (mg $CaCO_3$/L)	82				69	
	TR chlorine (mg/L)	<0.10				<0.10	
	Temperature (°C)	24.9	24.8	24.9	25.0	25.0	25.0
		Initial	Final	Initial	Final	Initial	Final

ETS Environmental Testing Solutions, Inc.

Species: *Ceriodaphnia dubia*
Client: TVA / Sequoyah Nuclear Plant, Outfall 101 **Date:** 11-17-09

		Day							
		3		4 KDL		KDL 5		6	
	Analyst	KDL	LAB	LAB	BSL	BSL	KDL	KDL	KDL
Concentration	Parameter								
CONTROL	pH (S.U.)	7.71	7.68	7.55	7.54	7.42	7.57	7.79	7.57
	DO (mg/L)	7.8	8.1	7.9	8.1	7.8	8.0	8.0	7.8
	Conductivity (µmhos/cm)	332		336		334		334	
	Alkalinity (mg $CaCO_3$/L)			62		62			
	Hardness (mg $CaCO_3$/L)			90		88			
	Temperature (°C)	24.6	24.9	24.7	25.0	24.7	24.9	24.8	25.3
11.3%	pH (S.U.)	7.73	7.68	7.68	7.54	7.57	7.58	7.62	7.52
	DO (mg/L)	8.2	8.1	8.1	8.0	7.8	8.1	8.0	7.8
	Conductivity (µmhos/cm)	308		307		303		297	
	Temperature (°C)	24.9	24.9	24.7	25.0	24.7	25.2	24.9	25.1
22.6%	pH (S.U.)	7.72	7.68	7.65	7.54	7.53	7.59	7.61	7.52
	DO (mg/L)	8.2	8.1	8.0	8.0	7.9	8.1	8.1	7.8
	Conductivity (µmhos/cm)	288		296		286		280	
	Temperature (°C)	24.9	25.0	24.7	25.0	24.7	25.0	24.9	25.0
45.2%	pH (S.U.)	7.71	7.66	7.62	7.53	7.47	7.58	7.59	7.57
	DO (mg/L)	8.2	8.2	8.1	7.9	8.0	8.0	8.1	7.8
	Conductivity (µmhos/cm)	254		255		254		249	
	Temperature (°C)	25.0	24.9	24.7	24.9	24.7	25.0	24.9	25.2
72.6%	pH (S.U.)	7.67	7.65	7.60	7.52	7.41	7.56	7.56	7.48
	DO (mg/L)	8.2	8.2	8.3	7.9	8.2	8.0	8.2	7.8
	Conductivity (µmhos/cm)	217		213		217		211	
	Temperature (°C)	25.0	25.1	24.8	24.9	24.8	25.1	24.9	24.9
100%	pH (S.U.)	7.63	7.62	7.55	7.48	7.32	7.54	7.48	7.46
	DO (mg/L)	8.0	8.2	8.1	7.9	8.3	8.1	8.2	7.9
	Conductivity (µmhos/cm)	166		167		168		166	
	Alkalinity (mg $CaCO_3$/L)			62					
	Hardness (mg $CaCO_3$/L)			69					
	TR Chlorine (mg/L)			<0.10					
	Temperature (°C)	25.2	24.8	24.9	24.8	24.8	25.1	24.9	25.2
100% Intake	pH (S.U.)	7.64	7.63	7.52	7.49	7.26	7.56	7.47	7.46
	DO (mg/L)	8.2	8.0	8.1	8.0	8.4	8.1	8.2	8.0
	Conductivity (µmhos/cm)	164		167		167		163	
	Alkalinity (mg $CaCO_3$/L)			58					
	Hardness (mg $CaCO_3$/L)			73					
	TR chlorine (mg/L)			<0.10					
	Temperature (°C)	25.0	24.8	24.9	25.0	25.0	24.9	25.0	25.2
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

ETS
Environmental Testing Solutions, Inc.

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 #: ~~TN0020168~~ TN 0026450
Project #: 5812

County: ~~Rhea~~ HAMILTON
Outfall: 101

Dilution preparation information:						*Comments:*
Dilution prep (%)	11.3	22.6	45.2	72.6	100	Each concentration was UV-treated
Effluent volume (mL)	282.5	565	1130	1815	2500	for 2 minutes to remove pathogenic
Diluent volume (mL)	2217.5	1935	1370	685	0	Interferences.
Total volume (mL)	2500	2500	2500	2500	2500	

Test organism information:		*Test information:*		
Organism age:	22.50 HOURS OLD	Randomizing template:	BLUE	
Date and times organisms were born between:	11-16-09 1600	Incubator number and shelf location:	3B	
Organism source:	ATOX BATCH PP 11-16-09	*Artemia* CHM number:	CHM444	
		Drying information for weight determination:		
Transfer bowl information:	pH = 7.50 S.U. Temperature = 24.7°C	Date / Time in oven:	11-24-09	1350
		Initial oven temperature:	60°C	
Average transfer volume:	0.2305 ml	Date / Time out of oven:	11-25-09	1350
		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	11-17-09	—	—	1600	JH	1430	JH	091117.05	091117.06	11-12-09 A
1	11-18-09	0800	JH	1400	JH	1332	JH	091117.05	091117.06	11-12-09 A
2	11-19-09	0800	JH	1400	JH	1330	JH	091118.03	091118.04	11-12-09 B
3	11-20-09	0800	JH	1400	JH	1333	JH	091118.03	091118.04	11-12-09 B
4	11-21-09	0800	JH	1400	JH	1330	JH	091120.04	091120.05	11-17-09
5	11-22-09	0800	JH	1400	JH	1334	JH	091120.04	091120.05	11-19-09
6	11-23-09	0800	JH	1400	JH	1332	JH	091120.04	091120.05	11-19-09
7	11-24-09					1331	JH			

Control information:		Acceptance criteria	*Summary of test endpoints:*	
% Mortality:	0%	≤ 20%	7-day LC_{50}	>100%
Average weight per initial larvae:	0.802		NOEC	100%
Average weight per surviving larvae:	0.802	≥ 0.25mg/larvae	LOEC	>100%
			ChV	>100%
			IC_{25}	>100%

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas***
Client: **TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated** **Date:** 11-17-09

Survival and Growth Data

Day	CONTROL UV-treated				11.3%				22.6%			
	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	9rd	10	10	10	10	10
7	10	10	10	10	10	10	9	10	10	10	10	10
A = Pan weight (mg) Tray color code:: Navy Analyst: KJS Date: 10-25-09	14.32	14.17	12.74	14.11	14.06	14.05	15.70	14.43	13.63	14.15	12.46	13.82
B = Pan + Larvae weight (mg) Analyst: MJS Date: 12-01-09	22.80	22.15	20.46	22.81	22.82	22.62	23.34	21.98	21.12	22.11	21.00	21.88
C = Larvae weight (mg) = B – A	8.48	7.18	7.72	8.70	8.76	8.57	7.64	7.55	7.49	7.96	8.54	8.06
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.848	0.718	0.772	0.870	0.876	0.857	0.764	0.755	0.749	0.796	0.854	0.806
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.802				0.813		-1.47.		0.801		0.17.	

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.

Calculations and data reviewed: JH

Comments:

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas***
Client: **TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated** **Date:** 11-17-09

Survival and Growth Data

Day	45.2%				72.6%				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 lg	10
A = Pan weight (mg) Tray color code:: Navy Analyst: KLS Date: 10-29-09	13.84	13.27	14.92	13.36	13.35	13.47	14.87	13.07	13.18	14.61	14.66	15.39
B = Pan + Larvae weight (mg) Analyst: MS Date: 12.01.09	21.08	21.43	23.17	22.01	22.25	21.22	23.43	21.21	20.93	22.18	24.05	24.06
C = Larvae weight (mg) = B – A	7.24	8.16	8.25	8.65	8.90	7.75	8.56	8.14	7.75	7.57	9.39	8.67
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.724	0.816	0.825	0.865	0.890	0.775	0.856	0.814	0.775	0.757	0.939	0.867
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.808		-0.7%		0.834		-4.0%		0.835		-4.1%	

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.

Calculations and data reviewed: [illegible]

Comments:

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas***
Client: **TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated** **Date:** 11-17-09

Survival and Growth Data

Day	100% Intake			
	Y	Z	AA	BB
0	10	10	10	10
1	10	10	10	10
2	10	10	10	10
3	10	10	10	10
4	10	10	10	10
5	10	10	10	10
6	10	10	10	10
7	10	10	10	10
A = Pan weight (mg) Tray color code:: Navy Analyst: KLS Date: 10-29-09	15.40	13.16	15.73	12.86
B = Pan + Larvae weight (mg) Analyst: MLS Date: Nov 12-21-09	23.53	20.42	23.53	20.56
C = Larvae weight (mg) = B – A	8.13	7.26	7.80	7.70
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.813	0.726	0.780	0.770
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.772		3.7%	

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.

Calculations and data reviewed: H

Comments:

Environmental Testing Solutions, Inc.

TVA / Sequoyah Nuclear Plant, Outfall 101
UV-treated
November 17-24, 2009

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: 5812
Reveiwed by:

Concentration (%)	Replicate	Initial number of larvae	Final number of larvae	A = Pan weight (mg)	B = Pan + Larvae weight (mg)	Larvae weight (mg) = A - B	Not for Compliance Assessment, Internal Laboratory QC: 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 (Mean weight per initial number of larvae) (%)	Percent reduction from control (%)
Control	A	10	10	14.32	22.80	8.48	0.848	0.802	8.7	0.848	100.0	0.802	8.7	Not applicable
	B	10	10	14.97	22.15	7.18	0.718			0.718				
	C	10	10	12.74	20.46	7.72	0.772			0.772				
	D	10	10	14.11	22.81	8.70	0.870			0.870				
11.3%	E	10	10	14.06	22.82	8.76	0.876	0.834	6.5	0.876	97.5	0.813	7.7	-1.4
	F	10	10	14.05	22.62	8.57	0.857			0.857				
	G	10	9	15.70	23.34	7.64	0.849			0.764				
	H	10	10	14.43	21.98	7.55	0.755			0.755				
22.6%	I	10	10	13.63	21.12	7.49	0.749	0.801	5.4	0.749	100.0	0.801	5.4	0.1
	J	10	10	14.15	22.11	7.96	0.796			0.796				
	K	10	10	12.46	21.00	8.54	0.854			0.854				
	L	10	10	13.82	21.88	8.06	0.806			0.806				
45.2%	M	10	10	13.84	21.08	7.24	0.724	0.808	7.4	0.724	100.0	0.808	7.4	-0.7
	N	10	10	13.27	21.43	8.16	0.816			0.816				
	O	10	10	14.92	23.17	8.25	0.825			0.825				
	P	10	10	13.36	22.01	8.65	0.865			0.865				
72.6%	Q	10	10	13.35	22.25	8.90	0.890	0.834	6.0	0.890	100.0	0.834	6.0	-4.0
	R	10	10	13.47	21.22	7.75	0.775			0.775				
	S	10	10	14.87	23.43	8.56	0.856			0.856				
	T	10	10	13.07	21.21	8.14	0.814			0.814				
100%	U	10	10	13.18	20.93	7.75	0.775	0.835	10.1	0.775	100.0	0.835	10.1	-4.1
	V	10	10	14.61	22.18	7.57	0.757			0.757				
	W	10	10	14.66	24.05	9.39	0.939			0.939				
	X	10	10	15.39	24.06	8.67	0.867			0.867				
100% Intake	Y	10	10	15.40	23.53	8.13	0.813	0.772	4.6	0.813	100.0	0.772	4.6	3.7
	Z	10	10	13.16	20.42	7.26	0.726			0.726				
	AA	10	10	15.73	23.53	7.80	0.780			0.780				
	BB	10	10	12.86	20.56	7.70	0.770			0.770				

Outfall 101:
Dunnett's MSD value: 0.1075
PMSD: 13.4

Intake:
Dunnett's MSD value: 0.0764
PMSD: 9.5

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).

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.

TVA / Sequoyah Nuclear Plant, Outfall 101
UV-treated
November 17-24, 2009
Statistical Analyses

ETS Environmental Testing Solutions, Inc.

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	11/17/2009	Test ID:	PpFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101
End Date:	11/24/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	UV-treated				

Conc-%	1	2	3	4
D-Control	0.8480	0.7180	0.7720	0.8700
11.3	0.8760	0.8570	0.7640	0.7550
22.6	0.7490	0.7960	0.8540	0.8060
45.2	0.7240	0.8160	0.8250	0.8650
72.6	0.8900	0.7750	0.8560	0.8140
100	0.7750	0.7570	0.9390	0.8670
Intake	0.8130	0.7260	0.7800	0.7700

			Transform: Untransformed						1-Tailed		Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.8020	1.0000	0.8020	0.7180	0.8700	8.727	4				0.8153	1.0000
11.3	0.8130	1.0137	0.8130	0.7550	0.8760	7.672	4	-0.247	2.410	0.1075	0.8153	1.0000
22.6	0.8013	0.9991	0.8013	0.7490	0.8540	5.374	4	0.017	2.410	0.1075	0.8153	1.0000
45.2	0.8075	1.0069	0.8075	0.7240	0.8650	7.381	4	-0.123	2.410	0.1075	0.8153	1.0000
72.6	0.8338	1.0396	0.8338	0.7750	0.8900	5.997	4	-0.712	2.410	0.1075	0.8153	1.0000
100	0.8345	1.0405	0.8345	0.7570	0.9390	10.150	4	-0.729	2.410	0.1075	0.8153	1.0000
Intake	0.7723	0.9629	0.7723	0.7260	0.8130	4.648	4					

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.939999402	0.884	-0.02446093	-1.22636643
Bartlett's Test indicates equal variances (p = 0.91)	1.50255847	15.08627224		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	100	>100		1	0.107485809	0.134022205	0.000919567	0.003978306	0.943894863	5, 18
Treatments vs D-Control										

Linear Interpolation (200 Resamples)

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

TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
UV-treated
November 17-24, 2009

ETS
Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	11/17/2009	Test ID:	PpFRCR	Sample ID:	TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
End Date:	11/24/2009	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	UV-treated				

Conc-%	1	2	3	4
D-Control	0.8480	0.7180	0.7720	0.8700
11.3	0.8760	0.8570	0.7640	0.7550
22.6	0.7490	0.7960	0.8540	0.8060
45.2	0.7240	0.8160	0.8250	0.8650
72.6	0.8900	0.7750	0.8560	0.8140
100	0.7750	0.7570	0.9390	0.8670
Intake	0.8130	0.7260	0.7800	0.7700

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
D-Control	0.8020	1.0000	0.8020	0.7180	0.8700	8.727	4			
11.3	0.8130	1.0137	0.8130	0.7550	0.8760	7.672	4			
22.6	0.8013	0.9991	0.8013	0.7490	0.8540	5.374	4			
45.2	0.8075	1.0069	0.8075	0.7240	0.8650	7.381	4			
72.6	0.8338	1.0396	0.8338	0.7750	0.8900	5.997	4			
100	0.8345	1.0405	0.8345	0.7570	0.9390	10.150	4			
Intake	0.7723	0.9629	0.7723	0.7260	0.8130	4.648	4	0.756	1.943	0.0764

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.96844363	0.749	-0.33306569	-0.81375687
F-Test indicates equal variances (p = 0.30)	3.80257463	47.46722794		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences Treatments vs D-Control	0.07642232	0.09528968	0.001770125	0.003093458	0.478019476	1, 6

TVA / Sequoyah Nuclear Plant, Outfall 101 - UV-treated
November 17-24, 2009

ETS
Environmental Testing Solutions, Inc.

