

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

TN0026450 **101 G**
 PERMIT NUMBER DISCHARGE NUMBER

MONITORING PERIOD
 YEAR MO DAY YEAR MO DAY
 From **18 10 01** To **18 10 31**

F - FINAL
 DIFFUSER DISCHARGE
 EFFLUENT

*** NO DISCHARGE ***

ATTN:Millicent Garland

NOTE: Read instructions before completing this form.

| PARAMETER | SAMPLE MEASUREMENT | QUANTITY OR LOADING | | | QUALITY OR CONCENTRATION | | | | NO. EX | FREQUENCY OF ANALYSIS | SAMPLE TYPE |
|--|--------------------|-------------------------|----------------------------|----------|--------------------------|-------------------|----------------------------|---------|--------|-----------------------|-------------|
| | | AVERAGE | MAXIMUM | UNITS | MINIMUM | AVERAGE | MAXIMUM | UNITS | | | |
| TEMPERATURE, WATER DEG. CENTIGRADE | SAMPLE MEASUREMENT | ***** | ***** | ** | ***** | ***** | 39.3 | 04 | 0 | 31 / 31 | RCORDR |
| 00010 1 0 | PERMIT REQUIREMENT | ***** | ***** | *** | ***** | ***** | Req. Mon. DAILY MAX | DEG. C. | | CONTI NUOUS | CALCTD |
| EFFLUENT GROSS | | | | | | | | | | | |
| TEMPERATURE, WATER DEG. CENTIGRADE | SAMPLE MEASUREMENT | ***** | ***** | ** | ***** | ***** | 27.1 | 04 | 0 | 31 / 31 | MODEL D |
| 00010 Z 0 | PERMIT REQUIREMENT | ***** | ***** | *** | ***** | ***** | 30.5 DAILY MX | DEG. C. | | CONTI NUOUS | CALCTD |
| INSTREAM MONITORING | | | | | | | | | | | |
| TEMP. DIFF. BETWEEN SAMP. & UPSTRM DEG.C | SAMPLE MEASUREMENT | ***** | ***** | ** | ***** | ***** | 2.5 | 04 | 0 | 31 / 31 | CALCTD |
| 00016 1 S | PERMIT REQUIREMENT | ***** | ***** | *** | ***** | ***** | 3.0 DAILY MX | DEG. C. | | CONTI NUOUS | CALCTD |
| EFFLUENT GROSS | | | | | | | | | | | |
| FLOW, IN CONDUIT OR THRU TREATMENT PLANT | SAMPLE MEASUREMENT | ***** | ***** | 03 | ***** | ***** | ***** | ** | 0 | 31 / 31 | RCORDR |
| 50050 1 0 | PERMIT REQUIREMENT | ***** | Req. Mon. DAILY MAX | MGD | ***** | ***** | ***** | *** | | CONTI NUOUS | RCORDR |
| EFFLUENT GROSS | | | | | | | | | | | |
| FLOW, IN CONDUIT OR THRU TREATMENT PLANT | SAMPLE MEASUREMENT | 1806 | ***** | 03 | ***** | ***** | ***** | 03 | 0 | 31 / 31 | CALCTD |
| 50050 1 0 | PERMIT REQUIREMENT | Req. Mon. MO AVG | ***** | MGD | ***** | ***** | ***** | MGD | | CONTI NUOUS | CALCTD |
| EFFLUENT GROSS VALUE | | | | | | | | | | | |
| CHLORINE, TOTAL RESIDUAL | SAMPLE MEASUREMENT | ***** | ***** | ** | ***** | 0.016 | 0.028 | 19 | 0 | 20 / 31 | GRAB |
| 50060 1 0 | PERMIT REQUIREMENT | ***** | ***** | *** | ***** | 0.1 MO AVG | 0.1 DAILY MAX | MG/L | | FIVE PER WEEK | CALCTD |
| EFFLUENT GROSS VALUE | | | | | | | | | | | |
| TEMPERATURE - C, RATE OF CHANGE | SAMPLE MEASUREMENT | ***** | 0.4 | 62 | ***** | ***** | ***** | ** | 0 | 31 / 31 | CALCTD |
| 82234 1 0 | PERMIT REQUIREMENT | ***** | 2.0 DAILY MX | DEG C/HR | ***** | ***** | ***** | *** | | CONTI NUOUS | CALCTD |
| EFFLUENT GROSS | | | | | | | | | | | |

| | | | | | | |
|--|---|-----------|----------|------|----|-----|
| NAME/TITLE PRINCIPAL EXECUTIVE OFFICER | I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. | TELEPHONE | | DATE | | |
| Anthony L. Williams | | 423 | 843-7001 | 18 | 11 | 08 |
| Site Vice President | | | | | | |
| TYPED OR PRINTED | SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT | AREA CODE | NUMBER | YEAR | MO | DAY |

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

No closed mode operation. The following injections occurred: Flogard MS 6236 (max calc. was 0.029 mg/L, limit is 2.0 mg/L), Spectrus BD 1500 (max calc. was 0.031 mg/L, limit is 2.0 mg/L), and Spectrus CT 1300 (max calc. was 0.033 mg/L, limit is 0.05 mg/L).

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

MAJOR
 (SUBR 01)

TN0026450 **101 T**
 PERMIT NUMBER DISCHARGE NUMBER

F - FINAL
 BIOMONITORING FOR OUTFALL 101
 EFFLUENT

| MONITORING PERIOD | | | | | | |
|-------------------|----|-----|------|----|-----|----|
| YEAR | MO | DAY | YEAR | MO | DAY | |
| 18 | 10 | 01 | To | 18 | 10 | 31 |

*** NO DISCHARGE ***

ATTN:Millicent Garland

NOTE: Read instructions before completing this form.

| PARAMETER | X | QUANTITY OR LOADING | | | QUALITY OR CONCENTRATION | | | | NO. EX | FREQUENCY OF ANALYSIS | SAMPLE TYPE |
|-----------------------------------|--------------------|---------------------|---------|-------|--------------------------|---------|---------|---------|--------|-----------------------|-------------|
| | | AVERAGE | MAXIMUM | UNITS | MINIMUM | AVERAGE | MAXIMUM | UNITS | | | |
| IC25 STATRE 7DAY CHR CERIODAPHNIA | SAMPLE MEASUREMENT | ***** | ***** | ** | >100.0 | ***** | ***** | 23 | 0 | 3 / 180 | COMPOS |
| TRP3B 1 0 EFFLUENT GROSS | PERMIT REQUIREMENT | ***** | ***** | **** | 42.8 MINIMUM | ***** | ***** | PERCENT | | SEMI ANNUAL | COMPOS |
| IC25 STATRE 7DAY CHR PIMEPHALES | SAMPLE MEASUREMENT | ***** | ***** | ** | >100.0 | ***** | ***** | 23 | 0 | 3 / 180 | COMPOS |
| TRP6C 1 0 EFFLUENT GROSS | PERMIT REQUIREMENT | ***** | ***** | **** | 42.8 MIMINUM | ***** | ***** | PERCENT | | SEMI ANNUAL | COMPOS |
| | SAMPLE MEASUREMENT | | | | | | | | | | |
| | PERMIT REQUIREMENT | | | | | | | | | | |
| | SAMPLE MEASUREMENT | | | | | | | | | | |
| | PERMIT REQUIREMENT | | | | | | | | | | |
| | SAMPLE MEASUREMENT | | | | | | | | | | |
| | PERMIT REQUIREMENT | | | | | | | | | | |
| | SAMPLE MEASUREMENT | | | | | | | | | | |
| | PERMIT REQUIREMENT | | | | | | | | | | |

| | | | | | | |
|--|---|-----------|----------|------|----|-----|
| NAME/TITLE PRINCIPAL EXECUTIVE OFFICER Anthony L. Williams Site Vice President TYPED OR PRINTED | I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. | TELEPHONE | | DATE | | |
| | | 423 | 843-7001 | 18 | 11 | 08 |
| | SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT | AREA CODE | NUMBER | YEAR | MO | DAY |

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

Toxicity was sampled October 8 - 12, 2018.

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

TN0026450 **103 G**
 PERMIT NUMBER DISCHARGE NUMBER

F - FINAL
 LOW VOL. WASTE TREATMENT POND
 EFFLUENT

MONITORING PERIOD
 From **18 10 01** To **18 10 31**

*** NO DISCHARGE ***

ATTN:Millicent Garland

NOTE: Read instructions before completing this form.

| PARAMETER | X | QUANTITY OR LOADING | | | QUALITY OR CONCENTRATION | | | | NO. EX | FREQUENCY OF ANALYSIS | SAMPLE TYPE |
|--|--------------------|-----------------------------------|------------------------------------|-------|--------------------------|-----------------------|--------------------------|-------|--------|-----------------------|-------------|
| | | AVERAGE | MAXIMUM | UNITS | MINIMUM | AVERAGE | MAXIMUM | UNITS | | | |
| PH 00400 1 0 EFFLUENT GROSS | SAMPLE MEASUREMENT | ***** | ***** | ** | 6.6 | ***** | 7.7 | 12 | 0 | 6 / 31 | GRAB |
| | PERMIT REQUIREMENT | ***** | ***** | ** | 6.0 MINIMUM | ***** | 9.0 MAXIMUM | SU | | ONCE/ WEEK | GRAB |
| SOLIDS, TOTAL SUSPENDED 00530 1 0 EFFLUENT GROSS | SAMPLE MEASUREMENT | ***** | ***** | ** | ***** | 5.8 | 5.9 | 19 | 0 | 1 / 31 | GRAB |
| | PERMIT REQUIREMENT | ***** | ***** | ** | ***** | 30.0 MO AVG | 100.0 DAILY MX | MG/L | | ONCE/ MONTH | GRAB |
| OIL AND GREASE 00556 1 0 EFFLUENT GROSS | SAMPLE MEASUREMENT | ***** | ***** | ** | ***** | <5.0 | <5.0 | 19 | 0 | 1 / 31 | GRAB |
| | PERMIT REQUIREMENT | ***** | ***** | ** | ***** | 15.0 MO AVG | 20.0 DAILY MX | MG/L | | ONCE/ MONTH | GRAB |
| FLOW, IN CONDUIT OR THRU TREATMENT PLANT 50050 1 0 EFFLUENT GROSS | SAMPLE MEASUREMENT | 1.396 | 1.547 | 03 | ***** | ***** | ***** | ** | 0 | 5 / 31 | INSTAN |
| | PERMIT REQUIREMENT | Req. Mon. MO AVG | Req. Mon DAILY MX | MGD | ***** | ***** | ***** | ** | | ONCE/ WEEK | INSTAN |
| | SAMPLE MEASUREMENT | | | | | | | | | | |
| | PERMIT REQUIREMENT | | | | | | | | | | |
| | SAMPLE MEASUREMENT | | | | | | | | | | |
| | PERMIT REQUIREMENT | | | | | | | | | | |
| | SAMPLE MEASUREMENT | | | | | | | | | | |
| | PERMIT REQUIREMENT | | | | | | | | | | |

| | | | | | | |
|--|---|-----------|----------|------|----|-----|
| NAME/TITLE PRINCIPAL EXECUTIVE OFFICER Anthony L. Williams Site Vice President TYPED OR PRINTED | I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. | TELEPHONE | | DATE | | |
| | | 423 | 843-7001 | 18 | 11 | 08 |
| | | AREA CODE | NUMBER | YEAR | MO | DAY |

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

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

TN0026450 **110 G**
 PERMIT NUMBER DISCHARGE NUMBER

(SUBR 01)
 F - FINAL
 RECYCLED COOLING WATER
 EFFLUENT

MONITORING PERIOD

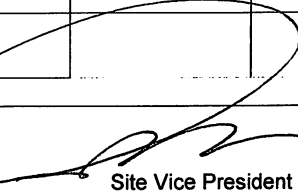
From **18 10 01** To **18 10 31**

*** NO DISCHARGE ***

NOTE: Read instructions before completing this form.

ATTN:Millicent Garland

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

| | | | | | | | |
|---|---|--|-----------|----------|------|----|-----|
| NAME/TITLE PRINCIPAL EXECUTIVE OFFICER Anthony L. Williams Site Vice President TYPED OR PRINTED | I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. |  Site Vice President SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT | TELEPHONE | | DATE | | |
| | | | AREA CODE | NUMBER | YEAR | MO | DAY |
| | | | 423 | 843-7001 | 18 | 11 | 08 |

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
 No Discharge this Period

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

TN0026450 **110 T**
 PERMIT NUMBER DISCHARGE NUMBER

(SUBR 01)
 F - FINAL
 RECYCLED COOLING WATER
 EFFLUENT

MONITORING PERIOD

From **18 10 01** To **18 10 31**

*** NO DISCHARGE ***

NOTE: Read instructions before completing this form.

ATTN:Millicent Garland

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

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|--|---|---|----------|------|----|-----|
| NAME/TITLE PRINCIPAL EXECUTIVE OFFICER Anthony L. Williams Site Vice President TYPED OR PRINTED | I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. | TELEPHONE | | DATE | | |
| | | AREA CODE | NUMBER | YEAR | MO | DAY |
| | | 423 | 843-7001 | 18 | 11 | 08 |
| | | SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT Site Vice President | | | | |

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
 No Discharge this Period

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

TN0026450 **118 G**
 PERMIT NUMBER DISCHARGE NUMBER

(SUBR 01)
 F - FINAL
 WASTEWATER & STORM WATER
 EFFLUENT

MONITORING PERIOD
 From **18 10 01** To **18 10 31**

*** NO DISCHARGE ***

ATTN:Millicent Garland

NOTE: Read instructions before completing this form.

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

| | | | | | | |
|--|---|-----------|----------|------|----|-----|
| NAME/TITLE PRINCIPAL EXECUTIVE OFFICER Anthony L. Williams Site Vice President TYPED OR PRINTED | I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. | TELEPHONE | | DATE | | |
| | | 423 | 843-7001 | 18 | 11 | 08 |
| | | AREA CODE | NUMBER | YEAR | MO | DAY |

[Signature]
 Site Vice President
 SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
 During this reporting period, there has been no flow from the Dredge Pond other than that resulting from rainfall. No Discharge this Period

ENVIRONMENTAL RECORDS PROCESSING FORM

| | | |
|---|--|---------------------------------------|
| Title of File: SQN_October 2018 Semi-Annual Toxicity Report for DSN101 | | |
| Site/Plant/Project Name: Sequoyah Nuclear Plant | Accession Number (optional): | Work Order Number (optional): |
| Your Name: Donald W. Snodgrass | Date Submitted (YYYYMMDD): 20181109 | Document Date (YYYYMMDD): 20181109 |

Instructions:

1) Complete the Environmental Records Processing Form.

- You must include a document date on the form.
Examples:
 - Annual Report = Dec 31 of year report covers (20XX1231)
 - Manifests - shipment date
 - Permit & Letters - submittal date
- Verify that only one box is checked for the Document Type.

2) Save the entire document as a single PDF file with the Environmental Records Processing Form as the first page.

- Name the file using the following convention: Site/Plant/Project Name_Title of file.pdf.
Notes:
 - Site/Plant/Project Name - see EDMS Acronyms & Facility Abbreviations on [Environment InsideNet Page](#) for approved abbreviations
- Examples:
 - CSC_2013 Annual Hazardous Waste Report.pdf
 - WLH_February 2014 DMR.pdf.

3) Email the PDF to ENVrecords@tva.gov for processing

For assistance, please contact the Responsible Environmental Person for your site/project, the Environmental Media Specialists (See Contacts on [Environment InsideNet Page](#)), or your Business Support Representative.

AIR

- Air Compliance Records
- Air Correspondence
- Air Quality Permits & Applications
- Open Burning Permits & Records
- Refrigeration Technicians Certifications - Contractors
- Refrigerant Usage Logs & Surveillance Records
- SF6 Emission Reports

ASBESTOS

- Asbestos Correspondence
- Asbestos Disposal Compliance Records
- Asbestos Medical Surveillance Records - Contractors
- Asbestos Sampling Compliance Records
- Asbestos Worker Certifications - Contractors

DRINKING WATER

- Drinking Water Correspondence
- Drinking Water Laboratory Results
- Operator Certifications - Contractors

ENDANGERED SPECIES

- Endangered Species Compliance Records
- Endangered Species Correspondence

GROUNDWATER

- Groundwater Permit Compliance Records
- Groundwater Permit Correspondence
- Groundwater Permits & Applications

HAZARDOUS WASTE

- Hazardous Waste Correspondence
- Hazardous Waste Inspection Records
- Hazardous Waste Permit & Applications
- Hazardous Waste Permit Compliance Records
- Mixed Waste Compliance Records
- Mixed Waste Correspondence
- Uniform Hazardous Waste Manifest (UHWM), Land Disposal Restriction Notification (LDRN) Records, and PCB Certificates of Disposals (CDs)
- Waste Characterization & Laboratory Records

NATIONAL HISTORIC PRESERVATION ACT (NHPA)

- NHPA Compliance Records
- NHPA Correspondence

NEPA

- Environmental Assessments-Administrative Records
- Environmental Impact Statements-Administrative

* PCB waste manifests and certificates of disposal are managed via the hazardous waste document type: "Uniform Hazardous Waste Manifests, Land Disposal Restriction Notification (LDRN) Records, PCB Certificates of Disposal (CDs)"

ENVIRONMENTAL RECORDS PROCESSING FORM

- Records
 Non-Project NEPA Correspondence

OIL SPILL PREVENTION & COUNTERMEASURES

- Certificates of Applicability of Substantial Harm Criteria
- Facility Response Plan Compliance Records
- Facility Response Plan Correspondence
- Oil Transfer Manual Compliance Records
- Oil Transfer Manual Correspondence
- SPCC Correspondence
- SPCC Equipment Testing
- SPCC Plan Compliance Records
- SPCC Plans
- SPCC Spill Records

PCBS*

- PCB Annual Logs
- PCB Cleanup Records
- PCB Compliance Records
- PCB Correspondence

PESTICIDES

- Pesticide Applicator Certifications - Contractor
- Pesticide Correspondence
- Pesticide Inventory
- Pesticide Use Compliance Records

SARA TITLE III, EPCRA

- CERCLA Correspondence
- CERCLA Reasonable Care Evaluations
- Form R Toxic Release Inventory Supporting Documentation
- SARA Correspondence

SOLID WASTE (INCLUDES SPECIAL WASTE)

- Solid Waste Correspondence
- Solid Waste Disposal Permits & Applications
- Solid Waste Disposal Compliance Records
- Other Solid Waste Compliance Records (Special Waste Analysis)

UNDERGROUND STORAGE TANKS (USTs)

- UST Certification Forms & Certificates
- UST Closure
- UST Correspondence
- UST Financial Responsibility
- UST Manufacturer's Information for New USTs & Monitoring Systems
- UST Monitoring & Calibration

USED OIL

- Used Oil Correspondence
- Used Oil Sampling Results & Burn Records

- Used Oil Shipping Papers

WATER/WASTEWATER

- Corps of Engineer Permit Correspondence
- Corps of Engineer Permits & Applications
- Corps of Engineer Permit Compliance Records
- Injection Well Permit Correspondence
- Injection Well Permits & Applications
- Injection Well Permit Compliance Records
- National Pollutant Discharge Elimination System (NPDES) Correspondence
- NPDES Permits & Applications
- NPDES Permit Compliance Records
- Non-Project Water Compliance
- Sewage Treatment Compliance Records
- Sewage Treatment Correspondence
- Sewage Treatment Permits & Applications
- Storm Water Correspondence
- Storm Water Permit Compliance Records
- Storm Water Permits, Notices of Intent, & Applications
- Tennessee Aquatic Resource Alteration Permit Compliance Record
- Tennessee Aquatic Resource Alteration Permit Correspondence
- Tennessee Aquatic Resource Alteration Permits & Applications
- Water Quality Certification Compliance Records
- Water Quality Certification Correspondence
- Water Quality Certification Permits & Applications

GENERAL/OTHER NON-MEDIA SPECIFIC

- EMS Correspondence
- EMS Documents
- Environmental Event Reports (after Reporting to CDO and other required notifications)
- Environmental Audit Correspondence
- Environmental Audit Reports
- Environmental Outlook Documents
- Environmental Performance Reports (Internal)
- Environmental Performance Reports (External)
- Regulatory Issue Summaries
- ERAL Audit Reports
- ERAL Correspondence & Contracts
- External Correspondence on Proposed Regulations or Legislation
- Operational Control Procedures
- Self-Assessment Reports
- Utility Group Reports/Meeting Notes
- TVA Environmental Policy

* PCB waste manifests and certificates of disposal are managed via the hazardous waste document type: "Uniform Hazardous Waste Manifests, Land Disposal Restriction Notification (LDRN) Records, PCB Certificates of Disposal (CDs)"

**TENNESSEE VALLEY AUTHORITY
TOXICITY TEST REPORT**

INTRODUCTION / EXECUTIVE SUMMARY

Report Date: November 09, 2018

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: October 07 – 12, 2018
10. Average Flow on Days Sampled (MGD): 1748, 1891, 1740
11. Pertinent Site Conditions: Production / operation data will be provided upon request.
12. Test Dates: October 09 – 16, 2018
13. Test Type: Short-term Chronic Definitive
14. Test Species: Fathead Minnows (*Pimephales promelas*)
Daphnids (*Ceriodaphnia dubia*)
15. Concentrations Tested (%):
Pimephales promelas: UV treated Outfall 101: 10.7, 21.4, 42.8, 85.6, 100
UV treated Intake: 100

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



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

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

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

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

22. Notes: Exposures to samples collected October 07 – 12, 2018 from Outfall 101 resulted in no toxic effects to fathead minnows or daphnids. The resulting IC25 values, for both species, were >100 percent. Exposure of minnows and daphnids to intake samples resulted in no significant difference from the controls during this study period.



METHODS SUMMARY

Samples:

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

| Sample ID | Date (MM-DD-YY) Time (ET) Collected | Date (MM-DD-YY) Time (ET) Received | Arrival Temp. (°C) | Initial TRC* (mg/L) | Date (MM-DD-YY) Time (ET) Last Used By |
|-----------|-------------------------------------|------------------------------------|-----------------------|---------------------|---|
| 101 | 10-07-18 0800 to 10-08-18 0700 | 10-08-18 1530 | 1.2 | <0.10 | 10-09-18 1010 10-10-18 0923 |
| Intake | 10-07-18 0800 to 10-08-18 0700 | 10-08-18 1530 | 1.1 | <0.10 | 10-09-18 1010 10-10-18 0923 |
| 101 | 10-09-18 0800 to 10-10-18 0700 | 10-10-18 1240 | 5.6 | <0.10 | 10-11-18 0925 10-12-18 0915 |
| Intake | 10-09-18 0800 to 10-10-18 0700 | 10-10-18 1240 | 2.4 | <0.10 | 10-11-18 0925 10-12-18 0915 |
| 101 | 10-11-18 0800 to 10-12-18 0700 | 10-12-18 1320 | 1.1, 1.7 [†] | <0.10 | 10-13-18 0958 10-14-18 0939 10-15-18 0911 |
| Intake | 10-11-18 0800 to 10-12-18 0700 | 10-12-18 1320 | 1.9 | <0.10 | 10-13-18 0958 10-14-18 0939 10-15-18 0911 |

*TRC = Total Residual Chlorine

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

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

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



| | <i>Pimephales promelas</i> | <i>Ceriodaphnia dubia</i> |
|--------------------------------------|---|--|
| <u>Test Organisms:</u> | | |
| 1. Source: | <u>In-house Cultures</u> | <u>In-house Cultures</u> |
| 2. Age: | <u>< 24-hours old</u> | <u>< 24-hours old</u> |
| <u>Test Method Summary:</u> | | |
| 1. Test Conditions: | <u>Static, Renewal</u> | <u>Static, Renewal</u> |
| 2. Test Duration: | <u>7 days</u> | <u>Until at least 60% of control females have 3 broods</u> |
| 3. Control / Dilution Water: | <u>Moderately Hard Synthetic</u> | <u>Moderately Hard Synthetic</u> |
| 4. Number of Replicates: | <u>4</u> | <u>10</u> |
| 5. Organisms per Replicate: | <u>10</u> | <u>1</u> |
| 6. Test Initiation: (Date/Time): | <u>10-09-18 0827 ET</u> | <u>10-09-18 1010 ET</u> |
| 7. Test Termination: (Date/Time): | <u>10-16-18 0732 ET</u> | <u>10-16-18 0920 ET</u> |
| 8. Test Temperature: Outfall 101: | <u>Mean = 24.6°C</u> <u>(24.2 – 25.1°C)</u> | <u>Mean = 24.9°C</u> <u>(24.7 – 25.2°C)</u> |
| 9. Physical / Chemical Measurements: | <u>Alkalinity, hardness, total residual chlorine, and conductivity were measured at the laboratory in each 100% sample. Daily temperatures were measured in one replicate for each test concentration. Pre- and post-exposure test solutions were analyzed daily for pH and dissolved oxygen.</u> | |
| 10. Statistics: | <u>Statistics were performed according to methods prescribed by EPA using ToxCalc version 5.0 statistical software (Tidepool Scientific Software, McKinneyville, CA).</u> | |



TOXICITY TEST RESULTS (see Appendix C for Bench Sheets)

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

Conducted October 09 – 16, 2018 using effluent from Outfall 101.

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

| Test Solutions (% Effluent) | Mean Dry Weight (mg) (replicate number) | | | | |
|--------------------------------|--|-------|-------|-------|-------|
| | 1 | 2 | 3 | 4 | Mean |
| Control, UV-treated | 0.841 | 0.861 | 0.908 | 0.941 | 0.888 |
| 10.7% | 0.749 | 0.876 | 0.936 | 0.890 | 0.863 |
| 21.4% | 0.874 | 0.878 | 0.896 | 0.819 | 0.867 |
| 42.8% | 0.878 | 0.927 | 0.981 | 0.866 | 0.913 |
| 85.6% | 0.872 | 0.905 | 0.894 | 0.975 | 0.912 |
| 100.0% | 0.766 | 0.909 | 0.913 | 0.952 | 0.885 |
| Intake | 0.972 | 0.903 | 0.847 | 0.815 | 0.884 |
| Control, Non-treated | 0.840 | 0.878 | 0.949 | 0.875 | 0.886 |

IC₂₅ Value: > 100%
 Permit Limit: 42.8%

95% Confidence Limits:
 Upper Limit: NA
 Lower Limit: NA

Calculated TU Estimates: < 1.0 TUc*

Permit Limit: 2.3 TUc

*TU_a = 100/LC₅₀; TU_c = 100/ IC₂₅



TOXICITY TEST RESULTS (see Appendix C for Bench Sheets)

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

Conducted October 09 – 16, 2018 using effluent from Outfall 101.

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

| Test Solutions (% Effluent) | Reproduction (#young/female/7 days) Data (replicate number) | | | | | | | | | | Mean |
|--------------------------------|--|----|----|----|----|----|----|----|----|----|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| Control | 29 | 31 | 34 | 28 | 27 | 32 | 27 | 31 | 33 | 32 | 30.4 |
| 10.7% | 32 | 33 | 35 | 33 | 30 | 37 | 36 | 30 | 37 | 38 | 34.1 |
| 21.4% | 33 | 34 | 39 | 35 | 35 | 34 | 36 | 35 | 39 | 33 | 35.3 |
| 42.8% | 35 | 33 | 40 | 39 | 34 | 31 | 39 | 38 | 40 | 36 | 36.5 |
| 85.6% | 35 | 36 | 41 | 37 | 40 | 34 | 37 | 41 | 37 | 38 | 37.6 |
| 100.0% | 38 | 37 | 41 | 39 | 41 | 37 | 40 | 37 | 39 | 37 | 38.6 |

IC₂₅ Value: ≥ 100%
 Permit Limit: 42.8%

95% Confidence Limits:
 Upper Limit: NA
 Lower Limit: NA

Calculated TU Estimates: < 1.0 TU_c*

Permit Limit: 2.3 TU_c

*TU_a = 100/LC₅₀; TU_c = 100/ IC₂₅



TOXICITY TEST RESULTS (see Appendix C for Bench Sheets)

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

Conducted October 09 – 16, 2018 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 | 30 | 27 | 31 | 27 | 32 | 30 | 28 | 29 | 29 | 29 | 29.2 |
| Intake | 37 | 38 | 36 | 34 | 37 | 38 | 38 | 34 | 35 | 35 | 36.2 |
| IC ₂₅ Value: <u>> 100%</u> Permit Limit: <u>N/A</u> 95% Confidence Limits: Upper Limit: <u>NA</u> Lower Limit: <u>NA</u> | | | | | | Calculated TU Estimates: <u>< 1.0 TUc*</u> Permit Limit: <u>N/A</u> | | | | | |

*TU_a = 100/LC₅₀; TU_c = 100/ IC₂₅

REFERENCE TOXICANT TEST RESULTS (see Appendix A and D)

| Species | Date | Time | Duration | Toxicant | Results (IC ₂₅) |
|----------------------------|-----------------------|------|----------|----------|-----------------------------|
| <i>Pimephales promelas</i> | October 09 – 16, 2018 | 0816 | 7 days | KCl | 0.67 g/L |
| <i>Ceriodaphnia dubia</i> | October 09 – 16, 2018 | 0947 | 7-days | NaCl | 1.06 g/L |





PHYSICAL/CHEMICAL SUMMARY

Water Chemistry Mean Values and Ranges for UV-treated *Pimephales promelas* and Non-treated *Ceriodaphnia dubia*, Sequoyah Nuclear Plant (SQN), Effluent Outfall 101 and Intake performed October 09-16, 2018.

| Test | Sample ID | Temperature (°C) | | Dissolved Oxygen (mg/L) | | pH (S.U.) | | Conductance (µmhos/cm) | Alkalinity (mg/L CaCO ₃) | Hardness (mg/L CaCO ₃) | *Total Residual Chlorine (mg/L) | |
|----------------------------|----------------------|------------------|-------------|-------------------------|-------------|-------------|-------------|------------------------|--------------------------------------|------------------------------------|---------------------------------|---|
| | | Initial | Final | Initial | Final | Initial | Final | | | | | |
| <i>Pimephales promelas</i> | Control, Non-treated | 24.7 | 24.4 | 7.8 | 7.6 | 7.62 | 7.32 | 309 | 59 | 81 | - | - |
| | | 24.6 - 24.7 | 24.3 - 24.5 | 7.7 - 8.0 | 6.6 - 7.9 | 7.49 - 7.75 | 7.06 - 7.70 | 297 - 319 | 58 - 60 | 80 - 84 | - | - |
| | Control, UV-treated | 24.7 | 24.6 | 7.9 | 7.8 | 7.70 | 7.34 | 307 | 59 | 81 | - | - |
| | | 24.7 - 24.8 | 24.4 - 24.7 | 7.8 - 8.1 | 7.1 - 8.1 | 7.46 - 7.87 | 7.13 - 7.71 | 295 - 318 | 59 - 59 | 80 - 82 | - | - |
| | 10.7% | 24.8 | 24.5 | 8.0 | 7.7 | 7.69 | 7.30 | 294 | - | - | - | - |
| | | 24.7 - 24.9 | 24.3 - 24.6 | 7.9 - 8.1 | 7.0 - 8.1 | 7.48 - 7.87 | 7.09 - 7.69 | 276 - 314 | - | - | - | - |
| | 21.4% | 24.8 | 24.4 | 8.1 | 7.7 | 7.68 | 7.30 | 275 | - | - | - | - |
| | | 24.7 - 24.9 | 24.3 - 24.6 | 7.9 - 8.2 | 6.8 - 8.1 | 7.48 - 7.86 | 7.06 - 7.68 | 264 - 291 | - | - | - | - |
| 42.8% | 24.8 | 24.5 | 8.1 | 7.7 | 7.66 | 7.29 | 240 | - | - | - | - | |
| | 24.7 - 25.0 | 24.3 - 24.6 | 8.0 - 8.2 | 6.7 - 8.2 | 7.48 - 7.84 | 7.06 - 7.65 | 231 - 250 | - | - | - | - | |
| 85.6% | 24.9 | 24.5 | 8.1 | 7.8 | 7.61 | 7.27 | 170 | - | - | - | - | |
| | 24.7 - 25.0 | 24.2 - 24.7 | 8.0 - 8.3 | 6.7 - 8.2 | 7.46 - 7.80 | 6.97 - 7.62 | 162 - 179 | - | - | - | - | |
| 100% | 24.9 | 24.4 | 8.2 | 7.8 | 7.58 | 7.21 | 149 | 53 | 53 | - | < 0.10 | |
| | 24.8 - 25.0 | 24.2 - 24.7 | 8.1 - 8.3 | 6.8 - 8.2 | 7.44 - 7.79 | 6.96 - 7.59 | 137 - 160 | 50 - 54 | 52 - 54 | < 0.10 | < 0.10 | |
| Intake | 25.0 | 24.5 | 8.2 | 7.8 | 7.55 | 7.17 | 143 | 53 | 55 | - | < 0.10 | |
| | 24.7 - 25.1 | 24.3 - 24.7 | 8.0 - 8.4 | 6.7 - 8.3 | 7.43 - 7.80 | 6.92 - 7.53 | 135 - 158 | 52 - 56 | 52 - 58 | < 0.10 | < 0.10 | |
| <i>Ceriodaphnia dubia</i> | Control, Non-treated | 24.7 | 25.0 | 7.8 | 7.9 | 7.62 | 7.64 | 309 | 59 | 81 | - | - |
| | | 24.7 - 24.8 | 24.8 - 25.2 | 7.7 - 7.9 | 7.8 - 8.0 | 7.49 - 7.75 | 7.40 - 7.82 | 297 - 319 | 58 - 60 | 80 - 84 | - | - |
| | 10.7% | 24.8 | 24.9 | 7.9 | 8.0 | 7.73 | 7.63 | 291 | - | - | - | - |
| | | 24.7 - 24.9 | 24.8 - 25.1 | 7.7 - 8.1 | 7.9 - 8.1 | 7.50 - 7.86 | 7.41 - 7.81 | 279 - 308 | - | - | - | - |
| | 21.4% | 24.8 | 24.9 | 7.9 | 8.0 | 7.70 | 7.62 | 272 | - | - | - | - |
| | | 24.7 - 24.9 | 24.8 - 25.1 | 7.7 - 8.1 | 7.9 - 8.1 | 7.48 - 7.83 | 7.42 - 7.80 | 262 - 285 | - | - | - | - |
| | 42.8% | 24.8 | 24.9 | 8.0 | 8.0 | 7.66 | 7.60 | 239 | - | - | - | - |
| | | 24.7 - 25.0 | 24.7 - 25.1 | 7.7 - 8.2 | 8.0 - 8.1 | 7.45 - 7.81 | 7.41 - 7.79 | 232 - 249 | - | - | - | - |
| 85.6% | 24.9 | 25.0 | 8.0 | 8.1 | 7.58 | 7.57 | 170 | - | - | - | - | |
| | 24.8 - 25.0 | 24.8 - 25.2 | 7.8 - 8.2 | 7.9 - 8.1 | 7.39 - 7.75 | 7.40 - 7.75 | 160 - 177 | - | - | - | - | |
| 100% | 24.9 | 24.9 | 8.1 | 8.1 | 7.54 | 7.55 | 142 | 52 | 53 | - | < 0.10 | |
| | 24.7 - 25.0 | 24.8 - 25.0 | 7.8 - 8.2 | 7.8 - 8.2 | 7.36 - 7.73 | 7.35 - 7.74 | 134 - 148 | 50 - 54 | 50 - 54 | < 0.10 | < 0.10 | |
| Intake | 24.9 | 24.9 | 8.1 | 8.1 | 7.53 | 7.53 | 141 | 53 | 55 | - | < 0.10 | |
| | 24.7 - 25.0 | 24.8 - 25.1 | 7.8 - 8.3 | 7.8 - 8.3 | 7.36 - 7.76 | 7.32 - 7.74 | 134 - 148 | 52 - 56 | 52 - 58 | < 0.10 | < 0.10 | |

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

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

SUMMARY / CONCLUSIONS

Exposures to samples collected October 07 – 12, 2018 from Outfall 101 resulted in no toxic effects to fathead minnows or daphnids. The resulting IC25 values, for both species, were >100 percent. Exposure of minnows and daphnids to intake samples resulted in no significant difference from the controls during this study period.



Appendix A

ADDITIONAL TOXICITY TEST INFORMATION

SUMMARY OF METHODS

1. *Pimephales promelas*

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

2. *Ceriodaphnia dubia*

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

DEVIATIONS / MODIFICATIONS TO TEST PROTOCOL

1. *Pimephales promelas*

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

2. *Ceriodaphnia dubia*

None

DEVIATIONS / MODIFICATIONS TO PRETEST CULTURE OR HOLDING OF TEST ORGANISMS

1. *Pimephales promelas*

None

2. *Ceriodaphnia dubia*

None



PHYSICAL AND CHEMICAL METHODS

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

QUALITY ASSURANCE

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

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

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



REFERENCES

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



Sequoyah Nuclear Plant Biomonitoring
October 09 – 16, 2018

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

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

| 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 |

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

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

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

| Date | Towerbrom mg/L TRC | Floguard MS 6237 mg/L Phosphate/Zinc | Spectrus BD1500 mg/L Quat | Nalco 73551 mg/L EO/PO | Spectrus CT1300 mg/L Quat | Floguard MS6236 mg/L Phosphate |
|------------|--------------------------|---|---------------------------------|---------------------------------|------------------------------------|---|
| 07/23/2017 | - | - | - | | | |
| 07/24/2017 | 0.0124 | 0.04/0.01 | - | | | |
| 07/25/2017 | 0.0081 | 0.04/0.01 | - | | | |
| 07/26/2017 | 0.0232 | 0.04/0.01 | 0.03 | | | |
| 07/27/2017 | 0.0179 | - | - | | | |
| 07/28/2017 | 0.0296 | - | 0.03 | | | |
| 5/13/2018 | | | | | | |
| 5/14/2018 | | | | | | |
| 5/15/2018 | 0.0229 | | 0.030 | | | 0.0275 |
| 5/16/2018 | 0.0159 | | 0.030 | | | 0.0275 |
| 5/17/2018 | 0.0133 | | 0.030 | | | 0.0275 |
| 5/18/2018 | | | | | | |
| 10/07/2018 | - | | - | | - | - |
| 10/08/2018 | 0.0221 | | - | | - | 0.02852 |
| 10/09/2018 | 0.0098 | | - | | 0.0332 | 0.02852 |
| 10/10/2018 | 0.0187 | | 0.031 | | 0.0332 | 0.02852 |
| 10/11/2018 | 0.0200 | | 0.031 | | - | 0.02852 |
| 10/12/2018 | 0.0187 | | 0.031 | | - | 0.02852 |

Sequoyah Nuclear Plant Biomonitoring
October 09 – 16, 2018

Appendix C

Chain of Custody Records and
Toxicity Test Bench Sheets

BIOMONITORING CHAIN OF CUSTODY RECORD

Client: TVA
 Project Name: Sequoyah NP Toxicity
 O. Number: N/A
 Facility Sampled: Sequoyah NP
 NPDES Number: TN0026450
 Collected By: *Kelly Robinson, Andy Parker*
Kelly Blumett, Amy Park

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): Contractor
 General Comments:
 101 Bottle Comp @ 0830
 INT Bottle Comp @ 0808

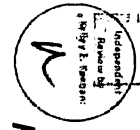
| Field Identification / Sample Description | Grab/Comp | Collection Date/Time | | Container Number & Volume Collected | Flow (MGD) | Rain Event? (Mark as Appropriate) | | | | Laboratory Use | | | | |
|---|-----------|----------------------|------------|-------------------------------------|---------------|-----------------------------------|----------------|----|-------|--|--------------------|----|------|------------|
| | | Date (mm/dd/yy) | Time (EST) | | | Yes | If Yes. Inches | No | Trace | ETS Log Number | Arrival Temp. (°C) | By | Time | Appearance |
| SQN-101-TOX | Comp | Start 10-7-18 | 0800 | / | / | / | / | / | / | 101008.02 | 1.2°C | N | 1530 | * |
| | | End 10-8-18 | 0700 | 1 (2.5gal) | <i>1748.7</i> | | | ✓ | | | | | | |
| SQN-INT-TOX | Comp | Start 10-7-18 | 0800 | / | / | / | / | / | / | 101008.03 | 1.1°C | N | 1530 | * |
| | | End 10-8-18 | 0700 | 1 (2.5 gal) | N/A | | | ✓ | | * CUSTOMER SEALS INTACT. SAMPLES RECEIVED IN GOOD CONDITION. | | | | |

Project # 13633

Sample Custody - Fill In From Top Down

| Relinquished By (Signature): | Date/Time | Received By (Signature): | Date/Time |
|--|-------------------|--|-------------------|
| <i>Kelly Blumett</i> TVA | 10-8-18 / 1115 ET | <i>Amy Park</i> ¹⁰⁻⁰⁸⁻¹⁸ TVA CONTRACTOR | 10-8-18 / 1115 ET |
| <i>Amy Park</i> SONIC DELIVERY TVA CONTRACTOR | 10-8-18 / 1530 ET | <i>N</i> ETJ | 10.08.18 1530 ET |
| | | | |
| | | | |

Whole Effluent Sample Receipt Log



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*Sample temperature performed using Sample Receiving Thermometer: SN 160928622

| Date Received | Time Received | Received by | Received from | *Sample Temp. (°C) | Project number | Sample number | Sample name and description | State | Comments |
|---------------|---------------|-------------|---------------|--------------------|----------------|---------------|---------------------------------------|-------|----------|
| 10-08-18 | 1200 | K. Keenan | W. Ladd | 3.4 | 13632 | 181008 .01 | Andrews WWTP - Pp | NC | |
| 10-08-18 | 1530 | K. Keenan | A. Panter | 1.2 | 13633 | 181008 .02 | TVA - Sequoyah Nuclear Plant - 101 | TN | |
| 10-08-18 | 1530 | K. Keenan | A. Panter | 1.1 | 13633 | 181008 .03 | TVA - Sequoyah Nuclear Plant - Intake | TN | |

BIOMONITORING CHAIN OF CUSTODY RECORD

Client: TVA
 Project Name: Sequoyah NP Toxicity
 O. Number: N/A
 Facility Sampled: Sequoyah NP
 NPDES Number: TN0026450
 Collected By: *Kelly Robinette, Olga Moore*
Kelly Robinette Olga Moore

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

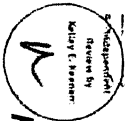
Delivered By (Circle One):
 FedEx UPS Bus Client _____
 Other (specify): *Sonic*
 General Comments:
 101 Bottle Comp @ *0725*
 INT Bottle Comp @ *0745*

| 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 | Appearance | |
| SQN-101-TOX | Comp | Start | <i>10/09/18</i> | <i>0800</i> | <i>1 (2.5gal)</i> | <i>1840.59</i> | | | | | <i>10101031</i> | <i>5.6°C</i> | <i>J</i> | <i>1240</i> | <i>*</i> |
| | | End | <i>10/10/18</i> | <i>0700</i> | | | | | | | | | | | |
| SQN-INT-TOX | Comp | Start | <i>10/09/18</i> | <i>0800</i> | <i>1 (2.5 gal)</i> | <i>N/A</i> | | | | | <i>10101032</i> | <i>2.4°C</i> | <i>J</i> | <i>1240</i> | <i>*</i> |
| | | End | <i>10/10/18</i> | <i>0700</i> | | | | | | | | | | | |

project # 13633

Sample Custody - Fill In From Top Down

| Relinquished By (Signature): | Date/Time | Received By (Signature): | Date/Time |
|----------------------------------|---------------------------|----------------------------------|--------------------------|
| <i>Kelly Robinette</i> TVA | <i>10/10/18 @ 0833 ET</i> | <i>B R Skilar</i> SONIC DELIVERY | <i>10-10-18 08:33 ET</i> |
| <i>B R Skilar</i> SONIC DELIVERY | <i>10-10-18 1240 ET</i> | <i>J</i> ETS JIM SUMNER | <i>10-10-18 1240 ET</i> |
| | | | |
| | | | |



Whole Effluent Sample Receipt Log

*Sample temperature performed using Sample Receiving Thermometer: SN 160928622

| Date Received | Time Received | Received by | Received from | *Sample Temp. (°C) | Project number | Sample number | Sample name and description | State | Comments |
|---------------|---------------|-------------|---------------|--------------------|----------------|---------------|---------------------------------------|-------|----------|
| 10-10-18 | 0931 | K. Keenan | Fed - Ex | 1.8 | 13645 | 181010 .01 | ALCOA - 005 | NC | |
| 10-10-18 | 0931 | K. Keenan | Fed - Ex | 1.8 | 13646 | 181010 .02 | ALCOA - 012 | NC | |
| 10-10-18 | 0931 | K. Keenan | Fed - Ex | 1.8 | 13647 | 181010 .03 | PCS Phosphate, Inc. | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 1.6 | 13648 | 181010 .04 | Cary/Apex WTF | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.4 | 13649 | 181010 .05 | Clarkton WWTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.4 | 13650 | 181010 .06 | Cherry Point | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 1.4 | 13651 | 181010 .07 | Dunn WWTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.3 | 13652 | 181010 .08 | Farmville WWTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.4 | 13653 | 181010 .09 | Franklinton WTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.4 | 13654 | 181010 .10 | Hamlet WWTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.2 | 13655 | 181010 .11 | Greenville WTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 1.2 | 13656 | 181010 .12 | Goldsboro WRF - 001 | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.4 | 13657 | 181010 .13 | Hermitage House WWTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 1.7 | 13658 | 181010 .14 | Marshall SS | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 1.4 | 13659 | 181010 .15 | Mayodan WWTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.4 | 13660 | 181010 .16 | Mt. Olive WWTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 1.4 | 13661 | 181010 .17 | Newport WWTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.2 | 13662 | 181010 .18 | Pasquotank WTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.4 | 13663 | 181010 .19 | Princeton WWTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 1.6 | 13664 | 181010 .20 | Radiator Specialty | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 1.7 | 13665 | 181010 .21 | M'Kean Maffit WWTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.4 | 13666 | 181010 .22 | Smithfield Packing | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.8 | 13667 | 181010 .23 | South Mills WTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 1.5 | 13668 | 181010 .24 | Greenville WWTP | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.4 | 13669 | 181010 .25 | Bay Valley Foods | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 1.6 | 13670 | 181010 .26 | Mt. Olive Pickle Company | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 2.4 | 13671 | 181010 .27 | Worsley | NC | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 1.1 | 13672 | 181010 .28 | TVA - Lagoon Creek CC - Outfall 001 | TN | |
| 10-10-18 | 1042 | K. Keenan | Fed - Ex | 1.3 | 13672 | 181010 .29 | TVA - Lagoon Creek CC - Well Water | TN | |
| 10-10-18 | 1109 | K. Keenan | W. Ladd | 2.0 | 13632 | 181010 .30 | Andrews WWTP -Pp | NC | |
| 10-10-18 | 1240 | J. Sumner | TVA Courier | 5.6 | 13633 | 181010 .31 | TVA - Sequoyah Nuclear Plant - 101 | TN | |
| 10-10-18 | 1240 | J. Sumner | TVA Courier | 2.4 | 13633 | 181010 .32 | TVA - Sequoyah Nuclear Plant - Intake | TN | |

BIOMONITORING CHAIN OF CUSTODY RECORD

| | | |
|---|---|---|
| Client: TVA Project Name: Sequoyah NP Toxicity O. Number: N/A Facility Sampled: Sequoyah NP NPDES Number: TN0026450 Collected By: <i>Kelly Robinette, Obie Moore</i> <i>Kelly Robinette, Obie Moore</i> | 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): <i>Sonic</i> General Comments: 101 Bottle Comp @ 0728 INT Bottle Comp @ 0750 |
|---|---|---|

| 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 | Appearance |
| SQN-101-TOX | Comp | Start | 10/11/18 | 0800 | / | / | / | / | / | 10101223 | 1.1, 1.7°C | J | 1320 | * |
| | | End | 10/12/18 | 0700 | | | | | | | | | | |
| SQN-INT-TOX | Comp | Start | 10/11/18 | 0800 | / | / | / | / | / | 10101224 | 1.9°C | J | 1320 | * |
| | | End | 10/12/18 | 0700 | | | | | | | | | | |

PNW, UT# 13033

Sample Custody - Fill In From Top Down

| Relinquished By (Signature): | Date/Time | Received By (Signature): | Date/Time |
|----------------------------------|-----------------|----------------------------------|----------------|
| <i>Kelly Robinette</i> TVA | 10-12-18 / 0845 | <i>BR Skeler</i> SONIC DELIVERY | 10-12-18 08:45 |
| <i>BR Skeler</i> SONIC DELIVERED | 10/24/18 13:20 | <i>Jim Sumner</i> ETS JIM SUMNER | 10-12-18 1320 |
| | | | |
| | | | |



Whole Effluent Sample Receipt Log

*Sample temperature performed using Sample Receiving Thermometer; SN 160928622

| Date | Received Time | Received by | Received from | *Sample Temp, (°C) | Project number | Sample number | Sample name and description | State | Comments |
|----------|---------------|-------------|---------------|--------------------|----------------|---------------|---------------------------------------|-------|----------|
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 1.6 | 13648 | 181012 .01 | Car/Apex WTP | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.0 | 13649 | 181012 .02 | Clarkton WTP | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.0 | 13650 | 181012 .03 | Cherry Point | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.7 | 13651 | 181012 .04 | Dunn WTP | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.4 | 13652 | 181012 .05 | Farville WTP | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 1.6 | 13653 | 181012 .06 | Franklin WTP | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.4 | 13654 | 181012 .07 | Hanlet WTP | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.1 | 13655 | 181012 .08 | Greenville WTP | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.0 | 13656 | 181012 .09 | Goldsboro WRF - 001 | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 1.9 | 13658 | 181012 .11 | Marshall SS | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.5 | 13659 | 181012 .12 | Mayodan WTP | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.0 | 13660 | 181012 .13 | Mt. Olive WTP | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 3.5 | 13661 | 181012 .14 | Newport WTP | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.0 | 13663 | 181012 .15 | Princeton WTP | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.2 | 13664 | 181012 .16 | Radiator Specialty | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 1.8 | 13665 | 181012 .17 | M'Kean Maffit WTP | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.0 | 13666 | 181012 .18 | Smithfield Packing | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 2.0 | 13669 | 181012 .19 | Bay Valley Foods | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 1.7 | 13670 | 181012 .20 | Mt. Olive Pickle Company | NC | |
| 10-12-18 | 0951 | K. Keenan | Fed - Ex | 1.4 | 13668 | 181012 .21 | Greenville WTP | NC | |
| 10-12-18 | 1250 | K. Keenan | W. Ladd | 0.6 | 13632 | 181012 .22 | Andrews WWTP - Pp | NC | |
| 10-12-18 | 1320 | J. Sumner | TVA Counter | 1.1/1.7 | 13633 | 181012 .23 | TVA - Sequoyah Nuclear Plant - 101 | TN | |
| 10-12-18 | 1320 | J. Sumner | TVA Counter | 1.9 | 13633 | 181012 .24 | TVA - Sequoyah Nuclear Plant - Intake | TN | |

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

Client: Tennessee Valley Authority
 Facility: Sequoyah Nuclear Plant
 NPDES #: TN0026450
 Project #: 13633

County: Hamilton
 Outfall: 101

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

| <i>Test organism information:</i> | | <i>Test information:</i> | |
|-----------------------------------|---|---|---------------|
| Organism source: | In-house culture | Randomizing template: | BLUR |
| Age: | < 24-hours old | Incubator number and shelf location: | 7C |
| Spawn date: | 10-04-18 | Artemia CHM number: | CHM984 |
| Hatch dates and times: | 10-08-18 1625 TO 10-09-18 0600 | <i>Drying information for weight determination:</i> | |
| Transfer vessel information: | pH = 7.80 S.U. Temperature = 24.4 °C | Date / Time in oven: | 10-16-18 0745 |
| Average transfer volume: | < 0.25 mL | Initial oven temperature: | 60 °C |
| | | Date / Time out of oven: | 10-17-18 0745 |
| | | 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 | 10-09-18 | 0605 | JL | 1205 | JL | 0827 | JL | 181008-02 | 181008-03 | 10-03-18 |
| 1 | 10-10-18 | 0600 | JL | 1200 | JL | 0821 | JL | 181008-02 | 181008-03 | 10-03-18 |
| 2 | 10-11-18 | 0600 <i>0600 0610</i> | JL | 1210 | JL | 0825 | JL | 181010-31 | 181010-32 | 10-07-18 |
| 3 | 10-12-18 | 0610 | JL | 1200 | JL | 0822 | JL | 181010-31 | 181010-32 | 10-07-18 |
| 4 | 10-13-18 | 0700 | JL | 1300 | JL | 0912 | JL | 181012-23 | 181012-24 | 10-11-18 A |
| 5 | 10-14-18 | 0700 | JL | 1300 | JL | 0939 | JL | 181012-23 | 181012-24 | 10-11-18 A |
| 6 | 10-15-18 | 0600 | JL | 1210 | JL | 0819 | JL | 181012-23 | 181012-24 | 10-11-18 A |
| 7 | 10-16-18 | | | | | 0732 | JL | | | |

| <i>Control information:</i> | | Acceptance criteria | <i>Summary of test endpoints:</i> | |
|--------------------------------------|-------|---------------------|-----------------------------------|--------|
| % Mortality: | 0% | ≤ 20% | 7-day LC ₅₀ | > 100% |
| Average weight per initial larvae: | 0.888 | | NOEC | 100% |
| Average weight per surviving larvae: | 0.888 | ≥ 0.25mg/larvac | LOEC | > 100% |
| | | | ChV | > 100% |
| | | | IC ₂₅ | > 100% |



Species: *Pimephales promelas*

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

Date: 10-09-18

Survival and Growth Data

| Day | CONTROL | | | | 10.7% | | | | 21.4% | | | |
|--|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | A | B | C | D | E | F | G | H | I | J | K | L |
| 0 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 1 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 2 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 3 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 4 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 5 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 6 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 7 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 70 | 10 | 10 | 10 |
| A = Pan weight (mg) Tray color code: <u>Cob4</u> Analyst: <u>TS</u> Date: <u>08.23.18</u> | 15.80 | 13.35 | 15.37 | 14.40 | 15.12 | 14.98 | 13.70 | 15.79 | 15.39 | 13.86 | 13.60 | 12.77 |
| B = Pan + Larvae weight (mg) Analyst: <u>JL</u> Date: <u>10-17-18</u> | 24.21 | 21.96 | 21.45 | 23.81 | 22.61 | 23.71 | 23.06 | 24.69 | 21.13 | 22.64 | 22.56 | 20.96 |
| C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>JL</u> | 8.41 | 8.61 | 9.08 | 9.41 | 7.49 | 8.76 | 9.36 | 8.90 | 8.74 | 8.78 | 8.96 | 8.19 |
| Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>JL</u> | 0.841 | 0.861 | 0.908 | 0.941 | 0.749 | 0.876 | 0.936 | 0.890 | 0.874 | 0.878 | 0.896 | 0.819 |
| Average weight per initial number of larvae (mg) | 0.888 | | | | 0.863 | | 2.87. | | 0.867 | | 2.47. | |
| Percent reduction from control (%) | | | | | | | | | | | | |

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

Comments:



Species: *Pimephales promelas*

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

Date: 10-09-18

Survival and Growth Data

| Day | 42.8% | | | | 85.6% | | | | 100% | | | | |
|--|------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | M | N | O | P | Q | R | S | T | U | V | W | X | |
| 0 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 1 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 2 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 3 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 4 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 5 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 6 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 7 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| A = Pan weight (mg) Tray color code: <u>1064</u> Analyst: <u>TS</u> Date: <u>08.23.18</u> | | 15.00 | 15.72 | 15.22 | 15.54 | 15.73 | 14.86 | 14.86 | 15.72 | 15.82 | 14.72 | 15.24 | 15.78 |
| B = Pan + Larvae weight (mg) Analyst: <u>JH</u> Date: <u>10-17-18</u> | | 23.78 | 24.99 | 25.63 | 24.20 | 24.45 | 23.91 | 23.80 | 25.47 | 23.48 | 23.81 | 24.37 | 25.30 |
| C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>JH</u> | | 8.78 | 9.27 | 9.81 | 8.66 | 8.72 | 9.05 | 8.94 | 9.75 | 7.66 | 9.09 | 9.13 | 9.52 |
| Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>JH</u> | | 0.878 | 0.927 | 0.981 | 0.866 | 0.872 | 0.905 | 0.894 | 0.975 | 0.766 | 0.909 | 0.913 | 0.952 |
| Average weight per initial number of larvae (mg) | Percent reduction from control (%) | 0.913 | | -2.87 | | 0.912 | | -2.77 | | 0.885 | | 0.37 | |

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

Comments:

Species: Pimephales promelas

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

Date: 10-09-18

Survival and Growth Data

| Day | 100% Intake | | | | Control - Non-treated | | | | GG | HH | II | JJ |
|---|-------------|-------|-------|-------|-----------------------|-------|--|-------|----|----|----|----|
| | Y | Z | AA | BB | CC | DD | EE | FF | | | | |
| 0 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | |
| 1 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | |
| 2 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | |
| 3 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | |
| 4 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | |
| 5 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | |
| 6 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | |
| 7 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | |
| A = Pan weight (mg) Tray color code: <u>ruby</u> Analyst: <u>TS</u> Date: <u>08.23.18</u> | 15.19 | 15.64 | 14.51 | 14.90 | 13.52 | 15.59 | 13.62 | 14.23 | | | | |
| B = Pan + Larvae weight (mg) Analyst: <u>J</u> Date: <u>10-17-18</u> | 24.91 | 24.67 | 22.98 | 23.05 | 21.92 | 24.37 | 23.11 | 22.98 | | | | |
| C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>J</u> | 9.72 | 9.03 | 8.47 | 8.15 | 8.40 | 8.78 | 9.49 | 8.75 | | | | |
| Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>J</u> | 0.972 | 0.903 | 0.847 | 0.815 | 0.840 | 0.878 | 0.949 | 0.875 | | | | |
| Average weight per initial number of larvae (mg) | 0.884 | | 0.47. | | 0.886 | | 0.949 0.875 Not Applicable | | | | | |
| Percent reduction from control (%) | | | | | | | | | | | | |

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

| |
|-----------|
| Comments: |
| |
| |
| |





Environmental Testing Solutions, Inc.

TVA / Sequoyah Nuclear Plant, Outfall 101
October 09-16, 2018

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: 13633

| Not for Compliance Assessment, Internal Laboratory QC | | | | | | | | | | | | | | |
|---|-----------|--------------------------|------------------------|---------------------|------------------------------|----------------------------|--|---|---|--|-------------------|---|---|------------------------------------|
| Concentration (%) | Replicate | Initial number of larvae | Final number of larvae | A = Pan weight (mg) | B = Pan + Larvae weight (mg) | Larvae weight (mg) = B - A | Weight / Surviving number of larvae (mg) | Mean weight / Surviving number of larvae (mg) | Coefficient of variation (Mean weight per surviving number of larvae) (%) | Weight / Initial number of larvae (mg) | Mean survival (%) | Mean weight / Initial number of larvae (mg) | Coefficient of variation (Mean weight per initial number of larvae) (%) | Percent reduction from control (%) |
| Control, Non-treated | CC | 10 | 10 | 13.52 | 21.92 | 8.40 | 0.840 | 0.886 | 5.2 | 0.840 | 100.0 | 0.886 | 5.2 | Not applicable |
| | DD | 10 | 10 | 15.59 | 24.37 | 8.78 | 0.878 | | | 0.878 | | | | |
| | EE | 10 | 10 | 13.62 | 23.11 | 9.49 | 0.949 | | | 0.949 | | | | |
| | FF | 10 | 10 | 14.23 | 22.98 | 8.75 | 0.875 | | | 0.875 | | | | |
| Control, UV-treated | A | 10 | 10 | 15.89 | 24.21 | 8.31 | 0.831 | 0.888 | 5.1 | 0.841 | 100.0 | 0.888 | 5.1 | Not applicable |
| | B | 10 | 10 | 13.35 | 21.96 | 8.61 | 0.861 | | | 0.861 | | | | |
| | C | 10 | 10 | 15.37 | 24.45 | 9.08 | 0.908 | | | 0.908 | | | | |
| | D | 10 | 10 | 14.40 | 23.81 | 9.41 | 0.941 | | | 0.941 | | | | |
| 10.7% | E | 10 | 10 | 15.12 | 22.61 | 7.49 | 0.749 | 0.863 | 9.3 | 0.749 | 100.0 | 0.863 | 9.3 | 2.8 |
| | F | 10 | 10 | 14.98 | 23.74 | 8.76 | 0.876 | | | 0.876 | | | | |
| | G | 10 | 10 | 13.70 | 23.06 | 9.36 | 0.936 | | | 0.936 | | | | |
| | H | 10 | 10 | 15.79 | 24.69 | 8.90 | 0.890 | | | 0.890 | | | | |
| 21.4% | I | 10 | 10 | 15.39 | 24.13 | 8.74 | 0.874 | 0.867 | 3.8 | 0.874 | 100.0 | 0.867 | 3.8 | 2.4 |
| | J | 10 | 10 | 13.86 | 22.64 | 8.78 | 0.878 | | | 0.878 | | | | |
| | K | 10 | 10 | 13.60 | 22.56 | 8.96 | 0.896 | | | 0.896 | | | | |
| | L | 10 | 10 | 12.77 | 20.96 | 8.19 | 0.819 | | | 0.819 | | | | |
| 42.8% | M | 10 | 10 | 15.90 | 23.78 | 8.78 | 0.878 | 0.913 | 5.7 | 0.878 | 100.0 | 0.913 | 5.7 | -2.8 |
| | N | 10 | 10 | 15.72 | 24.99 | 9.27 | 0.927 | | | 0.927 | | | | |
| | O | 10 | 10 | 15.22 | 25.03 | 9.81 | 0.981 | | | 0.981 | | | | |
| | P | 10 | 10 | 15.54 | 24.20 | 8.66 | 0.866 | | | 0.866 | | | | |
| 85.6% | Q | 10 | 10 | 15.73 | 24.45 | 8.72 | 0.872 | 0.912 | 4.9 | 0.872 | 100.0 | 0.912 | 4.9 | -2.7 |
| | R | 10 | 10 | 14.86 | 23.91 | 9.05 | 0.905 | | | 0.905 | | | | |
| | S | 10 | 10 | 14.86 | 23.80 | 8.94 | 0.894 | | | 0.894 | | | | |
| | T | 10 | 10 | 15.72 | 25.47 | 9.75 | 0.975 | | | 0.975 | | | | |
| 100% | U | 10 | 10 | 15.82 | 25.48 | 7.66 | 0.766 | 0.885 | 9.2 | 0.766 | 100.0 | 0.885 | 9.2 | 0.3 |
| | V | 10 | 10 | 14.72 | 23.81 | 9.09 | 0.909 | | | 0.909 | | | | |
| | W | 10 | 10 | 15.24 | 24.37 | 9.13 | 0.913 | | | 0.913 | | | | |
| | X | 10 | 10 | 15.78 | 25.30 | 9.52 | 0.952 | | | 0.952 | | | | |
| 100% Intake | Y | 10 | 10 | 15.19 | 24.91 | 9.72 | 0.972 | 0.884 | 7.8 | 0.972 | 100.0 | 0.884 | 7.8 | 0.4 |
| | Z | 10 | 10 | 15.64 | 24.67 | 9.03 | 0.903 | | | 0.903 | | | | |
| | AA | 10 | 10 | 14.51 | 22.98 | 8.47 | 0.847 | | | 0.847 | | | | |
| | BB | 10 | 10 | 14.90 | 23.05 | 8.15 | 0.815 | | | 0.815 | | | | |

Outfall 101:
Dunnett's MSD value: 0.1007
PMSD: 11.3

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: 0.0801
PMSD: 9.0

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

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



TVA / Sequoyah Nuclear Plant, Outfall 101
October 09-16, 2018

Statistical Analyses

Environmental Testing Solutions, Inc.

| Larval Fish Growth and Survival Test-7 Day Growth | | | |
|---|--------------|---------------|---------------------------------|
| Start Date: | 10/9/2018 | Test ID: | PpFRCR |
| End Date: | 10/16/2018 | Lab ID: | ETS-Envir Testing Sol. |
| Sample Date: | October 2018 | Protocol: | FWCHR-EPA-821-R-02-013 |
| Comments: | UV Treated | Sample ID: | TVA / SQN 101 |
| | | Sample Type: | DMR-Discharge Monitoring Report |
| | | Test Species: | PP-Pimephales promelas |

| Conc-% | 1 | 2 | 3 | 4 |
|-------------|--------|--------|--------|--------|
| Non-Control | 0.8400 | 0.8780 | 0.9490 | 0.8750 |
| UV-Control | 0.8410 | 0.8610 | 0.9080 | 0.9410 |
| 10.7 | 0.7490 | 0.8760 | 0.9360 | 0.8900 |
| 21.4 | 0.8740 | 0.8780 | 0.8960 | 0.8190 |
| 42.8 | 0.8780 | 0.9270 | 0.9810 | 0.8660 |
| 85.6 | 0.8720 | 0.9050 | 0.8940 | 0.9750 |
| 100 | 0.7660 | 0.9090 | 0.9130 | 0.9520 |
| Intake | 0.9720 | 0.9030 | 0.8470 | 0.8150 |

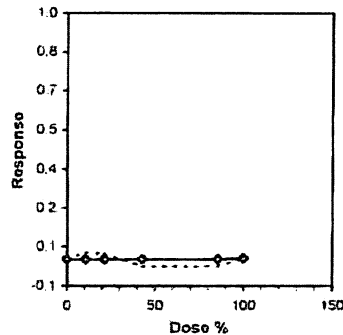
| Conc-% | Mean | N-Mean | Transform: Untransformed | | | | N | t-Stat | 1-Tailed | | Isotonic | |
|-------------|--------|--------|--------------------------|--------|--------|-------|---|--------|----------|--------|----------|--------|
| | | | Mean | Min | Max | CV% | | | Critical | MSD | Mean | N-Mean |
| Non-Control | 0.8855 | 0.9975 | 0.8855 | 0.8400 | 0.9490 | 5.162 | 4 | | | | 0.8884 | 1.0000 |
| UV-Control | 0.8878 | 1.0000 | 0.8878 | 0.8410 | 0.9410 | 5.099 | 4 | * | | | 0.8884 | 1.0000 |
| 10.7 | 0.8628 | 0.9718 | 0.8628 | 0.7490 | 0.9360 | 9.278 | 4 | 0.598 | 2.410 | 0.1007 | 0.8884 | 1.0000 |
| 21.4 | 0.8668 | 0.9763 | 0.8668 | 0.8190 | 0.8960 | 3.835 | 4 | 0.502 | 2.410 | 0.1007 | 0.8884 | 1.0000 |
| 42.8 | 0.9130 | 1.0284 | 0.9130 | 0.8660 | 0.9810 | 5.745 | 4 | -0.604 | 2.410 | 0.1007 | 0.8884 | 1.0000 |
| 85.6 | 0.9115 | 1.0268 | 0.9115 | 0.8720 | 0.9750 | 4.882 | 4 | -0.568 | 2.410 | 0.1007 | 0.8884 | 1.0000 |
| 100 | 0.8850 | 0.9969 | 0.8850 | 0.7660 | 0.9520 | 9.228 | 4 | 0.066 | 2.410 | 0.1007 | 0.8850 | 0.9962 |
| Intake | 0.8843 | 0.9961 | 0.8843 | 0.8150 | 0.9720 | 7.790 | 4 | | | | | |

| Auxiliary Tests | Statistic | Critical | Skew | Kurt |
|--|-----------|----------|---------|---------|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.93304 | 0.884 | -0.6932 | 0.22375 |
| Bartlett's Test indicates equal variances (p = 0.66) | 3.2891 | 15.0863 | | |
| The control means are not significantly different (p = 0.95) | 0.06995 | 2.44691 | | |