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

Daily Chemical Analyses

Project number: 5812

Reviewed by: [signature]

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)	7.65	7.50	7.61	7.39	7.58	7.41	7.68	7.53	7.62	7.22	7.53	7.19	7.61	7.19
	DO (mg/L)	8.0	7.7	7.9	7.4	7.9	7.3	8.2	8.1	7.9	7.3	8.0	6.9	7.9	6.4
	Conductivity (µmhos/cm)	332		330		321		320		320		312		313	
	Alkalinity (mg/L $CaCO_3$)	61				62				61		61			
	Hardness (mg/L $CaCO_3$)	90				88				90		86			
	Temperature (°C)	25.0	24.8	24.9	24.7	24.7	24.9	24.8	24.7	24.8	24.9	24.8	24.8	24.7	24.7
11.3%	pH (SU)	7.64	7.48	7.63	7.39	7.59	7.39	7.68	7.51	7.63	7.16	7.54	7.19	7.61	7.18
	DO (mg/L)	7.7	7.6	8.0	7.3	7.9	7.4	8.0	7.6	7.8	7.3	7.9	7.0	8.0	6.9
	Conductivity (µmhos/cm)	311		312		307		308		310		304		301	
	Temperature (°C)	25.1	24.6	24.9	24.9	24.9	25.0	25.0	24.8	24.8	24.6	24.8	24.8	24.9	24.7
22.6%	pH (SU)	7.63	7.49	7.63	7.40	7.57	7.38	7.69	7.52	7.62	7.16	7.53	7.18	7.60	7.18
	DO (mg/L)	7.8	7.6	8.0	7.3	7.9	7.1	8.0	7.7	7.9	7.2	7.9	7.1	8.1	7.1
	Conductivity (µmhos/cm)	299		296		293		292		292		290		291	
	Temperature (°C)	25.1	24.6	25.0	24.9	24.9	24.8	25.0	24.8	24.8	24.6	24.8	24.8	24.9	24.7
45.2%	pH (SU)	7.61	7.49	7.62	7.37	7.53	7.36	7.68	7.48	7.60	7.16	7.49	7.19	7.59	7.15
	DO (mg/L)	7.9	7.5	8.0	7.2	7.9	7.1	8.1	7.7	7.9	7.3	7.9	7.0	8.1	7.0
	Conductivity (µmhos/cm)	264		262		261		259		273		270		266	
	Temperature (°C)	25.2	24.7	25.0	24.8	25.0	24.8	25.0	24.8	24.8	24.8	24.8	24.7	24.9	24.7
72.6%	pH (SU)	7.59	7.47	7.62	7.35	7.49	7.34	7.65	7.48	7.53	7.11	7.43	7.19	7.57	7.15
	DO (mg/L)	8.0	7.4	8.0	7.2	8.0	7.3	8.1	7.7	7.8	7.3	8.0	6.8	8.1	6.9
	Conductivity (µmhos/cm)	220		223		218		214		217		217		215	
	Temperature (°C)	25.2	24.7	25.0	24.8	25.0	25.0	25.0	24.6	24.8	24.8	25.0	24.6	25.0	24.9
100%	pH (SU)	7.56	7.44	7.57	7.38	7.44	7.30	7.62	7.47	7.51	7.09	7.37	7.16	7.52	7.13
	DO (mg/L)	8.0	7.6	8.0	7.3	8.0	7.1	8.1	7.8	8.0	7.3	8.0	6.9	8.2	6.9
	Conductivity (µmhos/cm)	181		181		171		171		169		169		170	
	Alkalinity (mg/L $CaCO_3$)	68				62				58					
	Hardness (mg/L $CaCO_3$)	78				78				65					
	Temperature (°C)	25.3	24.7	25.2	24.8	25.0	24.8	25.2	24.7	24.9	24.7	25.0	24.9	25.1	24.7
100% Intake	pH (SU)	7.49	7.44	7.60	7.37	7.44	7.31	7.61	7.47	7.51	7.10	7.37	7.07	7.52	7.09
	DO (mg/L)	8.3	7.7	8.0	7.3	8.1	7.3	8.2	7.8	8.0	7.2	8.2	6.9	8.2	6.9
	Conductivity (µmhos/cm)	181		189		168		169		160		164		168	
	Alkalinity (mg/L $CaCO_3$)	66				60				64					
	Hardness (mg/L $CaCO_3$)	78				69				69					
	Temperature (°C)	25.2	24.5	25.0	24.8	25.0	24.8	25.1	24.6	25.1	24.7	24.9	24.6	24.9	24.8

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** **Date:** 11-17-09

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

Daily Chemistry:

		Day					
		0		1		2	
	Analyst	KBL	KBL	KBL	LAB	LAB	KBL
Concentration	Parameter						
CONTROL UV-treated	pH (S.U.)	7.65	7.50	7.61	7.39	7.58	7.41
	DO (mg/L)	8.0	7.7	7.9	7.4	7.9	7.3
	Conductivity (µmhos/cm)	332		330		321	
	Alkalinity (mg $CaCO_3$/L)	61				62	
	Hardness (mg $CaCO_3$/L)	90				88	
	Temperature (°C)	25.0	24.8	24.9	24.7	24.7	24.9
11.3%	pH (S.U.)	7.64	7.48	7.63	7.39	7.59	7.39
	DO (mg/L)	7.7	7.6	8.0	7.3	7.9	7.4
	Conductivity (µmhos/cm)	311		312		307	
	Temperature (°C)	25.1	24.6	24.9	24.9	24.9	25.0
22.6%	pH (S.U.)	7.63	7.49	7.63	7.40	7.57	7.38
	DO (mg/L)	7.8	7.6	8.0	7.3	7.9	7.1
	Conductivity (µmhos/cm)	299		296		293	
	Temperature (°C)	25.1	24.6	25.0	24.9	24.9	24.8
45.2%	pH (S.U.)	7.61	7.49	7.62	7.37	7.53	7.36
	DO (mg/L)	7.9	7.5	8.0	7.2	7.9	7.1
	Conductivity (µmhos/cm)	264		262		261	
	Temperature (°C)	25.2	24.7	25.0	24.8	25.0	24.8
72.6%	pH (S.U.)	7.59	7.47	7.62	7.35	7.49	7.34
	DO (mg/L)	8.0	7.4	8.0	7.2	8.0	7.3
	Conductivity (µmhos/cm)	220		223		218	
	Temperature (°C)	25.2	24.7	25.0	24.8	25.0	25.0
100%	pH (S.U.)	7.56	7.44	7.57	7.38	7.44	7.30
	DO (mg/L)	8.0	7.6	8.0	7.3	8.0	7.1
	Conductivity (µmhos/cm)	181		181		171	
	Alkalinity (mg $CaCO_3$/L)	68				62	
	Hardness (mg $CaCO_3$/L)	78				78	
NON TREATED →	TR chlorine (mg/L)	<0.10				<0.10	
	Temperature (°C)	25.3	24.7	25.2	24.8	25.0	24.8
100% Intake	pH (S.U.)	7.49	7.44	7.60	7.37	7.44	7.31
	DO (mg/L)	8.3	7.7	8.0	7.3	8.1	7.3
	Conductivity (µmhos/cm)	181		189		168	
	Alkalinity (mg $CaCO_3$/L)	66				60	
	Hardness (mg $CaCO_3$/L)	78				69	
NON TREATED →	TR chlorine (mg/L)	<0.10				<0.10	
	Temperature (°C)	25.2	24.5	25.0	24.8	25.0	24.8
		Initial	Final	Initial	Final	Initial	Final

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas***
Client: **TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated** **Date:** 11-17-09

		Day							
		3		4		5		6	
	Analyst	KBL	LAB	LAB	BSC	BSC	KBL	KBL	KBL
Concen-tration	Parameter								
CONTROL UV-treated	pH (S.U.)	7.68	7.53	7.62	7.22	7.53	7.19	7.61	7.19
	DO (mg/L)	8.2	8.1	7.9	7.3	8.0	6.9	7.9	6.4
	Conductivity (µmhos/cm)	320		320		312		313	
	Alkalinity (mg $CaCO_3$/L)			61		61			
	Hardness (mg $CaCO_3$/L)			90		86			
	Temperature (°C)	24.8	24.7	24.8	24.9	24.8	24.8	24.7	24.7
11.3%	pH (S.U.)	7.68	7.51	7.63	7.16	7.54	7.19	7.61	7.18
	DO (mg/L)	8.0	7.6	7.8	7.3	7.9	7.0	8.0	6.9
	Conductivity (µmhos/cm)	308		310		304		301	
	Temperature (°C)	25.0	24.8	24.8	24.6	24.8	24.8	24.9	24.7
22.6%	pH (S.U.)	7.69	7.52	7.62	7.16	7.53	7.18	7.60	7.18
	DO (mg/L)	8.0	7.7	7.9	7.2	7.9	7.1	8.1	7.1
	Conductivity (µmhos/cm)	292		292		290		291	
	Temperature (°C)	25.0	24.8	24.8	24.6	24.8	24.8	24.9	24.7
45.2%	pH (S.U.)	7.68	7.48	7.60	7.16	7.49	7.19	7.59	7.15
	DO (mg/L)	8.1	7.7	7.9	7.3	7.9	7.0	8.1	7.0
	Conductivity (µmhos/cm)	259		273		270		266	
	Temperature (°C)	25.0	24.8	24.8	24.8	24.8	24.7	24.9	24.7
72.6%	pH (S.U.)	7.65	7.48	7.53	7.11	7.43	7.19	7.57	7.15
	DO (mg/L)	8.1	7.7	7.8	7.3	8.0	6.8	8.1	6.9
	Conductivity (µmhos/cm)	214		217		217		215	
	Temperature (°C)	25.0	24.6	24.8	24.8	25.0	24.6	25.0	24.9
100%	pH (S.U.)	7.62	7.47	7.51	7.09	7.37	7.16	7.52	7.13
	DO (mg/L)	8.1	7.8	8.0	7.3	8.0	6.9	8.2	6.9
	Conductivity (µmhos/cm)	171		169		169		170	
	Alkalinity (mg $CaCO_3$/L)			58					
	Hardness (mg $CaCO_3$/L)			65					
NON-TREATED→	TR Chlorine (mg/L)			<0.10					
	Temperature (°C)	25.2	24.7	24.9	24.7	25.0	24.9	25.1	24.7
100% Intake	pH (S.U.)	7.61	7.47	7.51	7.10	7.37	7.07	7.52	7.09
	DO (mg/L)	8.2	7.8	8.0	7.2	8.2	6.9	8.2	6.9
	Conductivity (µmhos/cm)	169		160		164		168	
	Alkalinity (mg $CaCO_3$/L)			64					
	Hardness (mg $CaCO_3$/L)			69					
NON-TREATED→	TR chlorine (mg/L)			<0.10					
	Temperature (°C)	25.1	24.6	25.1	24.7	24.9	24.6	24.9	24.8
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

ETS
Environmental Testing Solutions, Inc.

Total Residual Chlorine
(Orion Electrode Method, Orion 97-70)

Matrix: Water, RL = 0.10 mg/L
Meter: Accumet Model AR25 pH/Ion Meter

Analyst	UAB	Iodide reagent:	INR357
Date analyzed	11-17-09	Acid reagent:	INR353

Calibration:

	0.10 mg/L	1.00 mg/L	Slope
Reference standard number	INSS673	INSS673	-49.3%

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

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%)
INSS673	0.50	0.471	94.2%

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
091117.04	Synterra-eff	clear w/ part, NO color	S 0.0134	
↓	Duplicate		D 0.0140	UB

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	Reagent Blank		<0.00841
091117.03	Synterra-inf	clear, NO color, PARTICLES	<0.00618
091117.01	Sweeny	clear, w/ part, NO color	<0.00471
091116.02	PAF-RWI-A	slightly cloudy w/ part, pale tan	<0.00403
091116.01	PAF-DSN-out-001-A	slightly cloudy, pale tan	0.0250
091117.02	Wilmington	clear, pale tan	<0.00164
091117.05	SQN-101-TOX A	clear w/ particles, pale tan	0.00200
091117.06	SQN-INT TOX	clear, NO color	<0.00152
		UAB	UB

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%)
INSS673	0.50	0.477	95.4%

Reviewed by [illegible]
Date reviewed 11-17-09

ETS
Environmental Testing Solutions, Inc.