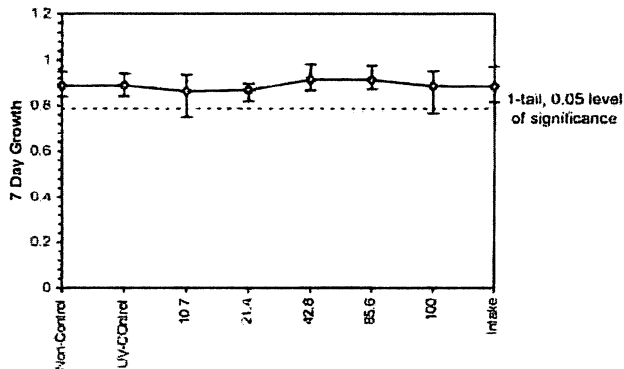
| Hypothesis Test (1-tail, 0.05) | NOEC | LOEC | ChV | TU | MSDu | MSDp | MSB | MSE | F-Prob | df |
|--------------------------------|------|------|-----|----|---------|---------|---------|---------|---------|-------|
| Dunnnett's Test | 100 | >100 | | 1 | 0.10073 | 0.11347 | 0.00182 | 0.00349 | 0.75724 | 5, 18 |

Treatments vs UV-Control

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



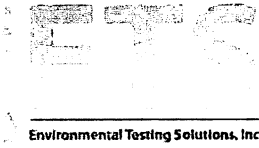
Dose-Response Plot



Printed and
 signed by
 the tester
[Signature]



TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
October 09-16, 2018



Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

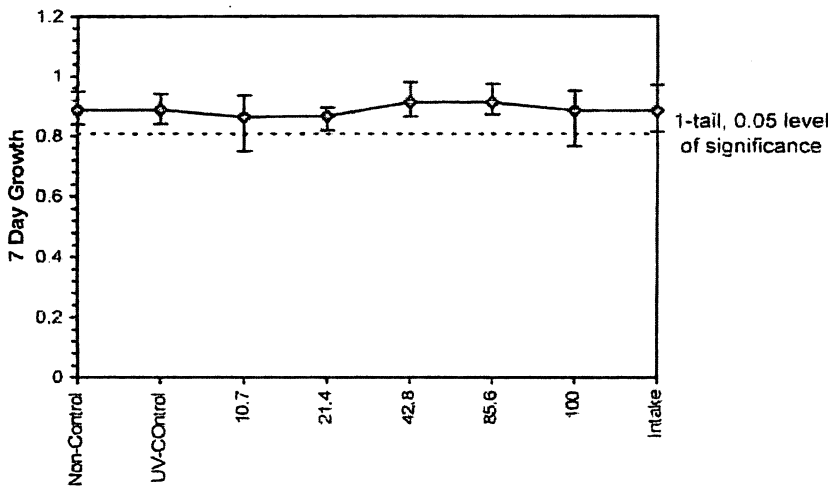
| | | | | | |
|--------------|--------------|-----------|------------------------|---------------|---------------------------------|
| Start Date: | 10/9/2018 | Test ID: | PpFRCR | Sample ID: | TVA / SQN 101 - Intake |
| End Date: | 10/16/2018 | Lab ID: | ETS-Envir. Testing Sol | Sample Type: | DMR-Discharge Monitoring Report |
| Sample Date: | October 2018 | Protocol: | FWCHR-EPA-821-R-02-013 | Test Species: | PP-Pimephales promelas |
| Comments: | UV Treated | | | | |

| Conc-% | 1 | 2 | 3 | 4 |
|-------------|--------|--------|--------|--------|
| Non-Control | 0.8400 | 0.8780 | 0.9490 | 0.8750 |
| UV-CONTROL | 0.8410 | 0.8610 | 0.9080 | 0.9410 |
| 10.7 | 0.7490 | 0.8760 | 0.9360 | 0.8900 |
| 21.4 | 0.8740 | 0.8780 | 0.8960 | 0.8190 |
| 42.8 | 0.8780 | 0.9270 | 0.9810 | 0.8660 |
| 85.6 | 0.8720 | 0.9050 | 0.8940 | 0.9750 |
| 100 | 0.7660 | 0.9090 | 0.9130 | 0.9520 |
| Intake | 0.9720 | 0.9030 | 0.8470 | 0.8150 |

| Conc-% | Transform: Untransformed | | | | | | | t-Stat | 1-Tailed Critical | MSD |
|-------------|--------------------------|--------|--------|--------|--------|-------|---|--------|-------------------|--------|
| | Mean | N-Mean | Mean | Min | Max | CV% | N | | | |
| Non-Control | 0.8855 | 0.9975 | 0.8855 | 0.8400 | 0.9490 | 5.162 | 4 | | | |
| UV-CONTROL | 0.8878 | 1.0000 | 0.8878 | 0.8410 | 0.9410 | 5.099 | 4 | | | |
| 10.7 | 0.8628 | 0.9718 | 0.8628 | 0.7490 | 0.9360 | 9.278 | 4 | | | |
| 21.4 | 0.8668 | 0.9763 | 0.8668 | 0.8190 | 0.8960 | 3.835 | 4 | | | |
| 42.8 | 0.9130 | 1.0284 | 0.9130 | 0.8660 | 0.9810 | 5.745 | 4 | | | |
| 85.6 | 0.9115 | 1.0268 | 0.9115 | 0.8720 | 0.9750 | 4.882 | 4 | | | |
| 100 | 0.8850 | 0.9969 | 0.8850 | 0.7660 | 0.9520 | 9.228 | 4 | | | |
| Intake | 0.8843 | 0.9961 | 0.8843 | 0.8150 | 0.9720 | 7.790 | 4 | 0.085 | 1.943 | 0.0801 |

| Auxiliary Tests | Statistic | Critical | Skew | Kurt | | |
|---|-----------|----------|---------|---------|---------|------|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.95112 | 0.749 | 0.40793 | -0.9433 | | |
| F-Test indicates equal variances (p = 0.51) | 2.31582 | 47.4683 | | | | |
| The control means are not significantly different (p = 0.95) | 0.06995 | 2.44691 | | | | |
| Hypothesis Test (1-tail, 0.05) | MSDu | MSDp | MSB | MSE | F-Prob | df |
| Homoscedastic t Test indicates no significant differences Treatments vs UV-CONTROL | 0.08008 | 0.09021 | 2.5E-05 | 0.0034 | 0.93508 | 1, 6 |

Dose-Response Plot



Entered and Reviewed by
 Jim Sumner
JS



Species: Pimephales promelas

Date: 10-09-18

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

Daily Chemistry:

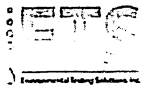
| Analyst | | Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.) | | | | | |
|-----------------------|---------------------------------------|--|-------|-----------------|-------|---------|-------|
| | | 0 | | 1 | | 2 | |
| | | MS | MU | MS | TS MS | TS MS | KL |
| Concentration | Parameter | | | | | | |
| CONTROL UV-treated | pH (S.U.) | 7.79 | 7.71 | 7.87 | 7.50 | 7.81 | 7.15 |
| | DO (mg/L) | 7.9 | 7.6 | 7.9 | 7.8 | 8.1 | 7.1 |
| | Conductivity (µmhos/cm) | 305 | | 311 | | 295 | |
| | *Alkalinity (mg CaCO ₃ /L) | 59 | | 10.1 | | 59 | |
| | *Hardness (mg CaCO ₃ /L) | 82 | | 10.1 | | 80 | |
| | *Temperature (°C) | 24.7 | 24.6 | 24.8 | 24.7 | 24.7 | 24.5 |
| 10.7% | pH (S.U.) | 7.74 | 7.69 | 7.87 | 7.48 | 7.76 | 7.11 |
| | DO (mg/L) | 8.0 | 7.6 | 8.0 | 7.8 | 8.1 | 7.0 |
| | Conductivity (µmhos/cm) | 276 | | 314 | | 301 | |
| | *Temperature (°C) | 24.8 | 24.3 | 24.9 | 24.5 | 24.7 | 24.6 |
| 21.4% | pH (S.U.) | 7.73 | 7.68 | 7.86 | 7.48 | 7.77 | 7.12 |
| | DO (mg/L) | 8.1 | 7.7 | 8.1 | 7.8 | 8.2 | 6.8 |
| | Conductivity (µmhos/cm) | 267 | | 291 | | 269 | |
| | *Temperature (°C) | 24.8 | 24.6 | 24.9 | 24.5 | 24.7 | 24.3 |
| 42.8% | pH (S.U.) | 7.71 | 7.65 | 7.84 | 7.48 | 7.72 | 7.12 |
| | DO (mg/L) | 8.1 | 7.7 | 8.2 | 7.8 | 8.2 | 6.7 |
| | Conductivity (µmhos/cm) | 234 | | 250 | | 234 | |
| | *Temperature (°C) | 24.8 | 24.6 | 25.0 | 24.6 | 24.7 | 24.6 |
| 85.6% | pH (S.U.) | 7.64 | 7.62 | 7.80 | 7.44 | 7.65 | 7.12 |
| | DO (mg/L) | 8.1 | 7.8 | 8.2 | 7.9 | 8.3 | 6.7 |
| | Conductivity (µmhos/cm) | 169 | | 179 | | 162 | |
| | *Temperature (°C) | 24.9 | 24.5 | 25.0 | 24.6 | 24.7 | 24.2 |
| 100% | pH (S.U.) | 7.61 | 7.59 | 7.79 | 7.40 | 7.66 | 7.03 |
| | DO (mg/L) | 8.1 | 7.8 | 8.3 | 7.9 | 8.3 | 6.8 |
| | Conductivity (µmhos/cm) | 142 | | 157 | | 137 | |
| | *Alkalinity (mg CaCO ₃ /L) | 54 | | | | 50 | |
| | *Hardness (mg CaCO ₃ /L) | 54 | | | | 52 | |
| | *TR chlorine (mg/L) | <0.10 | | | | <0.10 | |
| | *Temperature (°C) | 25.0 | 24.7 | 25.0 | 24.6 | 24.8 | 24.5 |
| 100% Intake | pH (S.U.) | 7.58 | 7.53 | 7.80 | 7.36 | 7.54 | 6.99 |
| | DO (mg/L) | 8.1 | 7.8 | 8.3 | 8.0 | 8.4 | 6.7 |
| | Conductivity (µmhos/cm) | 142 | | 158 | | 135 | |
| | *Alkalinity (mg CaCO ₃ /L) | 56 | | | | 52 | |
| | *Hardness (mg CaCO ₃ /L) | 58 | | | | 52 | |
| | *TR chlorine (mg/L) | <0.10 | | | | <0.10 | |
| | *Temperature (°C) | 25.0 | 24.7 | 25.1 | 24.3 | 25.0 | 24.6 |
| | | Initial | Final | Initial | Final | Initial | Final |

*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1.

*Alkalinity, hardness and total residual chlorine performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet.

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

Independent Review By:
Kelsey E. Keenan



Species: *Pimephales promelas*

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

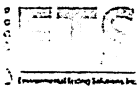
Date: 10-09-18

| Analyst | | Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.) | | | | | | | |
|-----------------------|---------------------------------------|--|-------|---------|-------|----------------|-------|----------------|-------|
| | | 3 | | 4 | | 5 | | 6 | |
| | | W | BSC | BSC | TS | TS | MS | MS | TS |
| Concentration | Parameter | | | | | | | | |
| CONTROL UV-treated | pH (S.U.) | 7.69 | 7.13 | 7.61 | 7.42 | 7.70 | 7.26 | 7.46 | 7.18 |
| | DO (mg/L) | 7.8 | 8.1 | 8.0 | 8.1 | 8.0 | 7.6 | 7.9 | 8.0 |
| | Conductivity (µmhos/cm) | 309 | | 295 | | 318 | | 317 | |
| | *Alkalinity (mg CaCO ₃ /L) | 108 | | 59 | | 108 | | 108 | |
| | *Hardness (mg CaCO ₃ /L) | 108 | | 80 | | 108 | | 108 | |
| | *Temperature (°C) | 24.8 | 24.6 | 24.7 | 24.5 | 24.8 | 24.6 | 24.7 | 24.4 |
| 10.7% | pH (S.U.) | 7.69 | 7.09 | 7.60 | 7.37 | 7.67 | 7.25 | 7.48 | 7.14 |
| | DO (mg/L) | 7.9 | 7.8 | 8.1 | 8.1 | 8.0 | 7.7 | 7.9 | 8.1 |
| | Conductivity (µmhos/cm) | 292 | | 280 | | 298 | | 300 | |
| | *Temperature (°C) | 24.9 | 24.5 | 24.8 | 24.5 | 24.8 | 24.4 | 24.7 | 24.4 |
| 21.4% | pH (S.U.) | 7.69 | 7.09 | 7.59 | 7.38 | 7.64 | 7.27 | 7.48 | 7.09 |
| | DO (mg/L) | 7.9 | 7.7 | 8.1 | 8.1 | 8.1 | 7.8 | 8.0 | 8.1 |
| | Conductivity (µmhos/cm) | 277 | | 264 | | 281 | | 274 | |
| | *Temperature (°C) | 24.9 | 24.5 | 24.8 | 24.3 | 24.8 | 24.4 | 24.7 | 24.5 |
| 42.8% | pH (S.U.) | 7.60 | 7.06 | 7.55 | 7.37 | 7.61 | 7.25 | 7.48 | 7.07 |
| | DO (mg/L) | 8.0 | 7.9 | 8.1 | 8.2 | 8.1 | 7.8 | 8.0 | 8.2 |
| | Conductivity (µmhos/cm) | 244 | | 231 | | 248 | | 242 | |
| | *Temperature (°C) | 24.9 | 24.5 | 24.8 | 24.3 | 24.8 | 24.5 | 24.8 | 24.3 |
| 85.6% | pH (S.U.) | 7.64 | 7.11 | 7.49 | 7.35 | 7.56 | 7.27 | 7.46 | 6.97 |
| | DO (mg/L) | 8.0 | 7.7 | 8.1 | 8.2 | 8.2 | 7.8 | 8.1 | 8.2 |
| | Conductivity (µmhos/cm) | 171 | | 166 | | 178 | | 167 | |
| | *Temperature (°C) | 25.0 | 24.4 | 24.8 | 24.3 | 24.8 | 24.7 | 24.8 | 24.6 |
| 100% | pH (S.U.) | 7.61 | 7.06 | 7.46 | 7.27 | 7.53 | 7.18 | 7.44 | 6.96 |
| | DO (mg/L) | 8.1 | 7.6 | 8.1 | 8.2 | 8.2 | 7.8 | 8.1 | 8.2 |
| | Conductivity (µmhos/cm) | 145 | | 140 | | 160 | | 153 | |
| | *Alkalinity (mg CaCO ₃ /L) | | | 54 | | | | | |
| | *Hardness (mg CaCO ₃ /L) | | | 54 | | | | | |
| | *TR chlorine (mg/L) | | | <0.10 | | | | | |
| 100% Intake | *Temperature (°C) | 25.0 | 24.2 | 24.9 | 24.2 | 24.8 | 24.3 | 24.9 | 24.5 |
| | pH (S.U.) | 7.61 | 6.96 | 7.43 | 7.28 | 7.49 | 7.13 | 7.43 | 6.92 |
| | DO (mg/L) | 8.2 | 7.6 | 8.0 | 8.3 | 8.2 | 7.9 | 8.1 | 8.2 |
| | Conductivity (µmhos/cm) | 142 | | 135 | | 148 | | 142 | |
| | *Alkalinity (mg CaCO ₃ /L) | | | 52 | | | | | |
| | *Hardness (mg CaCO ₃ /L) | | | 54 | | | | | |
| | *TR chlorine (mg/L) | | | <0.10 | | | | | |
| *Temperature (°C) | 25.1 | 24.5 | 25.0 | 24.4 | 24.7 | 24.7 | 24.8 | 24.6 | |
| | | Initial | Final | Initial | Final | Initial | Final | Initial | Final |

*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1.

*Alkalinity, hardness and total residual chlorine performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet. Total residual chlorine was performed on non-treated Outfall 101 and Intake samples.

Independent Review by
Kelley E. Dignan:
K



Species: Pimephales promelas
 Client: TVA / Sequoyah Nuclear Plant, Outfall 101, ~~100-16~~ ^{NON-TREATED} ~~100-16~~ ¹⁰⁰⁻¹⁶

Date: 10-09-18

Daily Chemistry:

| | | Day | | | | | |
|---------------------|---------------------------------------|---|-------|-------------------|-------|---------|-------|
| | | (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.) | | | | | |
| | | 0 | | 1 | | 2 | |
| Analyst | | MS | MS | MS | TS | TS | M |
| Concentration | Parameter | | | | | | |
| Control Non-treated | pH (S.U.) | 7.69 | 7.70 | 7.75 | 7.52 | 7.59 | 7.17 |
| | DO (mg/L) | 7.7 | 7.8 | 7.8 | 7.9 | P.O | 6.6 |
| | Conductivity (umhos/cm) | 319 | | 316 | | 302 | |
| | *Alkalinity (mg CaCO ₃ /L) | 60 | | 100-16 | | 59 | |
| | *Hardness (mg CaCO ₃ /L) | 84 | | 100-16 | | 80 | |
| | *Temperature (°C) | 24.6 | 24.4 | 24.7 | 24.4 | 24.6 | 24.3 |
| | | Initial | Final | Initial | Final | Initial | Final |

| | | Day | | | | | | | |
|---------------------|---------------------------------------|---|-------|-----------|-------|-------------------|-------|-------------------|-------|
| | | (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.) | | | | | | | |
| | | 3 | | 4 | | 5 | | 6 | |
| Analyst | | M | BSL | TS | TS | MS | MS | TS | |
| Concentration | Parameter | | | | | | | | |
| Control Non-treated | pH (S.U.) | 7.61 | 7.10 | 7.50 | 7.39 | 7.70 | 7.28 | 7.49 | 7.06 |
| | DO (mg/L) | 7.7 | 7.5 | 7.8 | 7.9 | 7.7 | 7.7 | 7.7 | 7.9 |
| | Conductivity (umhos/cm) | 300 | | 298 (297) | | 313 | | 313 | |
| | *Alkalinity (mg CaCO ₃ /L) | 100-16 | | 58 | | 100-16 | | 100-16 | |
| | *Hardness (mg CaCO ₃ /L) | 100-16 | | 80 | | 100-16 | | 100-16 | |
| | *Temperature (°C) | 24.7 | 24.5 | 24.6 | 24.5 | 24.7 | 24.4 | 24.7 | 24.3 |
| | | Initial | Final | Initial | Final | Initial | Final | Initial | Final |

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





TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated
October 09-16, 2018

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

Daily Chemical Analyses

Project number: 13633

| Concentration | Parameter | Day 0 | | Day 1 | | Day 2 | | Day 3 | | Day 4 | | Day 5 | | Day 6 | |
|----------------------|--------------------------------------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|
| | | Initial | Final | Initial | Final | Initial | Final | Initial | Final | Initial | Final | Initial | Final | Initial | Final |
| Control, Non-treated | pH (SU) | 7.69 | 7.70 | 7.75 | 7.52 | 7.59 | 7.17 | 7.61 | 7.10 | 7.50 | 7.39 | 7.70 | 7.28 | 7.49 | 7.06 |
| | DO (mg/L) | 7.7 | 7.8 | 7.8 | 7.9 | 8.0 | 6.6 | 7.7 | 7.5 | 7.8 | 7.9 | 7.7 | 7.7 | 7.7 | 7.9 |
| | Conductivity (µmhos/cm) | 319 | | 316 | | 302 | | 300 | | 297 | | 313 | | 313 | |
| | Alkalinity (mg/L CaCO ₃) | 60 | | | | 59 | | | | 58 | | | | | |
| | Hardness (mg/L CaCO ₃) | 84 | | | | 80 | | | | 80 | | | | | |
| | Temperature (°C) | 24.6 | 24.4 | 24.7 | 24.4 | 24.6 | 24.3 | 24.7 | 24.5 | 24.6 | 24.5 | 24.7 | 24.4 | 24.7 | 24.3 |
| Control, UV-treated | pH (SU) | 7.79 | 7.71 | 7.87 | 7.50 | 7.81 | 7.15 | 7.69 | 7.13 | 7.61 | 7.42 | 7.70 | 7.26 | 7.46 | 7.18 |
| | DO (mg/L) | 7.9 | 7.6 | 7.9 | 7.8 | 8.1 | 7.1 | 7.8 | 8.1 | 8.0 | 8.1 | 8.0 | 7.6 | 7.9 | 8.0 |
| | Conductivity (µmhos/cm) | 305 | | 311 | | 295 | | 309 | | 295 | | 318 | | 317 | |
| | Alkalinity (mg/L CaCO ₃) | 59 | | | | 59 | | | | 59 | | | | | |
| | Hardness (mg/L CaCO ₃) | 82 | | | | 80 | | | | 80 | | | | | |
| | Temperature (°C) | 24.7 | 24.6 | 24.8 | 24.7 | 24.7 | 24.5 | 24.8 | 24.6 | 24.7 | 24.5 | 24.8 | 24.6 | 24.7 | 24.4 |
| 10.7% | pH (SU) | 7.74 | 7.69 | 7.87 | 7.48 | 7.76 | 7.11 | 7.69 | 7.09 | 7.60 | 7.37 | 7.67 | 7.25 | 7.48 | 7.14 |
| | DO (mg/L) | 8.0 | 7.6 | 8.0 | 7.8 | 8.1 | 7.0 | 7.9 | 7.8 | 8.1 | 8.1 | 8.0 | 7.7 | 7.9 | 8.1 |
| | Conductivity (µmhos/cm) | 276 | | 314 | | 301 | | 292 | | 280 | | 298 | | 300 | |
| | Temperature (°C) | 24.8 | 24.3 | 24.9 | 24.5 | 24.7 | 24.6 | 24.9 | 24.5 | 24.8 | 24.5 | 24.8 | 24.4 | 24.7 | 24.4 |
| 21.4% | pH (SU) | 7.73 | 7.68 | 7.86 | 7.48 | 7.77 | 7.12 | 7.69 | 7.06 | 7.59 | 7.38 | 7.64 | 7.27 | 7.48 | 7.09 |
| | DO (mg/L) | 8.1 | 7.7 | 8.1 | 7.8 | 8.2 | 6.8 | 7.9 | 7.7 | 8.1 | 8.1 | 8.1 | 7.8 | 8.0 | 8.1 |
| | Conductivity (µmhos/cm) | 267 | | 291 | | 269 | | 277 | | 264 | | 281 | | 274 | |
| | Temperature (°C) | 24.8 | 24.6 | 24.9 | 24.5 | 24.7 | 24.3 | 24.9 | 24.5 | 24.8 | 24.3 | 24.8 | 24.4 | 24.7 | 24.5 |
| 42.8% | pH (SU) | 7.71 | 7.65 | 7.84 | 7.48 | 7.72 | 7.12 | 7.68 | 7.06 | 7.55 | 7.37 | 7.61 | 7.25 | 7.48 | 7.07 |
| | DO (mg/L) | 8.1 | 7.7 | 8.2 | 7.8 | 8.2 | 6.7 | 8.0 | 7.8 | 8.1 | 8.2 | 8.1 | 7.8 | 8.0 | 8.2 |
| | Conductivity (µmhos/cm) | 234 | | 250 | | 234 | | 244 | | 231 | | 248 | | 242 | |
| | Temperature (°C) | 24.8 | 24.6 | 25.0 | 24.6 | 24.7 | 24.6 | 24.9 | 24.5 | 24.8 | 24.3 | 24.8 | 24.5 | 24.8 | 24.3 |
| 85.6% | pH (SU) | 7.64 | 7.62 | 7.80 | 7.44 | 7.65 | 7.12 | 7.64 | 7.11 | 7.49 | 7.35 | 7.56 | 7.27 | 7.46 | 6.97 |
| | DO (mg/L) | 8.1 | 7.8 | 8.2 | 7.9 | 8.3 | 6.7 | 8.0 | 7.7 | 8.1 | 8.2 | 8.2 | 7.8 | 8.1 | 8.2 |
| | Conductivity (µmhos/cm) | 169 | | 179 | | 162 | | 171 | | 166 | | 178 | | 167 | |
| | Temperature (°C) | 24.9 | 24.5 | 25.0 | 24.6 | 24.7 | 24.2 | 25.0 | 24.4 | 24.8 | 24.3 | 24.8 | 24.7 | 24.8 | 24.6 |
| 100% | pH (SU) | 7.61 | 7.59 | 7.79 | 7.40 | 7.60 | 7.03 | 7.61 | 7.06 | 7.46 | 7.27 | 7.53 | 7.18 | 7.44 | 6.96 |
| | DO (mg/L) | 8.1 | 7.8 | 8.3 | 7.9 | 8.3 | 6.8 | 8.1 | 7.6 | 8.1 | 8.2 | 8.2 | 7.8 | 8.1 | 8.2 |
| | Conductivity (µmhos/cm) | 142 | | 157 | | 137 | | 145 | | 146 | | 160 | | 153 | |
| | Alkalinity (mg/L CaCO ₃) | 54 | | | | 50 | | | | 54 | | | | | |
| | Hardness (mg/L CaCO ₃) | 54 | | | | 52 | | | | 54 | | | | | |
| | *Total Residual Chlorine (mg/L) | <0.10 | | | | <0.10 | | | | <0.10 | | | | | |
| | Temperature (°C) | 25.0 | 24.7 | 25.0 | 24.6 | 24.8 | 24.5 | 25.0 | 24.2 | 24.9 | 24.2 | 24.8 | 24.3 | 24.9 | 24.5 |
| 100% Intake | pH (SU) | 7.58 | 7.53 | 7.80 | 7.36 | 7.54 | 6.99 | 7.61 | 6.96 | 7.43 | 7.28 | 7.49 | 7.13 | 7.43 | 6.92 |
| | DO (mg/L) | 8.1 | 7.8 | 8.3 | 8.0 | 8.4 | 6.7 | 8.2 | 7.6 | 8.0 | 8.3 | 8.2 | 7.9 | 8.1 | 8.2 |
| | Conductivity (µmhos/cm) | 142 | | 158 | | 135 | | 142 | | 135 | | 148 | | 142 | |
| | Alkalinity (mg/L CaCO ₃) | 56 | | | | 52 | | | | 52 | | | | | |
| | Hardness (mg/L CaCO ₃) | 58 | | | | 52 | | | | 54 | | | | | |
| | *Total Residual Chlorine (mg/L) | <0.10 | | | | <0.10 | | | | <0.10 | | | | | |
| Temperature (°C) | 25.0 | 24.7 | 25.1 | 24.3 | 25.0 | 24.6 | 25.1 | 24.5 | 25.0 | 24.4 | 24.7 | 24.7 | 24.8 | 24.6 | |

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

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 #: 13633

County: Hamilton
Outfall: 101

| <i>Dilution preparation information:</i> | | | | | | <i>Comments:</i> |
|--|--------|------|------|------|------|------------------|
| Dilution prep (%) | 10.7 | 21.4 | 42.8 | 85.6 | 100 | |
| Effluent volume (mL) | 267.5 | 535 | 1070 | 2140 | 2500 | |
| Diluent volume (mL) | 2232.5 | 1965 | 1430 | 360 | 0 | |
| Total volume (mL) | 2500 | 2500 | 2500 | 2500 | 2500 | |

| <i>Test organism source information:</i> | | | | | | | | | | <i>Test information:</i> | |
|---|--|--|--|--|--|--|--|--|--|---|--|
| Organism age: | | | | | | | | | | < 24-hours old | |
| Date and times organisms were born between: | | | | | | | | | | 10-09-18 0615 to 0935 | |
| Culture board: | | | | | | | | | | 10-02-18 A 10-02-18 B | |
| Replicate number: | | | | | | | | | | 1 2 3 4 5 6 7 8 9 10 | |
| Culture board cup number: | | | | | | | | | | 3 4 5 8 12 14 18 20 25 29 | |
| Transfer vessel information: | | | | | | | | | | pH = 7.85 S.U. Temperature = 24.9 °C | |
| Average transfer volume (mL): | | | | | | | | | | < 0.25 mL | |
| | | | | | | | | | | Randomizing template color: <u>ORANGE</u> | |
| | | | | | | | | | | Incubator number and shelf location: <u>2C3</u> | |
| | | | | | | | | | | YWT batch: <u>10-01-18</u> | |
| | | | | | | | | | | Selenastrum batch: <u>10-01-18</u> | |

Daily renewal information:

| Day | Date | Test initiation and feeding, renewal and feeding, or termination time | MHSW batch used | Sample numbers used | | Analyst |
|-----|----------|---|-----------------|---------------------|-----------|---------|
| | | | | Outfall 101 | Intake | |
| 0 | 10-09-18 | 1010 | 10-03-18 | 181008-02 | 181008-03 | J |
| 1 | 10-10-18 | 0923 | 10-03-18 | 181008-02 | 181008-03 | J |
| 2 | 10-11-18 | 0925 | 10-07-18 | 181010-31 | 181010-32 | J |
| 3 | 10-12-18 | 0915 | 10-07-18 | 181010-31 | 181010-32 | J |
| 4 | 10-13-18 | 0958 | 10-11-18 A | 181012-23 | 181012-24 | J |
| 5 | 10-14-18 | 0913 | 10-11-18 A | 181012-23 | 181012-24 | J |
| 6 | 10-15-18 | 0911 | 10-11-18 A | 181012-23 | 181012-24 | J |
| 7 | 10-16-18 | 0920 | | | | J |

| <i>Control information:</i> | | | | <i>Summary of test endpoints:</i> | |
|---|-----------|-----------|-------------------------|-----------------------------------|---------|
| | Control-1 | Control-2 | Acceptance criteria | | |
| % of Male Adults: | 07. | 07. | ≤ 20% | 7-day LC ₅₀ | > 1007. |
| % Adults having 3 rd Broods: | 1007. | 1007. | ≥ 60% surviving adults | NOEC | 1007. |
| % Mortality: | 07. | 07. | ≤ 20% | LOEC | > 1007. |
| Mean Offspring/Female: | 30.4 | 29.2 | ≥ 15.0 offspring/female | ChV | > 1007. |
| % CV: | 8.27. | 5.57. | < 42.0 % | IC ₂₅ | > 1007. |



Species: *Ceriodaphnia dubia*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 10-09-18

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 | 5 | 5 | 5 | 3 | 4 | 5 | 4 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 11 | 13 | 13 | 10 | 10 | 12 | 10 | 12 | 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 | 14 | 14 | 17 | 13 | 12 | 15 | 14 | 15 | 18 | 15 |
| Total young produced | | 29 | 31 | 34 | 28 | 27 | 32 | 27 | 31 | 33 | 32 |
| Final Adult Mortality | | L | L | L | L | L | L | L | L | L | L |
| X for 3 rd Broods | | X | X | X | X | X | X | X | X | X | X |

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

| | |
|------------------------|------|
| Concentration: | |
| % Mortality: | 07. |
| Mean Offspring/Female: | 30.4 |

CONC: 10.7%

Survival and Reproduction Data

| Day | | Replicate number | | | | | | | | | |
|-----------------------|-----------------|------------------|----|----|----|----|----|----|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 2 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 3 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 4 | Young produced | 4 | 5 | 4 | 4 | 5 | 4 | 6 | 5 | 5 | 5 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 12 | 13 | 13 | 11 | 10 | 13 | 13 | 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 | 15 | 18 | 18 | 15 | 20 | 17 | 15 | 20 | 21 |
| Total young produced | | 32 | 33 | 35 | 33 | 30 | 37 | 36 | 30 | 37 | 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: | 07. |
| Mean Offspring/Female: | 34.1 |
| % Reduction from Control-1: | -12.27. |



Species: Ceriodaphnia dubia

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 10-09-18

CONC: 21.4%

Survival and Reproduction Data

| Day | | Replicate number | | | | | | | | | |
|-----------------------|-----------------|------------------|----|----|----|----|----|----|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 2 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 3 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 4 | Young produced | 4 | 4 | 6 | 5 | 5 | 4 | 6 | 4 | 5 | 4 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 12 | 12 | 13 | 10 | 12 | 11 | 12 | 13 | 13 | 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 | 17 | 18 | 20 | 20 | 18 | 19 | 18 | 18 | 21 | 19 |
| Total young produced | | 33 | 34 | 39 | 35 | 35 | 34 | 36 | 35 | 39 | 33 |
| Final Adult Mortality | | L | L | L | L | L | L | L | L | L | L |

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

| | |
|-----------------------------|---------|
| Concentration: | |
| % Mortality: | 07. |
| Mean Offspring/Female: | 35.3 |
| % Reduction from Control-1: | -16.17. |

CONC: 42.8%

Survival and Reproduction Data

| Day | | Replicate number | | | | | | | | | |
|-----------------------|-----------------|------------------|----|----|----|----|----|----|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 2 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 3 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 4 | Young produced | 4 | 4 | 6 | 6 | 4 | 4 | 5 | 5 | 6 | 5 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 14 | 12 | 13 | 13 | 13 | 11 | 13 | 14 | 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 | 17 | 17 | 21 | 20 | 17 | 16 | 21 | 19 | 21 | 20 |
| Total young produced | | 35 | 33 | 40 | 39 | 34 | 31 | 39 | 38 | 40 | 36 |
| Final Adult Mortality | | L | L | L | L | L | L | L | L | L | L |

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

| | |
|-----------------------------|---------|
| Concentration: | |
| % Mortality: | 07. |
| Mean Offspring/Female: | 36.5 |
| % Reduction from Control-1: | -20.17. |



Species: Ceriodaphnia dubia

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 10-09-18

CONC: 85.6%

Survival and Reproduction Data

| Day | | Replicate number | | | | | | | | | |
|-----------------------|-----------------|------------------|----|----|----|----|----|----|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 2 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 3 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 4 | Young produced | 5 | 5 | 6 | 5 | 7 | 4 | 4 | 5 | 5 | 5 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 12 | 14 | 13 | 14 | 12 | 13 | 13 | 14 | 12 | 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 | 18 | 17 | 22 | 18 | 21 | 17 | 20 | 22 | 20 | 19 |
| Total young produced | | 35 | 36 | 41 | 37 | 40 | 34 | 31 | 41 | 37 | 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: | 07. |
| Mean Offspring/Female: | 31.6 |
| % Reduction from Control-1: | -23.77. |

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 | 5 | 6 | 6 | 5 | 4 | 6 | 5 | 5 | 7 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 14 | 13 | 14 | 14 | 15 | 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 | 19 | 19 | 21 | 19 | 21 | 21 | 20 | 20 | 22 | 18 |
| Total young produced | | 38 | 37 | 41 | 39 | 41 | 37 | 40 | 37 | 39 | 37 |
| Final Adult Mortality | | L | L | L | L | L | L | L | L | L | L |

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

| Concentration: | |
|-----------------------------|---------|
| % Mortality: | 07. |
| Mean Offspring/Female: | 38.6 |
| % Reduction from Control-1: | -27.07. |



Species: *Ceriodaphnia dubia*

Client: TVA / Sequovah Nuclear Plant, Outfall 101

Date: 10-09-18

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 | 3 | 5 | 5 | 5 | 3 | 3 | 6 | 4 | 4 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 10 | 10 | 12 | 10 | 13 | 11 | 10 | 12 | 10 | 11 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 6 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 7 | Young produced | 16 | 14 | 14 | 12 | 14 | 16 | 15 | 11 | 15 | 14 |
| Total young produced | | 30 | 21 | 31 | 21 | 32 | 30 | 28 | 29 | 29 | 29 |
| Final Adult Mortality | | L | L | L | L | L | L | L | L | L | L |
| X for 3 rd Broods | | X | X | X | X | X | X | X | X | X | X |

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

| | |
|------------------------|------|
| Concentration: | |
| % Mortality: | 07. |
| Mean Offspring/Female: | 29.2 |

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 | 6 | 5 | 4 | 6 | 7 | 4 | 4 | 5 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 13 | 12 | 12 | 11 | 12 | 13 | 10 | 13 | 12 | 13 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 6 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 7 | Young produced | 19 | 20 | 18 | 18 | 21 | 19 | 21 | 17 | 19 | 17 |
| Total young produced | | 37 | 38 | 36 | 34 | 37 | 38 | 38 | 34 | 35 | 35 |
| Final Adult Mortality | | L | L | L | L | L | L | L | L | L | L |

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

| | |
|-----------------------------|---------|
| Concentration: | |
| % Mortality: | 07. |
| Mean Offspring/Female: | 36.2 |
| % Reduction from Control-2: | -24.07. |



Verification of *Ceriodaphnia* Reproduction Totals



Environmental Testing Solutions, Inc.