Total Residual Chlorine
(Orion Electrode Method, Orion 97-70)

Matrix: Water, RL = 0.10 mg/L
Meter: Accumet Model AR25 pH/Ion Meter

Analyst	UAB	Iodide reagent:	INR357
Date analyzed	11-19-09	Acid reagent:	INR353

Calibration:

	0.10 mg/L	1.00 mg/L	Slope
Reference standard number	INSS673	INSS673	-49.8%

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

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%)
INSS673	0.50	0.510	102.0%

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
091119.02	Sweeny	clear w/ particles, NO color	S <0.00425	
"	Duplicate		D <0.00331	UB

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	Reagent Blank		<0.0097
091119.03	Wilmington WWTP	clear, pale tan	<0.000932
091119.01	Black River IN-storm	clear, tan	<0.000622
091118.05	PAF-DSN-001B	slightly cloudy, pale tan	0.0162
091118.03	SQN-101-TOX-B/A	clear, No color	<0.00533
091118.04	SQN-int.TOX	slightly cloudy w/ particles pale tan	<0.00410
091118.06	PAF-RWI B	slightly cloudy w/ particles, pale tan	<0.00375
		UAB	
			UB

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%)
INSS673	0.50	0.502	100.4%

Reviewed by	[signature]
Date reviewed	11-19-09

ETS
Environmental Testing Solutions, Inc.

Total Residual Chlorine
(Orion Electrode Method, Orion 97-70)

Matrix: Water, RL = 0.10 mg/L
Meter: Accumet Model AR25 pH/Ion Meter

Analyst	LAB	Iodide reagent:	IN12357
Date analyzed	11-21-09	Acid reagent:	IN12353

Calibration:

	0.10 mg/L	1.00 mg/L	Slope
Reference standard number	IN55673	IN55673	-49.1%

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

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%)
IN55673	0.50	0.500	100.0%

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
091120.03	Swannanoa Base Flow	clear w/ particles, pale tan	S <0.00390	
↓	Duplicate		D <0.00305	LB

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	Reagent Blank		<0.00888
091121.01	Sweeny	clear w/ particles, no color	0.00441
091121.02	Wilmington	clear, pale tan	<0.000841
091121.03	Little River-Instream	cloudy w/ particles, tan	<0.000445
091120.07	PAF-RWI-C	cloudy w/ particles, pale tan	0.00213
091120.06	PAF-DSN-001 C	clear, particles, pale tan	0.00888
091120.05	SQN-INT-TOX	clear, particles, pale tan	<0.00408
091120.04	SQN-101-TOX A	clear, no color	<0.00251
		LAB	LB

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%)
~~IN~~ LB IN55673	0.50	0.492	98.4%

Reviewed by	JJ
Date reviewed	11-21-09

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	KLK
Date analyzed	11-15-09

Titrate samples to pH = 4.50 S.U.

Time initiated	0850
Time completed	0941

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_2SO_4 = (5 ml Na_2CO_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
4.8	IN6329	IN55704	0.0	12.0	12.0	0.0208	10.4

Blk correction 0.0-0.0=0.0ml

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%)
IN55734	100	100	12.0	21.5	9.5	10.4	99	99.0%

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%)
11-12-09A	MHS H2O	100	21.5	27.4	5.9	10.4	S 61	
↓	Duplicate (B)	↓	27.4	33.3	5.9	↓	D 61	—

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)
IN55734	50	100	27.4	38.2	10.8	10.4	110

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%)
61	49	98.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
11-12-09B	MHS H2O	100	38.2	44.2	6.0	10.4	62
11-14-09	↓	↓	0.0	5.8	5.8	↓	60
11-09-09	Salt SW	↓	37.7	48.0	10.3	↓	110
	Marshall Pond	↓	5.8	8.8	3.0	↓	31
091112.03	AK CUTEL	↓	9.3	9.5	0.2	↓	2.1
091111.08	ERM - pilot	50	9.5	20.0	10.5	(2) ↓	220
091110.02	Foxwood 1	100	20.0	22.7	2.7	↓	28
091112.02	↓ 2	↓	22.7	25.3	2.6	↓	27
091114.04	↓ 3	↓	25.4	28.2	2.8	↓	29

Reviewed by: [illegible]

Date reviewed: 11-15-09

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	KLV
Date analyzed	11-15-09

Titrate samples to pH = 4.50 S.U.

Time initiated	
Time completed	

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_2SO_4 = (5 ml Na_2CO_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

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%)
INS5734	100	100	28.2	37.7	9.5	10.4	99	99.0%

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%)
	Swann Stream	100	0.0	1.7	1.7	10.4	S 18	
	Duplicate (B)	↓	1.7	3.2	1.5	↓	D 16	11.8%

not enough to dupl - 2mg/L difference

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)
INS5734	50	100	1.7	3.0	6.3	10.4	66

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%)
16	50	100.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
	Swann Bridge	100	8.0	9.3	1.3	10.4	14
	Blk River Bridge		9.3	9.8	0.5		5.2
	Little River Bridge		10.0	11.6	1.6		17
	Blk River Stream		11.6	12.4	0.8		8.3
	Little River Stream		12.4	13.9	1.5		16
66580	VWIN T1		13.9	15.6	1.7		18
66581	T2		15.6	17.6	2.0		21
66582	T3		17.6	18.0	0.4		4.2
66583	T4	↓	18.2	19.6	1.4	↓	15

Reviewed by: JH

Date reviewed: 11-15-09

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst: KEL

Date analyzed: 11-15-09

Titrate samples to pH = 4.50 S.U.

Time initiated:

Time completed:

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_2SO_4 = (5 ml Na_2CO_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

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%)
INSS734	100	100	19.6	29.2	9.6	10.4	100	100.0%

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%)
11.14.09	Salt SW	100	7.3			10.4	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 alkalinity (A) (mg $CaCO_3$/L)
INSS734	50	100				10.4	

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%)

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
66584	TH-15 VWIN	100	29.2	29.9	0.7	10.4	7.3
66585	T6 ↓	↓	29.9	31.8	1.9	↓	20
091107.11	Hercules 1	25	31.8	34.6	2.8	14	120
091110.01	↓ 2	↓	34.6	37.5	2.9	↓	120
091112.01	↓ 3	↓	37.6	40.4	2.8	↓	120

Reviewed by:

Date reviewed: 11-15-09

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	BSL
Date analyzed	11.22.09

Titrate samples to pH = 4.50 S.U.

Time initiated	1050
Time completed	1232

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_2SO_4 = (5 ml Na_2CO_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~~ 5.7 BSL	INR329	JNSS704	0.1	11.8	11.7	0.0214	10.7

BlK Correction: 0.0 → 0.1 = 0 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%)
JNSS734	100	100	11.8	21.7	9.9	10.7	106	106%

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%)
11-19-09	MHS H2O	100	21.7	27.5	5.8	10.7	S 62	
↓	Duplicate (B)	↓	27.5	33.3	5.8	10.7	D 62	0%

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)
JNSS734	50	100	27.5	38.3 ~~30.5~~ BSL	10.8 ~~11.8~~ BSL	10.7	120

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%)
62	58	116%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
11.21.09	MHS H2O	100	38.3	44.0	5.7	10.7	61
11-19-09	SSW	↓	44.0	47.2	3.2	↓	34
11.17-09	MHS H2O	↓	0.0	5.8	5.8	↓	62
11-14-09	Salt SW	↓	~~5.0~~ 0.0	~~11.7~~ 9.1	~~5.9~~ 9.1 BSL	↓	~~103~~ BSL 97
11-17-09	↓	↓	~~11.7~~ 9.1 BSL	19.3	10.2	↓	110
11-19-09	↓	↓	19.3	28.9	9.6	↓	100
11.21.09	↓	↓	28.9	39.3	10.4	↓	110
091116.05	TVA PAF001 1	50	39.3	44.3	5.0	(2)	110 = 107
091118.05	↓ 2	↓	44.3	49.5	5.2	↓	110 = 111

Reviewed by: [illegible] Date reviewed: 11-22-09

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	BSC
Date analyzed	~~11-23-09 BSC~~ 11-22-09

Titrate samples to pH = 4.50 S.U.

Time initiated	
Time completed	

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_2SO_4 = (5 ml Na_2CO_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

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%)
INSS 734	100	100	0.0	9.5	9.5	10.7	100	100%

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%)
091120.06	TVAPAF001 3	50	9.5	14.5	5.0	(2) 10.7	S 110=107	
↓	Duplicate (B)	↓	14.5	19.6	5.1	↓ ↓	D 110 =109	0%

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)
INSS734	~~50~~ 100 BSC	50	14.5	24.3	9.8	(2) 10.7	210

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%)
110	100	100%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
091116.02	TVA-PAF001int 1	50	24.3	29.9	5.6	(2) 10.7	120
091118.06	↓ 2	↓	29.9	35.8	5.9	↓	130 = 126
091120.07	↓ 3	↓	35.8	41.3	5.5	↓	120 = 118
091118.07	TVAPAF002 AP	50	41.3	47.2	5.9	(2)	130 = 126
091118.08	↓ APint	↓	0.0	5.3	5.3	↓	110 = 113
091118.09	AA	↓	5.3	11.0	5.7	↓	120 = 122
091118.10	↓ AAint	↓	11.0	16.9	5.9	↓	130 = 126
091117.05	TVA-SAN 101 1	50	16.9	21.4	4.5	(2)	96
091118.03	↓ 2	↓	21.4	24.5	3.1	↓ —	66

Reviewed by: [illegible] Date reviewed: 11-22-09

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	BSK / KLW
Date analyzed	11.22.09

Titrate samples to pH = 4.50 S.U.

Time initiated	
Time completed	

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_2SO_4 = (5 ml Na_2CO_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

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%)
INSS734	100	100	24.5	34.0	9.5	10.7	102	102%

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%)
091120.04	TVASQN101 3	50	34.2	37.1	2.9	(2) 10.7	S 62	
↓	Duplicate (B)	↓	37.1	40.0	2.9	↓	D 62	—

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)
INSS734	100	50	37.1	44.7	7.6	(2) 10.7	160

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%)
62	98	98.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
091117.06	TVA-SQN int 1	50	0.0	3.1	3.1	(2) 10.7	66
091118.04	2		3.1	6.1	3.0		64
091120.05	3		6.1	8.8	2.7		50
091117.05	TVASQN101 UV 1		8.8	12.0	3.2		68
091118.03	2		12.0	14.9	2.9		62
091120.04	3		14.9	17.6	2.7		58
091117.06	TVASQN Int UV 1		17.7	20.8	3.1		66
091118.04	2		20.8	23.6	2.8		60
091120.05	3		23.6	26.6	3.0		64

Reviewed by: [signature] Date reviewed: 11-22-09

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst: [illegible]

Date analyzed: 11-22-09

Time initiated:

Time completed:

Titrate samples to pH = 4.50 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_2SO_4 = (5 ml Na_2CO_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

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%)
INSS 734	100	100	26.0	36.2	9.6	10.7	103	103.0%

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%)
091117.01	Sweeny 1	25	36.2	36.5	0.3	(4) 10.7	S 13	
↓	Duplicate (B)	↓	36.5	36.8	0.3	↓	D 13	

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)
INSS 734	200	25	36.5	41.6	5.1	(4) 10.7	280

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%)
13	207	103.5%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
091119.02	Sweeny 2	25	41.6	42.0	0.4	(4) 10.7	17
091121.01	↓ 3	↓	42.0	42.3	0.3	↓	13
091117.02	Wilmington 1	100	7.4	13.5	6.1		65
091119.03	↓ 2	↓	13.5	18.5	5.0		54
091121.02	↓ 3	↓	18.5	23.2	4.7		50
091117.01+02	Blend 1	50	23.2	25.5	2.3	(2)	49
091119.02+03	2	↓	25.6	28.0	2.4	↓	51
091121.01+02	↓ 3	↓	28.0	29.0	1.0	↓	30
	Lth Oliver 1	100	30.0	31.0	1.0	—	19

Reviewed by: [illegible]

Date reviewed: 11-22-09

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst: ~~BSA~~ KGL

Date analyzed: 11-22-09

Titrate samples to pH = 4.50 S.U.

Time initiated:

Time completed:

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_2SO_4 = (5 ml Na_2CO_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

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%)
JNS5734	100	100	31.8	41.1	9.3	10.7	100	100.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	~~0.5~~ 1.8 Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
	Little River 2	100	29.6	31.4	~~0.5~~	10.7	S 19	
	Duplicate (B)	↓	31.4	33.3	1.9	↓	D 20	5.1%

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)
JNS5734	50	100	31.4	38.2	6.8	10.7	73

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%)
20	53	106.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
	Swan River 1	100	38.2	39.1	0.9	10.7	9.6
	↓ 2	↓	39.1	40.0	0.9	↓	9.6
	Big River Stream	↓	40.0	40.5	0.5	↓	5.4

KG

Reviewed by: JL

Date reviewed: 11-22-09

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst: KLK

Date analyzed: ~~HOT~~ 11-20-09

Titrate samples to pH = 4.50 S.U.

Time initiated:

Time completed:

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_2SO_4 = (5 ml Na_2CO_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

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%)
	100	100						

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%)
							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 alkalinity (A) (mg $CaCO_3$/L)

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%)

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
11-12-09 A	MHS UU 1	100	40.5	46.2	5.7	10.7	61
11-12-09 B	2		21.6	27.4	5.8		62
11-17-09	3		27.4	33.1	5.7		61
11-19-09	4		33.1	38.8	5.7		61

Reviewed by: [illegible]

Date reviewed: 11-22-09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst	[illegible]	Time initiated	0820
Date analyzed	11-15-09	Time completed	0848

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
INK332	INSS6056	0.0	10.0	10.0	0.020	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%)
INSS702	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
11-12-09A	MHS H2O	50	12.0	16.5	4.5	20.0	S 90	
↓	Duplicate (B)	↓	16.5	21.0	4.5	↓	D 90	—

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)
INSS702	40	50	16.5	~~210~~ 230	6.5	20.0	130

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%)
90	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
11-12-09 B	MHS H2O	↓	23.0	27.5	4.5	↓	90
11-14-09	↓	↓	27.5	32.0	4.5	↓	90
166474	Marshall PPO	↓	32.0	36.9	4.9	↓	98
	Marshall	↓	36.9	41.9	5.0	↓	100
091112.03	CYTEC	↓	41.9	42.2	0.3	↓	6.0
091111.08	ERM- pilot	10	00	3.9	3.9	(5) ↓	390
091110.02	Foxwood 1	50	3.9	7.0	3.1	↓	62
091112.02	↓ 2	↓	7.0	8.3	1.3	↓	26
091114.04	↓ 3	↓	8.3	9.9	1.6	↓	32

Page 72 of 102 If 10 ml titrant is used, sample must be diluted. Reviewed by: [illegible] Date reviewed 11-15-09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst	KLL	Time initiated	
Date analyzed	11.15.09	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

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%)
INSS702	40	50	9.9	11.9	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
	Swann. Stream	50	12.0	12.5	0.5	20.0	S 10	
	Duplicate (B)	↓	12.5	13.0	0.5	↓	D 10	→

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)
INSS702	40	50	12.5	15.0	2.5	20.0	50

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%)
10	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)						✓
	Swann. Bridge	50	15.0	15.9	0.9	20.0	18
	Blk River Bridge	↓	15.9	16.2	0.3	↓	6.0
	Little River Bridge		16.2	17.0	0.8		16
	Blk River Stream		17.0	18.3	1.3		26
	Little River Stream		18.3	19.4	1.1		22

Note: If 1.5 ml of titrant is used, sample must be diluted. Reviewed by: [signature] Date reviewed 11-15-09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst	BSC	Time initiated	0913
Date analyzed	11-22-09	Time completed	1045

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
IN2332	INSS656	0.5	10.3	9.8	~~0.0204~~ 0.0204 BSC ~~0.2041~~ BSC	20.4

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%)
INSS 702	40	50	10.3	12.2	1.9	20.4	39	~~98%~~ 97.5%

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
11-19-09	MHS H2O	50	12.2	16.5	4.3	20.4	S 88	
↓	Duplicate (B)	↓	16.5	20.9	4.4	↓	D 90	2.2%

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)
INSS 702	40	50	16.5	23.0	6.5	20.4	130

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%)
90	40	100%

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	23.0	23.0	0.0	20.4	ND
11-21-09	MHS H2O		23.0	27.1	4.1		84
11-19-09	SSW		27.1	29.2	2.1		43
11-17-09	MHS H2O		29.2	33.6	4.4		90
11-12-09 A	MHS UV 1		33.6	38.0	4.4		90
11-12-09 B	2		38.0	42.3	4.3		88
11-17-09	3		42.3	46.7	4.4		90
11-19-09	4	↓	0.0	4.2	4.2		86
091116.01	TVA-PAF 001 1	10	4.2	10.9	6.7	(5)	680 = 683
091118.05	↓ 2	↓	10.9	17.3	6.4	↓	650 = 653

Note: If full titrant is used, sample must be diluted. Reviewed by: [illegible] Date reviewed 11-22-09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst: BSC

Date analyzed: 11-22-09

Time initiated:

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

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%)
INS5702	40	50	17.3	19.4	2.1	20.4	43	~~108%~~ 107.5%

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
091120.06	TVAPAF001 3	10	19.4	26.1	6.7	(5) 20.4	S 680 = 683	
	Duplicate (B)	↓	26.1	32.6 ~~32.2~~	6.5 ~~6.1~~	↓ ↓	D 660 ~~620~~ = 660	3.0% ~~9.2%~~ BSC

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)
INS5702	200	10	~~26.6~~ 26.1	34.6	8.5	(5) 20.4	870

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%)
~~620~~ BSC 660	210	105%

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 CaCO3/L)~~						
091116.02	TVA PAF001 int 1	25	34.6	38.1	3.5	(2) 20.4	140 = 143
091118.06	↓ 2	↓	38.1	41.6	3.5	↓	140 = 143
091120.07	↓ 3	↓	41.6	45.0	3.4	↓	140 = 139
091118.07	TVAPAF002 AP	10	0.0	2.2	2.2	(5)	220 = 224
091118.08	AP int	25	2.2	6.1	3.9	(2)	160 = 159
091118.09	↓ AA	10	6.1	8.0	1.9	(5)	190 = 194
091118.10	↓ AA int	25	8.0	11.8	3.8	(2)	160 = 155
091117.05	TVA SQN 101 ↓	25	11.8	13.8	2.0	(2)	82
091118.03	↓ 2	↓	13.0	15.7	2.7	↓	110

Note: If 7.5 ml of titrant is used, sample must be diluted. Reviewed by: KDL Date reviewed: 11-22-09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst	BSC
Date analyzed	11.22.09

Time initiated	
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~~

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%)
INS5702	40	50	15.7	17.5	1.8	20.4	~~38~~ 37	~~92%~~ 92.5%

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
091120.04	TVA-SQN 101 3	25	17.5	19.2	1.7	(2) 20.4	S 69	
↓	Duplicate (B)	↓	~~19.2~~ 20.7	~~20.7~~ 22.3	~~1.5~~ 1.6	↓ (2) 20.4	D ~~61~~ BSC 65	6.0%

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)
INS5702	80	25	20.7	24.3	3.6	(2) 20.4	150

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%)
65	85	~~106%~~ 106.2%

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)						
091117.06	TVA SQN INT 1	25	24.3	26.3	2.0	(2) 20.4	82
091118.04	2	↓	26.3	28.0	1.7	↓	69
091120.05	3	↓	28.0	29.8	1.8	↓	73
091117.05	TVA SQN 101UV 1	25	29.8	31.7	1.9	(2)	78
091118.03	2	↓	31.7	33.6	1.9	↓	78
091120.04	3	↓	33.6	35.2	1.6	↓	65
091117.06	TVA SQN INT UV 1	25	35.2	37.1	1.9	(2)	78
091118.04	2	↓	37.1	38.8	1.7	↓	69
091120.05	3	↓	38.8	40.5	1.7	↓	69

Note: If titrant is used, sample must be diluted. Reviewed by: KCR Date reviewed 11.22.09

ETS Environmental Testing Solutions, Inc.

Total Hardness (SM 2340 C)

RL = 1.0 mg $CaCO_3$/L

Analyst: BSC

Date analyzed: 11-22-09

Time initiated:

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

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%)
INSS702	40	50	40.5	42.3	1.8	20.4	37	~~93%~~ 92.5%

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
	Little River 1	50	42.3	43.9	1.6	20.4	S 33	
	Duplicate (B)	↓	43.9	45.4	1.5	↓	D 31	6.3%

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)
INSS702	40	50	43.9	47.1	3.2	20.4	65

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%)
31	34	85%

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)						
	Little River 2	50	10.0	11.8	1.8	20.4	37
	Swann River 1	↓	11.8	12.9	1.1	↓	22
	↓ 2	↓	12.9	13.9	1.0	↓	20
	Bill River Storm	↓	13.9	15.1	1.2	↓	24

Note: If >1.5ml of titrant is used, sample must be diluted.

Reviewed by: KH

Date reviewed: 11.22.09

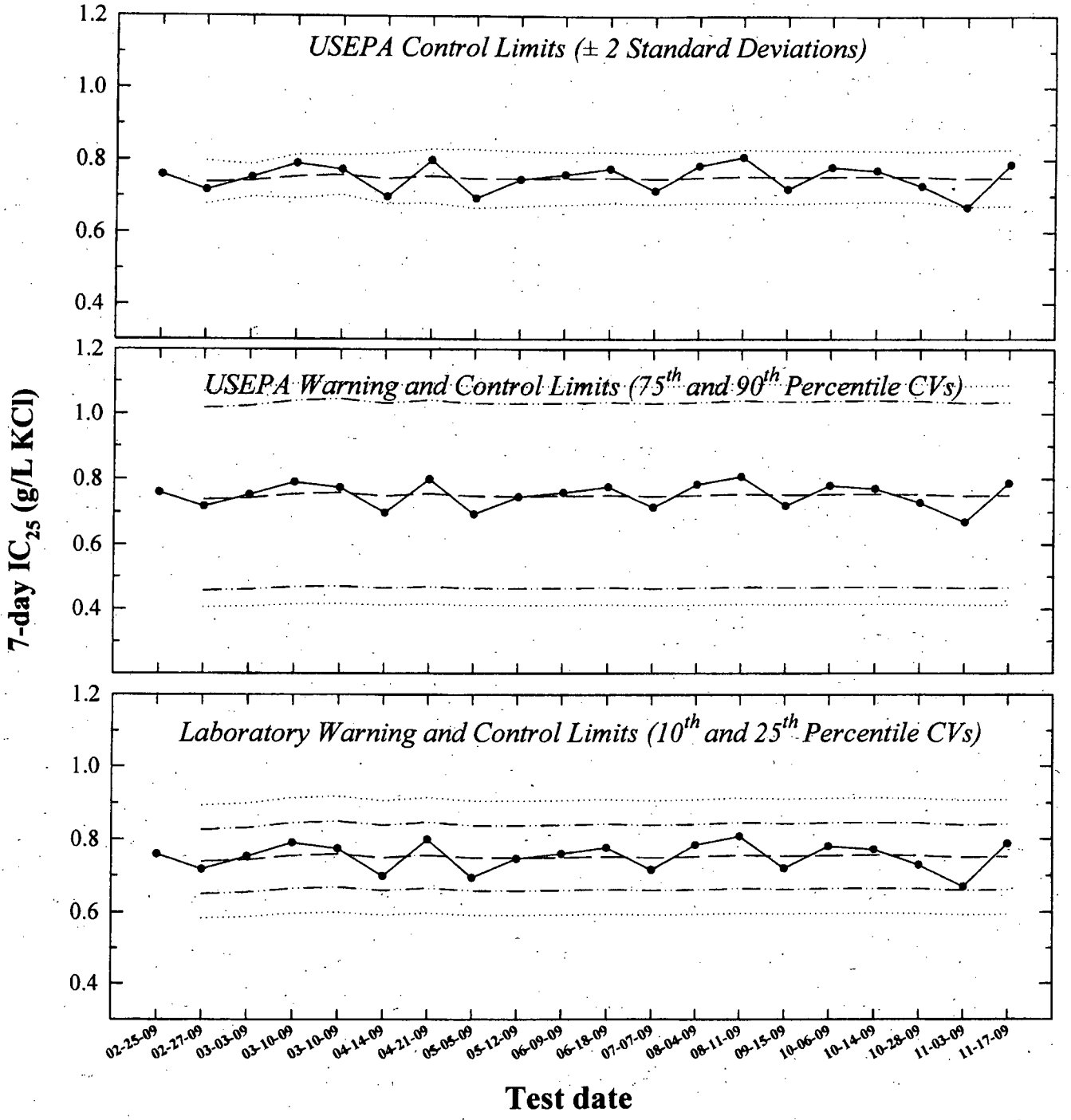
Sequoyah Nuclear Plant Biomonitoring
November 17 – 24, 2009

Appendix D

Reference Toxicant Test and
Control Chart

ETS
Environmental Testing Solutions, Inc.

Pimephales promelas
Chronic Reference Toxicant Control Chart
Organism Source: Aquatox, Inc.



—•— **7-day IC_{25}** = 25% inhibition concentration. An estimation of the concentration of potassium chloride that would cause a 25% reduction in *Pimephales* growth for the test population.

— — **Central Tendency** (mean IC_{25})

—·—·— **Warning Limits** (mean $IC_{25} \pm S_{A.10}$ or $S_{A.75}$)

····· **Control Limits** (mean $IC_{25} \pm S_{A.25}$, $S_{A.90}$, or 2 Standard Deviations)

ETS
Environmental Testing Solutions, Inc.