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 | 5 | 5 | 3 | 4 | 5 | 4 | 4 | 43 |
| 5 | 11 | 13 | 13 | 10 | 10 | 12 | 10 | 12 | 10 | 13 | 114 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 14 | 14 | 17 | 13 | 12 | 15 | 14 | 15 | 18 | 15 | 147 |
| Total | 29 | 31 | 34 | 28 | 27 | 32 | 27 | 31 | 33 | 32 | 304 |

85.6%

| Day | Replicate number | | | | | | | | | | Total |
|--------------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 5 | 5 | 6 | 5 | 7 | 4 | 4 | 5 | 5 | 5 | 51 |
| 5 | 12 | 14 | 13 | 14 | 12 | 13 | 13 | 14 | 12 | 14 | 131 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 18 | 17 | 22 | 18 | 21 | 17 | 20 | 22 | 20 | 19 | 194 |
| Total | 35 | 36 | 41 | 37 | 40 | 34 | 37 | 41 | 37 | 38 | 376 |

10.7%

| Day | Replicate number | | | | | | | | | | Total |
|--------------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 4 | 5 | 4 | 4 | 5 | 4 | 6 | 5 | 5 | 5 | 47 |
| 5 | 12 | 13 | 13 | 11 | 10 | 15 | 13 | 10 | 12 | 12 | 119 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 16 | 15 | 18 | 18 | 15 | 20 | 17 | 15 | 20 | 21 | 175 |
| Total | 32 | 33 | 35 | 33 | 30 | 37 | 36 | 30 | 37 | 38 | 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 | 5 | 6 | 6 | 5 | 4 | 6 | 5 | 5 | 7 | 54 |
| 5 | 14 | 15 | 14 | 14 | 15 | 12 | 14 | 12 | 12 | 12 | 132 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 19 | 19 | 21 | 19 | 21 | 21 | 20 | 20 | 22 | 18 | 200 |
| Total | 38 | 37 | 41 | 39 | 41 | 37 | 40 | 37 | 39 | 37 | 386 |

21.4%

| Day | Replicate number | | | | | | | | | | Total |
|--------------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 4 | 4 | 6 | 5 | 5 | 4 | 6 | 4 | 5 | 4 | 47 |
| 5 | 12 | 12 | 13 | 10 | 12 | 11 | 12 | 13 | 13 | 10 | 118 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 17 | 18 | 20 | 20 | 18 | 19 | 18 | 18 | 21 | 19 | 188 |
| Total | 33 | 34 | 39 | 35 | 35 | 34 | 36 | 35 | 39 | 33 | 353 |

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 | 3 | 5 | 5 | 5 | 3 | 3 | 6 | 4 | 4 | 42 |
| 5 | 10 | 10 | 12 | 10 | 13 | 11 | 10 | 12 | 10 | 11 | 109 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 16 | 14 | 14 | 14 | 12 | 14 | 16 | 15 | 11 | 14 | 141 |
| Total | 30 | 27 | 31 | 27 | 32 | 30 | 28 | 29 | 29 | 29 | 292 |

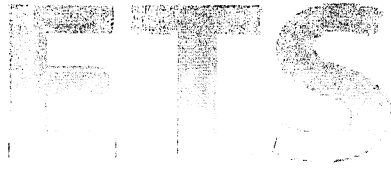
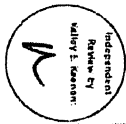
42.8%

| Day | Replicate number | | | | | | | | | | Total |
|--------------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 4 | 4 | 6 | 6 | 4 | 4 | 5 | 5 | 6 | 5 | 49 |
| 5 | 14 | 12 | 13 | 15 | 13 | 11 | 13 | 14 | 13 | 11 | 127 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 17 | 17 | 21 | 20 | 17 | 16 | 21 | 19 | 21 | 20 | 189 |
| Total | 35 | 33 | 40 | 39 | 34 | 31 | 39 | 38 | 40 | 36 | 365 |

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 | 6 | 5 | 4 | 6 | 7 | 4 | 4 | 5 | 52 |
| 5 | 13 | 12 | 12 | 11 | 12 | 13 | 10 | 13 | 12 | 13 | 121 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 19 | 20 | 18 | 18 | 21 | 19 | 21 | 17 | 19 | 17 | 189 |
| Total | 37 | 38 | 36 | 34 | 37 | 38 | 34 | 35 | 35 | 35 | 362 |

Reviewed by
 Kelley L. Keenan



Environmental Testing Solutions, Inc.

TVA / Sequoyah Nuclear Plant, Outfall 101

October 09-16, 2018

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

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

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

Quality Control

Verification of Data Entry, Calculations, and Statistical Analyses

Project number: 13633

| 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 | 29 | 31 | 34 | 28 | 27 | 32 | 27 | 31 | 33 | 32 | 100 | 30.4 | 8.2 | Not applicable |
| 10.7% | 32 | 33 | 35 | 33 | 30 | 37 | 36 | 30 | 37 | 38 | 100 | 34.1 | 8.6 | -12.2 |
| 21.4% | 33 | 34 | 39 | 35 | 35 | 34 | 36 | 35 | 39 | 33 | 100 | 35.3 | 6.1 | -16.1 |
| 42.8% | 35 | 33 | 40 | 39 | 34 | 31 | 39 | 38 | 40 | 36 | 100 | 36.5 | 8.7 | -20.1 |
| 85.6% | 35 | 36 | 41 | 37 | 40 | 34 | 37 | 41 | 37 | 38 | 100 | 37.6 | 6.4 | -23.7 |
| 100% | 38 | 37 | 41 | 39 | 41 | 37 | 40 | 37 | 39 | 37 | 100 | 38.6 | 4.3 | -27.0 |
| Control - 2 | 30 | 27 | 31 | 27 | 32 | 30 | 28 | 29 | 29 | 29 | 100 | 29.2 | 5.5 | Not applicable |
| 100% Intake | 37 | 38 | 36 | 34 | 37 | 38 | 38 | 34 | 35 | 35 | 100 | 36.2 | 4.5 | -24.0 |

Outfall 101:

Dunnett's MSD value: 2.576
 PMSD: 8.5

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.

Intake:

Dunnett's MSD value: 1.256
 PMSD: 4.3

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

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

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



TVA / Sequoyah Nuclear Plant, Outfall 101
October 09-16, 2018



Statistical Analyses

Environmental Testing Solutions, Inc.

| Ceriodaphnia Survival and Reproduction Test-Reproduction | | | | | |
|--|--------------|-----------|-------------------------|---------------|---------------------------------|
| Start Date: | 10/9/2018 | Test ID: | CdFRCR | Sample ID: | TVA / SQN 101 |
| End Date: | 10/16/2018 | Lab ID: | ETS-Envir. Testing Sol. | Sample Type: | DMR-Discharge Monitoring Report |
| Sample Date: | October 2018 | Protocol: | FWCHR-EPA-821-R-02-013 | Test Species: | CD-Ceriodaphnia dubia |
| Comments: | Non-treated | | | | |

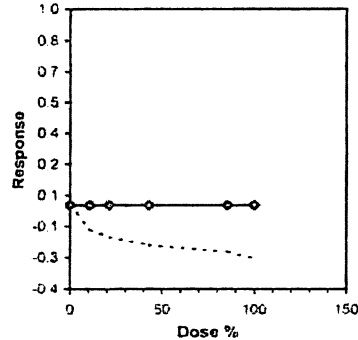
| Conc-% | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Control-1 | 29.000 | 31.000 | 34.000 | 28.000 | 27.000 | 32.000 | 27.000 | 31.000 | 33.000 | 32.000 |
| Control-2 | 30.000 | 27.000 | 31.000 | 27.000 | 32.000 | 30.000 | 28.000 | 29.000 | 29.000 | 29.000 |
| 10.7 | 32.000 | 33.000 | 35.000 | 33.000 | 30.000 | 37.000 | 36.000 | 30.000 | 37.000 | 38.000 |
| 21.4 | 33.000 | 34.000 | 39.000 | 35.000 | 35.000 | 34.000 | 36.000 | 35.000 | 39.000 | 33.000 |
| 42.8 | 35.000 | 33.000 | 40.000 | 39.000 | 34.000 | 31.000 | 39.000 | 38.000 | 40.000 | 36.000 |
| 85.6 | 35.000 | 36.000 | 41.000 | 37.000 | 40.000 | 34.000 | 37.000 | 41.000 | 37.000 | 38.000 |
| 100 | 38.000 | 37.000 | 41.000 | 39.000 | 41.000 | 37.000 | 40.000 | 37.000 | 39.000 | 37.000 |
| Intake | 37.000 | 38.000 | 36.000 | 34.000 | 37.000 | 38.000 | 38.000 | 34.000 | 35.000 | 35.000 |

| Conc-% | Transform: Untransformed | | | | | | | 1-Tailed | | Isotonic | | |
|-----------|--------------------------|--------|--------|--------|--------|-------|----|----------|----------|----------|--------|--------|
| | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD | Mean | N-Mean |
| Control-1 | 30.400 | 1.0411 | 30.400 | 27.000 | 34.000 | 8.235 | 10 | | | | 35.417 | 1.0000 |
| Control-2 | 29.200 | 1.0000 | 29.200 | 27.000 | 32.000 | 5.546 | 10 | | | | | |
| 10.7 | 34.100 | 1.1678 | 34.100 | 30.000 | 38.000 | 8.572 | 10 | -3.284 | 2.287 | 2.576 | 35.417 | 1.0000 |
| 21.4 | 35.300 | 1.2089 | 35.300 | 33.000 | 39.000 | 6.127 | 10 | -4.349 | 2.287 | 2.576 | 35.417 | 1.0000 |
| 42.8 | 36.500 | 1.2500 | 36.500 | 31.000 | 40.000 | 8.688 | 10 | -5.414 | 2.287 | 2.576 | 35.417 | 1.0000 |
| 85.6 | 37.600 | 1.2877 | 37.600 | 34.000 | 41.000 | 6.417 | 10 | -6.391 | 2.287 | 2.576 | 35.417 | 1.0000 |
| 100 | 38.600 | 1.3219 | 38.600 | 37.000 | 41.000 | 4.266 | 10 | -7.278 | 2.287 | 2.576 | 35.417 | 1.0000 |
| Intake | 36.200 | 1.2397 | 36.200 | 34.000 | 38.000 | 4.473 | 10 | | | | | |

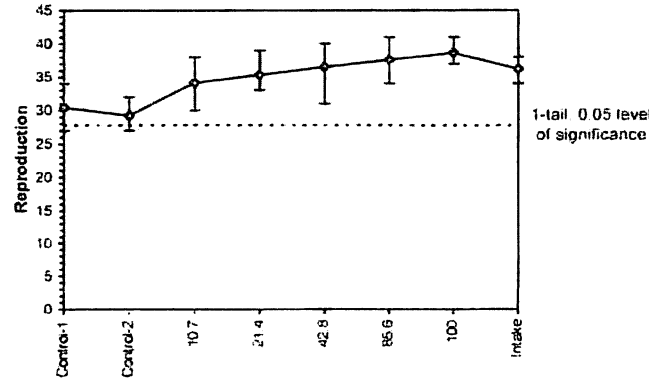
| Auxiliary Tests | Statistic | Critical | Skew | Kurt |
|--|-----------|----------|---------|--------|
| Kolmogorov D Test indicates normal distribution (p > 0.01) | 0.83947 | 1.035 | -0.0678 | -0.905 |
| Bartlett's Test indicates equal variances (p = 0.51) | 4.28526 | 15.0863 | | |
| The control means are not significantly different (p = 0.22) | 1.27279 | 2.10092 | | |

| Hypothesis Test (1-tail, 0.05) | NOEC | LOEC | ChV | TU | MSDu | MSDp | MSE | MSE | F-Prob | df |
|--------------------------------|------|------|-----|----|---------|---------|---------|--------|---------|-------|
| Dunnell's Test | 100 | >100 | | 1 | 2.57619 | 0.08474 | 85.9767 | 6.3463 | 1.4E-08 | 5, 54 |

| Linear Interpolation (200 Resamples) | | | | |
|--------------------------------------|------|----|--------|------|
| Point | % | SD | 95% CL | Skew |
| IC05 | >100 | | | |
| IC10 | >100 | | | |
| IC15 | >100 | | | |
| IC20 | >100 | | | |
| IC25 | >100 | | | |
| IC40 | >100 | | | |
| IC50 | >100 | | | |



Dose-Response Plot



Reviewed and
 Analyzed by
 [Signature]



TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake

October 09-16, 2018



Environmental Testing Solutions, Inc.

Statistical Analyses

Ceriodaphnia Survival and Reproduction Test-Reproduction

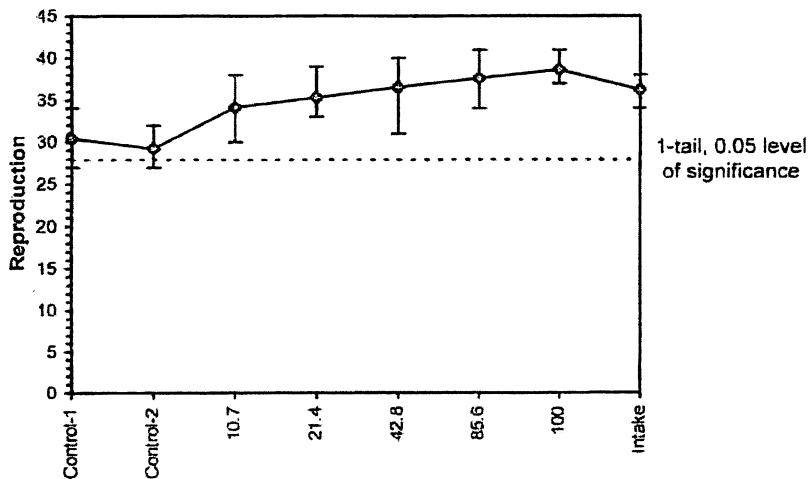
| | | | |
|---------------------------|----------------------------------|--|--|
| Start Date: 10/9/2018 | Test ID: CdFRCR | Sample ID: TVA / SQN 101 - Intake | |
| End Date: 10/16/2018 | Lab ID: ETS-Envir. Testing Sol. | Sample Type: DMR-Discharge Monitoring Report | |
| Sample Date: October 2018 | 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 | 29.000 | 31.000 | 34.000 | 28.000 | 27.000 | 32.000 | 27.000 | 31.000 | 33.000 | 32.000 |
| Control-2 | 30.000 | 27.000 | 31.000 | 27.000 | 32.000 | 30.000 | 28.000 | 29.000 | 29.000 | 29.000 |
| 10.7 | 32.000 | 33.000 | 35.000 | 33.000 | 30.000 | 37.000 | 36.000 | 30.000 | 37.000 | 38.000 |
| 21.4 | 33.000 | 34.000 | 39.000 | 35.000 | 35.000 | 34.000 | 36.000 | 35.000 | 39.000 | 33.000 |
| 42.8 | 35.000 | 33.000 | 40.000 | 39.000 | 34.000 | 31.000 | 39.000 | 38.000 | 40.000 | 36.000 |
| 85.6 | 35.000 | 36.000 | 41.000 | 37.000 | 40.000 | 34.000 | 37.000 | 41.000 | 37.000 | 38.000 |
| 100 | 38.000 | 37.000 | 41.000 | 39.000 | 41.000 | 37.000 | 40.000 | 37.000 | 39.000 | 37.000 |
| Intake | 37.000 | 38.000 | 36.000 | 34.000 | 37.000 | 38.000 | 38.000 | 34.000 | 35.000 | 35.000 |

| Conc-% | Transform: Untransformed | | | | | | | 1-Tailed | | |
|-----------|--------------------------|--------|--------|--------|--------|-------|----|----------|----------|-------|
| | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| Control-1 | 30.400 | 1.0411 | 30.400 | 27.000 | 34.000 | 8.235 | 10 | | | |
| Control-2 | 29.200 | 1.0000 | 29.200 | 27.000 | 32.000 | 5.546 | 10 | | | |
| 10.7 | 34.100 | 1.1678 | 34.100 | 30.000 | 38.000 | 8.572 | 10 | | | |
| 21.4 | 35.300 | 1.2089 | 35.300 | 33.000 | 39.000 | 6.127 | 10 | | | |
| 42.8 | 36.500 | 1.2500 | 36.500 | 31.000 | 40.000 | 8.688 | 10 | | | |
| 85.6 | 37.600 | 1.2877 | 37.600 | 34.000 | 41.000 | 6.417 | 10 | | | |
| 100 | 38.600 | 1.3219 | 38.600 | 37.000 | 41.000 | 4.266 | 10 | | | |
| Intake | 36.200 | 1.2397 | 36.200 | 34.000 | 38.000 | 4.473 | 10 | -9.666 | 1.734 | 1.256 |

| Auxiliary Tests | Statistic | Critical | Skew | Kurt | | |
|--|-----------|----------|---------|---------|---------|-------|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.92285 | 0.868 | -0.0072 | -1.1393 | | |
| F-Test indicates equal variances (p = 1.00) | 1 | 6.54109 | | | | |
| The control means are not significantly different (p = 0.22) | 1.27279 | 2.10092 | | | | |
| Hypothesis Test (1-tail, 0.05) | MSDu | MSDp | MSB | MSE | F-Prob | df |
| Homoscedastic t Test indicates no significant differences | 1.25578 | 0.04301 | 245 | 2.62222 | 1.5E-08 | 1, 18 |
| Treatments vs Control-2 | | | | | | |

Dose-Response Plot



Entered and Reviewed by
Jim Sumner
JS



Species: Ceriodaphnia dubia
 Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 10-09-18

Daily Chemistry:

| Concentration | | Parameter | Day | | | | | |
|-------------------|---------------------------------------|-----------|---|----------------|-------|---------|-------|--|
| | | | (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.) | | | | | |
| | | | 0 | | 1 | | 2 | |
| Analyst | | MS | MS | MS | TS | TS | W | |
| CONTROL | pH (S.U.) | 7.69 | 7.82 | 7.75 | 7.80 | 7.59 | 7.58 | |
| | DO (mg/L) | 7.7 | 7.9 | 7.8 | 7.9 | 7.9 | 7.9 | |
| | Conductivity (µmhos/cm) | 319 | | 316 | | 302 | | |
| | *Alkalinity (mg CaCO ₃ /L) | 60 | | 100 | | 59 | | |
| | *Hardness (mg CaCO ₃ /L) | 84 | | | | 80 | | |
| | *Temperature (°C) | 24.7 | 25.1 | 24.8 | 25.1 | 24.7 | 24.8 | |
| 10.7% | pH (S.U.) | 7.76 | 7.81 | 7.86 | 7.80 | 7.78 | 7.58 | |
| | DO (mg/L) | 7.9 | 8.0 | 7.8 | 7.9 | 7.7 | 8.0 | |
| | Conductivity (µmhos/cm) | 280 | | 308 | | 279 | | |
| | *Temperature (°C) | 24.8 | 25.1 | 24.9 | 25.0 | 24.7 | 24.8 | |
| 21.4% | pH (S.U.) | 7.73 | 7.80 | 7.83 | 7.79 | 7.75 | 7.57 | |
| | DO (mg/L) | 7.9 | 8.1 | 7.9 | 7.9 | 7.7 | 7.9 | |
| | Conductivity (µmhos/cm) | 264 | | 285 | | 262 | | |
| | *Temperature (°C) | 24.8 | 24.9 | 24.9 | 24.8 | 24.7 | 24.8 | |
| 42.8% | pH (S.U.) | 7.69 | 7.79 | 7.81 | 7.79 | 7.69 | 7.58 | |
| | DO (mg/L) | 7.9 | 8.1 | 7.9 | 8.0 | 7.9 | 8.0 | |
| | Conductivity (µmhos/cm) | 234 | | 249 | | 232 | | |
| | *Temperature (°C) | 24.9 | 25.1 | 25.0 | 24.8 | 24.7 | 24.8 | |
| 85.6% | pH (S.U.) | 7.60 | 7.74 | 7.75 | 7.75 | 7.57 | 7.50 | |
| | DO (mg/L) | 8.0 | 8.1 | 8.0 | 8.1 | 7.8 | 8.1 | |
| | Conductivity (µmhos/cm) | 165 | | 173 | | 160 | | |
| | *Temperature (°C) | 24.9 | 25.2 | 25.0 | 25.2 | 24.8 | 25.0 | |
| 100% | pH (S.U.) | 7.55 | 7.73 | 7.73 | 7.74 | 7.51 | 7.48 | |
| | DO (mg/L) | 8.2 | 8.1 | 8.1 | 8.1 | 7.8 | 8.1 | |
| | Conductivity (µmhos/cm) | 139 | | 147 | | 134 | | |
| | *Alkalinity (mg CaCO ₃ /L) | 54 | | | | 50 | | |
| | *Hardness (mg CaCO ₃ /L) | 54 | | | | 50 | | |
| | *TR chlorine (mg/L) | <0.10 | | | | <0.10 | | |
| | *Temperature (°C) | 25.0 | 24.8 | 25.0 | 24.8 | 24.8 | 24.8 | |
| 100% Intake | pH (S.U.) | 7.91 | 7.71 | 7.76 | 7.70 | 7.44 | 7.42 | |
| | DO (mg/L) | 8.2 | 8.3 | 8.3 | 8.2 | 7.8 | 8.0 | |
| | Conductivity (µmhos/cm) | 137 | | 148 | | 134 | | |
| | *Alkalinity (mg CaCO ₃ /L) | 56 | | | | 52 | | |
| | *Hardness (mg CaCO ₃ /L) | 58 | | | | 52 | | |
| | *TR chlorine (mg/L) | <0.10 | | | | <0.10 | | |
| *Temperature (°C) | 25.0 | 25.0 | 25.0 | 25.0 | 24.9 | 24.9 | | |
| | | Initial | Final | Initial | Final | Initial | Final | |

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



Species: *Ceriodaphnia dubia*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 10-09-18

| Concentration | | Parameter | Analyst | Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.) | | | | | | | |
|---------------|---------------------------------------|-----------------|---------|--|-------|-----------------|-------|-----------------|-------|----|-------|
| | | | | 3 | | 4 | | 5 | | 6 | |
| | | | | N | BS | BS | TS | TS | MS | MS | TS MS |
| CONTROL | pH (S.U.) | 7.61 | 7.60 | 7.50 | 7.69 | 7.70 | 7.40 | 7.49 | 7.61 | | |
| | DO (mg/L) | 7.7 | 8.0 | 7.8 | 8.0 | 7.7 | 7.8 | 7.7 | 7.9 | | |
| | Conductivity (µmhos/cm) | 300 | | 287 | | 313 | | 313 | | | |
| | *Alkalinity (mg CaCO ₃ /L) | 10/8 | | 58 | | 10/8 | | 10/8 | | | |
| | *Hardness (mg CaCO ₃ /L) | 10/8 | | 80 | | 10/8 | | 10/8 | | | |
| | *Temperature (°C) | 24.7 | 25.1 | 24.8 | 25.0 | 24.8 | 24.9 | 24.7 | 25.2 | | |
| 10.7% | pH (S.U.) | 7.74 | 7.58 | 7.66 | 7.69 | 7.80 | 7.41 | 7.50 | 7.51 | | |
| | DO (mg/L) | 8.0 | 8.0 | 8.1 | 8.1 | 8.1 | 7.9 | 7.9 | 8.0 | | |
| | Conductivity (µmhos/cm) | 296 | | 282 | | 293 | | 296 | | | |
| | *Temperature (°C) | 24.8 | 24.8 | 24.9 | 24.8 | 24.8 | 24.9 | 24.8 | 24.8 | | |
| 21.4% | pH (S.U.) | 7.75 | 7.59 | 7.62 | 7.68 | 7.77 | 7.42 | 7.48 | 7.48 | | |
| | DO (mg/L) | 8.0 | 8.1 | 8.1 | 8.1 | 8.1 | 8.0 | 7.9 | 8.1 | | |
| | Conductivity (µmhos/cm) | 272 | | 265 | | 279 | | 277 | | | |
| | *Temperature (°C) | 24.8 | 24.8 | 24.9 | 25.1 | 24.8 | 25.1 | 24.8 | 24.8 | | |
| 42.8% | pH (S.U.) | 7.67 | 7.57 | 7.59 | 7.67 | 7.73 | 7.41 | 7.45 | 7.44 | | |
| | DO (mg/L) | 8.1 | 8.0 | 8.1 | 8.1 | 8.2 | 8.0 | 7.9 | 8.1 | | |
| | Conductivity (µmhos/cm) | 240 | | 232 | | 245 | | 242 | | | |
| | *Temperature (°C) | 24.8 | 25.0 | 24.9 | 24.9 | 24.8 | 24.8 | 24.8 | 24.7 | | |
| 85.6% | pH (S.U.) | 7.60 | 7.55 | 7.52 | 7.64 | 7.66 | 7.40 | 7.39 | 7.40 | | |
| | DO (mg/L) | 8.1 | 7.9 | 8.1 | 8.1 | 8.2 | 8.1 | 8.0 | 8.1 | | |
| | Conductivity (µmhos/cm) | 173 | | 169 | | 177 | | 171 | | | |
| | *Temperature (°C) | 24.8 | 24.8 | 24.9 | 24.9 | 24.8 | 25.0 | 24.8 | 25.1 | | |
| 100% | pH (S.U.) | 7.50 | 7.52 | 7.46 | 7.62 | 7.63 | 7.38 | 7.36 | 7.35 | | |
| | DO (mg/L) | 8.2 | 7.8 | 8.1 | 8.2 | 8.2 | 8.1 | 8.1 | 8.2 | | |
| | Conductivity (µmhos/cm) | 145 | | 139 | | 148 | | 144 | | | |
| | *Alkalinity (mg CaCO ₃ /L) | | | 52 | | | | | | | |
| | *Hardness (mg CaCO ₃ /L) | | | 54 | | | | | | | |
| | *TR chlorine (mg/L) | | | <0.10 | | | | | | | |
| | *Temperature (°C) | 25.0 | 24.8 | 25.0 | 24.9 | 24.9 | 25.0 | 24.7 | 24.9 | | |
| 100% Intake | pH (S.U.) | 7.50 | 7.51 | 7.48 | 7.62 | 7.62 | 7.39 | 7.36 | 7.32 | | |
| | DO (mg/L) | 8.1 | 7.8 | 8.1 | 8.2 | 8.2 | 8.1 | 8.1 | 8.2 | | |
| | Conductivity (µmhos/cm) | 142 | | 136 | | 147 | | 141 | | | |
| | *Alkalinity (mg CaCO ₃ /L) | | | 52 | | | | | | | |
| | *Hardness (mg CaCO ₃ /L) | | | 54 | | | | | | | |
| | *TR chlorine (mg/L) | | | <0.10 | | | | | | | |
| | *Temperature (°C) | 24.9 | 24.9 | 24.8 | 24.9 | 24.7 | 24.8 | 24.9 | 25.1 | | |
| | | Initial | Final | Initial | Final | Initial | Final | Initial | Final | | |

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





TVA / Sequoyah Nuclear Plant, Outfall 101, Non-treated
October 09-16, 2018

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

Daily Chemical Analyses

Environmental Testing Solutions, Inc.

Project number: 13633

| 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) | 7.69 | 7.82 | 7.75 | 7.80 | 7.59 | 7.58 | 7.61 | 7.60 | 7.50 | 7.69 | 7.70 | 7.40 | 7.49 | 7.61 |
| | DO (mg/L) | 7.7 | 7.9 | 7.8 | 7.9 | 7.9 | 7.9 | 7.7 | 8.0 | 7.8 | 8.0 | 7.7 | 7.8 | 7.7 | 7.9 |
| | Conductivity (µmhos/cm) | 319 | | 316 | | 302 | | 300 | | 297 | | 313 | | 313 | |
| | Alkalinity (mg/L CaCO ₃) | 60 | | | | 59 | | | | 58 | | | | | |
| | Hardness (mg/L CaCO ₃) | 84 | | | | 80 | | | | 80 | | | | | |
| | Temperature (°C) | 24.7 | 25.1 | 24.8 | 25.1 | 24.7 | 24.8 | 24.7 | 25.1 | 24.8 | 25.0 | 24.8 | 24.9 | 24.7 | 25.2 |
| 10.7% | pH (SU) | 7.76 | 7.81 | 7.86 | 7.80 | 7.78 | 7.58 | 7.74 | 7.58 | 7.66 | 7.69 | 7.80 | 7.41 | 7.50 | 7.51 |
| | DO (mg/L) | 7.9 | 8.0 | 7.8 | 7.9 | 7.7 | 8.0 | 8.0 | 8.0 | 8.1 | 8.1 | 8.1 | 7.9 | 7.9 | 8.0 |
| | Conductivity (µmhos/cm) | 280 | | 308 | | 279 | | 296 | | 282 | | 293 | | 296 | |
| | Temperature (°C) | 24.8 | 25.1 | 24.9 | 25.0 | 24.7 | 24.8 | 24.8 | 24.8 | 24.9 | 24.8 | 24.8 | 24.9 | 24.8 | 24.8 |
| 21.4% | pH (SU) | 7.73 | 7.80 | 7.83 | 7.79 | 7.75 | 7.57 | 7.75 | 7.59 | 7.62 | 7.68 | 7.77 | 7.42 | 7.48 | 7.48 |
| | DO (mg/L) | 7.9 | 8.1 | 7.9 | 7.9 | 7.7 | 7.9 | 8.0 | 8.1 | 8.1 | 8.1 | 8.1 | 8.0 | 7.9 | 8.1 |
| | Conductivity (µmhos/cm) | 264 | | 285 | | 262 | | 272 | | 265 | | 279 | | 277 | |
| | Temperature (°C) | 24.8 | 24.9 | 24.9 | 24.8 | 24.7 | 24.8 | 24.8 | 24.8 | 24.9 | 25.1 | 24.8 | 25.1 | 24.8 | 24.8 |
| 42.8% | pH (SU) | 7.69 | 7.79 | 7.81 | 7.79 | 7.69 | 7.56 | 7.67 | 7.57 | 7.59 | 7.67 | 7.73 | 7.41 | 7.45 | 7.44 |
| | DO (mg/L) | 7.9 | 8.1 | 7.9 | 8.0 | 7.7 | 8.0 | 8.1 | 8.0 | 8.1 | 8.1 | 8.2 | 8.0 | 7.9 | 8.1 |
| | Conductivity (µmhos/cm) | 234 | | 249 | | 232 | | 240 | | 232 | | 245 | | 242 | |
| | Temperature (°C) | 24.9 | 25.1 | 25.0 | 24.8 | 24.7 | 24.8 | 24.8 | 25.0 | 24.9 | 24.9 | 24.8 | 24.8 | 24.8 | 24.7 |
| 85.6% | pH (SU) | 7.60 | 7.74 | 7.75 | 7.75 | 7.57 | 7.50 | 7.60 | 7.55 | 7.52 | 7.64 | 7.66 | 7.40 | 7.39 | 7.40 |
| | DO (mg/L) | 8.0 | 8.1 | 8.0 | 8.1 | 7.8 | 8.1 | 8.1 | 7.9 | 8.1 | 8.1 | 8.2 | 8.1 | 8.0 | 8.1 |
| | Conductivity (µmhos/cm) | 165 | | 173 | | 160 | | 173 | | 169 | | 177 | | 171 | |
| | Temperature (°C) | 24.9 | 25.2 | 25.0 | 25.2 | 24.8 | 25.0 | 24.8 | 24.8 | 24.9 | 24.9 | 24.8 | 25.0 | 24.8 | 25.1 |
| 100% | pH (SU) | 7.55 | 7.73 | 7.73 | 7.74 | 7.51 | 7.48 | 7.56 | 7.52 | 7.46 | 7.62 | 7.63 | 7.38 | 7.36 | 7.35 |
| | DO (mg/L) | 8.2 | 8.1 | 8.1 | 8.1 | 7.8 | 8.1 | 8.2 | 7.8 | 8.1 | 8.2 | 8.2 | 8.1 | 8.1 | 8.2 |
| | Conductivity (µmhos/cm) | 139 | | 147 | | 134 | | 145 | | 139 | | 148 | | 144 | |
| | Alkalinity (mg/L CaCO ₃) | 54 | | | | 50 | | | | 52 | | | | | |
| | Hardness (mg/L CaCO ₃) | 54 | | | | 50 | | | | 54 | | | | | |
| | Total Residual Chlorine (mg/L) | <0.10 | | | | <0.10 | | | | <0.10 | | | | | |
| | Temperature (°C) | 25.0 | 24.8 | 25.0 | 24.8 | 24.8 | 24.8 | 25.0 | 24.8 | 25.0 | 24.9 | 24.9 | 25.0 | 24.7 | 24.9 |
| 100% Intake | pH (SU) | 7.51 | 7.74 | 7.76 | 7.70 | 7.44 | 7.42 | 7.56 | 7.51 | 7.48 | 7.62 | 7.62 | 7.39 | 7.36 | 7.32 |
| | DO (mg/L) | 8.2 | 8.3 | 8.3 | 8.2 | 7.8 | 8.0 | 8.1 | 7.8 | 8.1 | 8.2 | 8.2 | 8.1 | 8.1 | 8.2 |
| | Conductivity (µmhos/cm) | 137 | | 148 | | 134 | | 142 | | 136 | | 147 | | 141 | |
| | Alkalinity (mg/L CaCO ₃) | 56 | | | | 52 | | | | 52 | | | | | |
| | Hardness (mg/L CaCO ₃) | 58 | | | | 52 | | | | 54 | | | | | |
| | Total Residual Chlorine (mg/L) | <0.10 | | | | <0.10 | | | | <0.10 | | | | | |
| | Temperature (°C) | 25.0 | 25.0 | 25.0 | 25.0 | 24.9 | 24.9 | 24.9 | 24.9 | 24.8 | 24.9 | 24.7 | 24.8 | 24.9 | 25.1 |

Total Residual Chlorine (4500-Cl G-2011), Screening Whole Effluent Toxicity Samples

Matrix: Water, RL = 0.10 mg/L

Analyst TS
 Date analyzed 10.09.18

DPD: CHM 1017

Positive and Negative Control:

| Control Type | Sample ID | Result (✓) | |
|------------------|-----------------|------------|----------|
| | | Positive | Negative |
| Negative control | Deionized water | | ✓ |
| Positive control | Tap water | ✓ | |

Sample screening:

| Sample number | Sample ID | Sample characteristics | Result (✓) | |
|-------------------|---------------|--------------------------------|------------|----------|
| | | | Positive | Negative |
| 181008.02 | TVA / SON 101 | light yellow, clear | | ✓ |
| 181008.03 | ↓ INTAKE | light yellow, clear, particles | | ✓ |
| 181008.01 | ANDREWS | light tan, clear, particles | | ✓ |
| 181009.04 | DENN WWTP | no color, clear | | ✓ |
| 181009.05 | FARMVILLE | no color, clear | | ✓ |
| 181009.06 | HAYLET | light tan, clear | | ✓ |
| 181009.02 | CHATTANOOGA | yellow, clear, particles | | ✓ |
| 181009.03 | LAMPLIGHTER | light tan, clear | | ✓ |
| 181009.01 | EASTMAN | light tan, clear, particles | | ✓ |
| <hr/> TS 10.09.18 | | | | |

Note: All samples were analyzed in excess of EPA recommended holding time (15 minutes) unless otherwise noted. A positive result indicates the presence of total residual chlorine above detection (> 0.10 mg/L), which results in a pink to red color change with the addition of the DPD indicator. A negative result indicates the absence of total residual chlorine, which results in no color change with the addition of the DPD indicator.