Pimephales promelas
Chronic Reference Toxicant Control Chart

Test number	Test date	7-day IC_{25} (g/L KCl)	CT (g/L KCl)	S	State and USEPA Control Limits CT - 2S	CT + 2S	$S_{A.10}$	Laboratory Warning Limits CT - $S_{A.10}$	CT + $S_{A.10}$	$S_{A.25}$	Laboratory Control Limits CT - $S_{A.25}$	CT + $S_{A.25}$	$S_{A.75}$	USEPA Warning Limits CT - $S_{A.75}$	CT + $S_{A.75}$	$S_{A.90}$	USEPA Control Limits CT - $S_{A.90}$	CT + $S_{A.90}$	CV
1	02-25-09	0.76																	
2	02-27-09	0.72	0.74	0.03	0.68	0.80	0.09	0.65	0.83	0.15	0.58	0.89	0.28	0.46	1.02	0.33	0.41	1.07	0.04
3	03-03-09	0.75	0.74	0.02	0.70	0.79	0.09	0.65	0.83	0.16	0.59	0.90	0.28	0.46	1.02	0.33	0.41	1.08	0.03
4	03-10-09	0.79	0.75	0.03	0.69	0.81	0.09	0.66	0.85	0.16	0.60	0.91	0.29	0.47	1.04	0.34	0.41	1.09	0.04
5	03-10-09	0.77	0.76	0.03	0.70	0.81	0.09	0.67	0.85	0.16	0.60	0.92	0.29	0.47	1.05	0.34	0.42	1.10	0.04
6	04-14-09	0.70	0.75	0.03	0.68	0.82	0.09	0.66	0.84	0.16	0.59	0.91	0.28	0.46	1.03	0.34	0.41	1.09	0.05
7	04-21-09	0.80	0.76	0.04	0.68	0.83	0.09	0.66	0.85	0.16	0.60	0.91	0.29	0.47	1.04	0.34	0.42	1.10	0.05
8	05-05-09	0.69	0.75	0.04	0.67	0.83	0.09	0.66	0.84	0.16	0.59	0.90	0.28	0.46	1.03	0.34	0.41	1.08	0.05
9	05-12-09	0.75	0.75	0.04	0.67	0.82	0.09	0.66	0.84	0.16	0.59	0.90	0.28	0.46	1.03	0.34	0.41	1.08	0.05
10	06-09-09	0.76	0.75	0.04	0.68	0.82	0.09	0.66	0.84	0.16	0.59	0.91	0.28	0.46	1.03	0.34	0.41	1.09	0.05
11	06-18-09	0.78	0.75	0.04	0.68	0.82	0.09	0.66	0.84	0.16	0.59	0.91	0.29	0.47	1.04	0.34	0.41	1.09	0.05
12	07-07-09	0.72	0.75	0.04	0.68	0.82	0.09	0.66	0.84	0.16	0.59	0.91	0.28	0.46	1.03	0.34	0.41	1.08	0.05
13	08-04-09	0.78	0.75	0.04	0.68	0.82	0.09	0.66	0.84	0.16	0.59	0.91	0.29	0.47	1.04	0.34	0.41	1.09	0.05
14	08-11-09	0.81	0.75	0.04	0.68	0.83	0.09	0.66	0.85	0.16	0.60	0.91	0.29	0.47	1.04	0.34	0.42	1.09	0.05
15	09-15-09	0.72	0.75	0.04	0.68	0.83	0.09	0.66	0.84	0.16	0.59	0.91	0.29	0.47	1.04	0.34	0.41	1.09	0.05
16	10-06-09	0.78	0.75	0.04	0.68	0.83	0.09	0.66	0.84	0.16	0.60	0.91	0.29	0.47	1.04	0.34	0.41	1.09	0.05
17	10-14-09	0.77	0.76	0.04	0.68	0.83	0.09	0.66	0.85	0.16	0.60	0.91	0.29	0.47	1.04	0.34	0.42	1.10	0.05
18	10-28-09	0.73	0.75	0.03	0.68	0.82	0.09	0.66	0.84	0.16	0.60	0.91	0.29	0.47	1.04	0.34	0.41	1.09	0.05
19	11-03-09	0.67	0.75	0.04	0.67	0.83	0.09	0.66	0.84	0.16	0.59	0.91	0.28	0.46	1.03	0.34	0.41	1.09	0.05
20	11-17-09	0.79	0.75	0.04	0.67	0.83	0.09	0.66	0.84	0.16	0.59	0.91	0.29	0.47	1.04	0.34	0.41	1.09	0.05

Note: 7-d IC_{25} = 7-day 25% inhibition concentration. An estimation of the concentration of potassium chloride that would cause a 25% reduction in Pimephales growth for the test population.

CT = Central tendency (mean IC_{25}).

S = Standard deviation of the IC_{25} values.

Laboratory Control and Warning Limits

Laboratory control and warning limits were established using the standard deviation of the IC_{25} values corresponding to the 10th and 25th percentile CVs. These ranges are more stringent than the control and warning limits recommended by USEPA for the test method and endpoint.

$S_{A.10}$ = Standard deviation corresponding to the 10th percentile CV. ($S_{A.10}$ = 0.12)

$S_{A.25}$ = Standard deviation corresponding to the 25th percentile CV. ($S_{A.25}$ = 0.21)

USEPA Control and Warning Limits

$S_{A.75}$ = Standard deviation corresponding to the 75th percentile CV. ($S_{A.75}$ = 0.38)

$S_{A.90}$ = Standard deviation corresponding to the 90th percentile CV. ($S_{A.90}$ = 0.45)

CV = Coefficient of variation of the IC_{25} values.

USEPA. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination Program. EPA-833-R-00-003. US Environmental Protection Agency, Cincinnati, OH.

Organisms obtained from Aquatox, Inc.

ETS
Environmental Testing Solutions, Inc.

Precision of Endpoint Measurements

Pimephales promelas
Chronic Reference Toxicant Data

Test number	Test date	Control Survival (%)	Control Mean Growth (mg/larvae)	CT for Control Growth (mg/larvae)	CV (%)	CT for Control Growth CV (%)	MSD	PMSD (%)	CT for PMSD (%)
1	02-25-09	100	0.659		8.2		0.07	11.1	
2	02-27-09	100	0.578	0.618	6.8	7.5	0.08	13.1	12.1
3	03-03-09	100	0.664	0.634	8.1	7.7	0.08	12.3	12.2
4	03-10-09	100	0.661	0.640	6.8	7.5	0.09	12.9	12.4
5	03-10-09	100	0.696	0.652	8.8	7.7	0.09	12.6	12.4
6	04-14-09	100	0.671	0.655	10.3	8.2	0.08	11.4	12.3
7	04-21-09	100	0.642	0.653	8.3	8.2	0.07	11.2	12.1
8	05-05-09	100	0.805	0.672	7.9	8.2	0.07	8.4	11.6
9	05-12-09	100	0.717	0.677	7.0	8.0	0.06	8.9	11.3
10	06-09-09	100	0.703	0.679	2.5	7.5	0.08	10.7	11.3
11	06-18-09	100	0.790	0.689	6.7	7.4	0.09	11.7	11.3
12	07-07-09	100	0.763	0.696	5.7	7.3	0.11	14.2	11.5
13	08-04-09	100	0.692	0.695	6.2	7.2	0.07	10.7	11.5
14	08-11-09	100	0.583	0.687	8.0	7.2	0.05	9.3	11.3
15	09-15-09	100	0.723	0.690	9.6	7.4	0.08	10.4	11.3
16	10-06-09	100	0.894	0.702	12.9	7.7	0.12	13.2	11.4
17	10-14-09	97.5	0.758	0.706	7.6	7.7	0.14	18.3	11.8
18	10-28-09	100	0.855	0.714	6.5	7.7	0.10	12.0	11.8
19	11-03-09	100	0.757	0.716	7.1	7.6	0.07	8.8	11.6
20	11-17-09	97.5	0.825	0.722	8.3	7.7	0.10	11.8	11.7

Note:

CV = Coefficient of variation for control growth.
Lower CV bound determined by USEPA (10th percentile) = 3.5%.
Upper CV bound determined by USEPA (90th percentile) = 20%

MSD = Minimum Significant Difference

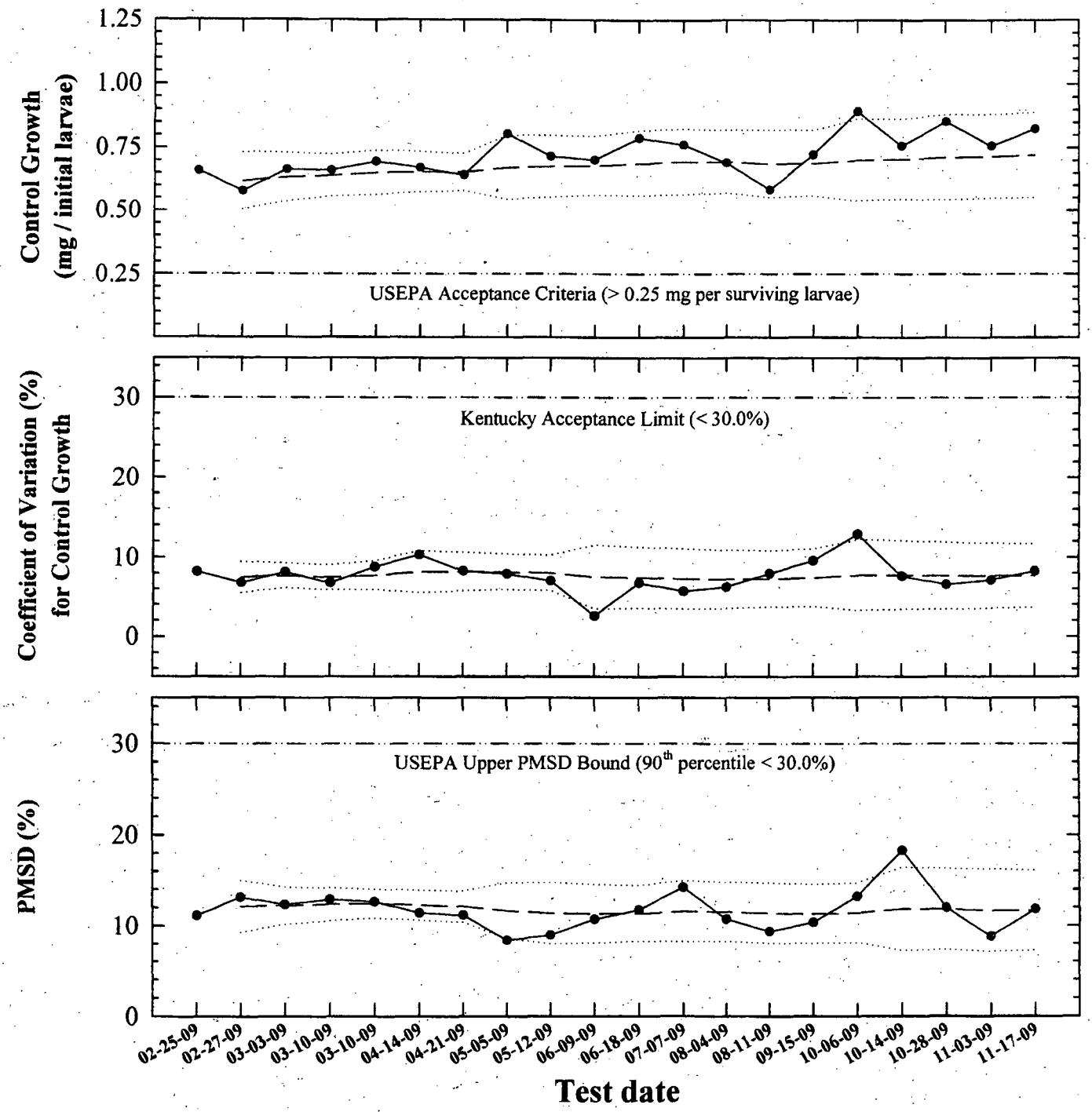
PMSD = Percent Minimum Significant Difference
PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.
Lower PMSD bound determined by USEPA (10th percentile) = 12%.
Upper PMSD bound determined by USEPA (90th percentile) = 30%.

CT = Central Tendancy (mean Control Growth, CV, or PMSD)

USEPA. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination Program. EPA-833-R-00-003. US Environmental Protection Agency, Cincinnati, OH.
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.

Environmental Testing Solutions, Inc.

Pimephales promelas
Chronic Reference Toxicant Control Chart
Precision of Endpoint Measurements
Organism Source: Aquatox, Inc.



—•— **Control Reproduction, Coefficient of Variation (CV), or Percent Minimum Significant Difference (PMSD)** PMSD is the minimum significant difference between the control and treatment that can be declared statistically significant.

— — **Central Tendency** (mean Control Growth, CV, or PMSD)

····· **Control Limits** (mean Control Growth, CV, or PMSD ± 2 Standard Deviations)

ETS Environmental Testing Solutions, Inc.

Potassium Chloride Chronic Reference Toxicant Test
(EPA-821-R-02-013 Method 1000.0)
Species: *Pimephales promelas*

PpKClCR Test Number: 193

Dilution preparation information:						*Comments:*
KCl Stock INSS number:	INSS 742					
Stock preparation:	50 g KCl/L: Dissolve 50 g KCl in 1-L Milli-Q water.					
Dilution prep (mg/L)	450	600	750	900	1050	
Stock volume (mL)	9	12	15	18	21	
Diluent volume (mL)	991	988	985	982	979	
Total volume (mL)	1000	1000	1000	1000	1000	

Test organism information:		*Test information:*	
Organism age:	20.33 HOURS OLD	Randomizing template:	PURPLE
Date and times organisms were born between:	11-16-09 1600	Incubator number and shelf location:	3E
Organism source:	ATOX BATCH Pp 11-16-09	*Artemia* CHM number:	CHM 444
		Drying information for weight determination:	
Transfer vessel information:	pH = 7.46 S.U. Temperature = 24.6 °C	Date / Time in oven:	11-24-09 1140
		Initial oven temperature:	60°C
Average transfer volume:	0.2305 mL	Date / Time out of oven:	11-25-09 1140
		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	11-17-09	—	—	1600	JH	1220	JH	11-12-09 A
1	11-18-09	0800	JH	1400	JH	1234	JH	11-12-09 A
2	11-19-09	0800	JH	1400	JH	1220	JH	11-12-09 B
3	11-20-09	0800	JH	1400	JH	1225	JH	11-12-09 B
4	11-21-09	0800	JH	1400	JH	1210	JH	11-17-09
5	11-22-09	0800	JH	1400	JH	1215	JH	11-19-09
6	11-23-09	0800	JH	1400	JH	1220	JH	11-19-09
7	11-24-09					1121	JH	

Control information:		Acceptance criteria
% Mortality:	2.5%	≤ 20%
Average weight per initial larvae:	0.825	
Average weight per surviving larvae:	0.845	≥ 0.25 mg/larvae

Summary of test endpoints:	
7-day LC_{50}	876.4
NOEC	600
LOEC	750
ChV	670.8
IC_{25}	787.3

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** PpKClCR Test Number: 193

Survival and Growth Data

Day	Control				450 mg KCl/L				600 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	9 d	10	10	10	10	10	10	10	10
5	10	10	10	9	10	10	10	10	10	10	10	10
6	10	10	10	9	10	10	10	10	9 d	10	10	10
7	10 lg	10	10	9	9 d	10	10	10	9	10	10 sm	9 d
A = Pan weight (mg) Tray color code:: yellow Analyst: KLS Date: 10-28-09	13.90	15.09	13.58	13.21	14.99	13.74	12.68	12.51	14.11	14.50	14.06	14.34
B = Pan + Larvae weight (mg) Analyst: BLS Date: 12.01.09	22.97	23.14	22.01	20.65	22.02	21.33	21.22	20.67	21.90	22.98	21.21	22.23
C = Larvae weight (mg) = B – A	9.07	8.05	8.43	7.44	7.03	7.59	8.54	8.16	7.79	8.48	7.15	7.89
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.907	0.805	0.843	0.744	0.703	0.759	0.854	0.816	0.779	0.848	0.715	0.789
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.825				0.783		5.17		0.783		5.17	

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.