Reviewed by dl
 Date reviewed 10-09-18

Total Residual Chlorine (4500-Cl G-2011), Screening Whole Effluent Toxicity Samples

Matrix: Water, RL = 0.10 mg/L

Analyst: JA
Date analyzed: 10-10-18

DPD: CHM 1017

Positive and Negative Control:

| Control Type | Sample ID | Result (✓) | |
|------------------|-----------------|------------|----------|
| | | Positive | Negative |
| Negative control | Deionized water | | ✓ |
| Positive control | Tap water | ✓ | |

Sample screening:

| Sample number | Sample ID | Sample characteristics | Result (✓) | |
|---------------|--------------|----------------------------|------------|----------|
| | | | Positive | Negative |
| 181010.31 | TVA / SQN101 | PALE TAN, CLEAR, PARTICLES | | ✓ |
| 181010.32 | ↓ INTAKE | PALE TAN, CLEAR, PARTICLES | | ✓ |
| | | | | |

Note: All samples were analyzed in excess of EPA recommended holding time (15 minutes) unless otherwise noted. A positive result indicates the presence of total residual chlorine above detection (> 0.10 mg/L), which results in a pink to red color change with the addition of the DPD indicator. A negative result indicates the absence of total residual chlorine, which results in no color change with the addition of the DPD indicator.

Reviewed by: JA
Date reviewed: 10-10-18

Total Residual Chlorine (ORION-97-70-1977), Confirmation of Whole Effluent Toxicity Samples

Matrix: Water, RL = 0.10 mg/L, Meter: Accumet Model AB250 pH/mV/Ion Meter

Analyst: MS
Date analyzed: 10/10/18
Calibration: 10-10-18 MS

Iodide reagent: INR 860
Acid reagent: INR 835

| | 0.10 mg/L | 1.00 mg/L | Slope (mV) (suggested range = 26 to 30 mV) |
|----------------------|------------------|------------------|---|
| Reference standard # | INSS <u>1617</u> | INSS <u>1617</u> | <u>26</u> |

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

Laboratory control sample:

| Reference standard number | True value (TV) (mg/L) | Measured value (MV) (mg/L) | % RS = MV / TV x 100 (acceptable range = 90 to 110%) |
|---------------------------|---------------------------|-------------------------------|---|
| INSS <u>1617</u> | 0.50 | <u>0.534</u> | <u>106.8%</u> |

Duplicate sample precision:

| Sample number | Sample ID | Total residual chlorine (mg/L) | %RPD = $\frac{ S - D }{[(S+D)/2]} \times 100$ (acceptable range = ± 10%) |
|------------------|----------------------|-----------------------------------|---|
| <u>181010.28</u> | <u>TVA LCC 001</u> | <u>S 20.023</u> | <u>MS</u> <u>10/10/18</u> |
| | <u>Duplicate</u> | <u>D 20.018</u> | |

Sample measurements:

| Sample number | Sample ID | Total residual chlorine (mg/L) |
|------------------------------|--|-----------------------------------|
| TV < 0.05 mg/L | Method Blank (MB) | <u>20.009</u> |
| TV = 0.30 mg/L | Method Detection Limit spike sample (MDLs) | <u>0.322</u> |
| <u>181010.29</u> | <u>TVA LCC WELL</u> | <u>20.004</u> |
| <u>181010.31</u> | <u>TVA SQN 101</u> | <u>20.007</u> |
| <u>181010.32</u> | <u>INTAKE</u> | <u>20.003</u> |
| <u>MS</u> <u>10/10/18</u> | | |

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

Laboratory control sample:

| Reference standard number | True value (TV) (mg/L) | Measured value (MV) (mg/L) | % RS = MV / TV x 100 (acceptable range = 90 to 110%) |
|---------------------------|---------------------------|-------------------------------|---|
| INSS <u>1617</u> | 0.50 | <u>0.502</u> | <u>100.4%</u> |

Reviewed by MS Date reviewed 10-10-18

Total Residual Chlorine (4500-Cl G-2011), Screening Whole Effluent Toxicity Samples

Matrix: Water, RL = 0.10 mg/L

Analyst TS
Date analyzed 10-13-18

DPD: CHM 1017

Positive and Negative Control:

| Control Type | Sample ID | Result (✓) | |
|------------------|-----------------|------------|----------|
| | | Positive | Negative |
| Negative control | Deionized water | | ✓ |
| Positive control | Tap water | ✓ | |

Sample screening:

| Sample number | Sample ID | Sample characteristics | Result (✓) | |
|--------------------|------------------------|------------------------------------|------------|----------|
| | | | Positive | Negative |
| 181012.23 | TVA/SQN101 | light yellow, clear, particles | | ✓ |
| 181012.24 | ↓ INTAKE | light yellow, clear, particles | | ✓ |
| 181012.22 | ANDREWS | light yellow, clear, particles | | ✓ |
| 181013.05 | DUNN WWTP | light tan, clear | | ✓ |
| 181013.04 | FARMVILLE | no color, clear | | ✓ |
| 181013.05 | HAMLET | light yellow, clear | | ✓ |
| 181013.02 | CHATTANOOGA | yellow, slightly cloudy, particles | | ✓ |
| | LANPLIGHTER | | | |
| 181013.01 | EASTMAN | light yellow, clear | | ✓ |
| <i>TS 10-13-18</i> | | | | |

Note: All samples were analyzed in excess of EPA recommended holding time (15 minutes) unless otherwise noted. A positive result indicates the presence of total residual chlorine above detection (> 0.10 mg/L), which results in a pink to red color change with the addition of the DPD indicator. A negative result indicates the absence of total residual chlorine, which results in no color change with the addition of the DPD indicator.

Reviewed by [Signature]
Date reviewed 10-13-18

Total Residual Chlorine (ORION-97-70-1977), Confirmation of Whole Effluent Toxicity Samples
Matrix: Water, RL = 0.10 mg/L, Meter: Accumet Model AB250 pH/mV/Ion Meter

Analyst TS
Date analyzed 10.13.18

Iodide reagent: INR 860
Acid reagent: INR 835

Calibration:

| | 0.10 mg/L | 1.00 mg/L | Slope (mV) (suggested range = 26 to 30 mV) |
|----------------------|------------------|------------------|---|
| Reference standard # | INSS <u>1617</u> | INSS <u>1617</u> | <u>29</u> |

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

Laboratory control sample:

| Reference standard number | True value (TV) (mg/L) | Measured value (MV) (mg/L) | % RS = MV / TV x 100 (acceptable range = 90 to 110%) |
|---------------------------|---------------------------|-------------------------------|---|
| INSS <u>1617</u> | <u>0.50</u> | <u>0.537</u> | <u>107.4%</u> |

Duplicate sample precision:

| Sample number | Sample ID | Total residual chlorine (mg/L) | %RPD = $\frac{ S - D }{[(S+D)/2]} \times 100$ (acceptable range = ± 10%) |
|-----------------------|-----------------------------------|-----------------------------------|---|
| <u>181012.23</u> ↓ | <u>TVA SQN 101</u> Duplicate | S <u>0.009</u> D <u>0.007</u> | <u>TS 10.13.18</u> |

Sample measurements:

| Sample number | Sample ID | Total residual chlorine (mg/L) |
|--|---|-----------------------------------|
| TV < 0.05 mg/L | Method Blank (MB) | <u>0.012</u> |
| TV = 0.30 mg/L | Method Detection Limit spike sample (MDL _s) | <u>0.312</u> |
| <u>181012.24</u> | <u>TVA SQN INTAKE</u> | <u>0.002</u> |
| <div style="position: absolute; top: 50%; left: 50%; transform: translate(-50%, -50%); opacity: 0.5;"> <p>TS 10.13.18</p> </div> | | |

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

Laboratory control sample:

| Reference standard number | True value (TV) (mg/L) | Measured value (MV) (mg/L) | % RS = MV / TV x 100 (acceptable range = 90 to 110%) |
|---------------------------|---------------------------|-------------------------------|---|
| INSS <u>1617</u> | <u>0.50</u> | <u>0.527</u> | <u>105.4%</u> |

Reviewed by AL Date reviewed 10.13.18

Analyst W
Date analyzed 10.07.10

Alkalinity (SM 2320 B-2011)

Matrix: Water, RL = 5.0 mg CaCO₃/L, Samples are titrated to pH = 4.5 S.U.

Titrant normality and multiplier determination:

| Titrant reference number | Normality check standard number | Begin mL | End mL | Total mL (E) | Normality (N) of H ₂ SO ₄ = (5 mL Na ₂ CO ₃ x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220) | pH Factor or Multiplier = (N x 50000)/ 100 mL sample = N x 500 |
|--------------------------|---------------------------------|----------|--------|--------------|---|--|
| INR 036 | INSS 1031 | 0.0 | 12.4 | 12.4 | 0.0202 | 10.1 |

Laboratory control standard (LCS):

| 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 1030 | 100 | 100 | 12.4 | 22.0 | 9.6 | 10.1 | 97 | 97.0% |

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%) |
|---------------|---------------|--------------------|----------|--------|----------|------------|--------------------------------------|---|
| 10.03.10 | SSW | 100 | 22.0 | 25.0 | 3.0 | 10.1 | ^S 30 | |
| 1 | Duplicate (D) | 1 | 25.0 | 28.1 | 3.1 | 1 | ^D 31 | 3.3% |

Sample measurements:

| Sample number | Sample ID | Sample volume (mL) | Begin mL | End mL | Total mL | Multiplier | Alkalinity (mg CaCO ₃ /L) |
|---|---------------------------------------|--------------------|----------|--------|----------|------------|--------------------------------------|
| MB (TV < 2.5 mg/L) | Deionized water, pH = <u>4.3</u> s.u. | 100 | 0.0 | 0.0 | 0.0 | 10.1 | ND |
| 10.01.10 | SSW | 100 | 20.1 | 31.1 | 3.0 | 10.1 | 30 |
| 10-03-10 | MHSW | 100 | 31.5 | 37.4 | 5.9 | 10.1 | 40 |
| 09.20.10A | ↓ | 100 | 37.4 | 43.2 | 5.8 | 10.1 | 59 |
| 09.24.10B | ↓ | 100 | 43.2 | 49.2 | 6.0 | 10.1 | 61 |
| 181004-01 | Chem hadl | 100 | 23.9 | 26.4 | 2.7 | 10.1 | 27 |
| <i>(Large diagonal line across the table with handwritten "10.07.10" written across it)</i> | | | | | | | |

Laboratory control standard (LCS):

| 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 1030 | 100 | 100 | 20.0 | 36.0 | 9.4 | 10.1 | 95 | 95.0% |

Reviewed by: dl Date reviewed: 10-07-10

Analyst BSL
Date analyzed 10.13.18

Alkalinity (SM 2320 B-2011)

Matrix: Water, RL = 5.0 mg CaCO₃/L, Samples are titrated to pH = 4.5 S.U.

Titrant normality and multiplier determination:

| Titrant reference number | Normality check standard number | Begin mL | End mL | Total mL (E) | Normality (N) of H ₂ SO ₄ = (5 mL Na ₂ CO ₃ x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220) | pH Factor or Multiplier = (N x 50000)/100 mL sample = N x 500 |
|--------------------------|---------------------------------|----------|--------|--------------|---|---|
| INR 836 | INSS 1654 | 0.0 | 12.0 | 12.0 | 0.0208 | 10.4 |

Laboratory control standard (LCS):

| 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 1638 | 100 | 100 | 12.0 | 21.4 | 9.4 | 10.4 | 98 | 98.0% |

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%) |
|---------------|---------------|--------------------|----------|--------|----------|------------|--------------------------------------|---|
| 10.08.10B | SSW | 100 | 21.4 | 24.3 | 2.9 | 10.4 | ^S 30 | |
| 1 | Duplicate (D) | 1 | 24.3 | 27.2 | 2.9 | 1 | ^D 30 | BSL 10.13.18 |

Sample measurements:

| Sample number | Sample ID | Sample volume (mL) | Begin mL | End mL | Total mL | Multiplier | Alkalinity (mg CaCO ₃ /L) |
|--------------------|---|--------------------|----------|--------|----------|------------|--------------------------------------|
| MB (TV < 2.5 mg/L) | Deionized water, pH = 5.77 S.U. BSL 10.13.18 | 100 | 0.0 | 0.1 | 0.1 | 10.4 | ND |
| 10.08.10A | SSW | | 27.2 | 30.1 | 2.9 | 10.4 | 30 |
| 10.11.10 | | | 30.1 | 33.1 | 3.0 | 10.4 | 31 |
| 10.11.10A | mHSSW | | 33.1 | 38.7 | 5.6 | 10.4 | 58 |
| 10.11.10B | | | 38.7 | 44.5 | 5.8 | 10.4 | 60 |
| 10.12.10 | | | 44.5 | 50.3 | 5.8 | 10.4 | 60 |
| 10.07.10 | | 100 | 0.0 | 6.0 | 6.0 | 10.4 | 59 |
| 10.10.10 | | | 6.0 | 11.8 | 5.8 | 10.4 | 60 |
| 181008.01 | Andrews 1 | 100 | 11.9 | 11.9 | 0.1 | | 1.0 |
| 181010.30 | 2 | | 11.9 | 13.4 | 1.5 | | 16 |
| 181012.22 | 3 | | 13.4 | 16.4 | 3.0 | 10.4 | 31 |
| 181009.04 | Dunn WWTP 1 | 100 | 16.4 | 18.4 | 2.0 | | 21 |
| 181011.05 | 2 | | 18.4 | 19.1 | 0.7 | | 7.3 |
| 181013.03 | 3 | | 19.1 | 20.3 | 1.2 | | 12 |
| 181009.05 | Farmville 1 | 100 | 20.3 | 26.6 | 6.3 | | 65 |
| 181011.07 | 2 | | 26.6 | 30.2 | 3.6 | | 37 |
| 181013.04 | 3 | | 30.2 | 32.7 | 2.5 | | 26 |
| 181009.06 | Hamlet 1 | 50 | 32.7 | 36.1 | 3.4 | | 71 |
| 181011.06 | 2 | | 36.1 | 41.0 | 4.9 | | 100 |
| 181013.05 | 3 | | 41.0 | 45.8 | 4.8 | | 100 |

Laboratory control standard (LCS):

| 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 | 100 | 100 | | | | | BSL 10.13.18 | |

Reviewed by:

W

Date reviewed:

10.14.18

Analyst BSL
Date analyzed 10.13.18

Alkalinity (SM 2320 B-2011)

Matrix: Water, RL = 5.0 mg CaCO₃/L, Samples are titrated to pH = 4.5 S.U.

Titrant normality and multiplier determination:

| Titrant reference number | Normality check standard number | Begin ml | End ml | Total ml (E) | Normality (N) of H ₂ SO ₄ = (5 mL Na ₂ CO ₃ x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220) | pH Factor or Multiplier = (N x 50000)/100 mL sample = N x 500 |
|--------------------------|---------------------------------|----------|--------|--------------|---|---|
| INR | INSS | | | | | BSL 10.13.18 |

Laboratory control standard (LCS):

| 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 1638 | 100 | 100 | 0.0 | 9.4 | 9.4 | 10.4 | 98 | 98.0% |

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%) |
|---------------|---------------|--------------------|----------|--------|----------|------------|--------------------------------------|---|
| 181009.01 | Eastman 1 | 25 | 9.4 | 12.4 | 3.0 (4) | 10.4 | ^S 120 | |
| ↓ | Duplicate (D) | ↓ | 12.4 | 15.4 | 3.0 (4) | ↓ | ^D 120 | BSL 10.13.18 |

Sample measurements:

| Sample number | Sample ID | Sample volume (mL) | Begin mL | End mL | Total mL | Multiplier | Alkalinity (mg CaCO ₃ /L) |
|--------------------|---------------------------------|--------------------|----------|--------|----------|------------|--------------------------------------|
| MB (TV < 2.5 mg/L) | Deionized water, pH = <u>su</u> | 100 | | | | BSL | 10.13.18 |
| 181011.02 | Eastman 2 | 25 | 15.4 | 19.2 | 3.8 (4) | 10.4 | 160 |
| 181013.01 | ↓ | 3 | ↓ | 19.2 | 23.2 | 4.0 (4) | 170 |
| 181009.02 | Chattanooga 1 | 25 | 23.2 | 28.8 | 5.6 (4) | | 230 |
| 181011.03 | ↓ | 2 | ↓ | 28.8 | 35.2 | 6.4 (4) | 270 |
| 181013.02 | ↓ | 3 | ↓ | 35.2 | 40.9 | 5.7 (4) | 240 |
| 181010.28 | TVA LCC 001 | 25 | 40.9 | 46.8 | 5.9 (4) | 10.4 | 250 → 240-245 |
| 181010.29 | ↓ | 50 | 0.0 | 2.1 | 2.1 (2) | | 27 → 44 10.14.18 |
| 10-03-18 | MHSW WV 1 | 100 | 2.1 | 7.8 | 5.7 | | 59 |
| 10-07-18 | ↓ | 2 | ↓ | 7.8 | 13.5 | 5.7 | 59 |
| 10-11-18 | ↓ | 3 | ↓ | 13.5 | 19.2 | 5.7 | 59 |
| 181010.31 | TVA SON 101 1 | 50 | 19.2 | 21.8 | 2.6 (2) | | 54 |
| 181010.31 | ↓ | 2 | ↓ | 21.8 | 24.2 | 2.4 (2) | 50 |
| 181012.23 | ↓ | 3 | ↓ | 24.2 | 26.7 | 2.5 (2) | 52 |
| 181008.02 | TVA SON 101 WV 1 | 50 | 26.7 | 29.3 | 2.6 (2) | | 54 |
| 181010.31 | ↓ | 2 | ↓ | 29.3 | 31.7 | 2.4 (2) | 50 |
| 181012.23 | ↓ | 3 | ↓ | 31.7 | 34.3 | 2.6 (2) | 54 |
| 181008.03 | TVA SON INT 1 | 50 | 34.3 | 37.0 | 2.7 (2) | | 56 |
| 181010.32 | ↓ | 2 | ↓ | 37.0 | 39.5 | 2.5 (2) | 52 |
| 181012.24 | ↓ | 3 | ↓ | 39.5 | 42.0 | 2.5 (2) | 52 |

Laboratory control standard (LCS):

| 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 | 100 | 100 | | | | | | BSL 10.13.18 |

Reviewed by:

μ

Date reviewed:

10.14.18

Analyst BSL
Date analyzed 10-13-18

Alkalinity (SM 2320 B-2011)

Matrix: Water, RL = 5.0 mg CaCO₃/L, Samples are titrated to pH = 4.5 S.U.

Titrant normality and multiplier determination:

| Titrant reference number | Normality check standard number | Begin mL | End mL | Total mL (E) | Normality (N) of H ₂ SO ₄ = (5 mL Na ₂ CO ₃ x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220) | pH Factor or Multiplier = (N x 50000)/ 100 mL sample = N x 500 |
|--------------------------|---------------------------------|----------|--------|--------------|---|--|
| INR | INSS | | | | | |

Laboratory control standard (LCS):

| 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 | 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 (D) | | | | | | D | |

Sample measurements:

| Sample number | Sample ID | Sample volume (mL) | Begin mL | End mL | Total mL | Multiplier | Alkalinity (mg CaCO ₃ /L) |
|--------------------|--|--------------------|----------|--------|----------|------------|--------------------------------------|
| MB (TV = 2.5 mg/L) | Deionized water, pH = <u> </u> s.u. | 100 | | | | | BSL 10-13-18 |
| 181008.03 | TWASON INTUJ 1 | 50 | 7.5 | 10.2 | 2.7 (2) | 10.4 | 56 |
| 181010.32 | ↓ 2 | ↓ | 10.2 | 12.7 | 2.5 (2) | ↓ | 52 |
| 181012.24 | ↓ 3 | ↓ | 12.7 | 15.2 | 2.5 (2) | ↓ | 52 |
| BSL 10-13-18 | | | | | | | |

Laboratory control standard (LCS):

| 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 1030 | 100 | 100 | 15.2 | 24.5 | 9.3 | 10.4 | 97 | 97.0% |

Reviewed by:

BSL

Date reviewed:

10-14-18

Analyst N
Date analyzed 10.07.0

Hardness (SM 2340 C-2011)
Matrix: Water, RL = 5.0 mg CaCO₃/L

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 |
|--------------------------|---------------------------------|----------|--------|--------------|--|---|
| INR 044 | INSS 1618 | 0.0 | 10.0 | 10.0 | 0.0200 | 20.0 |

Laboratory control standard (LCS):

| 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 1701 | 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 (acceptable range = ± 10%) |
|---------------|---------------|--------------------|----------|--------|----------|------------|------------------------------------|---|
| | COA-NF-ET | 50 | 12.0 | 12.3 | 0.3 | 20.0 | ^S 6.0 | |
| | Duplicate (D) | 1 | 12.3 | 12.6 | 0.3 | ↓ | ^D 6.0 | → 100.0% |

Sample measurements:

| Sample number | Sample ID | Sample volume (mL) | Begin mL | End mL | Total mL | Multiplier | Hardness (mg CaCO ₃ /L) |
|--------------------|-----------------|--------------------|----------|--------|----------|------------|------------------------------------|
| MB (TV < 2.5 mg/L) | Deionized water | 50 | 0.0 | 0.0 | 0.0 | 20.0 | ND |
| | COA NF UP | | 12.0 | 12.0 | 0.2 | | 4.0 = ND |
| | COA BT ET | | 12.0 | 13.1 | 0.3 | | 6.0 |
| | COA BT UP | | 13.1 | 13.4 | 0.3 | | 6.0 |
| 102790 | Fcity RS ET | 10 | 13.4 | 17.1 | 3.7 | (5) | 37.0 |
| 102791 | UP | 50 | 17.1 | 17.5 | 0.4 | | 8.0 |
| 181004.01 | Chemhude | | 17.5 | 21.1 | 3.6 | | 7.2 |
| 10.01.08 | SSW | | 21.1 | 23.1 | 2.0 | | 4.0 |
| 10.03.08 | 1 | | 23.1 | 25.1 | 2.0 | | 4.0 |
| 09.26.10A | MHSW | | 25.1 | 29.3 | 4.2 | | 8.4 |
| 09.26.10B | | | 29.3 | 33.5 | 4.2 | | 8.4 |
| 10.03.10 | | | 33.5 | 37.7 | 4.2 | | 8.4 |
| 110078 | | | | | | | |

Laboratory control standard (LCS):

| Reference standard number | True value (TV) (mg CaCO ₃ /L) | Sample volume (mL) | Begin mL | End mL | Total mL | Multiplier | Hardness (mg CaCO ₃ /L) | % RS = MV / TV x 100 (acceptable range = 90 to 110%) |
|---------------------------|---|--------------------|----------|--------|----------|------------|------------------------------------|--|
| INSS 1701 | 40 | 50 | 37.7 | 39.7 | 2.0 | 20.0 | 40 | 100.0% |

Reviewed by:

js

Date reviewed:

10-07-10

Analyst BSL
Date analyzed 10.13.18

Hardness (SM 2340 C-2011)
Matrix: Water, RL = 5.0 mg CaCO₃/L

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 |
|--------------------------|---------------------------------|----------|--------|--------------|--|---|
| INR 1178 844 | INSS 1618 | 0.0 | 10.0 | 10.0 | 0.0200 | 20.0 |

Laboratory control standard (LCS):

| 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 1701 | 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 (acceptable range = ± 10%) |
|---------------|---------------|--------------------|----------|--------|----------|------------|------------------------------------|---|
| | MVE | | | | | | | |
| | EES# 101805 | 50 | 12.0 | 13.2 | 1.2 | 20.0 | ^S 24 | |
| | Duplicate (D) | ↓ | 13.2 | 14.4 | 1.2 | ↓ | ^D 24 | BSL — 10.13.18 |

Sample measurements:

| Sample number | Sample ID | Sample volume (mL) | Begin mL | End mL | Total mL | Multiplier | Hardness (mg CaCO ₃ /L) |
|--------------------|-----------------|--------------------|----------|--------|----------|------------|------------------------------------|
| MB (TV < 2.5 mg/L) | Deionized water | 50 | 0.0 | 0.0 | 0.0 | 20.0 | ND |
| | EES# 101806 mVU | 50 | 12.0 | 13.7 | 1.7 | | 26 |
| 10.08.10A | SSW | | | 15.7 | 17.6 | 1.9 | 38 |
| 10.08.10B | | | | 17.6 | 19.4 | 1.9 | 36 |
| 10.11.10 | | | | 19.4 | 21.1 | 1.7 | 34 |
| 10.11.10A | MHSW | | | 21.1 | 23.1 | 4.0 | 40 |
| 10.11.10B | | | | 23.1 | 25.2 | 4.1 | 42 |
| 10.12.18 | | | | 29.2 | 33.4 | 4.2 | 44 |
| 10.07.10 | | | | 33.4 | 37.4 | 4.0 | 40 |
| 10.08.18 | | | | 37.4 | 41.4 | 4.0 | 40 |
| 181008.01 | Andrews 1 | 50 | | 41.4 | 44.1 | 2.7 | 54 |
| 181010.30 | | 2 | | 44.1 | 46.8 | 2.7 | 54 |
| 181012.22 | | 3 | | 46.8 | 49.5 | 2.7 | 54 |
| 181009.04 | Dunn WWTP 1 | 50 | | 0.0 | 1.2 | 1.2 | 24 |
| 181011.05 | | 2 | | 1.2 | 2.7 | 1.5 | 30 |
| 181013.03 | | 3 | | 2.7 | 3.1 | 1.2 | 24 |
| 181009.05 | Farmville 1 | 50 | | 2.7 | 3.1 | 0.4 | 8.0 |
| 181011.07 | | 2 | | 3.1 | 3.3 | 0.2 | 4.0 |
| 181013.04 | | 3 | | 3.3 | 3.3 | 0.1 | 2.0 |
| 181009.06 | Hamlet 1 | 50 | | 3.3 | 4.1 | 0.8 | 16 |

Laboratory control standard (LCS):

| Reference standard number | True value (TV) (mg CaCO ₃ /L) | Sample volume (mL) | Begin mL | End mL | Total mL | Multiplier | Hardness (mg CaCO ₃ /L) | % RS = MV / TV x 100 (acceptable range = 90 to 110%) |
|---------------------------|---|--------------------|----------|--------|----------|------------|------------------------------------|--|
| INSS | 40 | 50 | | | | | | BSL 10.13.18 |

Reviewed by:

BSL

Date reviewed:

10.14.18

Analyst BSL
Date analyzed 10.13.18

Hardness (SM 2340 C-2011)
Matrix: Water, RL = 5.0 mg CaCO₃/L

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 |
|--------------------------|---------------------------------|----------|--------|--------------|--|---|
| INR | INSS | | | | | BSL 10.13.18 |

Laboratory control standard (LCS):

| 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 1701 | 40 | 50 | 4.1 | 6.1 | 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 (acceptable range = ± 10%) |
|---------------|---------------|--------------------|----------|--------|----------|------------|------------------------------------|---|
| 181011.06 | Hamlet 2 | 50 | 6.1 | 6.9 | 0.8 | 20.0 | ^S 16 | |
| ↓ | Duplicate (D) | ↓ | 6.9 | 7.7 | 0.8 | ↓ | ^D 16 | BSL — 10.13.18 |

Sample measurements:

| Sample number | Sample ID | Sample volume (mL) | Begin mL | End mL | Total mL | Multiplier | Hardness (mg CaCO ₃ /L) |
|--------------------|-------------------|--------------------|----------|--------|----------|------------|------------------------------------|
| MB (TV = 2.5 mg/L) | Deionized water | 50 | | | | | BSL 10.13.18 |
| 181013.05 | Hamlet 3 | 50 | 1.3 | 2.2 | 0.9 | 20.0 | 18 |
| 181009.01 | Eastman 1 | 10 | 7.7 | 10.8 | 3.1 (S) | | 310 |
| 181011.02 | ↓ 2 | ↓ | 10.8 | 14.6 | 3.8 (S) | | 380 |
| 181013.01 | ↓ 3 | ↓ | 10.8 | 14.6 | 4.2 (S) | | 380 |
| 181009.02 | Chattanooga 1 | 25 | 14.6 | 18.8 | 4.2 (2) | | 170 |
| 181011.03 | ↓ 2 | ↓ | 18.8 | 23.1 | 4.3 (2) | | 170 |
| 181013.02 | ↓ 3 | ↓ | 6.4 | 10.6 | 4.2 (2) | | 170 |
| 181010.28 | TVA LCC 001 | 25 | 23.1 | 27.7 | 4.6 (2) | | 180 - 184 |
| 181010.29 | ↓ WWS | 50 | 27.7 | 29.5 | 1.8 | | 36 |
| 10-05-18 | MHSW VV 1 | 50 | 29.5 | 33.6 | 4.1 | | 82 |
| 10-07-18 | ↓ 2 | ↓ | 33.6 | 37.6 | 4.0 | | 80 |
| 10-11-18 A | ↓ 3 | ↓ | 37.6 | 41.6 | 4.0 | | 80 |
| 181008.02 | TVA SQN 101 1 | 50 | 41.6 | 44.3 | 2.7 | | 54 |
| 181010.31 | ↓ 2 | ↓ | 44.3 | 46.8 | 2.5 | | 50 |
| 181012.23 | ↓ 3 | ↓ | 46.8 | 49.5 | 2.7 | | 54 |
| 181008.03 | TVA SQN 101 WU 1 | 50 | 10.6 | 13.3 | 2.7 | | 54 |
| 181010.32 | ↓ 2 | ↓ | 13.3 | 15.9 | 2.6 | | 52 |
| 181012.23 | ↓ 3 | ↓ | 15.9 | 18.6 | 2.7 | | 54 |
| 181008.03 | TVA SQN LOT INT 1 | 50 | 18.6 | 21.5 | 2.9 | | 58 |

Laboratory control standard (LCS):

| Reference standard number | True value (TV) (mg CaCO ₃ /L) | Sample volume (mL) | Begin mL | End mL | Total mL | Multiplier | Hardness (mg CaCO ₃ /L) | % RS = MV / TV x 100 (acceptable range = 90 to 110%) |
|---------------------------|---|--------------------|----------|--------|----------|------------|------------------------------------|--|
| INSS | 40 | 50 | | | | | | BSL 10.13.18 |

Reviewed by:

BSL

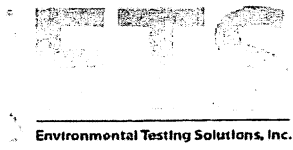
Date reviewed:

10.14.18

Sequoyah Nuclear Plant Biomonitoring
October 09 – 16, 2018

Appendix D

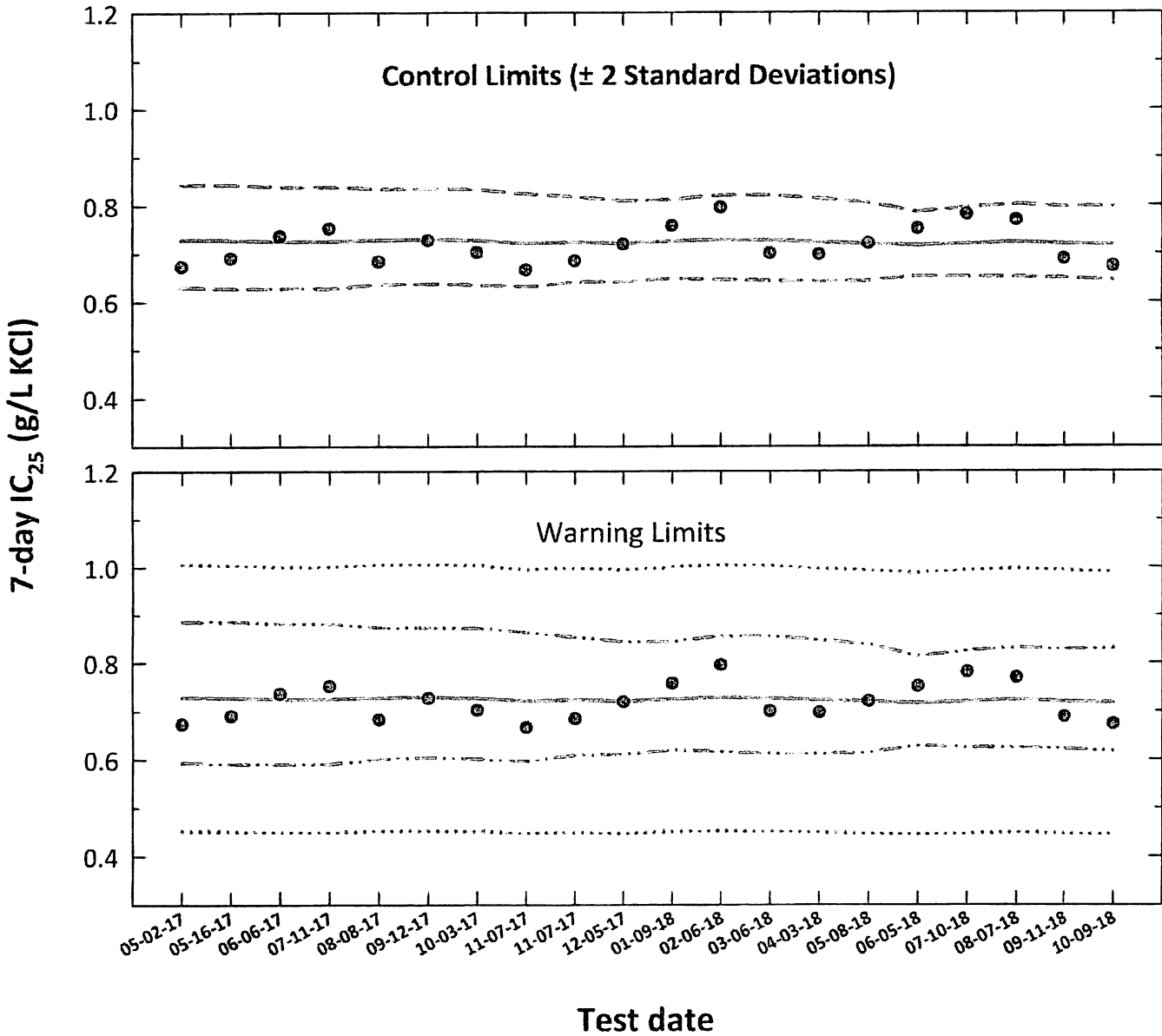
Reference Toxicant Test and
Control Chart



Pimephales promelas

Chronic Reference Toxicant Control Chart

Source: In-house Culture



● 7-day IC_{25} = 25% inhibition concentration. An estimation of the potassium chloride concentration which would cause a 25% reduction in *Pimephales* growth (calculated using ToxCalc).

— Central Tendency (mean logarithmic IC_{25} converted to anti-logarithmic values)

- - - Control Limits (mean logarithmic $IC_{25} \pm 2$ standard deviations converted to anti-logarithmic values)

..... Laboratory Warning Limits (mean logarithmic $IC_{25} \pm 2$ coefficient of variations converted to anti-logarithmic values)

..... USEPA Warning Limits (mean logarithmic $IC_{25} \pm S_{A.75}$ converted to anti-logarithmic values, $S_{A.75} = 75^{th}$ percentile of CVs reported nationally by USEPA)

Interim Review by
Kellie E. Keenan



Entered and Reviewed by
Jim Sumner





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

| Test number | Test date | 7-day IC ₂₅ ToxCal Determination (g/L KCl) | Log ₁₀ Conversion | | | Anti-logarithmic Values (g/L KCl) | | | | | | |
|-------------|-----------|---|------------------------------|---------|--------|-----------------------------------|----------------|---------|--|----------|--------------------------------------|------------------------|
| | | | 7-day IC ₂₅ | CT | S | CT | Control Limits | | Laboratory Calculated CV Warning Limits | | 75th Percentile CV Warning Limits | |
| | | | | | | | CT - 2S | CT + 2S | CT - 2CV | CT + 2CV | CT - S _{A,75} | CT + S _{A,75} |
| 1 | 05-02-17 | 0.6740 | -0.1714 | -0.1371 | 0.0316 | 0.7292 | 0.6305 | 0.8434 | 0.5939 | 0.8858 | 0.4521 | 1.0063 |
| 2 | 05-16-17 | 0.6906 | -0.1608 | -0.1382 | 0.0320 | 0.7275 | 0.6278 | 0.8431 | 0.5904 | 0.8864 | 0.4511 | 1.0040 |
| 3 | 06-06-17 | 0.7367 | -0.1327 | -0.1393 | 0.0314 | 0.7256 | 0.6280 | 0.8384 | 0.5911 | 0.8810 | 0.4499 | 1.0013 |
| 4 | 07-11-17 | 0.7519 | -0.1238 | -0.1393 | 0.0314 | 0.7257 | 0.6280 | 0.8385 | 0.5911 | 0.8811 | 0.4499 | 1.0014 |
| 5 | 08-08-17 | 0.6829 | -0.1656 | -0.1379 | 0.0294 | 0.7280 | 0.6357 | 0.8336 | 0.6012 | 0.8731 | 0.4513 | 1.0046 |
| 6 | 09-12-17 | 0.7271 | -0.1384 | -0.1371 | 0.0292 | 0.7294 | 0.6377 | 0.8342 | 0.6037 | 0.8730 | 0.4522 | 1.0065 |
| 7 | 10-03-17 | 0.7024 | -0.1534 | -0.1382 | 0.0293 | 0.7274 | 0.6355 | 0.8326 | 0.6011 | 0.8720 | 0.4510 | 1.0038 |
| 8 | 11-07-17 | 0.6666 | -0.1761 | -0.1421 | 0.0289 | 0.7210 | 0.6310 | 0.8238 | 0.5961 | 0.8636 | 0.4470 | 0.9949 |
| 9 | 11-07-17 | 0.6847 | -0.1645 | -0.1404 | 0.0265 | 0.7237 | 0.6406 | 0.8175 | 0.6089 | 0.8533 | 0.4487 | 0.9987 |
| 10 | 12-05-17 | 0.7191 | -0.1432 | -0.1424 | 0.0251 | 0.7205 | 0.6418 | 0.8089 | 0.6112 | 0.8432 | 0.4467 | 0.9943 |
| 11 | 01-09-18 | 0.7574 | -0.1207 | -0.1397 | 0.0244 | 0.7249 | 0.6478 | 0.8113 | 0.6185 | 0.8441 | 0.4495 | 1.0004 |
| 12 | 02-06-18 | 0.7951 | -0.0996 | -0.1377 | 0.0260 | 0.7283 | 0.6461 | 0.8211 | 0.6154 | 0.8557 | 0.4516 | 1.0051 |
| 13 | 03-06-18 | 0.7002 | -0.1548 | -0.1387 | 0.0263 | 0.7266 | 0.6437 | 0.8201 | 0.6126 | 0.8552 | 0.4505 | 1.0027 |
| 14 | 04-03-18 | 0.6973 | -0.1566 | -0.1411 | 0.0256 | 0.7225 | 0.6423 | 0.8128 | 0.6115 | 0.8474 | 0.4480 | 0.9971 |
| 15 | 05-08-18 | 0.7204 | -0.1424 | -0.1429 | 0.0243 | 0.7196 | 0.6435 | 0.8048 | 0.6138 | 0.8380 | 0.4462 | 0.9931 |
| 16 | 06-05-18 | 0.7512 | -0.1243 | -0.1451 | 0.0200 | 0.7160 | 0.6530 | 0.7852 | 0.6280 | 0.8126 | 0.4440 | 0.9881 |
| 17 | 07-10-18 | 0.7808 | -0.1075 | -0.1429 | 0.0216 | 0.7196 | 0.6514 | 0.7950 | 0.6248 | 0.8244 | 0.4462 | 0.9931 |
| 18 | 08-07-18 | 0.7690 | -0.1141 | -0.1410 | 0.0225 | 0.7228 | 0.6518 | 0.8015 | 0.6245 | 0.8317 | 0.4481 | 0.9974 |
| 19 | 09-11-18 | 0.6884 | -0.1621 | -0.1432 | 0.0222 | 0.7191 | 0.6491 | 0.7967 | 0.6217 | 0.8270 | 0.4458 | 0.9924 |
| 20 | 10-09-18 | 0.6735 | -0.1717 | -0.1442 | 0.0231 | 0.7175 | 0.6452 | 0.7979 | 0.6167 | 0.8296 | 0.4448 | 0.9901 |

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

CT = Central tendency of the IC₂₅ values.

S = Standard deviation of the IC₂₅ values.

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

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

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

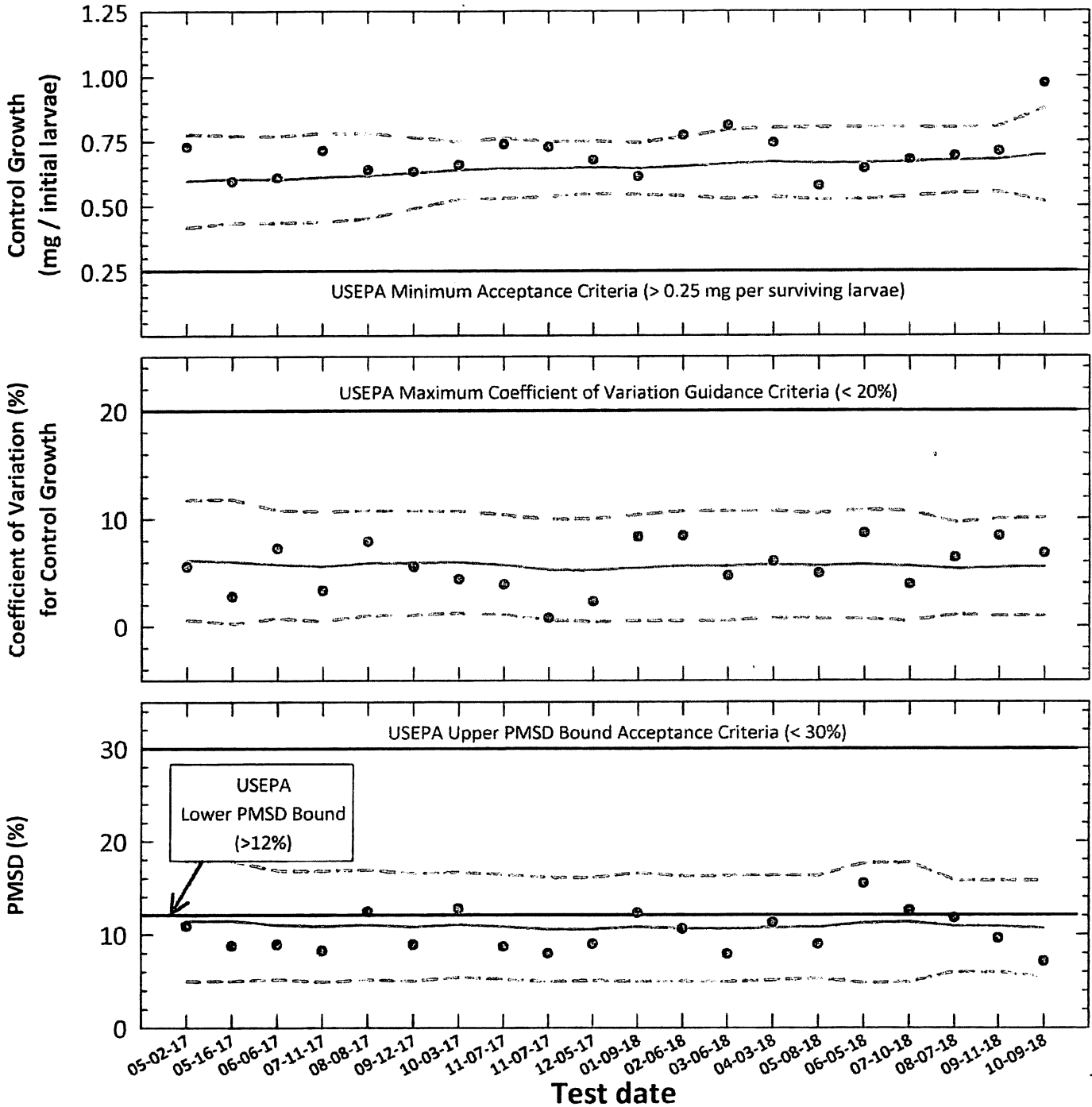
CV = Coefficient of variation.



Pimephales promelas

Chronic Reference Toxicant Testing, Test Acceptability Criteria

Organism Source: In-house Culture



● Control Growth, Coefficient of Variation (CV) or Percent Minimum Significant Difference (PMSD)
PMSD is the percent minimum significant difference between the control and treatment that can be declared statistically significant. The lower PMSD bound represents a practical limit to the sensitivity of the test method and is not a minimum acceptance criteria.

○ Central Tendency (mean Control Growth, CV or PMSD)
○ 95% Confidence Interval (mean Control Growth, CV or PMSD ± 2 Standard Deviations)

Independent Review by
Kelly E. Keenan

Entered and Reviewed by
Jim Sumner



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

| Test number | Test date | ToxCal Determination | | | | | Control Growth | | | Control Growth CV | | | Test PMSD | | |
|-------------|-----------|----------------------|--------------------------|--------|--------|----------|---------------------|---------------------------------|---------|-------------------|---------------------------------|---------|-----------|---------------------------------|---------|
| | | Control Survival (%) | Control Growth | | Test | | (mg/initial larvae) | | | (%) | | | (%) | | |
| | | | Mean (mg/initial larvae) | CV (%) | MSD | PMSD (%) | CT | 95% Confidence Interval CT - 2S | CT + 2S | CT | 95% Confidence Interval CT - 2S | CT + 2S | CT | 95% Confidence Interval CT - 2S | CT + 2S |
| 1 | 05-02-17 | 100 | 0.729 | 5.6 | 0.0792 | 10.9 | 0.596 | 0.416 | 0.776 | 6.2 | 0.6 | 11.8 | 11.4 | 5.0 | 17.8 |
| 2 | 05-16-17 | 100 | 0.593 | 2.8 | 0.0521 | 8.8 | 0.603 | 0.434 | 0.771 | 6.0 | 0.2 | 11.8 | 11.4 | 5.0 | 17.8 |
| 3 | 06-06-17 | 100 | 0.608 | 7.2 | 0.0542 | 8.9 | 0.601 | 0.434 | 0.768 | 5.8 | 0.7 | 10.8 | 11.0 | 5.2 | 16.8 |
| 4 | 07-11-17 | 100 | 0.713 | 3.3 | 0.0589 | 8.3 | 0.609 | 0.438 | 0.781 | 5.6 | 0.5 | 10.7 | 10.8 | 4.9 | 16.8 |
| 5 | 08-08-17 | 100 | 0.638 | 7.9 | 0.0791 | 12.4 | 0.616 | 0.451 | 0.781 | 5.9 | 1.0 | 10.8 | 11.0 | 5.1 | 16.9 |
| 6 | 09-12-17 | 100 | 0.631 | 5.6 | 0.0562 | 8.9 | 0.626 | 0.489 | 0.764 | 5.9 | 1.0 | 10.8 | 10.8 | 5.0 | 16.5 |
| 7 | 10-03-17 | 100 | 0.658 | 4.4 | 0.0838 | 12.7 | 0.637 | 0.525 | 0.748 | 6.0 | 1.2 | 10.7 | 11.0 | 5.4 | 16.6 |
| 8 | 11-07-17 | 100 | 0.738 | 3.9 | 0.0641 | 8.7 | 0.645 | 0.528 | 0.761 | 5.7 | 1.1 | 10.4 | 10.8 | 5.2 | 16.4 |
| 9 | 11-07-17 | 100 | 0.727 | 0.8 | 0.0580 | 8.0 | 0.642 | 0.535 | 0.749 | 5.3 | 0.6 | 10.0 | 10.5 | 5.0 | 16.1 |
| 10 | 12-05-17 | 100 | 0.676 | 2.3 | 0.0607 | 9.0 | 0.647 | 0.545 | 0.750 | 5.2 | 0.4 | 10.0 | 10.6 | 5.0 | 16.1 |
| 11 | 01-09-18 | 100 | 0.612 | 8.3 | 0.0752 | 12.3 | 0.643 | 0.543 | 0.744 | 5.4 | 0.5 | 10.4 | 10.8 | 5.0 | 16.6 |
| 12 | 02-06-18 | 100 | 0.772 | 8.4 | 0.0815 | 10.6 | 0.651 | 0.538 | 0.765 | 5.6 | 0.5 | 10.7 | 10.6 | 5.0 | 16.2 |
| 13 | 03-06-18 | 100 | 0.810 | 4.7 | 0.0640 | 7.9 | 0.660 | 0.526 | 0.794 | 5.6 | 0.5 | 10.7 | 10.6 | 4.9 | 16.3 |
| 14 | 04-03-18 | 100 | 0.743 | 6.1 | 0.0836 | 11.3 | 0.668 | 0.534 | 0.802 | 5.8 | 0.8 | 10.7 | 10.7 | 5.1 | 16.3 |
| 15 | 05-08-18 | 100 | 0.576 | 4.9 | 0.0516 | 9.0 | 0.663 | 0.523 | 0.803 | 5.6 | 0.7 | 10.5 | 10.8 | 5.3 | 16.3 |
| 16 | 06-05-18 | 100 | 0.643 | 8.7 | 0.0992 | 15.4 | 0.664 | 0.525 | 0.803 | 5.8 | 0.7 | 10.9 | 11.2 | 4.8 | 17.6 |
| 17 | 07-10-18 | 100 | 0.678 | 3.9 | 0.0850 | 12.5 | 0.669 | 0.535 | 0.803 | 5.6 | 0.5 | 10.7 | 11.3 | 4.9 | 17.7 |
| 18 | 08-07-18 | 100 | 0.692 | 6.4 | 0.0813 | 11.7 | 0.675 | 0.547 | 0.802 | 5.3 | 1.0 | 9.7 | 10.9 | 6.0 | 15.8 |
| 19 | 09-11-18 | 100 | 0.709 | 8.4 | 0.0680 | 9.6 | 0.678 | 0.551 | 0.805 | 5.5 | 0.9 | 10.0 | 10.9 | 6.0 | 15.8 |
| 20 | 10-09-18 | 100 | 0.973 | 6.8 | 0.0693 | 7.1 | 0.696 | 0.516 | 0.876 | 5.5 | 1.0 | 10.1 | 10.6 | 5.5 | 15.7 |

Note: Control Survival = USEPA minimum test acceptability criteria $\geq 80\%$ survival.
Control Mean Growth = USEPA minimum test acceptability criteria ≥ 0.25 mg/surviving larvae.
CV = Coefficient of variation for control growth.
USEPA maximum CV guidance criteria (90th percentile) $< 20\%$
MSD = Minimum significant difference.
PMSD = Percent minimum significant difference.
PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.
Lower PMSD bound determined by USEPA (10th percentile) $> 12\%$.
The lower PMSD bound represents a practical limit to the sensitivity of the test method and is not a minimum acceptance criteria.
Upper PMSD bound acceptance criteria determined by USEPA (90th percentile) $< 30\%$.
CT = Central tendency of the growth, CV or PMSD values.
S = Standard deviation of the growth, CV or PMSD values

Reviewed and Approved by:

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

Species: *Pimephales promelas*

PpKCICR Test Number: 44

| Dilution preparation information: | | | | | | | Comments: |
|-----------------------------------|------|--|------|--------|------|--------|-----------|
| KCl Stock INSS number: | | INSS 1719 | | | | | |
| Stock preparation: | | 50 g KCl/L: Dissolve 50 g KCl in 1-L Milli-Q water. | | | | | |
| Dilution prep (mg/L) | 300 | 450 | 600 | 750 | 900 | 1050 | |
| Stock volume (mL) | 9 | 13.5 | 18 | 22.5 | 27 | 31.5 | |
| Diluent volume (mL) | 1491 | 1486.5 | 1482 | 1477.5 | 1473 | 1468.5 | |
| Total volume (mL) | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | |

| Test organism information: | | Test information: | |
|------------------------------|--|--|---------------|
| Organism source: | In-house culture | Randomizing template: | Yellow |
| Age: | < 24-hours old | Incubator number and shelf location: | 7B |
| Spawn date: | 10-04-18 | Artemia CHM number: | CHM984 |
| Hatch dates and times: | 10-08-18 1625 TO 10-08-18 0605 ^{11:00 AM} 0600 | Drying information for weight determination: | |
| Transfer vessel information: | pH = 7.80 S.U. Temperature = 24.4 °C | Date / Time in oven: | 10-16-18 0745 |
| Average transfer volume: | < 0.25 mL | Initial oven temperature: | 60°C |
| | | Date / Time out of oven: | 10-17-18 0745 |
| | | 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 | 10-09-18 | 0605 | JL | 1205 | JL | 0816 | JL | 10-03-18 |
| 1 | 10-10-18 | 0600 | JL | 1200 | JL | 0810 | JL | 10-03-18 |
| 2 | 10-11-18 | 0610 | JL | 1210 | JL | 0812 | JL | 10-07-18 |
| 3 | 10-12-18 | 0610 | JL | 1210 | JL | 0810 | JL | 10-07-18 |
| 4 | 10-13-18 | 0700 | JL | 1300 | JL | 0900 | JL | 10-11-18A |
| 5 | 10-14-18 | 0700 | JL | 1300 | JL | 0927 | JL | 10-11-18A |
| 6 | 10-15-18 | 0600 | JL | 1210 | JL | 0808 | JL | 10-11-18A |
| 7 | 10-16-18 | | | | | 0717 | JL | |

| Control information: | | Acceptance criteria | Summary of test endpoints: | |
|--------------------------------------|-------|---------------------|----------------------------|-------|
| % Mortality: | 07 | ≤ 20% | 7-day LC ₅₀ | 820.8 |
| Average weight per initial larvae: | 0.973 | | NOEC | 450 |
| Average weight per surviving larvae: | 0.973 | ≥ 0.25 mg/larvac | LOEC | 600 |
| | | | ChV | 519.6 |
| | | | IC ₂₅ | 673.5 |



Species: *Pimephales promelas*

PpKClCR Test Number: 44

Survival and Growth Data

| Day | Control | | | | 300 mg KCl/L | | | | 450 mg KCl/L | | | | |
|---|------------------------------------|-------|-------|-------|--------------|-------|-------|-------|--------------|-------|-------|-------|-------|
| | A | B | C | D | E | F | G | H | I | J | K | L | |
| 0 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 1 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 2 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 3 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 4 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 5 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 6 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 7 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| A = Pan weight (mg) Tray color code: <u>grey</u> Analyst: <u>TS</u> Date: <u>09-29-18</u> | | 13.98 | 12.62 | 13.22 | 15.23 | 15.07 | 13.40 | 14.10 | 14.89 | 13.21 | 13.81 | 13.24 | 13.16 |
| B = Pan + Larvae weight (mg) Analyst: <u>J</u> Date: <u>10-17-18</u> | | 23.06 | 23.18 | 23.16 | 24.56 | 24.91 | 23.38 | 23.39 | 24.36 | 22.98 | 23.37 | 23.39 | 22.83 |
| C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>J</u> | | 9.08 | 10.56 | 9.94 | 9.33 | 9.84 | 9.98 | 9.29 | 9.47 | 9.77 | 9.56 | 10.15 | 9.67 |
| Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>J</u> | | 0.908 | 1.056 | 0.994 | 0.933 | 0.984 | 0.998 | 0.929 | 0.947 | 0.977 | 0.956 | 1.015 | 0.967 |
| Average weight per initial number of larvae (mg) | Percent reduction from control (%) | 0.973 | | | | 0.965 | | 0.87 | | 0.979 | | -0.67 | |

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

Comments:

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|--|
| |
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| |





Species: Pimephales promelas

PpKCICR Test Number: 44

Survival and Growth Data

| Day | 600 mg KCl/L | | | | 750 mg KCl/L | | | | 900 mg KCl/L | | | |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | M | N | O | P | Q | R | S | T | U | V | W | X |
| 0 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 1 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 8 ^{2d} | 8 ^{2d} | 7 ^{2d} | 8 ^{2d} |
| 2 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 8 | 8 | 7 | 8 |
| 3 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 8 | 8 | 7 | 8 |
| 4 | 10 | 10 | 10 | 10 | 10 | 9 ^{1d} | 10 | 9 ^{1d} | 7 ^{1d} | 4 ^{1d} | 7 | 7 ^{1d} |
| 5 | 10 | 9 ^{1d} | 10 | 9 ^{1d} | 8 ^{2d} | 8 ^{1d} | 7 ^{2d} | 8 ^{1d} | 5 ^{2d} | 3 ^{1d} | 5 ^{2d} | 4 ^{3d} |
| 6 | 10 | 9 | 10 | 9 | 8 | 6 ^{2d} | 6 ^{1d} | 7 ^{1d} | 5 | 3 | 5 | 4 |
| 7 | 9 ^{1d} | 9 | 9 ^{1d} | 9 | 7 ^{1d} | 6 | 6 | 7 | 4 ^{1d} | 3 | 4 ^{1d} | 4 |
| A = Pan weight (mg) Tray color code: <u>grey</u> Analyst: <u>TS</u> Date: <u>09-29-18</u> | 14.05 | 13.74 | 13.34 | 14.93 | 15.88 | 15.31 | 13.40 | 15.84 | 15.45 | 13.40 | 14.95 | 15.74 |
| B = Pan + Larvae weight (mg) Analyst: _____ Date: _____ | 22.79 | 21.96 | 21.38 | 22.87 | 22.66 | 21.70 | 19.11 | 22.73 | 19.51 | 16.34 | 19.19 | 20.40 |
| C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>dl</u> | 8.74 | 8.22 | 8.04 | 7.94 | 6.78 | 6.39 | 5.71 | 6.39 | 4.06 | 2.94 | 4.24 | 4.66 |
| Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>dl</u> | 0.874 | 0.822 | 0.804 | 0.794 | 0.678 | 0.639 | 0.571 | 0.639 | 0.406 | 0.294 | 0.424 | 0.466 |
| Average weight per initial number of larvae (mg) | 0.824 | | 15.37. | | 0.632 | | 35.17. | | 0.398 | | 59.17. | |
| Percent reduction from control (%) | 0.824 | | 15.37. | | 0.632 | | 35.17. | | 0.398 | | 59.17. | |

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.

Comments:



Species: Pimephales promelas

PpKCICR Test Number: 44

Survival and Growth Data

| Day | 1050 mg KCl/L | | | | |
|--|------------------------------------|-----------------|-----------------|-----------------|-------|
| | Y | Z | AA | BB | |
| 0 | 10 | 10 | 10 | 10 | |
| 1 | 4 ^{bd} | 5 ^{sd} | 5 ^{sd} | 5 ^{sd} | |
| 2 | 4 | 5 | 5 | 5 | |
| 3 | 4 | 5 | 5 | 5 | |
| 4 | 3 ^{id} | 2 ^{sd} | 3 ^{sd} | 3 ^{sd} | |
| 5 | 2 ^{id} | 1 ^{id} | 2 ^{id} | 2 ^{id} | |
| 6 | 2 | 1 | 2 | 2 | |
| 7 | 2 | 1 | 1 ^{id} | 1 ^{id} | |
| A = Pan weight (mg) Tray color code: <u>grey</u> Analyst: <u>TS</u> Date: <u>09.29.18</u> | | 15.16 | 14.00 | 14.71 | 14.57 |
| B = Pan + Larvae weight (mg) Analyst: <u>JL</u> Date: <u>10-17-18</u> | | 17.15 | 14.89 | 15.78 | 15.62 |
| C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>JL</u> | | 1.99 | 0.89 | 1.07 | 1.05 |
| Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>JL</u> | | 0.199 | 0.089 | 0.107 | 0.105 |
| Average weight per initial number of larvae (mg) | Percent reduction from control (%) | 0.125 | | 87.17. | |

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.

Comments:





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: 44

Test dates: October 09-16, 2018

| Concentration (mg/L KC) | Aspirate | Initial number of larvae | Final number of larvae | A = Pan weight (mg) | B = Pan + Larvae weight (mg) | Larvae weight (mg) = B - A | Weight / Surviving number of larvae (mg) | Mean weight / Surviving number of larvae (mg) | Coefficient of variation (Mean weight per surviving number of larvae) (%) | Weight / Initial number of larvae (mg) | Mean survival (%) | Mean weight / Initial number of larvae (mg) | Coefficient of variation (%) | Percent reduction from control (%) |
|-------------------------|----------|--------------------------|------------------------|---------------------|------------------------------|----------------------------|--|---|---|--|-------------------|---|------------------------------|------------------------------------|
| Control | A | 10 | 10 | 13.98 | 23.06 | 9.08 | 0.908 | 0.973 | 6.8 | 0.908 | 100.0 | 0.973 | 6.8 | Not applicable |
| | B | 10 | 10 | 12.62 | 23.18 | 10.56 | 1.056 | | | | | | | |
| | C | 10 | 10 | 13.22 | 23.16 | 9.94 | 0.994 | | | | | | | |
| | D | 10 | 10 | 15.23 | 24.56 | 9.33 | 0.933 | | | | | | | |
| 300 | E | 10 | 10 | 15.07 | 24.91 | 9.84 | 0.984 | 0.965 | 3.3 | 0.984 | 100.0 | 0.965 | 3.3 | 0.8 |
| | F | 10 | 10 | 13.40 | 23.38 | 9.98 | 0.998 | | | | | | | |
| | G | 10 | 10 | 14.10 | 23.39 | 9.29 | 0.929 | | | | | | | |
| | H | 10 | 10 | 14.89 | 24.36 | 9.47 | 0.947 | | | | | | | |
| 450 | I | 10 | 10 | 13.21 | 22.98 | 9.77 | 0.977 | 0.979 | 2.6 | 0.977 | 100.0 | 0.979 | 2.6 | -0.6 |
| | J | 10 | 10 | 13.81 | 23.37 | 9.56 | 0.956 | | | | | | | |
| | K | 10 | 10 | 13.24 | 23.39 | 10.15 | 1.015 | | | | | | | |
| | L | 10 | 10 | 13.16 | 22.83 | 9.67 | 0.967 | | | | | | | |
| 600 | M | 10 | 9 | 14.05 | 22.79 | 8.74 | 0.971 | 0.915 | 4.3 | 0.874 | 90.0 | 0.824 | 4.3 | 15.3 |
| | N | 10 | 9 | 13.74 | 21.95 | 8.22 | 0.913 | | | | | | | |
| | O | 10 | 9 | 13.34 | 21.38 | 8.04 | 0.893 | | | | | | | |
| | P | 10 | 9 | 14.93 | 22.87 | 7.94 | 0.882 | | | | | | | |
| 750 | Q | 10 | 7 | 15.88 | 22.66 | 6.78 | 0.969 | 0.975 | 6.6 | 0.678 | 65.0 | 0.632 | 7.0 | 35.1 |
| | R | 10 | 6 | 15.31 | 21.70 | 6.39 | 1.065 | | | | | | | |
| | S | 10 | 6 | 13.40 | 19.11 | 5.71 | 0.952 | | | | | | | |
| | T | 10 | 7 | 15.84 | 22.23 | 6.39 | 0.913 | | | | | | | |
| 900 | U | 10 | 4 | 15.45 | 19.51 | 4.06 | 1.015 | 1.055 | 7.6 | 0.406 | 37.5 | 0.398 | 18.5 | 59.1 |
| | V | 10 | 3 | 13.40 | 16.34 | 2.94 | 0.980 | | | | | | | |
| | W | 10 | 4 | 14.95 | 19.19 | 4.24 | 1.060 | | | | | | | |
| | X | 10 | 4 | 15.74 | 20.40 | 4.66 | 1.165 | | | | | | | |
| 1050 | Y | 10 | 2 | 15.16 | 17.15 | 1.99 | 0.995 | 1.001 | 8.1 | 0.199 | 12.5 | 0.125 | 40.0 | 87.1 |
| | Z | 10 | 1 | 14.00 | 14.89 | 0.89 | 0.890 | | | | | | | |
| | AA | 10 | 1 | 14.71 | 15.78 | 1.07 | 1.070 | | | | | | | |
| | BB | 10 | 1 | 14.57 | 15.62 | 1.05 | 1.050 | | | | | | | |

Dunnett's MSD value: 0.0693
 PMSD: 7.1

MSD = Minimum Significant Difference
 PMSD = Percent Minimum Significant Difference

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





Statistical Analyses

Environmental Testing Solutions, Inc.