Calculations and data reviewed: H

Comments:

ETS
Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** PpKClCR Test Number: 193

Survival and Growth Data

Day	750 mg KCl/L				900 mg KCl/L				1050 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	9 d	10	7 d	5 d	6 d	7 d	4 d	6 d	6 d	6 d
2	10	10	9	10	7	5	6	7	4	5 d	6	6
3	10	10	9	10	6 d	5	5 d	7	4	5	6	5 d
4	9 d	8 d	9	9 d	5 d	5	5	6 d	4	3 d	5 d	5
5	9	7 d	9	7 d	4 d	5	4 d	4 d	4	2 d	4 d	4 d
6	8 d	7	9	7	4	5	4	4	3 d	1 d	3 d	3 d
7	8	7 fg	9 fg	7	4 fg	5	4	4	2 d	1 fg	2 d	2 d
A = Pan weight (mg) Tray color code:: Yellow Analyst: KS Date: 10-28-09	13.48	14.64	13.84	14.21	14.79	15.29	13.62	14.31	15.18	15.72	14.42	14.73
B = Pan + Larvae weight (mg) Analyst: MS Date: 12-01-09	20.32	20.95	22.43	20.40	19.12	19.54	16.82	17.65	16.73	16.90	15.95	16.44
C = Larvae weight (mg) = B – A	6.84	6.31	8.59	6.19	4.33	4.25	3.20	3.34	1.55	1.18	1.53	1.71
Weight per initial number of larvae (mg) = C / Initial number of larvae	0.684	0.631	0.859	0.619	0.433	0.425	0.320	0.334	0.155	0.118	0.153	0.171
Average weight per initial number of larvae (mg)	0.698				0.378				0.149			
Percent reduction from control (%)		15.37%				54.27%				81.97%		

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.

Calculations and data reviewed: JL

Comments:

ETS
Environmental Testing Solutions, Inc.

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: PpKCICR #193
Test dates: November 17-24, 2009
Reveiwed by:

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) = A - B	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	13.90	22.97	9.07	0.907	0.845	5.2	0.907	97.5	0.825	8.3	Not applicable
	B	10	10	15.09	23.14	8.05	0.805			0.805				
	C	10	10	13.58	22.01	8.43	0.843			0.843				
	D	10	9	13.21	20.65	7.44	0.827			0.744				
450	E	10	9	14.99	22.02	7.03	0.781	0.803	5.2	0.703	97.5	0.783	8.4	5.1
	F	10	10	13.74	21.33	7.59	0.759			0.759				
	G	10	10	12.68	21.22	8.54	0.854			0.854				
	H	10	10	12.51	20.67	8.16	0.816			0.816				
600	I	10	9	14.11	21.90	7.79	0.865	0.826	9.1	0.779	95.0	0.783	7.0	5.1
	J	10	10	14.50	22.98	8.48	0.848			0.848				
	K	10	10	14.06	21.21	7.15	0.715			0.715				
	L	10	9	14.34	22.23	7.89	0.877			0.789				
750	M	10	8	13.48	20.32	6.84	0.855	0.899	4.6	0.684	77.5	0.698	15.9	15.3
	N	10	7	14.64	20.95	6.31	0.901			0.631				
	O	10	9	13.84	22.43	8.59	0.954			0.859				
	P	10	7	14.21	20.40	6.19	0.884			0.619				
900	Q	10	4	14.79	19.12	4.33	1.083	0.892	14.4	0.433	42.5	0.378	15.7	54.2
	R	10	5	15.29	19.54	4.25	0.850			0.425				
	S	10	4	13.62	16.82	3.20	0.800			0.320				
	T	10	4	14.31	17.65	3.34	0.835			0.334				
1050	U	10	2	15.18	16.73	1.55	0.775	0.894	21.8	0.155	17.5	0.149	15.0	81.9
	V	10	1	15.72	16.90	1.18	1.180			0.118				
	W	10	2	14.42	15.95	1.53	0.765			0.153				
	X	10	2	14.73	16.44	1.71	0.855			0.171				

Dunnett's MSD value: 0.0975
PMSD: 11.8

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.
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).

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.

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Survival

Start Date:	11/17/2009	Test ID:	PpKClCR	Sample ID:	REF-Ref Toxicant
End Date:	11/24/2009	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	0.9000
450	0.9000	1.0000	1.0000	1.0000
600	0.9000	1.0000	1.0000	0.9000
750	0.8000	0.7000	0.9000	0.7000
900	0.4000	0.5000	0.4000	0.4000
1050	0.2000	0.1000	0.2000	0.2000

			Transform: Arcsin Square Root						1-Tailed		Number	Total
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
D-Control	0.9750	1.0000	1.3713	1.2490	1.4120	5.942	4				1	40
450	0.9750	1.0000	1.3713	1.2490	1.4120	5.942	4	0.000	2.410	0.1471	1	40
600	0.9500	0.9744	1.3305	1.2490	1.4120	7.072	4	0.668	2.410	0.1471	2	40
*750	0.7750	0.7949	1.0846	0.9912	1.2490	11.294	4	4.696	2.410	0.1471	9	40
*900	0.4250	0.4359	0.7099	0.6847	0.7854	7.091	4	10.836	2.410	0.1471	23	40
*1050	0.1750	0.1795	0.4282	0.3218	0.4636	16.570	4	15.451	2.410	0.1471	33	40

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.91163939	0.884	-0.1184496	-0.6290117
Bartlett's Test indicates equal variances (p = 0.82)	2.20082235	15.0862722		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	600	750	670.820393		0.07612662	0.07923945	0.63093674	0.00745088	7.3E-12	5, 18
Treatments vs D-Control										

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	11.90075	2.02798845	7.9258926	15.8756075	0.025	0.02529665	7.81472778	1	2.94271355	0.08402832	3
Intercept	-30.020498	5.96965262	-41.721018	-18.319979							
TSCR	0.02489373	0.0167698	-0.0079751	0.05776254							

Point	Probits	mg/L	95% Fiducial Limits	
EC01	2.674	558.771764	439.30398	632.540335
EC05	3.355	637.528005	533.944092	700.273975
EC10	3.718	683.954056	591.864566	740.053467
EC15	3.964	717.172783	633.972402	768.743169
EC20	4.158	744.720889	669.099597	792.886858
EC25	4.326	769.196521	700.275338	814.793373
EC40	4.747	834.497847	781.392728	877.222284
EC50	5.000	876.422566	829.69787	922.532758
EC60	5.253	920.453569	875.571987	976.186221
EC75	5.674	998.595923	946.148753	1085.24501
EC80	5.842	1031.4153	973.075482	1134.89329
EC85	6.036	1071.03413	1004.29166	1196.99431
EC90	6.282	1123.05276	1043.78666	1281.46378
EC95	6.645	1204.83569	1103.60002	1419.80285
EC99	7.326	1374.65171	1222.28693	1724.95223

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	11/17/2009	Test ID:	PpKClCR	Sample ID:	REF-Ref Toxicant
End Date:	11/24/2009	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	0.9070	0.8050	0.8430	0.7440
450	0.7030	0.7590	0.8540	0.8160
600	0.7790	0.8480	0.7150	0.7890
750	0.6840	0.6310	0.8590	0.6190
900	0.4330	0.4250	0.3200	0.3340
1050	0.1550	0.1180	0.1530	0.1710

			Transform: Untransformed					1-Tailed			Isotonic	
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.8248	1.0000	0.8248	0.7440	0.9070	8.285	4				0.8248	1.0000
450	0.7830	0.9494	0.7830	0.7030	0.8540	8.441	4	0.933	2.180	0.0975	0.7830	0.9494
600	0.7828	0.9491	0.7828	0.7150	0.8480	6.959	4	0.939	2.180	0.0975	0.7828	0.9491
750	0.6983	0.8466	0.6983	0.6190	0.8590	15.872	4				0.6983	0.8466
900	0.3780	0.4583	0.3780	0.3200	0.4330	15.676	4				0.3780	0.4583
1050	0.1493	0.1810	0.1493	0.1180	0.1710	14.966	4				0.1493	0.1810

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.93505901	0.805	-0.079593823	-1.15766298
Bartlett's Test indicates equal variances (p = 0.93)	0.14925823	9.2103405		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	600	>600			0.09751355	0.11823407	0.002338083	0.00400172	0.57733494	2, 9
Treatments vs D-Control										

Linear Interpolation (200 Resamples)

Point	mg/L	SD	95% CL(Exp)		Skew
IC05*	444.48	171.45	43.33	936.54	-0.1280
IC10	671.85	93.51	216.91	825.11	-1.2941
IC15	745.05	48.64	537.03	808.42	-0.9607
IC20	768.01	29.70	646.35	819.59	-1.0239
IC25	787.32	20.62	712.96	835.30	-0.5410
IC40	845.27	13.72	797.28	882.88	-0.0132
IC50	883.90	13.24	846.50	930.45	0.3616

* indicates IC estimate less than the lowest concentration

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** PpKClCR Test Number: 193

Daily Chemistry:

		Day					
		0		1		2	
	Analyst	KW	KW	KW	LAB	LAB	KW
Concentration	Parameter						
CONTROL	pH (S.U.)	7.48	7.38	7.63	7.18	7.50	7.41
	DO (mg/L)	7.8	7.4	7.6	7.2	7.7	7.5
	Conductivity (µmhos/cm)	385		332		328	
	Alkalinity (mg $CaCO_3$/L)	61				62	
	Hardness (mg $CaCO_3$/L)	90				90	
	Temperature (°C)	24.8	24.8	24.7	25.0	24.9	24.6
450 mg KCl/L	pH (S.U.)	7.61	7.49	7.71	7.35	7.58	7.46
	DO (mg/L)	7.9	7.4	7.6	7.3	7.8	7.4
	Conductivity (µmhos/cm)	1150		1110		1160	
	Temperature (°C)	24.8	24.7	24.8	25.1	24.9	24.6
600 mg KCl/L	pH (S.U.)	7.60	7.51	7.74	7.40	7.60	7.51
	DO (mg/L)	7.9	7.5	7.6	7.3	7.8	7.4
	Conductivity (µmhos/cm)	1390		1430		1440	
	Temperature (°C)	25.0	24.7	24.8	25.1	24.8	24.6
750 mg KCl/L	pH (S.U.)	7.65	7.54	7.94	7.40	7.63	7.57
	DO (mg/L)	7.9	7.4	7.6	7.3	7.9	7.5
	Conductivity (µmhos/cm)	1660		1690		1690	
	Temperature (°C)	24.7	24.9	24.8	25.1	24.8	24.5
900 mg KCl/L	pH (S.U.)	7.65	7.56	7.76	7.46	7.65	7.54
	DO (mg/L)	7.9	7.4	7.6	7.3	7.8	7.6
	Conductivity (µmhos/cm)	1920		1960		1960	
	Temperature (°C)	24.8	24.7	24.7	25.2	24.8	24.5
1050 mg KCl/L	pH (S.U.)	7.65	7.59	7.77	7.49	7.66	7.56
	DO (mg/L)	8.0	7.4	7.6	7.3	7.7	7.7
	Conductivity (µmhos/cm)	2190		2220		2230	
	Temperature (°C)	24.8	24.8	24.8	25.0	24.8	24.8
STOCK	Conductivity (µmhos/cm)	68100					
		Initial	Final	Initial	Final	Initial	Final

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** PpKClCR Test Number: 193

		Day							
		3		4 KDL		5 KDL		6	
	Analyst	KDL	LAB	LAB	BSC	BSC	KDL	KDL	KDL
Concentration	Parameter								
CONTROL	pH (S.U.)	7.71	7.40	7.55	6.92	7.42	7.16	7.79	6.98
	DO (mg/L)	7.8	7.5	7.9	7.4	7.8	6.7	8.0	6.4
	Conductivity (µmhos/cm)	332		336		334		334	
	Alkalinity (mg $CaCO_3$/L)			62		62			
	Hardness (mg $CaCO_3$/L)			90		88			
	Temperature (°C)	24.6	24.5	24.7	24.8	24.8	24.5	24.7	24.9
450 mg KCl/L	pH (S.U.)	7.80	7.59	7.68	7.13	7.56	7.20	7.79	7.10
	DO (mg/L)	7.9	7.6	8.0	7.5	7.9	6.5	7.9	6.3
	Conductivity (µmhos/cm)	1130		1140		1160		1140	
	Temperature (°C)	24.6	24.3	24.7	24.9	24.8	24.8	24.8	24.9
600 mg KCl/L	pH (S.U.)	7.81	7.60	7.72	7.17	7.59	7.27	7.79	7.17
	DO (mg/L)	7.9	7.4	8.0	7.6	8.0	6.6	7.9	6.2
	Conductivity (µmhos/cm)	1410		1420		1430		1410	
	Temperature (°C)	24.9	24.6	24.7	24.6	24.8	24.8	24.8	24.6
750 mg KCl/L	pH (S.U.)	7.82	7.58	7.74	7.16	7.62	7.26	7.79	7.17
	DO (mg/L)	7.9	7.4	8.0	7.6	8.0	6.8	8.0	6.3
	Conductivity (µmhos/cm)	1660		1660		1690		1640	
	Temperature (°C)	24.7	24.4	24.7	24.8	24.8	24.7	24.8	24.9
900 mg KCl/L	pH (S.U.)	7.85	7.61	7.76	7.21	7.63	7.32	7.80	7.16
	DO (mg/L)	7.9	7.4	7.9	7.5	8.0	6.8	8.0	6.2
	Conductivity (µmhos/cm)	1930		1970		1960		1970	
	Temperature (°C)	24.8	24.4	24.6	24.7	24.7	24.7	24.8	24.5
1050 mg KCl/L	pH (S.U.)	7.84	7.65	7.78	7.21	7.63	7.29	7.80	7.17
	DO (mg/L)	7.9	7.4	7.9	7.4	8.0	6.6	8.0	6.0
	Conductivity (µmhos/cm)	2160		2200		2240		2140	
	Temperature (°C)	24.8	24.4	24.6	24.7	24.7	24.6	24.8	24.7
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

ETS
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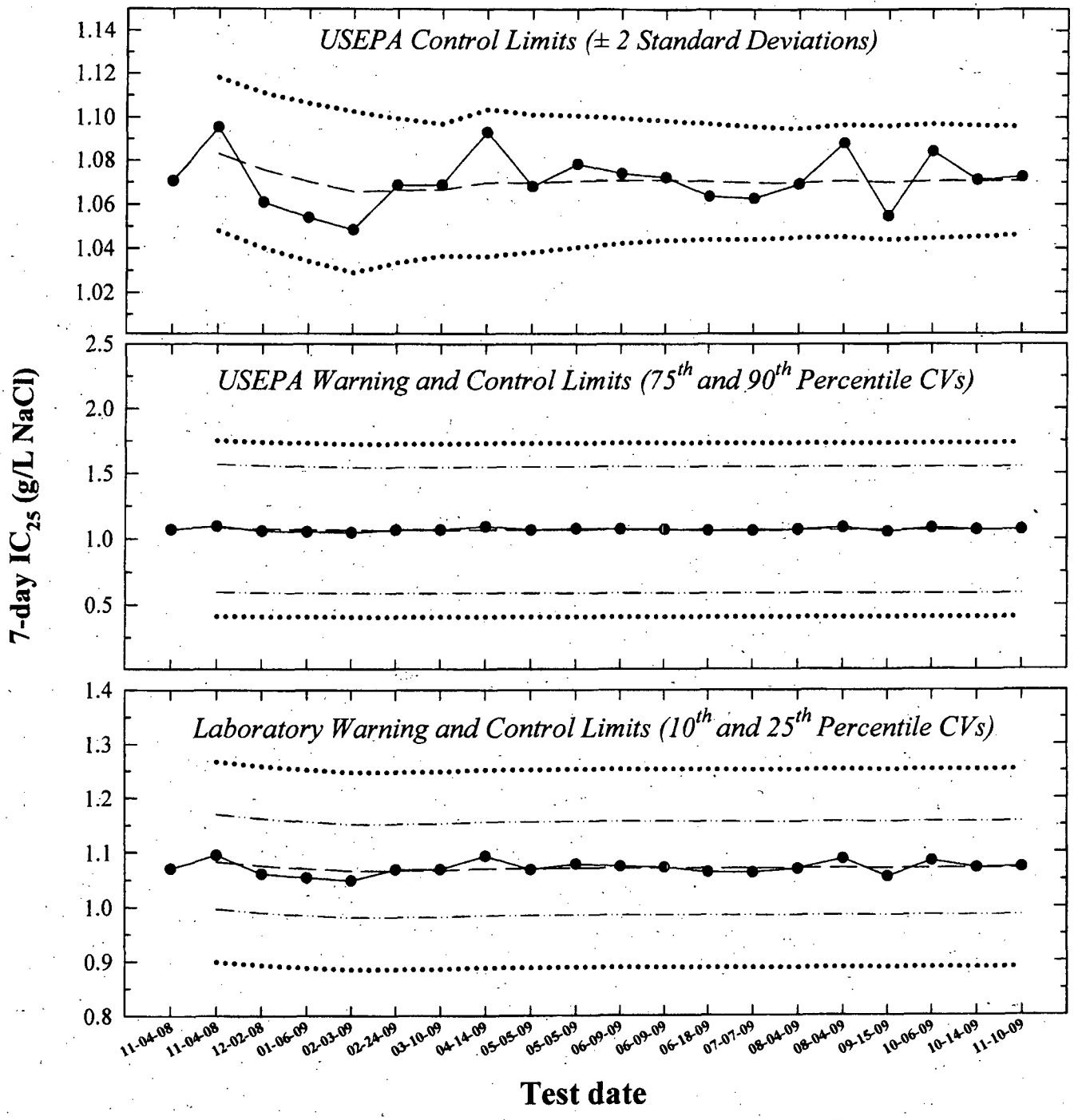
Ceriodaphnia dubia
Chronic Reference Toxicant Control Chart



—●— **7-day IC_{25}** = 25% inhibition concentration. An estimation of the concentration of sodium chloride that would cause a 25% reduction in *Ceriodaphnia* reproduction for the test population.

— — **Central Tendency** (mean IC_{25})

—·—·— **Warning Limits** (mean $IC_{25} \pm S_{A.10}$ or $S_{A.75}$)

····· **Control Limits** (mean $IC_{25} \pm S_{A.25}$, $S_{A.90}$, or 2 Standard Deviations)

Environmental Testing Solutions, Inc.

Ceriodaphnia dubia
Chronic Reference Toxicant Control Chart

Test number	Test date	7-day IC_{25} (g/L NaCl)	CT (g/L NaCl)	S	State and USEPA Control Limits CT - 2S	CT + 2S	$S_{A.10}$	Laboratory Warning Limits CT - $S_{A.10}$	CT + $S_{A.10}$	$S_{A.25}$	Laboratory Control Limits CT - $S_{A.25}$	CT + $S_{A.25}$	$S_{A.75}$	USEPA Warning Limits CT - $S_{A.75}$	CT + $S_{A.75}$	$S_{A.90}$	USEPA Control Limits CT - $S_{A.90}$	CT + $S_{A.90}$	CV
1	11-04-08	1.07																	
2	11-04-08	1.10	1.08	0.02	1.05	1.12	0.09	1.00	1.17	0.18	0.90	1.27	0.49	0.60	1.57	0.67	0.41	1.75	0.02
3	12-02-08	1.06	1.08	0.02	1.04	1.11	0.09	0.99	1.16	0.18	0.89	1.26	0.48	0.59	1.56	0.67	0.41	1.74	0.02
4	01-06-09	1.05	1.07	0.02	1.03	1.11	0.09	0.98	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.02
5	02-03-09	1.05	1.07	0.02	1.03	1.10	0.09	0.98	1.15	0.18	0.88	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.02
6	02-24-09	1.07	1.07	0.02	1.03	1.10	0.09	0.98	1.15	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.02
7	03-10-09	1.07	1.07	0.02	1.04	1.10	0.09	0.98	1.15	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
8	04-14-09	1.09	1.07	0.02	1.04	1.10	0.09	0.98	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.02
9	05-05-09	1.07	1.07	0.02	1.04	1.10	0.09	0.98	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
10	05-05-09	1.08	1.07	0.02	1.04	1.10	0.09	0.99	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
11	06-09-09	1.07	1.07	0.01	1.04	1.10	0.09	0.99	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.74	0.01
12	06-09-09	1.07	1.07	0.01	1.04	1.10	0.09	0.99	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.74	0.01
13	06-18-09	1.06	1.07	0.01	1.04	1.10	0.09	0.98	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
14	07-07-09	1.06	1.07	0.01	1.04	1.10	0.09	0.98	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
15	08-04-09	1.07	1.07	0.01	1.05	1.09	0.09	0.98	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
16	08-04-09	1.09	1.07	0.01	1.05	1.10	0.09	0.99	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.74	0.01
17	09-15-09	1.05	1.07	0.01	1.04	1.10	0.09	0.98	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
18	10-06-09	1.08	1.07	0.01	1.04	1.10	0.09	0.99	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
19	10-14-09	1.07	1.07	0.01	1.05	1.10	0.09	0.99	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
20	11-10-09	1.07	1.07	0.01	1.05	1.10	0.09	0.99	1.16	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.74	0.01

Note: **7-d IC_{25}** = 7-day 25% inhibition concentration. An estimation of the concentration of sodium chloride that would cause a 25% reduction in *Ceriodaphnia* reproduction for the test population.

CT = Central tendency (mean IC_{25}).

S = Standard deviation of the IC_{25} values.

Laboratory Control and Warning Limits

Laboratory control and warning limits were established using the standard deviation of the IC_{25} values corresponding to the 10th and 25th percentile CVs. These ranges are more stringent than the control and warning limits recommended by USEPA for the test method and endpoint.

$S_{A.10}$ = Standard deviation corresponding to the 10th percentile CV. ($S_{A.10}$ = 0.08)

$S_{A.25}$ = Standard deviation corresponding to the 25th percentile CV. ($S_{A.25}$ = 0.17)

USEPA Control and Warning Limits

$S_{A.75}$ = Standard deviation corresponding to the 75th percentile CV. ($S_{A.75}$ = 0.45)

$S_{A.90}$ = Standard deviation corresponding to the 90th percentile CV. ($S_{A.90}$ = 0.62)

CV = Coefficient of variation of the IC_{25} values.

USEPA. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination Program. EPA-833-R-00-003. US Environmental Protection Agency, Cincinnati, OH.

Environmental Testing Solutions, Inc.

Precision of Endpoint Measurements

Ceriodaphnia dubia
Chronic Reference Toxicant Data

Test number	Test date	Control Survival (%)	Control Mean Reproduction (offspring/female)	CT for Control Mean Reproduction (offspring/female)	CV (%)	CT for Control Reproduction CV (%)	MSD	PMSD (%)	CT for PMSD (%)
1	11-04-08	100	32.3		5.1		2.2	6.8	
2	11-04-08	100	31.5	31.9	6.2	5.6	2.4	7.7	7.2
3	12-02-08	100	31.5	31.8	4.6	5.3	2.5	8.0	7.5
4	01-06-09	100	33.2	32.1	4.0	4.9	2.0	6.1	7.1
5	02-03-09	100	31.4	32.0	6.6	5.3	1.9	6.0	6.9
6	02-24-09	100	32.2	32.0	6.0	5.4	1.8	5.7	6.7
7	03-10-09	100	31.9	32.0	5.8	5.5	2.6	8.2	6.9
8	04-14-09	100	33.9	32.2	6.7	5.6	2.0	5.8	6.8
9	05-05-09	100	33.6	32.4	4.3	5.5	2.3	6.8	6.8
10	05-05-09	100	34.6	32.6	7.7	5.7	2.2	6.5	6.8
11	06-09-09	100	31.3	32.5	6.4	5.8	2.1	6.7	6.7
12	06-09-09	100	31.1	32.4	9.4	6.1	2.6	8.3	6.9
13	06-18-09	100	32.3	32.4	7.3	6.2	1.9	5.8	6.8
14	07-07-09	100	29.9	32.2	3.3	6.0	2.2	7.2	6.8
15	08-04-09	100	30.4	32.1	4.7	5.9	2.2	7.3	6.9
16	08-04-09	100	32.0	32.1	5.1	5.8	2.2	6.9	6.9
17	09-15-09	100	31.6	32.0	5.4	5.8	2.2	7.0	6.9
18	10-06-09	100	31.4	32.0	4.3	5.7	2.4	7.6	6.9
19	10-14-09	100	33.3	32.1	3.5	5.6	2.6	7.7	7.0
20	11-10-09	100	34.0	32.2	6.2	5.6	2.6	7.7	7.0

Note:

CV = Coefficient of variation for control reproduction.
Lower CV bound determined by USEPA (10th percentile) = 8.9%.
Upper CV bound determined by USEPA (90th percentile) = 42%

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%.

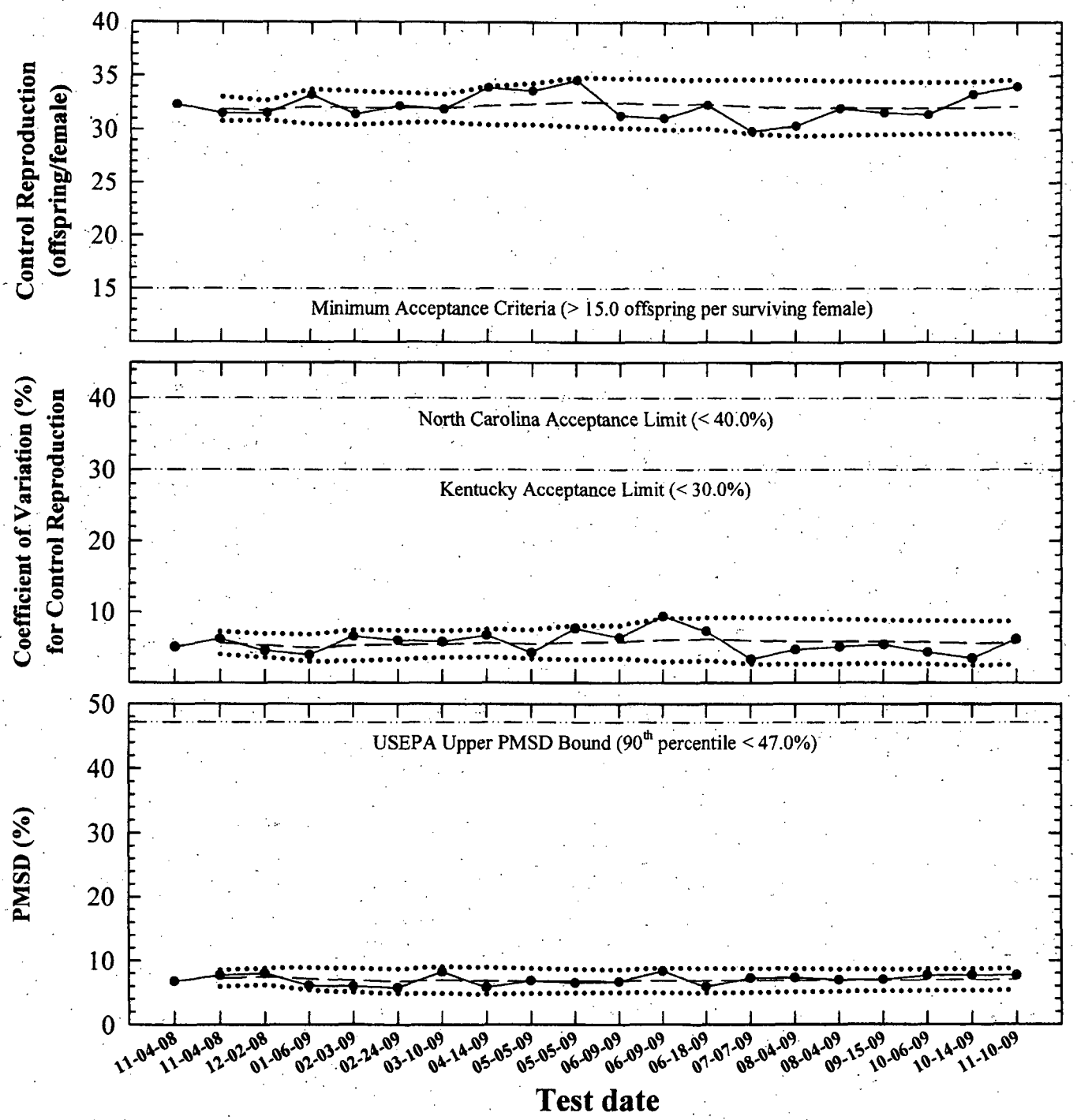
CT = Central Tendancy (Mean Control Reproduction, CV, or PMSD)

USEPA. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination Program. EPA-833-R-00-003. US Environmental Protection Agency, Cincinnati, OH.