Larval Fish Growth and Survival Test-7 Day Survival

| | | |
|-----------------------|----------------------------------|--------------------------------------|
| Start Date: 10/9/2018 | Test ID: PpKCICR | Sample ID: REF-Ref Toxicant |
| End Date: 10/16/2018 | 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 |

| Conc-mg/L | 1 | 2 | 3 | 4 |
|-----------|--------|--------|--------|--------|
| D-Control | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 300 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 450 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 600 | 0.9000 | 0.9000 | 0.9000 | 0.9000 |
| 750 | 0.7000 | 0.6000 | 0.6000 | 0.7000 |
| 900 | 0.4000 | 0.3000 | 0.4000 | 0.4000 |
| 1050 | 0.2000 | 0.1000 | 0.1000 | 0.1000 |

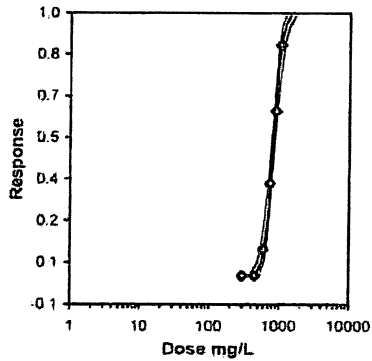
| Conc-mg/L | Mean | N-Mean | Transform: Arcsin Square Root | | | | Rank Sum | 1-Tailed Critical | Number Resp | Total Number | |
|-----------|--------|--------|-------------------------------|--------|--------|--------|----------|-------------------|-------------|--------------|----|
| | | | Mean | Min | Max | CV% | | | | | |
| D-Control | 1.0000 | 1.0000 | 1.4120 | 1.4120 | 1.4120 | 0.000 | 4 | | 0 | 40 | |
| 300 | 1.0000 | 1.0000 | 1.4120 | 1.4120 | 1.4120 | 0.000 | 4 | 18.00 | 10.00 | 0 | 40 |
| 450 | 1.0000 | 1.0000 | 1.4120 | 1.4120 | 1.4120 | 0.000 | 4 | 18.00 | 10.00 | 0 | 40 |
| *600 | 0.9000 | 0.8000 | 1.2490 | 1.2490 | 1.2490 | 0.000 | 4 | 10.00 | 10.00 | 4 | 40 |
| *750 | 0.6500 | 0.6500 | 0.9386 | 0.8861 | 0.9912 | 6.464 | 4 | 10.00 | 10.00 | 14 | 40 |
| *900 | 0.3750 | 0.3750 | 0.6584 | 0.5796 | 0.6847 | 7.979 | 4 | 10.00 | 10.00 | 25 | 40 |
| *1050 | 0.1250 | 0.1250 | 0.3572 | 0.3218 | 0.4636 | 19.861 | 4 | 10.00 | 10.00 | 35 | 40 |

| Auxiliary Tests | Statistic | Critical | Skew | Kurt |
|--|-----------|----------|---------|--------|
| Shapiro-Wilk's Test indicates non-normal distribution ($p < 0.01$) | 0.86556 | 0.896 | 0.55749 | 2.4279 |

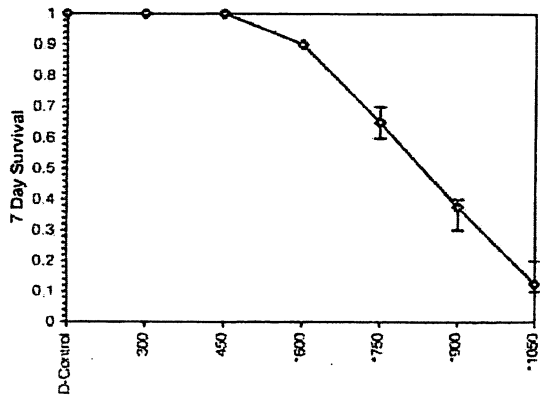
| Hypothesis Test (1-tail, 0.05) | NOEC | LOEC | CHV | TU |
|--------------------------------|------|------|---------|----|
| Steel's Many-One Rank Test | 450 | 600 | 519.615 | |

| Parameter | Value | SE | 95% Fiducial Limits | | Maximum Likelihood-Probit | | | | | | |
|-----------|---------|---------|---------------------|---------|---------------------------|---------|---------|---------|---------|--------|---|
| | | | Control | Chi-Sq | Critical | P-value | Mu | Sigma | Iter | | |
| Slope | 10.0802 | 1.29616 | 7.53969 | 12.6206 | 0 | 0.54481 | 9.48773 | 0.96899 | 2.91423 | 0.0992 | 3 |
| Intercept | -24.376 | 3.77401 | -31.773 | -16.979 | | | | | | | |

| Point | Probits | mg/L | 95% Fiducial Limits | |
|-------|---------|---------|---------------------|---------|
| EC01 | 2.674 | 482.445 | 400.783 | 541.007 |
| EC05 | 3.355 | 563.709 | 491.749 | 614.83 |
| EC10 | 3.718 | 612.486 | 547.704 | 659.058 |
| EC15 | 3.964 | 647.759 | 588.463 | 691.326 |
| EC20 | 4.158 | 677.235 | 622.492 | 718.692 |
| EC25 | 4.326 | 703.59 | 652.705 | 743.651 |
| EC40 | 4.747 | 774.639 | 731.584 | 814.793 |
| EC50 | 5.000 | 820.791 | 779.454 | 865.361 |
| EC60 | 5.253 | 869.692 | 826.7 | 923.242 |
| EC75 | 5.674 | 957.514 | 904.335 | 1036.48 |
| EC80 | 5.842 | 994.776 | 935.374 | 1087.21 |
| EC85 | 6.036 | 1040.04 | 972.077 | 1150.46 |
| EC90 | 6.282 | 1099.94 | 1019.38 | 1236.43 |
| EC95 | 6.645 | 1195.11 | 1092.42 | 1377.49 |
| EC99 | 7.326 | 1396.42 | 1241.18 | 1690.55 |

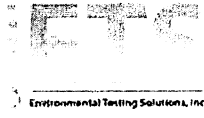


Dose-Response Plot



Entered and Reviewed by the Laboratory





Statistical Analyses

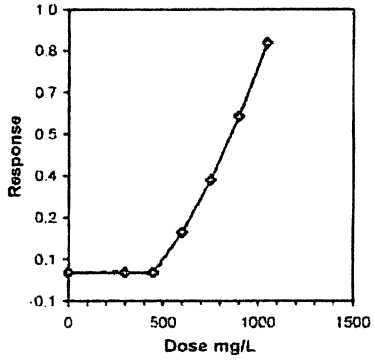
| Larval Fish Growth and Survival Test-7 Day Growth | | | | | |
|---|------------|-----------|-------------------------|---------------|------------------------|
| Start Date: | 10/9/2018 | Test ID: | PpKCICR | Sample ID: | REF-Ref Toxicant |
| End Date: | 10/16/2018 | Lab ID: | ETS-Envir. Testing Soi. | Sample Type: | KCL-Potassium chloride |
| Sample Date: | | Protocol: | FWCHR-EPA-821-R-02-013 | Test Species: | PP-Pimephales promelas |

| Conc-mg/L | 1 | 2 | 3 | 4 |
|-----------|--------|--------|--------|--------|
| D-Control | 0.9080 | 1.0560 | 0.9940 | 0.9330 |
| 300 | 0.9840 | 0.9980 | 0.9290 | 0.9470 |
| 450 | 0.9770 | 0.9560 | 1.0150 | 0.9670 |
| 600 | 0.8740 | 0.8220 | 0.8040 | 0.7940 |
| 750 | 0.6780 | 0.6390 | 0.5710 | 0.6390 |
| 900 | 0.4060 | 0.2940 | 0.4240 | 0.4660 |
| 1050 | 0.1990 | 0.0890 | 0.1070 | 0.1050 |

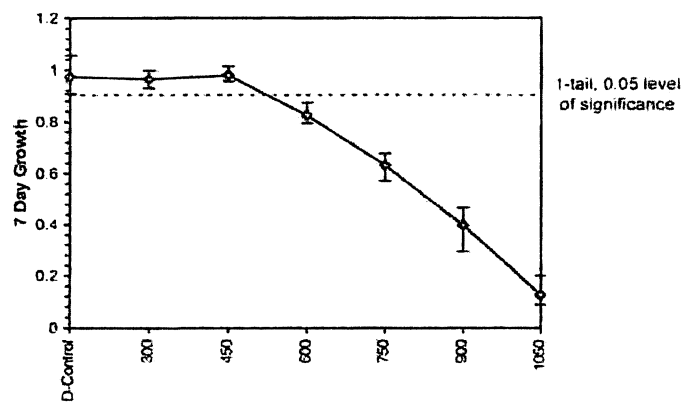
| Conc-mg/L | Transform: Untransformed | | | | | | | 1-Tailed | | | Isotonic | |
|-----------|--------------------------|--------|--------|--------|--------|--------|---|----------|----------|--------|----------|--------|
| | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD | Mean | N-Mean |
| D-Control | 0.9728 | 1.0000 | 0.9728 | 0.9080 | 1.0560 | 6.807 | 4 | | | | 0.9728 | 1.0000 |
| 300 | 0.9645 | 0.9915 | 0.9645 | 0.9290 | 0.9980 | 3.316 | 4 | 0.259 | 2.180 | 0.0693 | 0.9716 | 0.9988 |
| 450 | 0.9788 | 1.0062 | 0.9788 | 0.9560 | 1.0150 | 2.620 | 4 | -0.189 | 2.180 | 0.0693 | 0.9716 | 0.9988 |
| 600 | 0.8235 | 0.8466 | 0.8235 | 0.7940 | 0.8740 | 4.324 | 4 | | | | 0.8235 | 0.8466 |
| 750 | 0.6318 | 0.6494 | 0.6318 | 0.5710 | 0.6780 | 7.040 | 4 | | | | 0.6318 | 0.6494 |
| 900 | 0.3975 | 0.4086 | 0.3975 | 0.2940 | 0.4660 | 18.475 | 4 | | | | 0.3975 | 0.4086 |
| 1050 | 0.1250 | 0.1285 | 0.1250 | 0.0890 | 0.1990 | 39.989 | 4 | | | | 0.1250 | 0.1285 |

| Auxiliary Tests | Statistic | Critical | Skew | Kurt |
|--|-----------|----------|---------|---------|
| Shapiro-Wilk's Test indicates normal distribution ($p > 0.01$) | 0.97485 | 0.805 | 0.45632 | 0.19391 |
| Bartlett's Test indicates equal variances ($p = 0.26$) | 2.69204 | 9.21035 | | |
| Hypothesis Test (1-tail, 0.05) | NOEC | LOEC | ChV | TU |
| Dunnnett's Test | 450 | >450 | | |
| Treatments vs D-Control | MSDu | MSDp | MSB | MSE |
| | 0.08931 | 0.07125 | 0.0002 | 0.00202 |
| | F-Prob | df | | |
| | 0.9047 | 2.9 | | |

| Linear Interpolation (200 Resamples) | | | | | |
|--------------------------------------|--------|-------|-------------|--------|---------|
| Point | mg/L | SD | 95% CL(Exp) | Skew | |
| IC05 | 498.11 | 64.08 | 68.37 | 523.00 | -3.1814 |
| IC10 | 547.37 | 22.37 | 449.63 | 595.31 | -0.6658 |
| IC15 | 596.62 | 21.74 | 503.54 | 637.47 | -0.7512 |
| IC20 | 635.44 | 17.65 | 561.63 | 667.88 | -0.8234 |
| IC25 | 673.48 | 16.69 | 607.02 | 708.82 | -0.5824 |
| IC40 | 780.80 | 14.84 | 720.53 | 813.59 | -0.5453 |
| IC50 | 843.09 | 14.63 | 793.67 | 881.03 | -0.0458 |



Dose-Response Plot



Checked and Approved by



Species: Pimephales promelas

PpKCICR Test Number: 44

Daily Chemistry:

| Concentration | | Parameter | | Day | | | | | |
|---------------|---------------------------------------|-----------|-------|---|-------|---------|-------|---|--|
| | | | | (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.) | | | | | |
| | | | | 0 | | 1 | | 2 | |
| Analyst | | ML | ML | ML | TS | TS | W | | |
| CONTROL | pH (S.U.) | 7.69 | 7.75 | 7.75 | 7.55 | 7.59 | 7.30 | | |
| | DO (mg/L) | 7.7 | 7.4 | 7.0 | 7.9 | 8.0 | 7.6 | | |
| | Conductivity (µmhos/cm) | 319 | | 316 | | 302 | | | |
| | *Alkalinity (mg CaCO ₃ /L) | 60 | | 100.5 | | 59 | | | |
| | *Hardness (mg CaCO ₃ /L) | 84 | | | | 80 | | | |
| | *Temperature (°C) | 24.6 | 24.4 | 24.8 | 24.3 | 24.7 | 24.6 | | |
| 300 mg KCl/L | pH (S.U.) | 7.91 | 7.74 | 7.99 | 7.50 | 7.96 | 7.19 | | |
| | DO (mg/L) | 7.8 | 7.4 | 8.0 | 7.9 | 8.0 | 7.6 | | |
| | Conductivity (µmhos/cm) | 859 | | 879 | | 835 | | | |
| | *Temperature (°C) | 24.6 | 24.5 | 24.8 | 24.5 | 24.6 | 24.5 | | |
| 450 mg KCl/L | pH (S.U.) | 7.88 | 7.73 | 7.95 | 7.52 | 7.94 | 7.17 | | |
| | DO (mg/L) | 7.8 | 7.4 | 8.0 | 8.0 | 8.1 | 6.9 | | |
| | Conductivity (µmhos/cm) | 1120 | | 1130 | | 1090 | | | |
| | *Temperature (°C) | 24.6 | 24.5 | 24.9 | 24.5 | 24.6 | 24.5 | | |
| 600 mg KCl/L | pH (S.U.) | 7.87 | 7.75 | 7.94 | 7.55 | 7.92 | 7.17 | | |
| | DO (mg/L) | 7.9 | 7.5 | 8.1 | 8.2 | 8.1 | 7.0 | | |
| | Conductivity (µmhos/cm) | 1390 | | 1390 | | 1350 | | | |
| | *Temperature (°C) | 24.6 | 24.7 | 24.9 | 24.6 | 24.6 | 24.3 | | |
| 750 mg KCl/L | pH (S.U.) | 7.87 | 7.74 | 7.92 | 7.59 | 7.91 | 7.19 | | |
| | DO (mg/L) | 8.0 | 7.5 | 8.1 | 8.2 | 8.2 | 7.0 | | |
| | Conductivity (µmhos/cm) | 1630 | | 1630 | | 1590 | | | |
| | *Temperature (°C) | 24.6 | 24.3 | 24.9 | 24.3 | 24.6 | 24.6 | | |
| 900 mg KCl/L | pH (S.U.) | 7.86 | 7.79 | 7.92 | 7.58 | 7.90 | 7.30 | | |
| | DO (mg/L) | 8.1 | 7.7 | 8.2 | 8.2 | 8.3 | 7.7 | | |
| | Conductivity (µmhos/cm) | 1900 | | 1880 | | 1840 | | | |
| | *Temperature (°C) | 24.6 | 24.7 | 25.0 | 24.6 | 24.6 | 24.3 | | |
| 1050 mg KCl/L | pH (S.U.) | 7.86 | 7.76 | 7.93 | 7.02 | 7.90 | 7.31 | | |
| | DO (mg/L) | 8.1 | 7.8 | 8.2 | 8.2 | 8.3 | 7.7 | | |
| | Conductivity (µmhos/cm) | 2170 | | 2170 | | 2110 | | | |
| | *Temperature (°C) | 24.6 | 24.4 | 24.9 | 24.7 | 24.6 | 24.6 | | |
| | | Initial | Final | Initial | Final | Initial | Final | | |

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



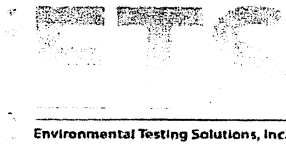
Species: Pimephales promelas

PpKCICR Test Number: 44

| | | Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.) | | | | | | | |
|---------------|---------------------------------------|--|-------|--------------------|-------|-----------------|-------|-----------------|-------|
| | | 3 | | 4 | | 5 | | 6 | |
| | | Analyst | W | BS- | BSL | TS | TS | HP | MP |
| Concentration | Parameter | | | | | | | | |
| CONTROL | pH (S.U.) | 7.01 | 7.18 | 7.50 | 7.41 | 7.70 | 7.32 | 7.49 | 7.45 |
| | DO (mg/L) | 7.7 | 7.8 | 7.8 | 7.9 | 7.7 | 7.6 | 7.7 | 7.7 |
| | Conductivity (µmhos/cm) | 300 | | 1000 887 297 | | 313 | | 313 | |
| | *Alkalinity (mg CaCO ₃ /L) | 1177 | | 58 | | 1177 | | 1177 | |
| | *Hardness (mg CaCO ₃ /L) | 1177 | | 80 | | 1177 | | 1177 | |
| | *Temperature (°C) | 24.6 | 24.5 | 24.7 | 24.3 | 24.7 | 24.6 | 24.6 | 24.3 |
| 300 mg KCl/L | pH (S.U.) | 7.07 | 7.14 | 7.61 | 7.44 | 7.74 | 7.34 | 7.73 | 7.39 |
| | DO (mg/L) | 7.9 | 7.7 | 7.8 | 7.8 | 7.8 | 7.3 | 8.0 | 7.9 |
| | Conductivity (µmhos/cm) | 825 | | 855 | | 894 | | 871 | |
| | *Temperature (°C) | 24.7 | 24.3 | 24.6 | 24.5 | 24.8 | 24.2 | 24.7 | 24.5 |
| 450 mg KCl/L | pH (S.U.) | 7.03 | 7.12 | 7.64 | 7.43 | 7.76 | 7.32 | 7.71 | 7.37 |
| | DO (mg/L) | 7.9 | 7.6 | 7.7 | 7.9 | 7.8 | 7.5 | 8.1 | 7.9 |
| | Conductivity (µmhos/cm) | 1070 | | 1110 | | 1140 | | 1110 | |
| | *Temperature (°C) | 24.7 | 24.3 | 24.6 | 24.5 | 24.8 | 24.2 | 24.6 | 24.2 |
| 600 mg KCl/L | pH (S.U.) | 7.02 | 7.24 | 7.67 | 7.46 | 7.77 | 7.35 | 7.69 | 7.38 |
| | DO (mg/L) | 7.9 | 7.7 | 7.8 | 7.9 | 7.8 | 7.2 | 8.1 | 8.0 |
| | Conductivity (µmhos/cm) | 1310 | | 1370 | | 1420 | | 1390 | |
| | *Temperature (°C) | 24.7 | 24.6 | 24.6 | 24.4 | 24.7 | 24.5 | 24.6 | 24.2 |
| 750 mg KCl/L | pH (S.U.) | 7.03 | 7.21 | 7.70 | 7.49 | 7.79 | 7.37 | 7.68 | 7.38 |
| | DO (mg/L) | 8.0 | 7.7 | 7.8 | 7.9 | 7.9 | 7.2 | 8.1 | 8.0 |
| | Conductivity (µmhos/cm) | 1500 | | 1630 | | 1710 | | 1640 | |
| | *Temperature (°C) | 24.7 | 24.2 | 24.6 | 24.2 | 24.7 | 24.7 | 24.6 | 24.4 |
| 900 mg KCl/L | pH (S.U.) | 7.04 | 7.19 | 7.71 | 7.61 | 7.81 | 7.48 | 7.68 | 7.39 |
| | DO (mg/L) | 8.0 | 7.7 | 7.9 | 8.0 | 8.0 | 7.2 | 8.1 | 8.1 |
| | Conductivity (µmhos/cm) | 1850 | | 1950 | | 2040 | | 1930 | |
| | *Temperature (°C) | 24.8 | 24.5 | 24.6 | 24.5 | 24.9 | 24.5 | 24.6 | 24.3 |
| 1050 mg KCl/L | pH (S.U.) | 7.03 | 7.38 | 7.72 | 7.61 | 7.81 | 7.50 | 7.69 | 7.40 |
| | DO (mg/L) | 8.1 | 7.6 | 7.8 | 8.0 | 8.0 | 7.0 | 8.2 | 8.2 |
| | Conductivity (µmhos/cm) | 1070 2090 | | 2120 | | 2240 | | 2170 | |
| | *Temperature (°C) | 24.7 | 24.2 | 24.6 | 24.2 | 24.7 | 24.5 | 24.5 | 24.4 |
| | | Initial | Final | Initial | Final | Initial | Final | Initial | Final |

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

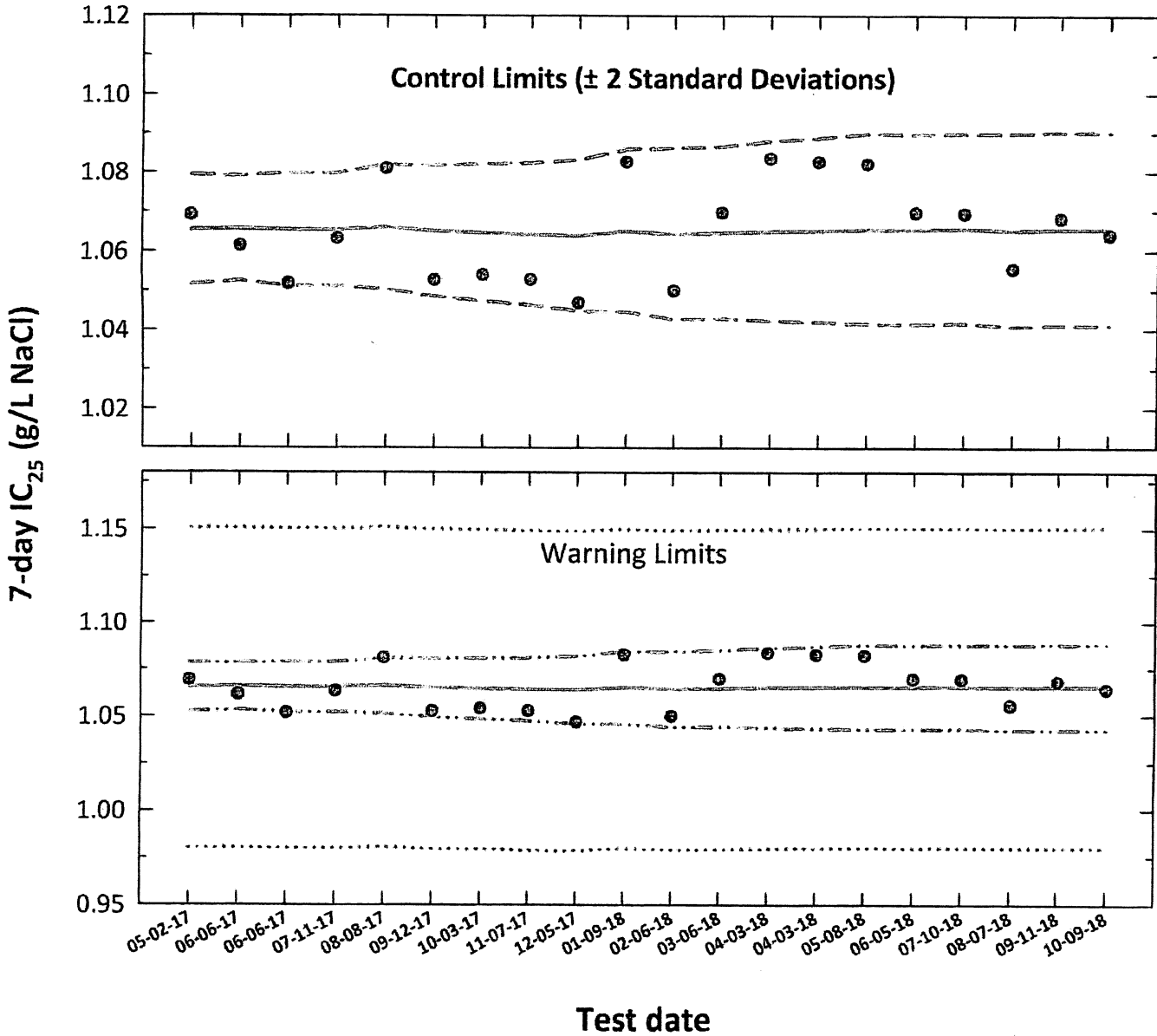
Independent Review
 Kelly E. Krenan



Ceriodaphnia dubia

Chronic Reference Toxicant Control Chart

Source: In-house Culture



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

INDEPENDENT
Review by
Katelyn E. Keenan

Entered and
Reviewed by
Jim Sumner



Environmental Testing Solutions, Inc.

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

| Test number | Test date | 7-day IC ₂₅ ToxCal Determination (g/L NaCl) | Log ₁₀ Conversion | | | Anti-logarithmic Values (g/L NaCl) | | | | | | |
|-------------|-----------|--|------------------------------|--------|--------|------------------------------------|----------------|---------|--|----------|--------------------------------------|------------------------|
| | | | 7-day IC ₂₅ | CT | S | CT | Control Limits | | Laboratory Calculated CV Warning Limits | | 10th Percentile CV Warning Limits | |
| | | | | | | | CT - 2S | CT + 2S | CT - 2CV | CT + 2CV | CT - S _{A,10} | CT + S _{A,10} |
| 1 | 05-02-17 | 1.0691 | 0.0290 | 0.0275 | 0.0028 | 1.0654 | 1.0516 | 1.0794 | 1.0525 | 1.0783 | 0.9802 | 1.1506 |
| 2 | 06-06-17 | 1.0614 | 0.0259 | 0.0276 | 0.0027 | 1.0657 | 1.0524 | 1.0791 | 1.0532 | 1.0781 | 0.9804 | 1.1509 |
| 3 | 06-06-17 | 1.0518 | 0.0219 | 0.0275 | 0.0029 | 1.0653 | 1.0511 | 1.0798 | 1.0520 | 1.0787 | 0.9801 | 1.1506 |
| 4 | 07-11-17 | 1.0631 | 0.0266 | 0.0275 | 0.0029 | 1.0654 | 1.0512 | 1.0798 | 1.0520 | 1.0787 | 0.9802 | 1.1506 |
| 5 | 08-08-17 | 1.0810 | 0.0338 | 0.0277 | 0.0032 | 1.0660 | 1.0502 | 1.0820 | 1.0512 | 1.0807 | 0.9807 | 1.1513 |
| 6 | 09-12-17 | 1.0527 | 0.0223 | 0.0274 | 0.0034 | 1.0650 | 1.0485 | 1.0818 | 1.0495 | 1.0805 | 0.9798 | 1.1502 |
| 7 | 10-03-17 | 1.0540 | 0.0228 | 0.0272 | 0.0035 | 1.0646 | 1.0474 | 1.0821 | 1.0484 | 1.0807 | 0.9794 | 1.1497 |
| 8 | 11-07-17 | 1.0528 | 0.0223 | 0.0270 | 0.0037 | 1.0642 | 1.0463 | 1.0824 | 1.0473 | 1.0810 | 0.9790 | 1.1493 |
| 9 | 12-05-17 | 1.0469 | 0.0199 | 0.0269 | 0.0039 | 1.0638 | 1.0449 | 1.0832 | 1.0460 | 1.0817 | 0.9787 | 1.1489 |
| 10 | 01-09-18 | 1.0826 | 0.0345 | 0.0274 | 0.0042 | 1.0651 | 1.0446 | 1.0859 | 1.0458 | 1.0843 | 0.9799 | 1.1503 |
| 11 | 02-06-18 | 1.0500 | 0.0212 | 0.0270 | 0.0044 | 1.0642 | 1.0427 | 1.0862 | 1.0440 | 1.0844 | 0.9791 | 1.1494 |
| 12 | 03-06-18 | 1.0697 | 0.0293 | 0.0272 | 0.0045 | 1.0646 | 1.0430 | 1.0867 | 1.0443 | 1.0849 | 0.9794 | 1.1498 |
| 13 | 04-03-18 | 1.0835 | 0.0348 | 0.0273 | 0.0047 | 1.0649 | 1.0424 | 1.0880 | 1.0437 | 1.0861 | 0.9797 | 1.1501 |
| 14 | 04-03-18 | 1.0827 | 0.0345 | 0.0274 | 0.0048 | 1.0651 | 1.0420 | 1.0888 | 1.0434 | 1.0869 | 0.9799 | 1.1503 |
| 15 | 05-08-18 | 1.0822 | 0.0343 | 0.0275 | 0.0049 | 1.0655 | 1.0415 | 1.0899 | 1.0430 | 1.0879 | 0.9802 | 1.1507 |
| 16 | 06-05-18 | 1.0696 | 0.0292 | 0.0275 | 0.0049 | 1.0653 | 1.0415 | 1.0897 | 1.0430 | 1.0877 | 0.9801 | 1.1506 |
| 17 | 07-10-18 | 1.0694 | 0.0291 | 0.0276 | 0.0049 | 1.0656 | 1.0417 | 1.0900 | 1.0432 | 1.0880 | 0.9804 | 1.1508 |
| 18 | 08-07-18 | 1.0555 | 0.0235 | 0.0274 | 0.0050 | 1.0652 | 1.0409 | 1.0900 | 1.0424 | 1.0879 | 0.9800 | 1.1504 |
| 19 | 09-11-18 | 1.0682 | 0.0287 | 0.0276 | 0.0050 | 1.0655 | 1.0413 | 1.0903 | 1.0428 | 1.0883 | 0.9803 | 1.1508 |
| 20 | 10-09-18 | 1.0640 | 0.0269 | 0.0275 | 0.0050 | 1.0654 | 1.0412 | 1.0902 | 1.0427 | 1.0882 | 0.9802 | 1.1507 |

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

CT = Central tendency of the IC₂₅ values.

S = Standard deviation of the IC₂₅ values.

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

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

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

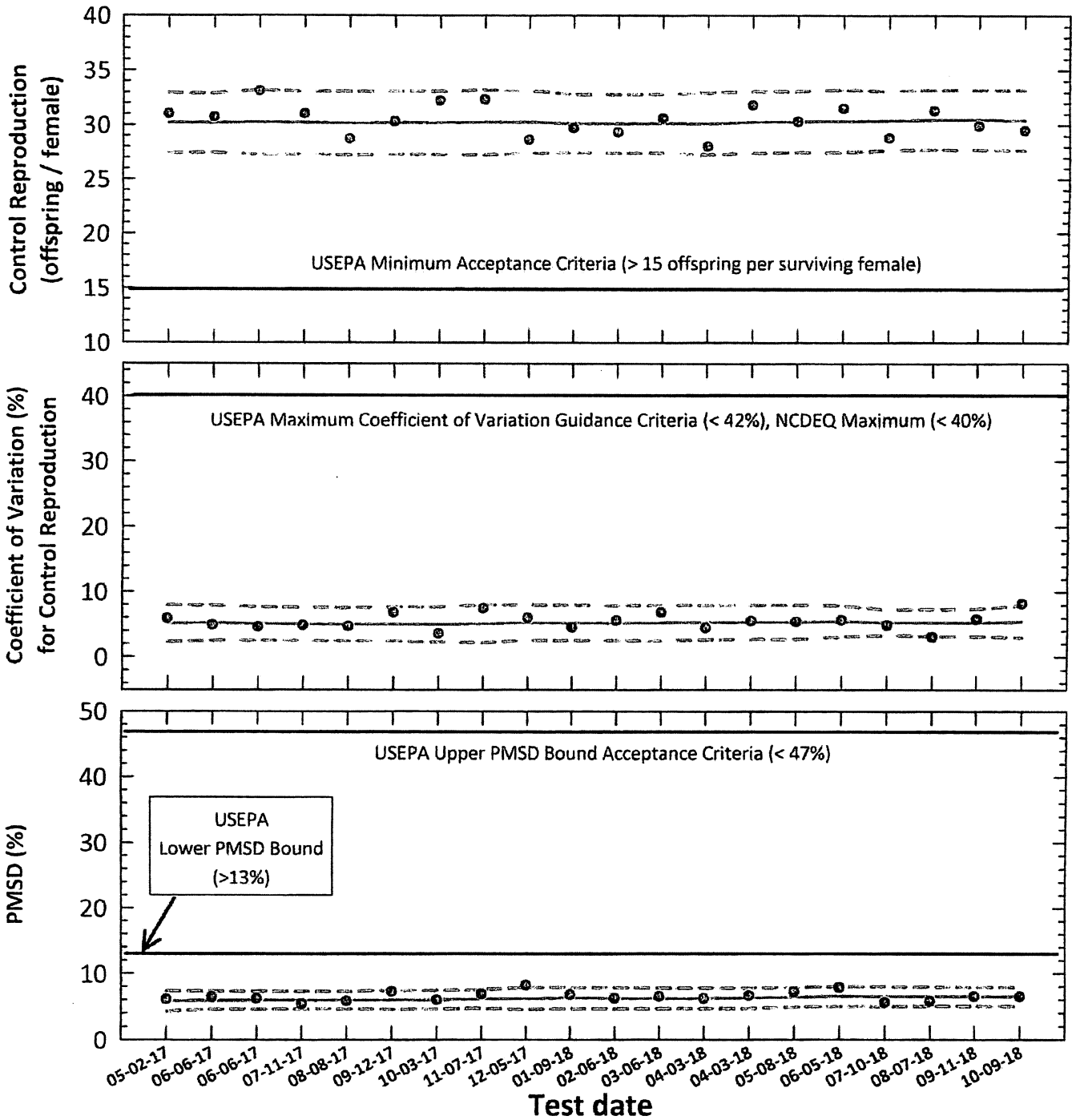
CV = Coefficient of variation.

Checked and
Reviewed by
Jim Sumner
JS

Ceriodaphnia dubia

Chronic Reference Toxicant Testing, Test Acceptability Criteria

Organism Source: In-house Culture



● **Control Reproduction, Coefficient of Variation (CV) or Percent Minimum Significant Difference (PMSD)**
 PMSD is the percent minimum significant difference between the control and treatment that can be declared statistically significant. The lower PMSD bound represents a practical limit to the sensitivity of the test method and is not a minimum acceptance criteria.