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.

Environmental Testing Solutions, Inc.

Ceriodaphnia dubia
Chronic Reference Toxicant Control Chart
Precision of Endpoint Measurements



—●— **Control Reproduction, Coefficient of Variation (CV), or Percent Minimum Significant Difference (PMSD)** PMSD is the minimum significant difference between the control and treatment that can be declared statistically significant.

— — **Central Tendency** (mean Control Reproduction, CV, or PMSD)

····· **Control Limits** (mean Control Reproduction, CV, or PMSD ± 2 Standard Deviations)

ETS Environmental Testing Solutions, Inc.

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

CdNaClCR #: 100

Dilution preparation information:						***Comments:***
NaCl Stock INSS number:		INSS 761				
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	

Test organism source information:											***Test information:***	
Organism age:	< 24-hours old										Randomizing template color:	GOLD
Date and times organisms were born between:	11-10-09 0620 TO 1110										Incubator number and shelf location:	282
Culture board:	11-03-09 A											
Replicate number:	1	2	3	4	5	6	7	8	9	10	YWT batch:	10-06-09
Culture board cup number:	7	8	9	11	13	20	25	26	27	29		
Transfer vessel information:	pH = 7.79 S.U. Temperature = 24.8 °C										*Selenastrum* batch:	11-01-09
Average transfer volume (mL):	0.0375 mL											

Daily renewal information:

Day	Date	Test initiation and feeding, renewal and feeding, or termination time	MHSW batch used	Analyst
0	11-10-09	1115	11-07-09 A	[illegible]
1	11-11-09	1016	11-07-09 A	[illegible]
2	11-12-09	1025	11-07-09 A	[illegible]
3	11-13-09	1015	11-07-09 A	[illegible]
4	11-14-09	1015	11-07-09 A	[illegible]
5	11-15-09	1025	11-12-09 A	[illegible]
6	11-16-09	1030	11-12-09 A	[illegible]
7	11-17-09	1036		[illegible]

Control information:		Acceptance criteria	***Summary of test endpoints:***	
% of Male Adults:	0%	≤ 20%	7-day LC_{50}	>1400
% Adults having 3rd Broods:	100%	≥ 80%	NOEC	800
% Mortality:	0%	≤ 20%	LOEC	1000
Mean Offspring/Female:	34.0	≥ 15.0 offspring/female	ChV	894.4
% CV:	6.27%	< 40.0 %	IC_{25}	1072.6

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia*** **CdNaClCR #:** 100

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	5	5	5	4	5	5	5	6	6	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	10	13	14	12	12	13	12	14	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	18	16	18	15	19	17	17	14	16	15
Total young produced		36	31	36	33	36	34	35	32	36	31
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3rd 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:	34.0

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	5	6	5	5	5	5	4	5	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	13	12	13	14	11	13	13	13	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	15	19	16	17	17	17	18	14	17	13
Total young produced		33	38	33	35	36	33	35	32	35	30
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:	0%
Mean Offspring/Female:	34.0
% Reduction from Control:	0%

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia*** **CdNaClCR #:** 100

800 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	5	5	4	5	5	5	5	5	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	12	13	12	10	12	14	12	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	17	17	17	19	16	14	14	18	14	14
Total young produced		34	34	34	36	31	31	33	35	31	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:	0%
Mean Offspring/Female:	33.0
% Reduction from Control:	2.9%

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	4	4	5	4	5	5	5	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	13	11	11	9	12	12	10	10	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	16	15	13	17	14	14	14	14	17
Total young produced		29	33	30	29	30	31	31	29	28	34
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:	0%
Mean Offspring/Female:	30.4
% Reduction from Control:	10.6%

Species: ***Ceriodaphnia dubia*** **CdNaClCR #:** 100

1200 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	3	4	3	5	5	3	3	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	9	5	5	0	8	10	0	9	7	8
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	5	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	8	5	9	0	7	7	10	4	9	6
Total young produced		20	14	17	10	20	20	13	17	20	18
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:	0%
Mean Offspring/Female:	16.9
% Reduction from Control:	50.3%

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	0	2	4	1	0	0	0	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	2	0	0	1	3	5	3	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	1	2	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	7	5	5	0	4	7	7	0	0	8
Total young produced		9	7	9	2	7	12	10	5	6	12
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:	0%
Mean Offspring/Female:	7.9
% Reduction from Control:	76.8%

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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: CdNaClCR #100
Test dates: November 10-17, 2009
Reveiwed by:

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	36	31	36	33	36	34	35	32	36	31	100	34.0	6.2	Not applicable
600	33	38	33	35	36	33	35	32	35	30	100	34.0	6.6	0.0
800	34	34	34	36	31	31	33	35	31	31	100	33.0	5.7	2.9
1000	29	33	30	29	30	31	31	29	28	34	100	30.4	6.2	10.6
1200	20	14	17	10	20	20	13	17	20	18	100	16.9	20.8	50.3
1400	9	7	9	2	7	12	10	5	6	12	100	7.9	39.8	76.8

Dunnett's MSD value: 2.604
PMSD: 7.7

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).

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.

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Environmental Testing Solutions, Inc.

Statistical Analyses

Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date:	11/10/2009	Test ID:	CdNaClCR	Sample ID:	REF-Ref Toxicant
End Date:	11/17/2009	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
Comments:					

Conc-mg/L	1	2	3	4	5	6	7	8	9	10
D-Control	36.000	31.000	36.000	33.000	36.000	34.000	35.000	32.000	36.000	31.000
600	33.000	38.000	33.000	35.000	36.000	33.000	35.000	32.000	35.000	30.000
800	34.000	34.000	34.000	36.000	31.000	31.000	33.000	35.000	31.000	31.000
1000	29.000	33.000	30.000	29.000	30.000	31.000	31.000	29.000	28.000	34.000
1200	20.000	14.000	17.000	10.000	20.000	20.000	13.000	17.000	20.000	18.000
1400	9.000	7.000	9.000	2.000	7.000	12.000	10.000	5.000	6.000	12.000

			Transform: Untransformed					1-Tailed			Isotonic	
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	34.000	1.0000	34.000	31.000	36.000	6.201	10				34.000	1.0000
600	34.000	1.0000	34.000	30.000	38.000	6.649	10	0.000	2.287	2.604	34.000	1.0000
800	33.000	0.9706	33.000	31.000	36.000	5.714	10	0.878	2.287	2.604	33.000	0.9706
*1000	30.400	0.8941	30.400	28.000	34.000	6.241	10	3.161	2.287	2.604	30.400	0.8941
*1200	16.900	0.4971	16.900	10.000	20.000	20.771	10	15.015	2.287	2.604	16.900	0.4971
*1400	7.900	0.2324	7.900	2.000	12.000	39.783	10	22.917	2.287	2.604	7.900	0.2324

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.85725808	1.035	-0.4383847	0.05843284
Bartlett's Test indicates equal variances (p = 0.27)	6.40927744	15.0862722		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	800	1000	894.427191		2.60422823	0.07659495	1213.54667	6.48518519	8.2E-33	5, 54
Treatments vs D-Control										

Linear Interpolation (200 Resamples)

Point	mg/L	SD	95% CL		Skew
IC05	853.846154	68.891583	658.291667	950.259615	-0.9158
IC10	984.615385	37.1605902	889.984375	1018.01841	-0.4734
IC15	1022.22222	10.1708642	1001.41628	1040.13001	0.1120
IC20	1047.40741	9.4426387	1027.71794	1065.06914	0.2104
IC25	1072.59259	9.34744229	1054.19332	1087.34371	0.2270
IC40	1148.14815	11.8528783	1126.04654	1168.22075	0.4312
IC50	1198.51852	16.0574224	1169.42431	1229.62477	0.4948

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia*** **CdNaClCR #:** 100

Daily Chemistry:

		Day					
		0		1		2	
	Analyst	KLK	KLK	KLK	KLK	KLK	KLK
Concentration	Parameter						
CONTROL	pH (S.U.)	7.78	7.55	7.53	7.74	7.68	7.70
	DO (mg/L)	7.6	7.9	7.8	7.7	7.6	7.8
	Conductivity (µmhos/cm)	346		326		330	
	Alkalinity (mg $CaCO_3$/L)	62					
	Hardness (mg $CaCO_3$/L)	90					
	Temperature (°C)	24.7	25.0	24.8	24.9	24.8	24.7
600 mg NaCl/L	pH (S.U.)	7.78	7.63	7.67	7.81	7.76	7.75
	DO (mg/L)	7.4	7.9	7.7	7.6	7.6	7.7
	Conductivity (µmhos/cm)	1510		1500		1490	
	Temperature (°C)	24.9	24.9	24.8	24.9	24.6	24.5
800 mg NaCl/L	pH (S.U.)	7.77	7.64	7.68	7.81	7.77	7.76
	DO (mg/L)	7.4	7.8	7.7	7.6	7.6	7.7
	Conductivity (µmhos/cm)	1850		1870		1890	
	Temperature (°C)	24.9	24.9	24.8	24.9	24.6	24.8
1000 mg NaCl/L	pH (S.U.)	7.75	7.65	7.69	7.81	7.84	7.76
	DO (mg/L)	7.5	7.8	7.7	7.6	7.7	7.7
	Conductivity (µmhos/cm)	2160		2200		2240	
	Temperature (°C)	24.8	24.9	24.7	24.9	24.8	24.8
1200 mg NaCl/L	pH (S.U.)	7.75	7.65	7.70	7.84	7.84	7.78
	DO (mg/L)	7.5	7.8	7.8	7.6	7.7	7.7
	Conductivity (µmhos/cm)	2630		2640		2680	
	Temperature (°C)	24.8	25.1	24.7	25.0	24.7	24.6
1400 mg NaCl/L	pH (S.U.)	7.74	7.65	7.73	7.83	7.84	7.77
	DO (mg/L)	7.5	7.8	7.8	7.6	7.7	7.7
	Conductivity (µmhos/cm)	2920		2980		3040	
	Temperature (°C)	24.8	24.9	24.7	25.0	24.7	24.8
STOCK	Conductivity (µmhos/cm)						
		Initial	Final	Initial	Final	Initial	Final

ETS Environmental Testing Solutions, Inc.

Species: ***Ceriodaphnia dubia*** **CdNaClCR #:** 100

		Day							
		3		4		5		6	
	Analyst	KL	LAB	LAB	KLN	KLN	KLN	KLN	KLN
Concentration	Parameter								
CONTROL	pH (S.U.)	7.78	7.58	7.43	7.72	7.76	7.61	7.76	7.54
	DO (mg/L)	7.6	7.8	7.5	7.6	7.5	8.1	8.0	8.0
	Conductivity (µmhos/cm)	333		345		343		325	
	Alkalinity (mg $CaCO_3$/L)					61			
	Hardness (mg $CaCO_3$/L)	K		K		90		K	
	Temperature (°C)	24.7	25.0	24.8	24.7	24.9	25.1	25.2	25.0
600 mg NaCl/L	pH (S.U.)	7.81	7.69	7.68	7.77	7.77	7.69	7.76	7.62
	DO (mg/L)	7.7	7.7	7.6	7.6	7.5	8.1	8.1	8.1
	Conductivity (µmhos/cm)	1510		1530		1490		1480	
	Temperature (°C)	24.7	24.8	25.0	25.1	25.0	25.1	25.0	25.0
800 mg NaCl/L	pH (S.U.)	7.86	7.74	7.72	7.78	7.77	7.69	7.81	7.62
	DO (mg/L)	7.7	7.7	7.7	7.6	7.5	8.1	8.1	8.1
	Conductivity (µmhos/cm)	1960		1890		1860		1930	
	Temperature (°C)	24.7	24.8	25.0	24.8	25.0	25.0	25.0	24.7
1000 mg NaCl/L	pH (S.U.)	7.87	7.76	7.74	7.81	7.78	7.69	7.80	7.66
	DO (mg/L)	7.8	7.7	7.7	7.6	7.5	8.2	8.1	8.2
	Conductivity (µmhos/cm)	2320		2300		2250		2330	
	Temperature (°C)	24.7	25.0	25.0	24.8	24.8	25.0	25.0	24.6
1200 mg NaCl/L	pH (S.U.)	7.86	7.77	7.76	7.80	7.79	7.73	7.80	7.67
	DO (mg/L)	7.8	7.6	7.6	7.6	7.5	8.2	8.2	8.2
	Conductivity (µmhos/cm)	2770		2750		2690		2760	
	Temperature (°C)	24.7	24.9	24.9	24.9	25.0	24.9	24.9	25.0
1400 mg NaCl/L	pH (S.U.)	7.89	7.79	7.78	7.80	7.81	7.73	7.80	7.66
	DO (mg/L)	7.8	7.6	7.7	7.7	7.6	8.2	8.2	8.2
	Conductivity (µmhos/cm)	3140		3120		3050		3140	
	Temperature (°C)	24.7	24.9	24.9	24.9	25.1	24.9	25.0	24.8
		Initial	Final	Initial	Final	Initial	Final	Initial	Final