Central Tendency (mean Control Reproduction, CV or PMSD)
95% Confidence Interval (mean Control Reproduction, CV or PMSD \pm 2 Standard Deviations)

Independent Review by
 Kelley E. Kossan
 2018-09-18

Entered and Reviewed by
 Jim Sumner



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

| Test number | Test date | ToxCal Determination | | | | | Control Reproduction | | | Control Reproduction CV | | | Test PMSD | | |
|-------------|-----------|----------------------|-------------------------|--------|-------|----------|----------------------|---|------|-------------------------|---|-----|-----------|---|-----|
| | | Control Survival (%) | Control Reproduction | | Test | | (offspring/female) | | | (%) | | | (%) | | |
| | | | Mean (offspring/female) | CV (%) | MSD | PMSD (%) | CT | 95% Confidence Interval CT - 2S CT + 2S | | CT | 95% Confidence Interval CT - 2S CT + 2S | | CT | 95% Confidence Interval CT - 2S CT + 2S | |
| 1 | 05-02-17 | 100 | 31.0 | 5.9 | 1.894 | 6.1 | 30.2 | 27.4 | 32.9 | 5.1 | 2.3 | 8.0 | 5.8 | 4.3 | 7.3 |
| 2 | 06-06-17 | 100 | 30.7 | 4.9 | 1.968 | 6.4 | 30.2 | 27.4 | 32.9 | 5.2 | 2.5 | 7.9 | 5.9 | 4.6 | 7.3 |
| 3 | 06-06-17 | 100 | 33.1 | 4.6 | 2.050 | 6.2 | 30.2 | 27.3 | 33.2 | 5.1 | 2.5 | 7.7 | 5.9 | 4.6 | 7.3 |
| 4 | 07-11-17 | 100 | 31.0 | 4.8 | 1.661 | 5.4 | 30.2 | 27.3 | 33.1 | 5.0 | 2.5 | 7.6 | 5.9 | 4.6 | 7.3 |
| 5 | 08-08-17 | 100 | 28.7 | 4.7 | 1.668 | 5.8 | 30.1 | 27.2 | 33.1 | 5.0 | 2.4 | 7.5 | 5.9 | 4.6 | 7.3 |
| 6 | 09-12-17 | 100 | 30.3 | 6.8 | 2.191 | 7.2 | 30.2 | 27.3 | 33.1 | 5.0 | 2.4 | 7.7 | 6.0 | 4.5 | 7.4 |
| 7 | 10-03-17 | 100 | 32.2 | 3.5 | 1.926 | 6.0 | 30.2 | 27.3 | 33.1 | 4.9 | 2.2 | 7.7 | 6.0 | 4.6 | 7.4 |
| 8 | 11-07-17 | 100 | 32.3 | 7.4 | 2.215 | 6.9 | 30.2 | 27.3 | 33.2 | 5.1 | 2.1 | 8.0 | 6.1 | 4.7 | 7.5 |
| 9 | 12-05-17 | 100 | 28.6 | 6.0 | 2.344 | 8.2 | 30.3 | 27.4 | 33.1 | 5.2 | 2.5 | 8.0 | 6.2 | 4.5 | 7.9 |
| 10 | 01-09-18 | 100 | 29.7 | 4.5 | 2.015 | 6.8 | 30.1 | 27.4 | 32.8 | 5.2 | 2.5 | 8.0 | 6.3 | 4.7 | 7.9 |
| 11 | 02-06-18 | 100 | 29.3 | 5.6 | 1.824 | 6.2 | 30.1 | 27.4 | 32.8 | 5.2 | 2.5 | 7.9 | 6.2 | 4.7 | 7.8 |
| 12 | 03-06-18 | 100 | 30.6 | 6.8 | 1.995 | 6.5 | 30.1 | 27.4 | 32.8 | 5.2 | 2.4 | 8.0 | 6.2 | 4.7 | 7.8 |
| 13 | 04-03-18 | 100 | 28.0 | 4.5 | 1.729 | 6.2 | 30.1 | 27.3 | 32.9 | 5.3 | 2.6 | 7.9 | 6.2 | 4.7 | 7.8 |
| 14 | 04-03-18 | 100 | 31.8 | 5.5 | 2.108 | 6.6 | 30.2 | 27.4 | 33.1 | 5.3 | 2.7 | 7.9 | 6.3 | 4.7 | 7.8 |
| 15 | 05-08-18 | 100 | 30.3 | 5.4 | 2.172 | 7.2 | 30.3 | 27.5 | 33.1 | 5.3 | 2.7 | 8.0 | 6.4 | 4.9 | 7.8 |
| 16 | 06-05-18 | 100 | 31.5 | 5.6 | 2.469 | 7.8 | 30.3 | 27.5 | 33.2 | 5.5 | 3.0 | 7.9 | 6.5 | 5.0 | 8.0 |
| 17 | 07-10-18 | 100 | 28.8 | 4.9 | 1.598 | 5.5 | 30.4 | 27.7 | 33.1 | 5.3 | 3.3 | 7.2 | 6.4 | 4.9 | 8.0 |
| 18 | 08-07-18 | 100 | 31.3 | 3.0 | 1.806 | 5.8 | 30.5 | 27.7 | 33.2 | 5.2 | 3.1 | 7.4 | 6.5 | 5.0 | 7.9 |
| 19 | 09-11-18 | 100 | 29.9 | 5.8 | 1.943 | 6.5 | 30.5 | 27.7 | 33.2 | 5.3 | 3.1 | 7.4 | 6.5 | 5.0 | 7.9 |
| 20 | 10-09-18 | 100 | 29.5 | 8.2 | 1.912 | 6.5 | 30.4 | 27.7 | 33.2 | 5.4 | 2.9 | 7.9 | 6.5 | 5.1 | 7.9 |

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

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

CV = Coefficient of variation for control reproduction.

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

MSD = Minimum significant difference.

PMSD = Percent minimum significant difference.

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

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

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

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

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

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

Entered and Reviewed by
JMS/BJM

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

CdNaCICR #: 220

| Dilution preparation information: | | | | | | Comments: |
|--|------|--|------|------|------|------------------|
| NaCl Stock INSS number: | | INSS <u>1705</u> | | | | |
| 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: | | <u>BLACK</u> | | |
| Date and times organisms were born between: | | | | | <u>10-09-18 0615 TO 0935</u> | | | | | Incubator number and shelf location: | | <u>2B1</u> | | |
| Culture board: | | <u>10-02-18 A</u> | | | | | | | | YWT batch: | | <u>10-01-18</u> | | |
| Replicate number: | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Selenastrum batch: | | <u>10-02-18</u> |
| Culture board cup number: | | <u>7</u> | <u>10</u> | <u>11</u> | <u>12</u> | <u>17</u> | <u>19</u> | <u>23</u> | <u>25</u> | <u>30</u> | <u>31</u> | | | |
| Transfer vessel information: | | pH = <u>7.85</u> S.U. Temperature = <u>24.9</u> °C | | | | | | | | | | | | |
| Average transfer volume (mL): | | < 0.25 mL | | | | | | | | | | | | |

Daily renewal information:

| Day | Date | Test initiation and feeding, renewal and feeding, or termination time | MHSW batch used | Analyst |
|-----|----------|---|-------------------|-----------|
| 0 | 10-09-18 | <u>0947</u> | <u>10-09-18</u> | <u>JL</u> |
| 1 | 10-10-18 | <u>0850</u> | <u>10-03-18</u> | <u>JL</u> |
| 2 | 10-11-18 | <u>0948</u> | <u>10-07-18</u> | <u>JL</u> |
| 3 | 10-12-18 | <u>0847</u> | <u>10-07-18</u> | <u>JL</u> |
| 4 | 10-13-18 | <u>0935</u> | <u>10-11-18 A</u> | <u>JL</u> |
| 5 | 10-14-18 | <u>0850</u> | <u>10-11-18 A</u> | <u>JL</u> |
| 6 | 10-15-18 | <u>0848</u> | <u>10-11-18 A</u> | <u>JL</u> |
| 7 | 10-16-18 | <u>0848</u> | | <u>JL</u> |

| Control information: | | Acceptance criteria | Summary of test endpoints: | |
|---|--------------|-------------------------|-----------------------------------|-----------------|
| % of Male Adults: | <u>07.</u> | ≤ 20% | 7-day LC ₅₀ | <u>>1400</u> |
| % Adults having 3 rd Broods: | <u>1007.</u> | ≥ 80% | NOEC | <u>1000</u> |
| % Mortality: | <u>07.</u> | ≤ 20% | LOEC | <u>1200</u> |
| Mean Offspring/Female: | <u>29.5</u> | ≥ 15.0 offspring/female | ChV | <u>1095.5</u> |
| % CV: | <u>8.27.</u> | < 40.0 % | IC ₂₅ | <u>1064.0</u> |



Species: *Ceriodaphnia dubia*

CdNaClCR #: 220

CONTROL

Survival and Reproduction Data

| Day | | Replicate number | | | | | | | | | |
|------------------------------|-----------------|------------------|----|----|----|----|----|----|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 2 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 3 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 4 | Young produced | 4 | 5 | 5 | 4 | 3 | 5 | 4 | 4 | 3 | 3 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 9 | 10 | 12 | 9 | 10 | 9 | 10 | 10 | 11 | 10 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 6 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 7 | Young produced | 16 | 18 | 16 | 17 | 13 | 18 | 14 | 14 | 14 | 15 |
| Total young produced | | 29 | 33 | 33 | 30 | 26 | 32 | 28 | 28 | 28 | 28 |
| Final Adult Mortality | | L | L | L | L | L | L | L | L | L | L |
| X for 3 rd Broods | | X | X | X | X | X | X | X | X | X | X |

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

| | |
|------------------------|------|
| Concentration: | |
| % Mortality: | 07. |
| Mean Offspring/Female: | 29.5 |

600 mg NaCl/L

Survival and Reproduction Data

| Day | | Replicate number | | | | | | | | | |
|-----------------------|-----------------|------------------|----|----|----|----|----|----|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 2 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 3 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 4 | Young produced | 4 | 3 | 5 | 4 | 5 | 5 | 3 | 5 | 4 | 5 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 9 | 10 | 13 | 10 | 12 | 11 | 11 | 10 | 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 | 16 | 16 | 13 | 16 | 12 | 16 | 15 | 13 | 13 | 15 |
| Total young produced | | 29 | 29 | 31 | 30 | 29 | 32 | 29 | 28 | 29 | 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: | 07. |
| Mean Offspring/Female: | 29.6 |
| % Reduction from Control: | -0.37. |



Species: Ceriodaphnia dubia
800 mg NaCl/L

CdNaCICR #: 220

Survival and Reproduction Data

| Day | | Replicate number | | | | | | | | | |
|-----------------------|-----------------|------------------|----|----|----|----|----|----|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 2 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 3 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 4 | Young produced | 4 | 6 | 5 | 3 | 5 | 5 | 4 | 4 | 4 | 3 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 11 | 11 | 11 | 10 | 12 | 12 | 10 | 10 | 10 | 9 |
| | 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 | 12 | 14 | 15 | 13 | 15 | 16 | 12 | 14 | 17 |
| Total young produced | | 29 | 29 | 30 | 28 | 30 | 32 | 30 | 26 | 28 | 29 |
| Final Adult Mortality | | L | L | L | L | L | L | L | L | L | L |

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

| Concentration: | |
|---------------------------|-------|
| % Mortality: | 07. |
| Mean Offspring/Female: | 29.1 |
| % Reduction from Control: | 1.47. |

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 | 5 | 3 | 5 | 3 | 3 | 4 | 3 | 5 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 10 | 9 | 10 | 10 | 11 | 10 | 12 | 9 | 11 | 12 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 6 | Young produced | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 7 | Young produced | 15 | 13 | 12 | 12 | 14 | 12 | 13 | 15 | 15 | 13 |
| Total young produced | | 29 | 26 | 27 | 25 | 30 | 25 | 28 | 28 | 29 | 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: | 07. |
| Mean Offspring/Female: | 27.7 |
| % Reduction from Control: | 6.17. |



Species: Ceriodaphnia dubia
 1200 mg NaCl/L

CdNaClCR #: 220

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 | 4 | 3 | 2 | 4 | 4 | 4 | 5 | 2 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 5 | Young produced | 0 | 4 | 0 | 0 | 2 | 0 | 5 | 3 | 0 | 0 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 6 | Young produced | 0 | 0 | 5 | 0 | 0 | 6 | 0 | 0 | 0 | 7 |
| | Adult mortality | L | L | L | L | L | L | L | L | L | L |
| 7 | Young produced | 7 | 0 | 0 | 10 | 10 | 0 | 0 | 0 | 10 | 0 |
| Total young produced | | 10 | 8 | 9 | 13 | 14 | 10 | 9 | 7 | 15 | 9 |
| Final Adult Mortality | | L | L | L | L | L | L | L | L | L | L |

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

| Concentration: | |
|---------------------------|--------|
| % Mortality: | 07. |
| Mean Offspring/Female: | 10.4 |
| % Reduction from Control: | 64.77. |

1400 mg NaCl/L

Survival and Reproduction Data

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

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

| Concentration: | |
|---------------------------|--------|
| % Mortality: | 07. |
| Mean Offspring/Female: | 1.6 |
| % Reduction from Control: | 94.67. |





Verification of *Ceriodaphnia* Reproduction Totals

Environmental Testing Solutions, Inc.

Control

| Day | Replicate number | | | | | | | | | | Total |
|-------|------------------|----|----|----|----|----|----|----|----|----|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 4 | 5 | 5 | 4 | 3 | 5 | 4 | 4 | 3 | 3 | 40 |
| 5 | 9 | 10 | 12 | 9 | 10 | 9 | 10 | 10 | 11 | 10 | 100 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 16 | 18 | 16 | 17 | 13 | 18 | 14 | 14 | 14 | 15 | 155 |
| Total | 29 | 33 | 33 | 30 | 26 | 32 | 28 | 28 | 28 | 28 | 295 |

1000 mg NaCl/L

| Day | Replicate number | | | | | | | | | | Total |
|-------|------------------|----|----|----|----|----|----|----|----|----|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 4 | 4 | 4 | 5 | 3 | 5 | 3 | 4 | 3 | 5 | 39 |
| 5 | 10 | 9 | 10 | 10 | 11 | 10 | 12 | 9 | 11 | 12 | 104 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 15 | 13 | 12 | 12 | 14 | 12 | 13 | 15 | 15 | 13 | 134 |
| Total | 29 | 26 | 27 | 25 | 30 | 25 | 28 | 28 | 29 | 30 | 277 |

600 mg NaCl/L

| Day | Replicate number | | | | | | | | | | Total |
|-------|------------------|----|----|----|----|----|----|----|----|----|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 4 | 3 | 5 | 4 | 5 | 5 | 3 | 5 | 4 | 5 | 43 |
| 5 | 9 | 10 | 13 | 10 | 12 | 11 | 11 | 10 | 12 | 10 | 108 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 16 | 16 | 13 | 16 | 12 | 16 | 15 | 13 | 13 | 15 | 145 |
| Total | 29 | 29 | 31 | 30 | 29 | 32 | 29 | 28 | 29 | 30 | 296 |

1200 mg NaCl/L

| Day | Replicate number | | | | | | | | | | Total |
|-------|------------------|---|---|----|----|----|---|---|----|----|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 3 | 4 | 4 | 3 | 2 | 4 | 4 | 4 | 5 | 2 | 35 |
| 5 | 0 | 4 | 0 | 0 | 2 | 0 | 5 | 3 | 0 | 0 | 14 |
| 6 | 0 | 0 | 5 | 0 | 0 | 6 | 0 | 0 | 0 | 7 | 18 |
| 7 | 7 | 0 | 0 | 10 | 10 | 0 | 0 | 0 | 10 | 0 | 37 |
| Total | 10 | 8 | 9 | 13 | 14 | 10 | 9 | 7 | 15 | 9 | 104 |

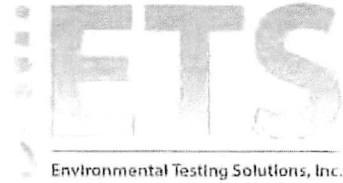
800 mg NaCl/L

| Day | Replicate number | | | | | | | | | | Total |
|-------|------------------|----|----|----|----|----|----|----|----|----|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 4 | 6 | 5 | 3 | 5 | 5 | 4 | 4 | 4 | 3 | 43 |
| 5 | 11 | 11 | 11 | 10 | 12 | 12 | 10 | 10 | 10 | 9 | 106 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 14 | 12 | 14 | 15 | 13 | 15 | 16 | 12 | 14 | 17 | 142 |
| Total | 29 | 29 | 30 | 28 | 30 | 32 | 30 | 26 | 28 | 29 | 291 |

1400 mg NaCl/L

| Day | Replicate number | | | | | | | | | | Total |
|-------|------------------|---|---|---|---|---|---|---|---|----|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 1 | 0 | 2 | 1 | 1 | 3 | 1 | 0 | 2 | 2 | 13 |
| 5 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1 | 2 | 2 | 1 | 1 | 3 | 1 | 1 | 2 | 2 | 16 |

Prepared and Reviewed by: [Signature]



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 #220
Test dates: October 09-16, 2018

| 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 | 29 | 33 | 33 | 30 | 26 | 32 | 28 | 28 | 28 | 28 | 100 | 29.5 | 8.2 | Not applicable |
| 600 | 29 | 29 | 31 | 30 | 29 | 32 | 29 | 28 | 29 | 30 | 100 | 29.6 | 4.0 | -0.3 |
| 800 | 29 | 29 | 30 | 28 | 30 | 32 | 30 | 26 | 28 | 29 | 100 | 29.1 | 5.5 | 1.4 |
| 1000 | 29 | 26 | 27 | 25 | 30 | 25 | 28 | 28 | 29 | 30 | 100 | 27.7 | 6.8 | 6.1 |
| 1200 | 10 | 8 | 9 | 13 | 14 | 10 | 9 | 7 | 15 | 9 | 100 | 10.4 | 25.7 | 64.7 |
| 1400 | 1 | 2 | 2 | 1 | 1 | 3 | 1 | 1 | 2 | 2 | 100 | 1.6 | 43.7 | 94.6 |

Dunnett's MSD value: 1.912
PMSD: 6.5

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.

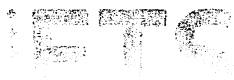
Lower PMSD bound determined by USEPA (10th percentile) = 13%.

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

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

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





Statistical Analyses

Environmental Testing Solutions, Inc

Ceriodaphnia Survival and Reproduction Test-Reproduction

| | | |
|-----------------------|----------------------------------|-------------------------------------|
| Start Date: 10/9/2018 | Test ID: CdNaClCR | Sample ID: REF-Ref Toxicant |
| End Date: 10/16/2018 | Lab ID: ETS-Envir. Tasting Sol. | Sample Type: NaCl-Sodium chloride |
| Sample Date: | Protocol: FWCHR-EPA-821-R-02-013 | Test Species: CD-Ceriodaphnia dubia |

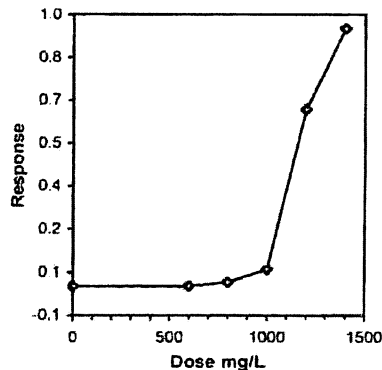
Comments:

| Conc-mg/L | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| D-Control | 29.000 | 33.000 | 33.000 | 30.000 | 26.000 | 32.000 | 28.000 | 28.000 | 28.000 | 28.000 |
| 600 | 29.000 | 29.000 | 31.000 | 30.000 | 29.000 | 32.000 | 29.000 | 28.000 | 29.000 | 30.000 |
| 800 | 29.000 | 29.000 | 30.000 | 28.000 | 30.000 | 32.000 | 30.000 | 26.000 | 28.000 | 29.000 |
| 1000 | 29.000 | 26.000 | 27.000 | 25.000 | 30.000 | 25.000 | 28.000 | 28.000 | 29.000 | 30.000 |
| 1200 | 10.000 | 8.000 | 9.000 | 13.000 | 14.000 | 10.000 | 9.000 | 7.000 | 15.000 | 9.000 |
| 1400 | 1.000 | 2.000 | 2.000 | 1.000 | 1.000 | 3.000 | 1.000 | 1.000 | 2.000 | 2.000 |

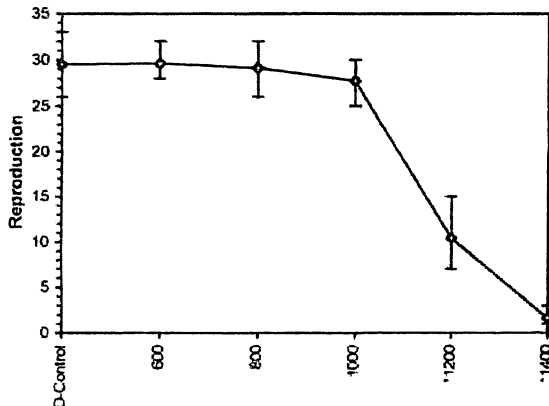
| Conc-mg/L | Transform: Untransformed | | | | | | | Rank Sum | 1-Tailed Critical | Isotonic | |
|-----------|--------------------------|--------|--------|--------|--------|--------|----|----------|-------------------|----------|--------|
| | Mean | N-Mean | Mean | Min | Max | CV% | N | | | Mean | N-Mean |
| D-Control | 29.500 | 1.0000 | 29.500 | 26.000 | 33.000 | 8.187 | 10 | | | 29.550 | 1.0000 |
| 600 | 29.600 | 1.0034 | 29.600 | 28.000 | 32.000 | 3.965 | 10 | 113.00 | 75.00 | 29.550 | 1.0000 |
| 800 | 29.100 | 0.9864 | 29.100 | 26.000 | 32.000 | 5.482 | 10 | 105.00 | 75.00 | 29.100 | 0.9848 |
| 1000 | 27.700 | 0.9390 | 27.700 | 25.000 | 30.000 | 6.818 | 10 | 86.50 | 75.00 | 27.700 | 0.9374 |
| *1200 | 10.400 | 0.3525 | 10.400 | 7.000 | 15.000 | 25.721 | 10 | 55.00 | 75.00 | 10.400 | 0.3519 |
| *1400 | 1.600 | 0.0542 | 1.600 | 1.000 | 3.000 | 43.700 | 10 | 55.00 | 75.00 | 1.600 | 0.0541 |

| Auxiliary Tests | Statistic | Critical | Skew | Kurt |
|--|-----------|----------|---------|--------|
| Kolmogorov D Test indicates normal distribution (p > 0.01) | 0.87488 | 1.035 | 0.41935 | 0.0382 |
| Bartlett's Test indicates unequal variances (p = 4.59E-03) | 16.954 | 15.0863 | | |
| Hypothesis Test (1-tail, 0.05) | NOEC | LOEC | ChV | TU |
| Steel's Many-One Rank Test | 1000 | 1200 | 1095.45 | |

| Linear Interpolation (200 Resamples) | | | | | |
|--------------------------------------|---------|---------|---------|---------|---------|
| Point | mg/L | SD | 95% CL | Skew | |
| IC05 | 946.786 | 102.278 | 673.236 | 1008.67 | -1.5854 |
| IC10 | 1012.77 | 21.5456 | 930.85 | 1025.48 | -2.8515 |
| IC15 | 1029.86 | 8.05625 | 1012.26 | 1042.05 | -0.2255 |
| IC20 | 1046.94 | 7.60606 | 1030.73 | 1058.6 | -0.2148 |
| IC25 | 1064.02 | 7.31883 | 1048.23 | 1075.01 | -0.2050 |
| IC40 | 1115.26 | 7.56893 | 1098.97 | 1129.87 | 0.0321 |
| IC50 | 1149.42 | 8.57853 | 1131.79 | 1167.31 | 0.3597 |



Dose-Response Plot



Reviewed and
Submitted by
Jim Lawrence
JL





Statistical Analyses

Environmental Testing Solutions, Inc.

Used for PMSD calculation only.

Ceriodaphnia Survival and Reproduction Test-Reproduction

| | | |
|-----------------------|----------------------------------|-------------------------------------|
| Start Date: 10/9/2018 | Test ID: CdNaClCR | Sample ID: REF-Ref Toxicant |
| End Date: 10/16/2018 | 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 | 29.000 | 33.000 | 33.000 | 30.000 | 26.000 | 32.000 | 28.000 | 28.000 | 28.000 | 28.000 |
| 600 | 29.000 | 29.000 | 31.000 | 30.000 | 29.000 | 32.000 | 29.000 | 28.000 | 29.000 | 30.000 |
| 800 | 29.000 | 29.000 | 30.000 | 28.000 | 30.000 | 32.000 | 30.000 | 26.000 | 28.000 | 29.000 |
| 1000 | 29.000 | 26.000 | 27.000 | 25.000 | 30.000 | 25.000 | 28.000 | 28.000 | 29.000 | 30.000 |
| 1200 | 10.000 | 8.000 | 9.000 | 13.000 | 14.000 | 10.000 | 9.000 | 7.000 | 15.000 | 9.000 |
| 1400 | 1.000 | 2.000 | 2.000 | 1.000 | 1.000 | 3.000 | 1.000 | 1.000 | 2.000 | 2.000 |

| Conc-mg/L | Mean | N-Mean | Transform: Untransformed | | | | N | t-Stat | 1-Tailed Critical | MSD |
|-----------|--------|--------|--------------------------|--------|--------|--------|----|--------|-------------------|-------|
| | | | Mean | Min | Max | CV% | | | | |
| D-Control | 29.500 | 1.0000 | 29.500 | 26.000 | 33.000 | 8.187 | 10 | | | |
| 600 | 29.600 | 1.0034 | 29.600 | 28.000 | 32.000 | 3.965 | 10 | -0.120 | 2.287 | 1.912 |
| 800 | 29.100 | 0.9864 | 29.100 | 26.000 | 32.000 | 5.482 | 10 | 0.478 | 2.287 | 1.912 |
| 1000 | 27.700 | 0.9390 | 27.700 | 25.000 | 30.000 | 6.818 | 10 | 2.153 | 2.287 | 1.912 |
| *1200 | 10.400 | 0.3525 | 10.400 | 7.000 | 15.000 | 25.721 | 10 | 22.847 | 2.287 | 1.912 |
| *1400 | 1.600 | 0.0542 | 1.600 | 1.000 | 3.000 | 43.700 | 10 | 33.373 | 2.287 | 1.912 |

| Auxiliary Tests | | Statistic | Critical | Skew | Kurt | | | | | |
|--|------|-----------|----------|---------|---------|--------|---------|---------|---------|-------|
| Kolmogorov D Test indicates normal distribution (p > 0.01) | | 0.87486 | 1.035 | 0.41935 | 0.0382 | | | | | |
| Bartlett's Test indicates unequal variances (p = 4.59E-03) | | 16.954 | 15.0863 | | | | | | | |
| Hypothesis Test (1-tail, 0.05) | NOEC | LOEC | ChV | TU | MSDu | MSDp | MSB | MSE | F-Prob | df |
| Dunnett's Test | 1000 | 1200 | 1095.45 | | 1.91164 | 0.0648 | 1489.66 | 3.49444 | 4.4E-42 | 5, 54 |
| Treatments vs D-Control | | | | | | | | | | |

Entered and Reviewed by
 Jim Sumner



Species: Ceriodaphnia dubia

CdNaCICR #: 220

Daily Chemistry:

| Concentration | | Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.) | | | | | |
|----------------|---------------------------------------|--|-------|----------------|-------|---------|-------|
| | | 0 | | 1 | | 2 | |
| | | Analyst | MS | MS | MS | TS | TS |
| CONTROL | pH (S.U.) | 7.69 | 7.89 | 7.75 | 7.81 | 7.59 | 7.69 |
| | DO (mg/L) | 7.7 | 7.8 | 7.8 | 8.0 | 7.9 | 7.9 |
| | Conductivity (µmhos/cm) | 319 | | 316 | | 302 | |
| | *Alkalinity (mg CaCO ₃ /L) | 60 | | 117 | | 59 | |
| | *Hardness (mg CaCO ₃ /L) | 84 | | 117 | | 80 | |
| | *Temperature (°C) | 24.8 | 25.0 | 24.9 | 24.8 | 24.6 | 24.8 |
| | 600 mg NaCl/L | pH (S.U.) | 7.81 | 7.84 | 7.89 | 7.86 | 7.77 |
| | DO (mg/L) | 7.8 | 7.8 | 7.8 | 8.0 | 7.8 | 7.9 |
| | Conductivity (µmhos/cm) | 1480 | | 1520 | | 1440 | |
| | *Temperature (°C) | 24.8 | 24.9 | 24.8 | 24.8 | 24.6 | 24.9 |
| 800 mg NaCl/L | pH (S.U.) | 7.82 | 7.84 | 7.88 | 7.81 | 7.80 | 7.65 |
| | DO (mg/L) | 7.8 | 7.9 | 7.8 | 8.0 | 7.9 | 8.0 |
| | Conductivity (µmhos/cm) | 1860 | | 1880 | | 1820 | |
| | *Temperature (°C) | 24.8 | 24.9 | 24.9 | 24.8 | 24.7 | 24.9 |
| 1000 mg NaCl/L | pH (S.U.) | 7.82 | 7.84 | 7.89 | 7.82 | 7.82 | 7.65 |
| | DO (mg/L) | 7.9 | 7.9 | 7.9 | 8.1 | 7.9 | 8.0 |
| | Conductivity (µmhos/cm) | 2180 | | 2230 | | 2160 | |
| | *Temperature (°C) | 24.8 | 24.8 | 24.9 | 25.0 | 24.7 | 25.0 |
| 1200 mg NaCl/L | pH (S.U.) | 7.82 | 7.85 | 7.89 | 7.83 | 7.83 | 7.68 |
| | DO (mg/L) | 7.9 | 7.9 | 7.9 | 8.1 | 7.9 | 8.0 |
| | Conductivity (µmhos/cm) | 2600 | | 2660 | | 2540 | |
| | *Temperature (°C) | 24.8 | 24.9 | 25.0 | 24.7 | 24.6 | 24.8 |
| 1400 mg NaCl/L | pH (S.U.) | 7.84 | 7.86 | 7.91 | 7.84 | 7.85 | 7.72 |
| | DO (mg/L) | 8.0 | 8.0 | 7.9 | 8.1 | 7.9 | 8.1 |
| | Conductivity (µmhos/cm) | 2970 | | 3010 | | 2970 | |
| | *Temperature (°C) | 24.8 | 24.8 | 25.0 | 24.8 | 24.7 | 24.9 |
| | | Initial | Final | Initial | Final | Initial | Final |

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



Species: Ceriodaphnia dubia

CdNaCICR #: 220

| Analyst | | Day | | | | | | | |
|----------------|---------------------------------------|---|-------|-----------------------|-------|------------------|-------|------------------|-------|
| | | (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.) | | | | | | | |
| | | 3 | | 4 | | 5 | | 6 | |
| Concentration | Parameter | RL | BSL | BSL | TS | TS | MS | MS | TS MS |
| CONTROL | pH (S.U.) | 7.61 | 7.69 | 2.87 (7.50) | 7.80 | 7.70 | 7.42 | 7.49 | 7.45 |
| | DO (mg/L) | 7.7 | 7.7 | 7.50 (7.50) | 7.9 | 7.7 | 7.7 | 7.7 | 7.7 |
| | Conductivity (µmhos/cm) | 300 | | 10.12 2.87 10.12 2.97 | | 313 | | 313 | |
| | *Alkalinity (mg CaCO ₃ /L) | 10.12 | | 58 | | 10.12 | | 10.12 | |
| | *Hardness (mg CaCO ₃ /L) | 10.12 | | 80 | | 10.12 | | 10.12 | |
| | *Temperature (°C) | 24.8 | 25.0 | 24.8 | 25.1 | 24.7 | 24.8 | 24.7 | 24.7 |
| | 600 mg NaCl/L | pH (S.U.) | 7.72 | 7.65 | 7.69 | 7.75 | 7.81 | 7.47 | 7.47 |
| | DO (mg/L) | 7.7 | 7.7 | 7.5 | 7.8 | 7.9 | 7.8 | 7.7 | 7.7 |
| | Conductivity (µmhos/cm) | 1490 | | 1470 | | 1480 | | 1510 | |
| | *Temperature (°C) | 24.9 | 24.8 | 24.9 | 24.8 | 24.8 | 24.8 | 24.8 | 24.7 |
| 800 mg NaCl/L | pH (S.U.) | 7.71 | 7.65 | 7.71 | 7.77 | 7.83 | 7.52 | 7.51 | 7.51 |
| | DO (mg/L) | 7.7 | 7.7 | 7.5 | 7.8 | 7.9 | 7.8 | 7.7 | 7.7 |
| | Conductivity (µmhos/cm) | 1860 | | 1840 | | 1810 | | 1870 | |
| | *Temperature (°C) | 24.9 | 24.8 | 24.9 | 24.8 | 24.7 | 24.9 | 24.9 | 24.9 |
| 1000 mg NaCl/L | pH (S.U.) | 7.72 | 7.68 | 7.73 | 7.79 | 7.82 | 7.52 | 7.53 | 7.52 |
| | DO (mg/L) | 7.7 | 7.8 | 7.5 | 7.9 | 8.0 | 7.9 | 7.8 | 7.8 |
| | Conductivity (µmhos/cm) | 2250 | | 2220 | | 2220 | | 2260 | |
| | *Temperature (°C) | 24.9 | 24.8 | 24.9 | 24.8 | 24.7 | 24.7 | 24.9 | 24.8 |
| 1200 mg NaCl/L | pH (S.U.) | 7.74 | 7.69 | 7.74 | 7.80 | 7.84 | 7.55 | 7.56 | 7.52 |
| | DO (mg/L) | 7.8 | 7.8 | 7.6 | 8.0 | 8.1 | 8.0 | 7.8 | 8.0 |
| | Conductivity (µmhos/cm) | 2600 | | 2590 | | 2590 | | 2600 | |
| | *Temperature (°C) | 25.0 | 25.1 | 24.9 | 24.9 | 24.9 | 24.9 | 24.9 | 24.9 |
| 1400 mg NaCl/L | pH (S.U.) | 7.76 | 7.69 | 7.74 | 7.81 | 7.86 | 7.58 | 7.59 | 7.54 |
| | DO (mg/L) | 7.9 | 7.8 | 7.7 | 8.0 | 8.1 | 8.0 | 7.9 | 8.0 |
| | Conductivity (µmhos/cm) | 3060 | | 2970 | | 2990 | | 3010 | |
| | *Temperature (°C) | 25.0 | 24.8 | 25.0 | 24.9 | 24.9 | 24.9 | 25.0 | 24.9 |
| | | Initial | Final | Initial | Final | Initial | Final | Initial | Final |

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

